

GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, Gudlavalleru – 521 356.

Department of Computer Science and Engineering



2020-21 SEM -I

I-B.Tech Handout

Vision of the Department

To be a centre of excellence in Computer Science and Engineering education and training to meet the challenging needs of the industry and society.

Mission of the Department

- To impart quality education through well-designed curriculum in tune with the growing software needs of the industry.
- To serve our students by inculcating in them problem solving, leadership, teamwork skills and the value of commitment to quality, ethical behavior & respect for others.
- To foster industry-academia relationship for mutual benefit and growth.

Program Educational Objectives (PEOs)

PEO1 : Identify, analyze, formulate and solve Computer Science and Engineering problems both independently and in a team environment by using the appropriate modern tools.

PEO2 : Manage software projects with significant technical, legal, ethical, social, environmental and economic considerations.

PEO3 : Demonstrate commitment and progress in lifelong learning, professional development, leadership and communicate effectively with professional clients and public.

HANDOUT ON APPLIED PHYSICS

Class & Sem. : I B.Tech – I Semester

Year : 2020-21

Branch : CSE

Credits : 3

1. Brief History and Scope of the Subject

“Physics is the subject, dealing with Nature & Natural Phenomena”

Every concept that we study in Physics is a consequence of Natural Observation. For example shadow formation led to the concept of Light Nature, etc. A sound knowledge of physics is essential for the engineering student to reach new heights of life.

Physics and Technology

The technological, steam engines and the detailed study of heat and thermodynamics were the initiators of the industrial revolution. The development of transistors and development of computers were the initiators of IT revolution. “There is plenty of room at the bottom” the statement made by Feynman started Nano revolution. Today we see the applications of physics in every walk of life. The radio, the television, the wireless, Lasers, optical fibers ,X-rays are used in the identification of fractures in bones. The electricity that we use in our homes and factories is derived from the conversion of some other form of energy great role in technology and in our daily lives. With a basic foundation of physics, you can appreciate and enjoy many more exciting things happening around you.

2. Pre-Requisites

Basic Knowledge of Mathematics, Fundamentals in Physics

3. Course Objectives

- To comprehend the characteristics of stimulated emission.
- To infer conditions for propagation of laser light in guided medium.
- To estimate the behavior of subatomic particles along with application of Schrödinger wave equation.
- To examine principles of solid state materials for use in the engineering applications.

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

- explain construction and working of laser
- relate the principles of propagation of light in optical fibers for applications in communications
- solve Schrodinger’s wave equation to find the wave function and associated probabilities for simple potentials
- identify conductivity mechanism in semiconductors
- correlate the electrical and magnetic properties of materials to the properties of atoms

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

	1	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
CO1	3														
CO2	3														
CO3	3	2													
CO4	2	2													
CO5	2														

7. Prescribed Text Books

1. Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar, Engineering Physics, 9th Edition, S. Chand Publications.
2. RK Gaur & SL Gupta, Engineering Physics, Dhanapat Rai publications.

Reference Books

1. A.J. Dekker, Solid state physics.
2. AjoyGhatak and K. Thyagarajan, Lasers - Fundamentals and Applications, Second Edition, Springer. .
3. Gerd Keiser, Optical fiber communications, Third Edition, Mc Graw Hill
4. Charles Kittel, Introduction to Solid-state physics, 8th Edition, John Wiley & Sons, Inc

9. URLs and Other E-Learning Resources

www.hyperphysics.phy-astr.gsu.edu/HBASE/hframe.html
www.extraphysics.com
www.walter-fendt.de/ph14e
www.phet.colorado.edu
www.sakshat.amrita.ac.in (for virtual lab)
www.forbhongir.blogspot.com
<https://sites.google.com/site/physicsbysureshsaganti>
 192.168.0.40/elibrary
www.vlab.co.in

10. Digital Learning Materials:

- <http://nptel.ac.in/courses/>
- <https://onlinecourses.nptel.ac.in>

11. Lecture Schedule / Lesson Plan

S.No	TOPIC	No of. Periods	No of. Tutorials
1.	Unit I LASER		
2.	Introduction	1	2(T)
3.	Characteristics of lasers	1	
4.	Requirement of laser	1	
5.	Spontaneous and Stimulated emission of radiation – Einstein's coefficients	2	
6.	Ruby laser	1	
7.	Helium Neon laser.	1	
8.	Semi Conductor laser diode	1	
9.	Problems on unit 1	1	
10	Unit II Optical fibers		
11	Construction of Optical fiber	1	2(T)
12	Principle of Optical Fiber - Total Internal Reflection,	1	
13	Numerical Aperture and Acceptance Angle, Optical Fiber Construction,	1	
14	Types of Optical Fibers	1	
15	Step Index Fibers and Graded Index Fibers	1	
16	Optical Fiber in communication Block diagram	1	
17	Advantages of Optical Fibers in Communications.	1	
18	Problems on unit 2	1	
19	Unit - III : Principles of quantum mechanics and its applications		
20	Origin of quantum theory ,Planck's quantum theory	1	2(T)
21	De Broglie's hypothesis, De Broglie's wave length	1	
22	Davission and Germer 's experiment	1	
23	Uncertainty principle and it's applications	1	
24	Schrodinger time independent wave equation	1	
25	Schrodinger time dependent wave equation	1	
26	Physical significance of wave function	1	
27	Particle in one dimensional infinite potential box	1	
28	Problems on unit 3	1	
29	Unit – IV : Semiconductor		
30	Introduction	1	2(T)
31	Intrinsic semiconductor – Density of electrons, holes	1	
32	carrier concentration, Fermi level, conductivity of Intrinsic semiconductor	1	
33	Extrinsic semiconductor -carrier concentration of p & n type semiconductor	2	

34	Drift and diffusion – Einstein’s equation	1	
35	LED, LCD construction and working	1	
36	Direct & indirect band gap semiconductors	1	
37	Problems on unit 4	1	
38	Unit V : Dielectrics & Magnetic Materials		
39	Dielectrics- Introduction ,Dielectric constant	1	
40	Electronic, ionic and orientation polarization	1	2(T)
41	Estimation of electronic and ionic polarization	1	
42	Internal fields	1	
43	Clausius – Mossotti equation,	1	
44	Frequency dependence of Polarization	1	
45	Ferroelectrics , Piezoelectricity and their applications	1	
46	Magnetic materials-Introduction	1	
47	Classification of magnetic materials	1	
48	Origin of magnetic moments	1	
49	Weiss theory of Ferro magnetism	1	
50	Soft and hard magnetic materials	1	
51	Problems on unit 5	1	2(T)
52	Total	48	

12. Seminar Topics

- LED,LCD
- types of semiconductor
- classification of magnetic materials

Assignment –cum- tutorial questions

UNIT - I

Section A

Objective questions

1. Laser is based on the phenomenon
 - (a) spontaneous emission
 - (b) stimulated emission
 - (c) absorption
 - (d) TIR
2. In CD,DVD _____ laser is used
 - (a) He-Ne gas
 - (b) ruby
 - (c) Semiconductor
 - (d) CO₂
3. If N be the number of atoms emitting light of intensity I total intensity of light by ordinary source NI, where as in Laser it is _____
 - (a) (NI)²
 - (b) N²I
 - (c) NI²
 - (d) 2NI
4. Under population inversion, the number of atoms in the higher energy state is _____ than in the lower energy state

5. Laser radiation is ____
 (a) Very narrow and collimated (b) monochromatic (c) Coherent and stimulated (d) all
6. In conventional light sources
 (a) Different atoms emit radiation at different times
 (b) There is no phase relation between the emitted photons
 (c) Different atoms emit photons in different directions
 (d) all
7. In laser source
 (a) Photons emitted by different atoms are in phase or maintain constant phase relationship
 (b) Different atoms emit photons in the same direction
 (c) Both a and b (d) none
8. Which among the following characteristics of Laser light specifies the precise movement of all individual light waves together through time and space?
 (a) Monochromatic (b) Directional (c) Coherent (d) Brightness
9. In Stimulated Emission, which among the following parameters of generated photon is/are similar to the photon of incident wave?
 (a) Phase (b) Frequency (c) Polarization & direction of travel
 (d) All of the above
10. In spontaneous emissions
 (a) Atoms are initially in the excited state
 (b) Transitions are without any aid of an external agency
 (c) Both a and b (d) none
11. In conventional light sources, the ratio of spontaneous emission rate to stimulated emission rate is nearly
 (a) 10^{10} (b) 10^{20} (c) 10^5 (d) 10^3
12. In excited states, the atoms will remain for a time of _____
 a) 10 ms b) 10 ns c) 10 μ s d) 10 fs
13. He-Ne gas laser is a _____
 (a) Continuous laser (b) pulsed laser
 (c) Both a and b (d) none
14. The ratio of the helium and neon gaseous atoms are

(a) 1:10 (b)10:1 (c)1:1 (d)1:20

15. Wavelength emitted by Ruby laser is:

(a) 6394 Å (b) 6943 Å (c) 6328 Å (d) 6943 nm

16. If the ruby rod contains 0.005% of chromium atoms then it appears in ___ color ()

(a) Red (b) yellow (c) pink (d) green

Section B

DESCRIPTIVE QUESTIONS

1. Derive the relation between Einstein's coefficients for a two energy level system.
2. From the relation between Einstein's coefficients, illustrate that spontaneous emission dominates in visible region whereas stimulated emission is dominant in the microwave region.
3. Explain the requirements of lasers.
4. With help of a neat diagram describe the construction and working of Ruby laser.
5. Explain the construction and working of He-Ne laser with the help of a neat diagram.
6. How does the semiconductor diode laser work? With a neat diagram illustrate the working principle?
7. Which diode laser is preferable? Hetero-junction or homo-junction diode laser. Illustrate with the necessary drawbacks and advantages.

Problems

1. The relative population of atoms in two energy levels E_1 and E_2 is 10^{-20} . Calculate the energy level difference in eV. Assume that $T=300\text{K}$.
2. Determine the ratio of stimulated emission to a spontaneous emission at a temperature of 250°C for a material with an emitted radiation of wavelength 600nm .
3. The metastable state of a ruby laser is at 1.8 eV . Calculate the wavelength of light emitted.
4. A semiconductor laser diode laser has a peak emission wavelength of $1.55\ \mu\text{m}$. find its energy gap in e V.
5. Calculate the wavelength of emitted radiation from GaAs which has a band gap of 1.44eV

Questions appeared in GATE/NPTEL

1. The population inversion in a two-level laser material cannot be achieved by optical pumping because,
 - a) The upward transitions are allowed but downward transitions are forbidden
 - b) The rate of upward transition is equal to the rate of downward transitions
 - c) The spontaneous decay rate of the higher level is very low
 - d) The upward transitions are forbidden but downward transitions are allowed
2. In He-Ne laser, the laser transition takes place in
 - a) He only
 - b) Ne only
 - c) He first and then in Ne
 - d) Ne first and then in He
3. Collimated light beams from a He-Ne laser and a Sodium vapour lamp (used for street lighting) are focused using a lens. The size of the spot at the focal point due to the laser is relatively smaller because.
 - a) Laser light is relatively more monochromatic.
 - b) The limiting divergence of laser light is relatively smaller.
 - c) The output power of the laser is relatively larger.
 - d) The wavelength of the laser is relatively longer.
4. The coherence length of laser light is
 - a) inversely proportional to length of active lasing medium
 - b) inversely proportional to width of spectral line
 - c) directly proportional to length of active lasing medium
 - d) directly proportional to width of spectral line

Unit II, Optical fibers

Section A

Objective questions

- Cladding in the optical fiber is mainly due to
 - To protect the fiber from mechanical stress
 - To protect the fiber from corrosion
 - To the proper mechanical strength
 - To provide proper electromagnetic guidance
- Self-focusing effect is produced in
 - Step index fiber
 - step index single mode fiber
 - Single mode graded index fiber
 - multimode graded index fiber
- Propagation of light through fiber core is due to
 - diffraction
 - interference
 - Total internal reflection
 - Refraction.
- In an optical fiber, let n_1 and n_2 be the refractive indices of core and cladding respectively. then
 - $\frac{(n_1-n_2)}{n_1} > 1$
 - $\frac{(n_1-n_2)}{n_1} < 1$
 - $\frac{(n_1-n_2)}{n_1} = 0$
 - $\frac{(n_1-n_2)}{n_1} = \infty$
- The numerical aperture of a fiber is given by
 - $\frac{(n_1^2-n_2^2)^{1/2}}{n_0}$
 - $\frac{(n_1^2-n_2^2)^{1/2}}{n_1}$
 - $\frac{(n_1^2-n_2^2)^{1/2}}{n_1}$
 - $\frac{(n_1^2-n_2^2)^{1/2}}{n_2}$
- Step index fiber can be
 - Monomode fiber only
 - multimode fiber only

(c) Monomode as well as multimode (d) Either monomode or multimode

7. Inter modal dispersion is negligible in

(a) Multimode step index fiber (b) multi-mode graded index fiber

(c) Mono mode step index fiber (d) all the above

8. Let n_1 and n_2 be the refractive indices of core and cladding respectively. Then

(a) $n_1 = n_2 - 1$ (b) $n_1 > n_2$ (c) $n_1 < n_2$ (d) $n_1 = n_2$

9. At the critical angle (θ_c), the angle of refraction is

(a) 90° (b) 0° (c) 45° (d) 60°

10. The trajectory of a lighting step index fiber is given as

(a) zig- zag path (b) straight line path

(c) Sinusoidal path (d) curved path

11. Which of the following is described by the concept of numerical aperture in an optical fibre?

a) Light scattering (b) Light collection

c) Light dispersion (d) Light polarization

12.. Which of the following is not a typical transmitter function In an optical fibre communication system?

a) Decoding of input data (b) Decoding of input data

c) Electrical to optical conversion (d) Recoding to match output standard

13. are not used nowadays for optical communication

a) Coaxial cable (b) Multimode fibre (b) Single-mode fibre

d) Multimode graded-index fibre

14. Which component provides additional strength and prevents the fiber from any damage?

a) Core (b) Cladding (c) Buffer Coating (d) None of the above

15. Which type of fiber has the highest modal dispersion?

a) Graded index mode (b) Step-index multimode (c) Step-index single mode (d) Graded index multimode

16.. is used as an optical transmitter on the Fiber Optical Communications.

a) APD (b) LED (c) PIN diode (d) LSA diode

17. Which kind of dispersion is caused by the difference in the propagation times of light rays that take different paths down a fiber?

- A. Modal dispersion B. Delay dispersion C. Material dispersion
D. Wavelength dispersion

Section B

DESCRIPTIVE QUESTIONS

1. Explain the principle behind the functioning of an optical fiber.
2. What is meant by acceptance angle for an optical fiber? Obtain mathematical expression for acceptance angle and numerical aperture.
3. What are the types of optical fibers? Classify them and explain the principle of propagation of light with neat diagrams.
4. Explain difference between the step index fiber and graded index fiber.
5. Explain with a neat block diagram the role of optical fibers in communication
6. What are the various applications of optical fibers?
7. What are the advantages of optical fibers over conventional mode of communication?

Problems

1. Calculate the acceptance angle and the numerical aperture of a given optical fiber, if the refractive indices of core and cladding are 1.533 and 1.468 respectively.
2. If an optical fiber has refractive indices of core and cladding as 1.53 and 1.42 respectively, then calculate its critical angle and fractional change in refractive indices.
3. A light ray enters core of refractive index 1.55 through the end face from a medium of refractive index 1.64 with an angle of incidence 62° . Calculate its angle of refraction at the interface.
4. The sum of refractive indices of core and cladding of a fiber are 3.05 and difference is 0.05 respectively. Calculate its numerical aperture and maximum accepting angle.
5. Calculate the numerical aperture, accepting angle and critical angle of an optical fiber, having fractional change of refractive index is 0.03 and refractive index of core is 1.45.

Questions from previous competitive examinations

1. Assertion (A) Optical fibres have broader bandwidth compared to conventional copper cables.

Reason (R): The information carrying capacity is limited by Rayleigh scattering loss.

- (a) Both A and R are true and R is the correct explanation of A
- (b) Both A and R are true and R is not the correct explanation of A
- (c) A is true but R is false
- (d) A is false but R is true

2. Consider the following statements: In optical communications, the losses in optical fibres can be caused by

- 1. Impurities
- 2. Microbending
- 3. Attenuation in glass
- 4. Stepped index operations

Which of these statements are correct?

- (a) 1,2 and 3 (b) 1, 3 and 4 (c) 1,2 and 4 (d) 2, 3 and 4

3. Assertion (A): Optical fibres are highly desirable for communication links for lasers.

Reason (R): Active nature of optical fibres provides high spectral purity of the signal.

- (a) Both A and R are true and R is the correct explanation of A
- (b) Both A and R are true and R is not the correct explanation of A
- (c) A is true but R is false
- (d) A is false but R is true

4. Velocity of light travelling in an optical fiber is

- (a) Equal to c (b) Greater than c by a few percent (c) Less than c by a few percent (d) Much greater than c , approaching the magnitude of c^2

5. Light from free space is incident at an angle θ to the normal of the facet of large core step index fibre. The refractive indices of core and cladding are 1.58

and 1.44 respectively. The maximum angle θ_i for which the light will be guided in the core of the fiber is

6. Fiber optic cable operate at frequencies near

1. 2 GHz b) 20 MHz c) 200 MHz d) 800 THz

UNIT – III, Principles of Quantum Mechanics and its Applications

Section A.

Objective Questions

1. The expression for Schrodinger time independent wave equation is _____.

2. The Schrödinger time dependent wave equation for a free particle is –

a) $i\hbar \frac{\partial}{\partial x} \psi(r, t) = -\frac{\hbar^2}{2m} \nabla^2 \psi(r, t)$ b)

$i\hbar \frac{\partial}{\partial t} \psi(r, t) = -\frac{\hbar^2}{2m} \nabla^2 \psi(r, t)$

c) $i\hbar \frac{\partial}{\partial t} \psi(r, t) = -\frac{\hbar^2}{2m} \nabla^2 \psi(r)$ d) None of the above

3. The normalized eigen function of n^{th} state of the particle in a deep potential well is _____.

a) $\Psi_n(x) = \sqrt{\frac{2}{L}} \sin \frac{n\pi}{L} x$

b) $\Psi_n(x) = \sin \frac{n\pi}{L} x$

c) $\Psi_n(x) = \sqrt{\frac{2}{L}} \sin \frac{n\pi}{L}$

d) None of the above

4. The normalization condition can be represented as _____

5. Existence of matter waves was experimentally first demonstrated by

(a) Newton

(b) Planck

(c) de-Broglie

(d) Davisson and Germer

6. According to uncertainty principle, it is not possible to measure both energy and _____ of a process very accurately and simultaneously.

7. The expression for Schrodinger time independent wave equation is _____.

8. Davisson and Germer's experiment relates to:

- (a) Interference (b) Polarization
(c) Phosphorescence (d) electron diffraction

9. If E is the kinetic energy of the material particle of mass 'm' then the de-Broglie wavelength is given by _____

- (a) $\frac{h}{\sqrt{2mE}}$ (b) $\frac{\sqrt{2mE}}{h}$ (c) $h\sqrt{2mE}$ (d) $\frac{h}{2mE}$

10. The Schrödinger time dependent wave equation for a free particle is –

- a) $i\hbar \frac{\partial}{\partial x} \psi(r, t) = -\frac{\hbar^2}{2m} \nabla^2 \psi(r, t)$ b) $i\hbar \frac{\partial}{\partial t} \psi(r, t) = -\frac{\hbar^2}{2m} \nabla^2 \psi(r, t)$
c) $i\hbar \frac{\partial}{\partial t} \psi(r, t) = -\frac{\hbar^2}{2m} \nabla^2 \psi(r)$ d) None of the above

11. The quantized energy do a particular of mass 'm' confined in one dimensional box of length L is _____

- (a) $\frac{n^2 h^2}{8mL^2}$ (b) $\frac{n^2 h^2}{8m^2 L^2}$
(c) $\frac{n^2 h}{8mL}$ (d) $\frac{n^2 h^2}{8Lm^2}$

12. The normalized eigen function of n^{th} state of the particle in a deep potential well is

- a) $\Psi_n(x) = \sqrt{\frac{2}{L}} \sin \frac{n\pi}{L} x$ b) $\Psi_n(x) = \sin \frac{n\pi}{L} x$
c) $\Psi_n(x) = \sqrt{\frac{2}{L}} \sin \frac{n\pi}{L}$ d) None of the above

13. Find the ground state energy of an electron when it is confined to move in a one dimensional box of length $0.01nm$

($m = 9.1 \times 10^{-31}Kg$ and $h = 6.625 \times 10^{-34}J - S$).

- a) $6.04 \times 10^{-18}J$ b) $5.04 \times 10^{-18}J$ c) $4.04 \times 10^{-18}J$
d) None of the above

Section B

Descriptive Questions

1. What are matter waves? Derive the expression for matter waves in various forms. List out the important properties of matter waves.
2. Describe the experimental verification of matter waves using Davisson-Germer experiment.
3. Derive Schrodinger's Time Dependent wave equation?
4. Derive expressions for wave functions, probability densities and energies for a particle in an infinite potential box.
5. Drive time independent Schrodinger's wave equation
6. Explain Planck's black body radiation law?
7. What is wave particle duality?
8. List out all the expressions for de-Broglie wavelength. Explain all the terms.
9. Distinguish between matter waves and electromagnetic waves.
10. What is Heisenberg's uncertainty principle? What are the implications of Heisenberg's uncertainty principle?

Problems

1. Calculate the wave length associated with an electron with energy 2000 eV?
2. If the kinetic energy of the neutron is 0.025eV calculate its de-Broglie wavelength (mass of neutron = 1.674×10^{-27} Kg)
3. Calculate the energies that can be possessed by a particle of mass 8.50×10^{-31} kg which is placed in an infinite potential box of width 10^{-9} cm.
4. Calculate the wavelength of matter wave associated with a neutron whose kinetic energy is 1.5 times the rest mass of electron. [Given that mass of neutron = 1.676×10^{-27} kg, mass of electron 9.1×10^{-31} Kg, velocity of light is 3×10^8 m/s].
5. A measurement of an electron's speed is 2×10^6 m/s and has an uncertainty of 10%. What is the minimum uncertainty in position?

Questions from previous competitive examinations

1. Light of wavelength 600 nm is incident on a metal with work function 2.28 eV. The de Broglie wavelength of the emitted electron is _____
2. If the kinetic energy of a free electron halves, its de Broglie wavelength changes by the **factor** _____
3. An electron and a photon have same wavelength. If p is the momentum of electron and E is the energy of photon. The magnitude of p/E in S.I unit is
(a) 3.0×10^8 (b) 3.33×10^{-9}
(c) 9.1×10^{-31} (d) 6.64×10^{-34}
4. An electron and a proton have the same de Broglie wave length. Then the kinetic energy of the electron is
a) zero b) infinity c) equal to the kinetic energy of the proton
d) greater than the kinetic energy of the proton
5. Each of photon and electron has an energy of 1 KeV. Calculate their corresponding wavelengths. Rest mass of the electron is 9.1×10^{-31} kg and $h = 6.63 \times 10^{-34}$ J-s.

UNIT-IV, Semiconductors

Section A.

Objective Questions

1. Einstein's relation between drift and diffusion mechanisms is _____.
2. In a material the diffusion current density is _____ to the concentration gradient of the charge carriers.
3. In an intrinsic semiconductor, the intrinsic conductivity depends on _____.
4. In a semiconductor, the direction of motion of hole is _____ to that of the direction of motion of electron.
5. When the temperature of semiconductor is nearly 0 K, it behaves as good as _____.
6. At absolute temperature the Fermi level in an intrinsic semiconductor is _____.

7. Example for the direct band gap semiconductor is _____.
8. When trivalent impurities are doped into the pure semiconductor the concentration of _____ will be increased.
9. At T=0K the electrons above Fermi level is _____ below Fermi level is _____.
10. Fermi function is valid for _____ particles.
11. When the temperature of semiconductor is nearly 0 K, it behaves as good as ----.
- a) Conductor b) semimetal c) insulator d) None of the above
12. When an electric field is applied to the semiconductor, the current density in terms of mobility of the electrons.
- a) $J_n = ne\mu_e E$ b) $J_n = pe\mu_e E$ c) $J_p = ne\mu_h E$ d) None of the above
13. The emission wavelength of emitted light is given by ----.
- a) $\lambda_g = \frac{hc}{E_g}$ b) $\lambda_g = \frac{p}{E_g}$ c) both a & b d) None of the above
14. The diffusion electron current density in an n-type of semiconductor is ---
- a) $J_n = eD_n \frac{dn}{dx}$ b) $J = -eD \frac{dx}{dn}$ c) $J = nqDn$ d) None of the above
15. When the diffusion mechanism occurs in a semiconductor?
- a) Concentration gradient of charge carriers exists in a semiconductor
- b) Concentration is same throughout the semiconductor
- c) External field required d) None of the above
16. A solar cell is basically a _____
- (a) a p-type Ge semiconductor (b) an illuminated n-p-n type transistor
- (c) an intrinsic silicon semiconductor (d) an illuminated silicon p-n junction diode
17. When the conductivity of a semiconductor is only due to breaking of covalent bonds, the semiconductor is called _____

- (a) an n-type semiconductor (b) a p-type semiconductor
(c) an intrinsic semiconductor (d) an extrinsic semiconductor

18. A donor impurity _____

- (a) increases the resistance of the semiconductor
(b) produces energy bands above the valence bands
(c) produces n type semiconductors
(d) produces p type semiconductors

19. In a substance the energy gap between the conduction band and the valence band is 0.001 eV. The substance must be _____

- (a) an insulator (b) a semiconductor (c) an alloy (d) a conductor

19. The dominant contribution to current comes from holes in the case of _____

- (a) metals
(b) intrinsic semiconductors
(c) p type extrinsic semiconductor
(d) n type extrinsic semiconductor

19. In a p- n junction, electric conduction takes place due to _____

- (a) drift (b) diffusion (c) drift and diffusion (d) barrier potential

21. An LED is a _____

(a) forward biased p – n junction diode (b) reverse biased p --n junction diode

- (c) photo diode (d) pin diode

22. Semiconductors have _____ temperature coefficient of resistance.

- a) Negative b) Positive c) Both positive and negative

d) None of the above

23. The colour of light emitted by a LED depends upon _____

- (a) its forward bias (b) its reverse bias (c) the material of the semiconductor

(d) the amount of forward or reverse current

Section A

Descriptive Questions

1. a) What are drift and diffusion currents? Obtain Einstein relations between their coefficients.
b) Show that $E_i = E_c + E_v / 2$
2. Derive an expression for the number of electrons per unit volume in the conduction band of N- type semiconductor.
3. Distinguish between direct and indirect band gap semiconductors
4. Obtain the expression for the conductivity of an intrinsic semiconductor in terms of carrier concentration.
5. Derive the expression for carrier concentration by obtaining density of holes and electrons in Intrinsic semiconductors..
6. Show that the Fermi level lies middle of conduction band and donor level for N-type semiconductor. $E_f = (E_c + E_d) / 2$
7. Prove that the carrier concentration of p type semiconductor is proportional to square root of donor concentration.
8. Explain the construction and working of LED,.
9. Describe how LCD works and write its advantages and uses.

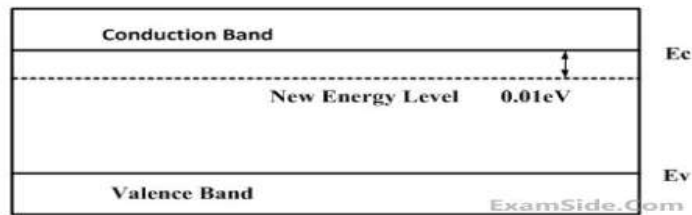
Problems

1. The following data are given for intrinsic germanium at 300K $n_i = 2.4 \times 10^{19} / m^3$, $\mu_e = 0.39 m^2 V^{-1} s^{-1}$, $\mu_p = 0.19 m^2 V^{-1} s^{-1}$ calculate the resistivity of the sample.
2. The resistivity of an an intrinsic semiconductor is 4.5 ohm-m at 20° C and 2.0 ohm-m at 32° C what is the energy gap?
3. Find the diffusion coefficient of electron in silicon at 300K if $\mu_e = 0.19 m^2 V^{-1} s^{-1}$
4. For an intrinsic semiconductor with gap $E_g = 0.7 eV$, Calculate the concentration of intrinsic charge carriers at 300k, assuming that $m_e^* = m_h^* = m_0 (9.1 \times 10^{-31} kg)$

5. The mobility of electrons and holes in an intrinsic semiconductor are 0.8 and 0.18 $m^2/V - s$. Find the intrinsic conductivity if $n_i = 2.5 \times 10^{19} /m^3$.

Question in competitive exams

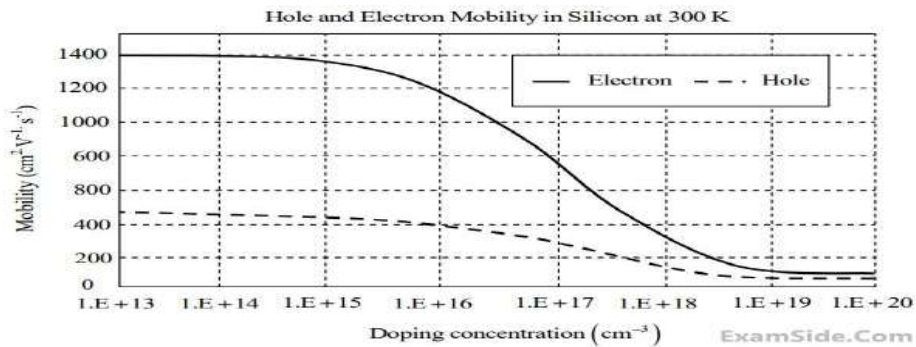
- Consider the following statements A & B and identify the correct answer.
 - (A) A zener diode should be connected in reverse bias for proper functioning.
 - (B) The potential barrier of a p-n junction lies between 2 V and 5 V
 - (a) Both A & B are correct
 - (b) Both A & B are wrong
 - (c) A is wrong and B is correct
 - (d) A is correct but B is wrong
- The potential barrier of a semiconductor is 0.6 V at room temperature. What is the approximate value of its potential barrier, if the temperature is increased by 20°C?
 - (a) 0.7 V (b) 0.8 V (c) 1.00 V (d) 0.5 V
- A small percentage of impurity is added to an intrinsic semiconductor at 300 K. Which one of the following statements is true for the energy band diagram shown in the following



figure?

- a) Intrinsic semiconductor doped with pentavalent atoms to form n-type semiconductor
 - b) Intrinsic semiconductor doped with trivalent atoms to form n-type semiconductor
 - c) Intrinsic semiconductor doped with pentavalent atoms to form p-type semiconductor
 - d) Intrinsic semiconductor doped with trivalent atoms to form p-type semiconductor
- A bar of Gallium Arsenide (GaAs) is doped with Silicon such that the Silicon atoms occupy Gallium and Arsenic sites in the GaAs crystal. Which one of the following statement is true?
 - a) Silicon atoms act as p-type dopants in Arsenic sites and n-type dopants in Gallium sites
 - b) Silicon atoms act as n-type dopants in Arsenic sites and p-type dopants in Gallium sites
 - c) Silicon atoms act as p-type dopants in Arsenic as well as Gallium sites
 - d) Silicon atoms act as n-type dopants in Arsenic as well as Gallium sites

5. A piece of silicon is doped uniformly with phosphorous with a doping concentration of $10^{16}/\text{cm}^3$. The expected value of mobility versus doping concentration for silicon assuming full dopant ionization is shown below. The charge of an electron is $1.6 \times 10^{-19} \text{C}$. The conductivity (in S cm^{-1}) of the silicon sample at 300 K is _____ . (answer: 1.92)



6. Assume electronic charge $q = 1.6 \times 10^{-19} \text{C}$, $kT/q = 25 \text{ mV}$ and electron mobility $\mu_n = 1000 \text{ cm}^2/\text{V}\cdot\text{s}$. If the concentration gradient of electrons injected into a P-type silicon sample is $1 \times 10^{21}/\text{cm}^4$, the magnitude of electron diffusion current density (in A/cm^2) is _____ .(answer: 4000)

UNIT-V

Dielectrics and Magnetic materials

Questions testing the remembering / understanding level of students

I. Objective

- The polarization that depends on the volume of the atom
 - Electronic polarization
 - Ionic polarization
 - Orientalional polarization
 - Space charge polarization
- _____ molecules tend to orient themselves in an external electric field.
- Identify a dielectric material
 - Silicon
 - Tin
 - Rubber
 - Mica
- The temperature dependent polarization is
 - Electronic polarization
 - Ionic polarization
 - Orientalional polarization
 - All the above
- Dielectric Strength of a material is

- a) the capacity to take two or more stress b) the capacity with stand higher voltages
- c) the capacity to withstand electrical mechanical shocks d) none
2. Choose the best insulator
- a) SiO₂ b) PVC c) Bakelite d) Porcelain
3. All insulators are dielectrics. (T/F)
4. Any insulator stores electric charge. (T/F)
5. In polar dielectrics, the dipoles align in single direction after switching off the external field. (T/F).
6. How does the capacitance of a capacitor vary on introduction of dielectric?
- a. Increases b. No changes c. Decreases d. None
7. Ferroelectric materials are characterised by
- a) Very high degree of polarisation.
 b) A sharp dependence of polarisation on temperature.
 c) Non-linear dependence of the charge Q on the applied voltage.
 d) All the above

II. DESCRIPTIVE QUESTIONS

1. Show that in a dielectric, the local field experienced by an atom is greater than the applied field.
2. What are the differences between insulators and dielectrics?
3. Derive the relation between dielectric constant and susceptibility.
4. Derive Clausius - Mossotti equation.
5. What is the temperature dependent polarization? Write the relation.
6. What are the differences between polar and non polar dielectrics?
7. Derive an expression for electronic polarizability in dielectrics.
8. Show that the ionic polarizability varies inversely with the frequency of vibrating molecule.
9. Draw the frequency response curve for polarisation in dielectrics

Problems:

1. The parallel plates of a capacitor have an area of $1 \times 10^{-1} \text{m}^2$ each and are $1 \times 10^{-2} \text{m}$ apart. A thin insulating plastic sheet is inserted between the capacitor plates. The potential difference drops to 1.00 kV between the plates whereas the charge on each plate remains constant. Calculate
 - a. Original capacitance
 - b. Magnitude of charge "q" on each plate
 - c. The capacitance 'C' after the dielectric is introduced.
 - d. Dielectric constant and permittivity.

2. If an electric field of magnitude 10^2 N/C introduces a displacement of $1.0 \times 10^{-6} \text{ m}$ between the electron cloud and the nucleus, what is the electronic polarisability thus in the material having an atomic number Z ?
3. A monatomic gas contains $3 \times 10^{25} \text{ atoms/m}^3$ at 1 atmospheric pressure and at room temperature. The radius of gaseous atoms is 0.2 nm. Find the dipole moment per unit electric field, polarization, dielectric constant and polarizability.
4. The polarisability of Ne gas is $0.35 \times 10^{-40} \text{ F m}^2$. If the gas contains $2.7 \times 10^{25} \text{ atoms m}^{-3}$ at 0° C and 1 atmospheric pressure, calculate its relative dielectric constant.

UNIT-VI

Magnetic properties

Section A

1. The magnetic moment of a free atom is due to _____
2. Susceptibility of diamagnetic materials is _____
3. In diamagnetic materials, the net magnetic moment of all the atoms is _____
4. The temperature independent susceptibility is _____
5. Diamagnetism is exhibited by all materials. (T/F)
6. Choose the correct option
 - a) $\chi < 1$ for dia, $\chi > 1$ for para, $\chi \ll 1$ for ferromagnets
 - b) $\chi < 1$ for dia, $\chi > 1$ for para, $\chi \gg 1$ for ferromagnets
 - c) $\chi < 1$ for dia, $\chi \gg 1$ for para, $\chi \ll 1$ for ferromagnets
 - d) $\chi < 1$ for dia, $\chi \ll 1$ for para, $\chi \gg 1$ for ferromagnets
7. Hysteresis curve or B-H curve is variation of
 - a) Magnetic induction with magnetic field intensity
 - b) Magnetic field with dipole moment
 - c) Magnetization with susceptibility
 - d) Susceptibility with dipole moment
8. When an external field is applied to a magnetic material,
 - a) A torque acts on individual dipole moments.
 - b) No force is experienced by the dipole moments.
 - c) The particles are in random motion
 - d) There is no change in the dipole moments of molecules.
9. Magnetic field strength in silicon is 1000 Am^{-1} . If the magnetic susceptibility is 3×10^{-7} , calculate the magnetization.
10. A magnetic material has a magnetization of 3000 A/m and flux density of $5 \times 10^{-3} \text{ Wbm}^{-2}$. The relative permeability of the material is _____

11. Stationary charged particles exhibit magnetism. (T/F)
12. Materials do not having permanent magnetic dipoles are
 a) Paramagnetic b) ferromagnetic c) ferromagnetic d) diamagnetic
13. When a diamagnetic material is placed inside an external magnetic field
 a) Induced magnetic dipoles act along the applied field direction .
 b) Induced magnetic dipoles act opposite to the applied field direction.
 c) Induced magnetic dipoles act perpendicular to the applied.
14. Diamagnetic susceptibility is
 a) Large, negative b) small, positive c) small, negative d) large, positive
15. Which of the following statement is wrong?
 a) Diamagnetic property is independent of temperature
 b) Paramagnetic property is dependent of temperature
 c) Paramagnetic property is independent of temperature
 d) Ferromagnetic property is dependent of temperature
16. Magnetic susceptibility χ is equal to
 a) The ratio of the magnetic induction in the sample to the applied magnetic field intensity.
 b) Magnetic moment per unit volume
 c) The ratio of the intensity of magnetization produced in the sample to the magnetic field intensity producing it.
 d) The ratio of the magnetic field intensity to the intensity of magnetization.
17. Relative permeability is related to magnetic susceptibility by
 a) $\mu_r = 1 - \chi$ b) $\mu_r = \chi - 1$ c) $\mu_r = 1 + \chi$ d) $\mu_r = 1 / \chi$
18. Choose the wrong statement
 a) Materials lacking permanent dipoles are called diamagnetic
 b) Materials possessing permanent dipoles which do not interact among themselves are called paramagnetic
 c) Materials possessing permanent dipoles which strongly interact among themselves are called ferromagnetic
 d) Materials in which magnitudes of permanent dipoles aligned antiparallel is equal are called antiferromagnetic.
19. The unit of magnetic field intensity is
 a) $A\ m^{-1}$ b) $H\ m^{-1}$ c) $Wb\ m^{-2}$ d) no units
20. Magnetic induction B is related to magnetic field intensity H by the relation
 a) $B = \mu_0 (H - M)$ b) $B = \mu_0 \frac{H}{M}$ c) $B = \mu_0 \frac{M}{H}$ d)
 $B = \mu_0 (H + M)$
21. One Bohr magneton equals
 a) $9.27 \times 10^{-24}\ A\ m^2$ b) $9.1 \times 10^{-31}\ A\ m^2$
 c) $9.27 \times 10^{-16}\ A\ m^2$ d) $9.1 \times 10^{-24}\ A\ m^2$
22. The temperature at which the transition of antiferro to para magnetism take place is called.
 a) Curie – Weiss temp. b) Curie temperature
 c) Debye temp. d) Neel temp.

23. The transition from the ferromagnetic to the paramagnetic state is named after
 a) Curie b) Curie-Weiss c) Neel d) Debye
24. Orbital magnetic dipole moment μ_0 of an revolving electrons is given by
 a) $\mu_0 = \left(\frac{er^2w_0}{2} \right)$ b) $-\frac{e^2r}{2w_0}$ c) $-\left(\frac{er^2w_0}{2} \right)$ d) $\frac{e^2r}{2w_0}$
25. Ferrites are
 a)ferromagnetic material.b) ferrimagnetic materials. c)anti ferromagnetic material.
 d)diamagnetic material

Section B

DESCRIPTIVE QUESTIONS

1. What is the origin of magnetism? Derive the expression for magnetic moment due to orbital motion and spin motion of charged particles.
2. Obtain the value of Bhor magneton and nuclear magneton.
3. Classify magnetic materials as dia, para and ferromagnetic materials.
4. How can the hysteresis curve be accounted based on Domain Weiss theory?
5. Identify coercivity and retentivity in BH Curve
6. Distinguish between soft and hard magnetic materials.
7. Explain the properties of ferrites and write its applications.

Problems

1. The electron in a hydrogen atom moves in a circular orbit of radius 0.5 \AA . The electron performs 700 revolutions per second. Determine the magnetic moment.
2. Find the relative permeability of a ferromagnetic material if field strength of 320amp/m produces a magnetization of 2200 amp/m in it.

Signature of the Faculty

LINEAR ALGEBRA & CALCULUS

Class & Sem. : I B.Tech–I Semester

Year : 2020-21

Branch : CSE

Credits : 4

1. Brief History and Scope of the Subject

“MATHEMATICS IS THE MOTHER OF ALL SCIENCES”, It is a necessary avenue to scientific knowledge, which opens new vistas of mental activity. A sound knowledge of engineering mathematics is essential for the Modern Engineering student to reach new heights in life. So students need appropriate concepts, which will drive them in attaining goals.

Scope of mathematics in engineering study :

Mathematics has become more and more important to engineering Science and it is easy to conjecture that this trend will also continue in the future. In fact solving the problems in modern Engineering and Experimental work has become complicated, time – consuming and expensive. Here mathematics offers aid in planning construction, in evaluating experimental data and in reducing the work and cost of finding solutions.

The most important objective and purpose in Engineering Mathematics is that the students becomes familiar with Mathematical thinking and recognize the guiding principles and ideas “Behind the science” which are more important than formal manipulations. The student should soon convince himself of the necessity for applying mathematical procedures to engineering problems.

2. Pre-Requisites

Basic Knowledge of Mathematics such as differentiation and Integration at Intermediate Level is necessary.

3. Course Objectives:

To make the students

- understand the procedure to solve the system of linear equations.
- know the method for finding eigenvalues and eigenvectors.

- familiar with the knowledge of differential calculus to support their concurrent and subsequent engineering studies.
- know how to find maxima and/or minima for a given surface.
- understand the methods to evaluate areas and volumes using integrals.

4. Course Outcomes:

- Upon successful completion of the course, the students will be able to
- solve the system of linear equations in various engineering problems.
- evaluate the eigenvalues and eigenvectors.
- solve linear ordinary differential equations .
- apply the techniques of partial differentiation in optimization problems and solve first order partial differential equations.
- compute areas and volumes using double and triple integrals.

PROGRAM OUTCOMES (POs)

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

5.Mapping of Course Outcomes with PO's & PSO's:

LA& C	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO: 1	3													
CO: 2	2	2												
CO: 3	2													
CO: 4	3	2												
CO: 5	3	2												

6.Prescribed Text Books

1. Erwin Kreyszig, Advanced Engineering Mathematics : 8th edition, Maitrey Printech Pvt. Ltd, 202, Noida.
- 2 B.S.Grewal, Higher Engineering Mathematics : 42nd edition, Khanna Publishers,2020 , New Delhi.

7. Reference Text Books

1. Schaum's Series, Differential Equations, Tata-Mc Graw Hill Company Limited.
2. Bali & Iyengar, Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd.

8.URLs and Other E-Learning Resources

Sonet CDs & IIT CDs on some of the topics are available in the digital library.

9. Digital Learning Materials:

- <http://nptel.ac.in/courses/106106094>
- <http://nptel.ac.in/courses/106106094/40>
- <http://nptel.ac.in/courses/106106094/30>
- <http://nptel.ac.in/courses/106106094/32>
- <http://textofvideo.nptl.iitm.ac.in/106106094/lecl.pdf>

10.Lecture Schedule / Lesson Plan

Topic	No. of Periods	
	Theory	Tutorial
UNIT –1: System of linear equations		
Rank of a matrix	1	2
Echelon form	1	
Normal form	3	
System of equations-Consistence and inconsistency	2	2
Solving non_homogeneous system	3	
UNIT-II : EIGEN VALUES AND EIGEN VECTORS		
Eigen values and Eigen vectors	2	2
Properties of eigen values and eigen vectors	2	

Cayley-Hamilton theorem	2	2
Finding inverse and power of a matrix	2	
Singular Value Decomposition	2	
UNIT-III: Ordinary differential equations		
Applications: Newtons law of cooling	2	2
Higher order linear ordinary differential equations		
Solving homogeneous D.E	2	2
Finding Particular integral of Non-Homogenous D.E. when RHS is e^{ax}	2	
Finding Particular integral of Non-Homogenous D.E. when RHS is $\sin ax$ or $\cos ax$.	2	
Finding Particular integral of Non-Homogenous D.E. when RHS is a polynomial in x .	2	2
Finding Particular integral of Non-Homogenous D.E. when RHS is e^{ax} . (a function of x)	2	
Method of variation of parameters	2	
UNIT-IV: Partial Derivatives and partial differential Equations		
Total derivative	1	2
Chain rule	1	
Maxima and Minima of functions of 2 or 3 variables with constraints	3	2
Maxima and Minima of functions of 2 or 3 variables without constraints	3	
Lagranges linear equation	3	
Non-linear P.D.E- By Charpit's Method	3	2
UNIT-V : Multiple Integrals		
Double integrals	2	2
Triple integrals	2	
Areas by using double integrals	2	2
Volumes by using Triple integrals	2	
Change the order of integration	2	
Total No. of Periods:	56	24

11. Seminar Topics

- Formation of ODE in the case of falling a stone from a height h
- Modeling and solving higher order ODE for Electrical Circuits
- Finding Maxima volume of an object inscribed in another object

Assignment-cum-Tutorial Questions

UNIT-I

A. MULTIPLE CHOICE QUESTIONS

1. If the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ -1 & 3 & 5 \\ 2 & k & 4 \end{bmatrix}$ is 2 then k=
- A) 11/4 B) 11/2 C) 11/6 D) 11/8
2. The rank of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ 0 & 2 & 2 \end{bmatrix}$
- (a) 0 (b) 1 (c) 2 (d) 3
3. If 5 non homogeneous equations are given with 4 unknowns. The system of equations $AX=B$ consistent if
- (a) The rank of $A=4$ (b) the rank of A is 3
(c) the rank of $A < 4$ (d) the rank of A is 5
4. If the system of equations $x - 3y - 8z = 0, 3x + y - \lambda z = 0, 2x + 3y + 6z = 0$ possess a nontrivial solution then $\lambda =$
- (a) 2 (b) $\frac{-4}{9}$ (c) 6 (d) 8
5. Every square matrix can be written as a product of lower and upper triangular matrices if
- (a) at least one principal minor is zero (b) all principal minors are non-zero
(c) all principal minors are zero (d) at least one principal minor is non-zero
6. Consider two statements:
P: Every matrix has rank
Q: Rank of a matrix is not unique
- (a) Both P and Q are false (b) Both P and Q are true
(c) P is true and Q is false (d) P is false and Q is true
7. Which of the following statement is correct
- a. Rank of a Non-zero matrix is Zero
b. Rank of a rectangular matrix of order $m \times n$ is m when $m > n$
c. Rank of a rectangular matrix of order $m \times n$ is m when $m < n$
d. Rank of a square matrix of order $n \times n$ is $n+1$.
- Rank of a non singular matrix of order m is
- a. m b. n c. 0 d. not defined
8. Rank of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$ is

- a. 1 b. 2 c. 3 d. 4

9. Find the values of k_1 and k_2 for which the non-homogeneous linear

system, $3x - 2y + z = k_2$; $5x - 8y + 9z = 3$; $2x + y + k_1z = -1$ has no solution

- a) $k_1 = -3, k_2 = 1/3$ b) $k_1 = 3, k_2 \neq 1/3$
 c) $k_1 = -3, k_2 \neq 1/3$ d) $k_1 = 3, k_2 = 1/3$

10. The equations $x + 4y + 8z = 16$, $3x + 2y + 4z = 12$ and $4x + y + 2z = 10$ have

- a) only one solution b) two solutions
 c) infinitely many solutions d) no solutions

B. Subjective Questions :

1. Determine the rank of matrix by reducing to echelon form

i) $A = \begin{bmatrix} 1 & -1 & -1 & 2 \\ 4 & 2 & 2 & -1 \\ 2 & 2 & 0 & -2 \end{bmatrix}$

ii) $A = \begin{bmatrix} 3 & 2 & -1 & 5 \\ 5 & 1 & 4 & -2 \\ 1 & -4 & 11 & -19 \end{bmatrix}$

iii) $A = \begin{bmatrix} -1 & -3 & 3 & -1 \\ 1 & 1 & -1 & 0 \\ 2 & -5 & 2 & -3 \\ -1 & 1 & 0 & 1 \end{bmatrix}$

vi) $A = \begin{bmatrix} 3 & -1 & 2 & 1 \\ 1 & 4 & 6 & 1 \\ 7 & -11 & -6 & 1 \\ 7 & 2 & 12 & 3 \end{bmatrix}$

2. Find the rank of the following matrices by reducing them into Normal form.

a) $\begin{bmatrix} 1 & 2 & 3 & 0 \\ 2 & 4 & 3 & 2 \\ 3 & 2 & 10 & 3 \\ 6 & 8 & 7 & 5 \end{bmatrix}$

b) $\begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$

3. Find the rank of the following matrices by reducing them into Canonical form

$\begin{bmatrix} 1 & 3 & 4 & 5 \\ 1 & 2 & 6 & 7 \\ 1 & 5 & 0 & 10 \end{bmatrix}, \begin{bmatrix} 3 & -1 & 2 \\ -6 & 2 & 4 \\ -3 & 1 & 2 \end{bmatrix}$

4. Test for the consistency and solve the following equations: $2x - 3y + 7z = 5$; $3x + y - 2z = 13$; $2x + 19y - 47z = 32$

5. Investigate for what values of a and b the simultaneous equations $x + ay + z = 3$; $x + 2y + 2z = b$; $x + 5y + 3z = 9$ have

- a) no solution b) a unique solution c) infinitely many solutions
6. Test for consistency and solve if the equations are consistent
 $x + 2y + 2z = 2, 3x - y + 3z = -4, x + 4y + 6z = 0$
7. Test for the consistency of following and solve the following equations:
 $x + 2y + z = 3 ; 2x + 3y + 2z = 5; 3x - 5y + 5z = 2; 3x + 9y - z = 4$
8. For what value of k the equations $x + y + z = 1; 2x + y + 4z = k; 4x + y + 10z = k^2$ have a solution and solve them completely in each case.
9. Solve the system of equations $10x - 2y + 3z + t = 10, -x + 4y + z = 8, 3x + y + 4z + 2t = 11$
 $y + 3t = 5$ by Gauss elimination method
10. Solve the system of equations $x + y + 2z = 4, 3x + y - 3z = -4, 2x - 3y - 5z = -5$ by using Gauss elimination method

(C). GATE Previous Paper Questions

1. The number of purely real elements in a lower triangular representation of the given 3 x 3 matrix obtained through the given decomposition is

$$\begin{bmatrix} 2 & 3 & 3 \\ 3 & 2 & 1 \\ 3 & 1 & 7 \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 \\ a_{12} & a_{22} & 0 \\ a_{13} & a_{23} & a_{33} \end{bmatrix} \begin{bmatrix} a_{11} & 0 & 0 \\ a_{12} & a_{22} & 0 \\ a_{13} & a_{23} & a_{33} \end{bmatrix}^T$$

- a) 5 b) 6 c) 8 d) 9

(Gate EEE2020)

2. The Rank of the matrix $M = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ is _____

(Gate 2019)

3. Which one of the following matrices is singular?

(Gate 2019)

- a) $\begin{bmatrix} 2 & 5 \\ 1 & 3 \end{bmatrix}$ b) $\begin{bmatrix} 3 & 2 \\ 2 & 3 \end{bmatrix}$ c) $\begin{bmatrix} 2 & 4 \\ 3 & 6 \end{bmatrix}$ d) $\begin{bmatrix} 4 & 3 \\ 6 & 2 \end{bmatrix}$

4. For the given orthogonal matrix Q.

(Gate 2018)

$$Q = \begin{bmatrix} 3/7 & 2/7 & 6/7 \\ -6/7 & 3/7 & 2/7 \\ 2/7 & 6/7 & -3/7 \end{bmatrix} \quad \text{The inverse is _____}$$

5. The Rank of the matrix $M = \begin{bmatrix} 5 & 10 & 10 \\ 1 & 0 & 2 \\ 3 & 6 & 6 \end{bmatrix}$

(Gate 2018)

- a) 0 b) 1 c) 2 d) 3

6. Consider a system of linear equation :
(Gate 2017)

$$\begin{aligned}x - 2y + 3z &= -1 \\x - 3y + 4z &= 1, \text{ and} \\-2x + 4y - 6z &= k\end{aligned}$$

The value of k for which the system has infinitely many solutions is

7. For what value of p the following set of equations will have no solution?
(Gate 2017)

$$2x + 3y = 5, \quad 3x + py = 10$$

8. The rank of the matrix $\begin{bmatrix} 1 & -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & -1 & 0 \\ 0 & 1 & -1 & 0 & 0 \\ -1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & -1 \end{bmatrix}$ is _____.

(Gate 2016)

9. Of linear equations $\begin{bmatrix} 2 & 1 & 3 \\ 3 & 0 & 1 \\ 1 & 2 & 5 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 5 \\ -4 \\ 14 \end{bmatrix}$ The system has (GATE 2014)

- a) A unique solution b) infinitely many solutions
b) No solution d) exactly two solutions

10. The system of equations $x + y + z = 6, x + 4y + 6z = 20, x + 4y + \lambda z = \mu$
(GATE 2011)

has no solution for values of λ and μ given by

- a) $\lambda = 6, \mu = 20$ b) $\lambda = 6, \mu \neq 20$
c) $\lambda \neq 6, \mu = 20$ d) $\lambda \neq 6, \mu \neq 20$

11. The rank of the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 1 & -1 & 0 \\ 1 & 1 & 1 \end{bmatrix}$ is

(GATE 2006)

- a) 0 b) 1 c) 2 d) 3

12. The determinant of a matrix A is 5 and the determinant of matrix B is 40 the determinant of matrix AB is _____
(GATE2014)

13. Consider the following system of equations $3x + 2y = 1, 4x + 7z = 1, x + y + z = 3, x - 2y + 7z = 0$ The number of solution for this system is
(GATE 2014)

14. The following system of equations $x_1 + x_2 + 2x_3 = 1, x_1 + 2x_2 + 3x_3 = 2, x_1 + 4x_2 + \alpha x_3 = 4$ has α unique solution the only possible values of α are

(GATE2008)

- a) 0 b) either 0 or 1 c) one of 0,1, or -1 d) any real number

15. Consider the following system of equations in three variables x_1, x_2 and x_3
 $2x_1 - x_2 + 3x_3 = 1$, $3x_1 + 2x_2 + 5x_3 = 2$, $-x_1 + 4x_2 + x_3 = 3$ then The system of equations has

(GATE 2005)

- a) No Solutions solutions b) More than one but a finite number of solutions
 c) Unique solutions d) All infinite number of solutions

16. How many solutions does the following system of linear equations have $-x + 5y = -1$, $x + 3y = 3$, $x - y = 2$

(GATE 2013)

- a) Infinitely many b) Two distinct solutions
 c) Unique d) None

17. For matrices of same dimension M and N and a scalar C which of these properties does not always hold

(GATE 2014)

- a) $(M^T)^T = M$ b) $(CM)^T = CM^T$
 c) $(M + N)^T = M^T + N^T$ d) $MN = NM$

18. In the LU decomposition of the matrix $\begin{bmatrix} 2 & 2 \\ 4 & 9 \end{bmatrix}$, if the diagonal elements of U are both 1, then lower diagonal entry l_{22} of L is _____.

(GATE 2009)

- a) 4 b) 5 c) 6
 d) 7

UNIT-II

EIGEN VALUES AND EIGEN VECTORS

A). Objective Questions

3 × 3

1. Two of the eigen values of a 3×3 matrix whose determinant equals 4 are -1 and 2 then the third eigen value of the matrix is equal to _____

2. The Eigen values of $A = \begin{bmatrix} 1 & 0 & -0 \\ 0 & 2 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ are _____

3. If the Eigen values of A are 1,3,0 then $|A| =$ _____

4. The Eigen values of A are (1,-1,2) then the eigen values of $\text{Adj}(A)$ are _____

5. If one of eigen values of A is 0 then A is _____

6. The eigen value of $\text{adj } A$ is _____

7. If A is orthogonal then $A^{-1} =$ _____

8. Can an eigen vector be a zero vector?(yes/no)

$$\begin{bmatrix} 1 & 0 & 0 \\ 1 & -2 & 0 \\ 2 & 2 & 3 \end{bmatrix}$$

9. The eigen values of A^2 are _____ where $A =$

10. Can a zero value be an eigen value?(yes/no)

11. If 2,1,3 are the eigen values of A then the eigen values of $B=3A+2I$ are _____

12. If A is a singular matrix then _____ is an eigen value.

13. Identify the relation between geometric and algebraic multiplicity.

14. The sum of two eigen values and trace of a 3×3 matrix are equal then the value of $|A|$ is _____

$$\begin{bmatrix} 3 & -2 & -8 \\ 0 & 3 & 1 \\ 0 & 0 & 3 \end{bmatrix}$$

15. Compute characteristic equation of $A =$

16. The matrix A has eigen values $\lambda_i \neq 0$ then $A^{-1}-2I+A$ has eigen values

19. The Eigen values of A are 2,3,4 then the Eigen values of 3A are ____ []

(a) 2,3,4 (b) $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$ (c) -2,3,2 (d) 6,9,12

20. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ then $A^3 =$ []

(a) $2A^2 + 5A$ (b) $4A^2 + 2A$

(c) $2A^2 + 5A$ (d) $5A^2 + 2A$

B. Subjective Questions :

1. Find the eigen values and eigen vectors of $\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$

2. Obtain the latent roots and latent vectors of $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$

3. Find the eigen values and eigen vectors of $\begin{bmatrix} 3 & 2 & 2 \\ 1 & 2 & 2 \\ -1 & -1 & 0 \end{bmatrix}$

4. Find the characteristic values and characteristic vectors of
$$\begin{bmatrix} 5 & -2 & 0 \\ -2 & 6 & 2 \\ 0 & 2 & 7 \end{bmatrix}$$

5. Verify that sum of eigen values is equal to trace of A for
$$A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$$

and find the corresponding eigen vector.

6. Verify Cayley Hamilton theorem for
$$A = \begin{bmatrix} 3 & 1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$$
 Hence find A^{-1} and A^4

7. Verify Cayley Hamilton theorem for
$$A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$$
. Hence find A^{-1} and A^4

8. For the matrix
$$A = \begin{bmatrix} 1 & 2 & -3 \\ 0 & 3 & 2 \\ 0 & 0 & -2 \end{bmatrix}$$
 find the eigen values of $3A^3 + 5A^2 - 6A + 2I$.

9. For the matrix
$$A = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 5 & 2 \\ 0 & 2 & 5 \end{bmatrix}$$
 Find the eigen values and eigen vectors of A^{-1}

10. Using Cayley Hamilton theorem find A^4 for the matrix
$$A = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 1 & 1 & 2 \end{bmatrix}$$
.

11. Find the singular value decomposition for the matrix
$$A = \begin{bmatrix} 3 & 2 & 2 \\ 2 & 3 & -2 \end{bmatrix}$$

12. Find the singular value decomposition for the matrix
$$A = \begin{bmatrix} 5 & 5 \\ -1 & 7 \end{bmatrix}$$

13. Find the singular value decomposition for the matrix
$$A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \\ -1 & 1 \end{bmatrix}$$

(C). GATE Previous Paper Questions:

(1) The product of eigenvalues of matrix P is

[GATE 2017]

$$\begin{bmatrix} 2 & 0 & 1 \\ 4 & -3 & 3 \\ 0 & 2 & -1 \end{bmatrix}$$

- (a) -6 (b) 2 (c) 6 (d) -3

$$\begin{bmatrix} 1/\sqrt{2} & 0 & 1/\sqrt{2} \\ 0 & 1 & 0 \\ 1/\sqrt{2} & 0 & 1/\sqrt{2} \end{bmatrix}$$

(2) Consider the matrix P=

Which one of the following statements about P is INCORRECT?

[GATE 2017]

- (a) Determinant of P is equal to 1. (b) P is orthogonal.
(c) Inverse of P is equal to its transpose. (d) All eigenvalues of P are real numbers.

3. Eigen vector of the matrix $\begin{bmatrix} -4 & 2 \\ 4 & 3 \end{bmatrix}$ is []

(GATE-2004)

- a) $\begin{bmatrix} 3 \\ 2 \end{bmatrix}$ b) $\begin{bmatrix} 4 \\ 3 \end{bmatrix}$ c) $\begin{bmatrix} 2 \\ -1 \end{bmatrix}$ d) $\begin{bmatrix} -2 \\ 1 \end{bmatrix}$

4. For the matrix $\begin{bmatrix} 4 & 2 \\ 2 & 4 \end{bmatrix}$ the eigen value corresponding to eigen vector $\begin{bmatrix} 101 \\ 101 \end{bmatrix}$ is []

- a) 2 b) 4 c) 6 d) 8

5. The eigen value of the matrix $\begin{bmatrix} 5 & 3 \\ 3 & -3 \end{bmatrix}$ is (GATE-1999)

- a) 6 b) 5 c) -3 d) -4

6. The 3 characteristic roots of $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 2 & 3 \\ 0 & 0 & 2 \end{bmatrix}$ are

(GATE-2000)

- a) 2,3,3 b) 1,2,2 c) 1,0,0 d) 0,2,3

7. The sum of the eigen values of $\begin{bmatrix} 1 & 2 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ are
(GATE-2004)

a)5 b)7 c)9 d)18

8. Eigen values of $S = \begin{bmatrix} 3 & 2 \\ 2 & 3 \end{bmatrix}$ are 5 and 1. Eigen values of $S^2 = SS$ are
(GATE-2006)

a)1,25 b)6,4 c)5,1 d)2,10

9. One of the eigen vectors of $A = \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix}$ is
(GATE-2010)

a) $\begin{bmatrix} 2 \\ -1 \end{bmatrix}$ b) $\begin{bmatrix} 2 \\ 1 \end{bmatrix}$ c) $\begin{bmatrix} 4 \\ 1 \end{bmatrix}$ d) $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$

10. The minimum and maximum eigen value of $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ are -2, 6. what is other eigen value?
(GATE-2007)

a)5 b)3 c)1 d)-1

11. All the four entries of 2x2 matrix $P = \begin{bmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{bmatrix}$ are non-zero and one of its eigen value is zero which of the following is true? []
(GATE-2008)

- a) $p_{11}p_{22} - p_{12}p_{21} = 1$ b) $p_{11}p_{22} - p_{12}p_{21} = -1$
c) $p_{11}p_{22} - p_{12}p_{21} = 0$ d) $p_{11}p_{22} + p_{12}p_{21} = 0$

12. Eigen values and the corresponding eigen vectors of a 2x2 matrix are given by

	Eigen value	Eigenvector
	$\lambda = 8$	$X = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$
	$\mu = 4$	$Y = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$

Then the matrix is

(GATE-2006)

- a) $\begin{bmatrix} 6 & 2 \\ 2 & 6 \end{bmatrix}$ b) $\begin{bmatrix} 4 & 6 \\ 6 & 4 \end{bmatrix}$ c) $\begin{bmatrix} 2 & 4 \\ 4 & 2 \end{bmatrix}$ d) $\begin{bmatrix} 4 & 8 \\ 8 & 4 \end{bmatrix}$

13. The characteristic equation of A is $t^2 - t - 1 = 0$, then

(GATE-2000)

- a) A^{-1} does not exist b) A^{-1} exist but cannot be determined from the data
c) $A^{-1} = A + I$ d) $A^{-1} = A - I$

14. A particular 3x3 matrix has an eigen value -1. The matrix $A + I$ reduces to

$$\begin{bmatrix} 1 & 0 & -2 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}, \text{ corresponding to eigen value } -1, \text{ all eigen vectors of } A \text{ are}$$

non-zero vectors of the form

(GATE-2002)

- a) $\begin{bmatrix} 2t \\ 0 \\ t \end{bmatrix}, t \in R$ b) $\begin{bmatrix} 2t \\ s \\ t \end{bmatrix}, s, t \in R$ c) $\begin{bmatrix} t \\ 0 \\ -2t \end{bmatrix}, t \in R$ d) $\begin{bmatrix} t \\ s \\ 2t \end{bmatrix}, s, t \in R$

15. By Cayley-hamilton theorem $A = \begin{bmatrix} -3 & 2 \\ -1 & 0 \end{bmatrix}$ satisfies the relation

(GATE-2007)

- a) $A + 3I + 2A^2 = 0$ b) $A^2 + 2A + 2I = 0$ c) $(A + I)(A + 2I) = 0$ d) $\exp(A) = 0$
14. From question (13), $A^9 =$

- a) $511A + 510I$ b) $309A + 104I$ c) $154A + 155I$ d) $\exp(9A)$

15. The number of linearly independent eigen vectors of $\begin{bmatrix} 2 & 1 \\ 0 & 2 \end{bmatrix}$ is

(GATE-2007)

- a) 0 b) 1 c) 2 d) infinite

Unit - III

A. Objective Questions

1. Degree and order of the D.E. $\sqrt{2\left(\frac{dy}{dx}\right)^3 + 4} = \left(\frac{d^2y}{dx^2}\right)^{3/2}$ are respectively

_____ & _____

2. Order of the differential equation $\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{3/2} = c \cdot \frac{d^2y}{dx^2}$ is _____

3. Solution of a differential equation which is not obtained from the

general solution is known as _____

4. Solution of $(D^2 - a^2)y = 0$ is _____
5. The particular integral of $(D^2 + 4^2)y = \sin 6x$ is _____
6. Roots of auxiliary equation $m^2(m^2 + 4) = 0$ are _____
7. Y_p of $\frac{1}{D^2 + 2D}e^{-2x} =$ _____
8. In a homogenous linear D.E. $f(D)y = 0$, the general solution of y is _____
9. In a non-homogenous linear D.E. $f(D)y = Q(x)$, then the general solution of y is _____
10. $\frac{1}{D^2 - 5D}x =$ _____
11. P.I. of $\frac{1}{f(D)}xv(x) =$ _____
12. The solution of the D.E. $(D^2 - 2D + 5)^2 y = 0$ is _____
13. The solution of the differential equation $y'' + y = 0$ satisfying the conditions $y(0)=1$ and $y(\pi/2)=2$ is _____
14. Solution of $(D^3 + D)y = 0$ is _____

a) $y = A\cos x + B\sin x$

b) $y = Ae^x + Be^{-x}$

c) $y = A + Be^x + Ce^{-x}$

d) $y = A + B\cos x + C\sin x$

15. Solution $(D^3 - D^2)y = 0$ is _____

a) $y = Ae^x + B$

b) $y = (A + Bx)e^x + C$

c) $y = A + Bx + Ce^x$

d) none

16. P.I. of $\left(\frac{1}{D^2 + 1}\right)\cos^2 x =$

a) $\cos x$

b) $-\cos x$

c) $\sin x$

d) $-\sin x$

17. General solution of $(D^2 - 1)y = x^2 + x$ is _____

a) $y = Ae^x + Be^{-x} + (x^2 + x + 2)$

b) $y = Ae^x + Be^{-x} - (x^2 + x + 2)$

c) $y = Ae^x + Be^{-x} + 1$

d) $y = A\cos x + B\sin x - 1$

18. P.I. of $(D + 1)^2 y = e^{-x} \cdot x$ is _____

a) $e^{-x} \cdot \frac{x^2}{2}$

b) $e^{-x} \cdot \frac{x^3}{6}$

c) $e^{-x} \cdot \frac{x^4}{24}$

d) $\frac{e^{-x}}{24}$

B) Subjective Questions:

- It is given that $y'' + 2y' - y = 0$, with $y(0) = 0$, $y(1) = 0$ then what is $y(0.5)$?
- Given that $x'' + 3x = 0$ and $x(0) = 1$, $x'(0) = 0$ then what is $x(1)$.
- Solve: $(D^2 - 4D + 3)y = \sin 3x \cos 2x$
- Solve $(D^2 - 1)y = 2e^x + 3x$
- Solve $(D^2 - 2D + 1)y = x e^x \sin x$.
- Solve $(4D^2 - 4D + 1)y = 100$.
- Solve $(D^3 - 5D^2 + 8D - 4)y = e^{2x}$.
- Solve $(D^4 - 4D + 4)y = e^{2x} + x^2 + \sin 3x$.

9. Solve $(D^2 - 4D + 4)y = 8x^2e^{2x}\sin 2x$.
10. Solve $(D^3 + 1)y = \cos(2x - 1)$
11. Solve $y'' - y' - 2y = 3e^{3x}$, $y(0) = 0$, $y'(0) = 2$
12. Solve $(D + 2)(D - 1)^2 y = 2 \sinh x$
13. Find y of $(D^3 - 7D^2 + 14D - 8)y = e^x \cos 2x$

GATE QUESTIONS

1. Solve for y if $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + y = 0$ with $y(0) = 1$ and $y'(0) = -2$. (GATE 1994)
2. $y = e^{-2x}$ is a solution of D.E $y'' + y' - 2y = 0$ (a) True (b) False (GATE 1994)
3. The solution of a D.E $y'' + 3y' + 2y = 0$ is _____ (GATE 1995)
4. Solve $\frac{d^4v}{dx^4} + 4\lambda^4v = 4x + x^2$ (GATE 1996)
5. The particular solution for the D.E $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = 5 \cos x$ is (GATE 1996)
6. Solve $\frac{d^4y}{dx^4} - y = 15 \cos 2x$ (GATE 1998)
7. Find the solution of the D.E. $\frac{d^2y}{dt^2} + \lambda^2 y = \cos(at + k)$ (GATE 2000)
8. The solution for the following D.E with boundary condition $y(0) = 2$ and $y'(1) = -3$ is, where $\frac{d^2y}{dx^2} = 3x - 2$ (GATE 2001)
9. Solve the D.E $\frac{d^2y}{dx^2} + y = x$ with the following conditions (i) as $x = 0$, $y = 1$ (ii) as $x = 0$, $y' = 1$. (GATE 2001)

UNIT-IV

Partial differentiation and Equations

A. Objective Questions :

1. Total derivative of $u(x, y)$ is $du =$

- a) $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y}$ b) $\frac{\partial u}{\partial x} \cdot dx + \frac{\partial u}{\partial y} \cdot dy$
c) $\frac{\partial u}{\partial x} \cdot dx - \frac{\partial u}{\partial y} \cdot dy$ d) $\frac{\partial u}{\partial x} - \frac{\partial u}{\partial y}$
2. $J \cdot J^1 = \text{-----}$ []
a) 1 b) Zero c) -1 d) none
3. If $u = \sin(x+y)$ then $\frac{\partial u}{\partial y} = \text{-----}$ []
a) $\sin x$ b) $\cos(x+y)$ c) $\tan(x+y)$ d) none
4. If $u = J \begin{pmatrix} u, v \\ x, y \end{pmatrix}$ then $J' \begin{pmatrix} x, y \\ u, v \end{pmatrix} =$ []
a) u b) $1/u$ c) 1 d) none
5. The minimum value of $x^2 + y^2 + z^2$ given that $x+y+z = 3a$ is []
a) $3a$ b) $4a^2$ c) $\frac{a^2}{3}$ d) $3a^2$
6. The stationary points of $x^3 y^2 (1-x-y)$ are []
a) $(0,1)$ b) $(-1,-1)$ c) $(1/2, 1/3)$ d) $(1,1)$
7. If the functions u & v of the independent variables x & y are functionally dependent then []
a) $J = 0$ b) $J \neq 0$ c) $J = 1$ d) $J \neq 1$
8. If $\ln - m^2 > 0$ & $l < 0$ then $f(x, y)$ has []
a) minimum value b) maximum value
c) zero value d) neither maximum nor minimum
9. If $f(x, y) = x^2 + y^2 + 6x + 12$ then minimum value $f(x, y)$ is []
a) -3 b) 3 c) 0 d) none
10. If $f_x(a, b) = 0, f_y(a, b) = 0$ then (a, b) is said to be []
a) saddle point b) stationary point
c) minimum point d) maximum point
11. The partial differential equation by eliminating arbitrary function from $z = f(x^2 + y^2)$ is _____
12. The partial differential equation by eliminating arbitrary function from $z = x^n f(y/x)$ is _____
13. The partial differential equation by eliminating arbitrary function from $z = y f(y/x)$ is _____

14. The partial differential equation by eliminating the arbitrary function from the relation $z = f(\sin x + \cos y)$ is _____
15. If the number of arbitrary constants to be eliminated is equal to the number of independent variables then we get a partial differential equation of _____ order
16. If the number of arbitrary constants to be eliminated is greater than the number of independent variables then we get a partial differential equation of _____ order
17. Lagrange's subsidiary equation is _____
18. The general solution of $\sqrt{p} + \sqrt{q} = 1$ is _____
19. The general solution of $z = px + qy + \log pq$ is _____

B) Subjective Questions :

1. If $u = x^2 + y^2 + z^2$ and $x = e^{2t}$, $y = e^{2t} \cos 3t$, $z = e^{2t} \sin 3t$ find total derivative of u .
2. If $z = u^3 v^5$, where $u = x + y$, $v = x - y$ find $\frac{\partial z}{\partial y}$ by the chain rule.
3. If $f(u, v, w)$ is differentiable, and $u = x - y$, $v = y - z$ and $w = z - x$ show that $\frac{\partial f}{\partial x} + \frac{\partial f}{\partial y} + \frac{\partial f}{\partial z} = 0$.
4. $u = f(r)$; $x = r \cos \theta$; $y = r \sin \theta$ prove that $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = f''(r) + \frac{1}{r} f'(r)$
5. If $u = \frac{yz}{x}$; $v = \frac{xz}{y}$, $w = \frac{xy}{z}$ show that $\frac{\partial(u, v, w)}{\partial(x, y, z)} = 4$
6. Show that the function $u = x + y + z$, $v = x^2 + y^2 + z^2 - 2xy - 2yz - 2zx$ and $w = x^3 + y^3 + z^3 - 3xyz$ are functionally related?
7. Find the points on the surface $z^2 = xy + 1$ nearest to the origin.
8. Find three positive numbers whose sum is 100 and whose product is maximum?
9. Find the min value of $x^2 + y^2 + z^2$ where $ax + by + cz = p$.
10. Find the volume of the greatest rectangular parallelepiped that can be inscribed in the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$
11. Form the partial differential equations from the following relations
(i) $f(x^2 + y^2, z - xy) = 0$ (ii) $f(x + z, y + z) = 0$ (v) $z = y f(x) + x g(y)$
$$p \tan x + q \tan y = \tan z$$
12. Solve _____
13. Solve $(x^2 - yz)p + (y^2 - zx)q = z^2 - xy$
$$(mz - ny)p + (nx - lz)q = lz - mx$$
14. Solve _____
15. Solve $z = p^2 x + q^2 y$ _____

16. Solve $pxy + pq + qy = yz$ by using Charpit's method.

C. GATE Questions

1. The solution at $x = 1, t = 1$ of the partial differential equation $\frac{\partial^2 u}{\partial x^2} = 25 \frac{\partial^2 u}{\partial t^2}$ subject to initial conditions of $u(0) = 3x$ and $\frac{\partial u}{\partial t}(0) = 3$ is _____ []

a)1 b)2 c)4 d)6 **GATE 2018**

2. Let $f(x,y) = \frac{ax^2 + by^2}{xy}$, where a and b are constants. If $\frac{\partial f}{\partial x} = \frac{\partial f}{\partial y}$ at $x = 1$ and $y = 2$, then the relation between a and b is _____ []

a) $a = \frac{b}{4}$ b) $a = \frac{b}{2}$ c) $a = 2b$ d) $a = 4b$

GATE 2018

3. At the point $x = 0$, the function $f(x) = x^3$ has _____ []
 a) local maximum b) local minimum
 c) both local maximum and minimum
 d) neither local maximum nor local minimum **GATE 2018**

4. Let $f(x) = 3x^3 - 7x^2 + 5x + 6$. The maximum value of $f(x)$ over the interval $[0, 2]$ is _____ (up to 1 decimal place) **GATE 2018**
 a) 10 b) 11 c) 12 d) 14

5. Consider the following partial differential equation for $u(x, y)$ with the constant $c > 1$: $\frac{\partial u}{\partial y} + c \frac{\partial u}{\partial x} = 0$. Solution of this equation is []

a) $u(x, y) = f(x + cy)$ b) $u(x, y) = f(x - cy)$
 c) $u(x, y) = f(cx + y)$ d) $u(x, y) = f(cx - y)$ **GATE 2017**

Unit- III SECTION-A

Objective Questions :

- 1) The value of $\int_0^{\sqrt{3}} \int_{-\sqrt{9-3y^2}}^{\sqrt{9-3y^2}} y \, dx \, dy$ is _____

2) $\int_0^{\log t} \int_0^x e^{x+y} \, dx \, dy =$ _____

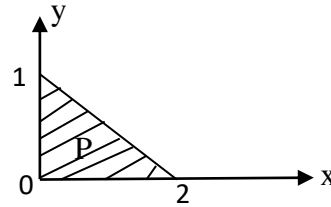
3) $\int_1^p \int_2^q \frac{dx \, dy}{x \, y} =$ _____

- 4) $\int_0^1 \int_0^1 \int_0^1 e^{x+y+z} dx dy dz$ is _____
- 5) $\int_{-1}^1 \int_0^z \int_{x-z}^{x+z} (x+y+z) dy dx dz$ is _____
- 6) $\int_0^1 \int_0^2 \int_1^2 x y z dx dy dz =$ _____
- 7) The form of area bounded by the parabola $y^2 = x$ and the line $x - y = 2$ can be expressed as _____

8) The double integral $\iint_{D_a} e^{-(x^2+y^2)} dA$ where D_a is the disc of radius $a > 0$ centered at the origin, is

- a) $2\pi e^{-a^2}$ b) $\pi(1 - e^{-a^2})$ c) 0 d) $\pi(e^{-a^2} - 1)$

9) Consider the shaded triangular region P shown in fig., then $\iint_P dx dy$ is _____



- a) $\frac{2}{3}$ b) $\frac{1}{6}$ c) $\frac{1}{2}$
- d) $\frac{1}{3}$

10) Area bounded by the curve $y^2 = x$ and the line $x=3$ is _____ sq. units

- a) $2\sqrt{3}$ b) $4\sqrt{3}$ c) $6\sqrt{3}$
- d) $8\sqrt{3}$

11) Area bounded by the curve $y = -3x^2$, $x=2$ and the two coordinate axes is _____ sq. units

- a) 2 b) 3 c) 6 d) 8

12) If E is the solid region bounded by the co-ordinate planes and $2x + 2y + z = 4$

- then the $\iiint_E y dv$ is _____
- a) -4/3 b) 4 c) 0 d) 4/3

SECTION-B

Descriptive Questions:

- 1) Find $\int_0^4 \int_0^{x^2} e^{y/x} dy dx$

2) Find $\int_0^1 \int_0^{\sqrt{1+x^2}} \frac{1}{1+x^2+y^2} dy dx$

3) Find $\int_0^1 \int_0^1 \int_{\sqrt{x^2+y^2}}^2 xyz dz dy dx$

4) Find $\int_{-a}^a \int_{-\sqrt{a^2-x^2}}^{\sqrt{a^2-x^2}} \int_0^{\sqrt{x^2+y^2}} z^2 dz dy dx$

5) Evaluate $\int_1^e \int_1^{\log y} \int_1^{e^x} \log z dz dy dx$.

SECTION-C

Questions testing the analyzing / evaluating ability of students:

1) If R is the triangular region bounded by the coordinate axis and the line $\frac{x}{a} + \frac{y}{b} = 1$,

find $\iint_R y dx dy$

2) Find $\iint_R f(x,y) dR$ where $f(x,y) = x^2 + y^2$, R is the region in the first quadrant bounded

by the coordinate axis and $x + y \leq 1$

3) Evaluate $\iint_R (x+y)^2 dx dy$ over the area bounded by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

4) Find the area of the region bounded by x-axis and the curves $y^2 = 4ax$, $x + y = 3a$

5) Find the area enclosed by the curves $y = 4x - x^2$, $y = x$

6) Find $\iiint_R z dx dy dz$ where R is the region inside the upper part of the sphere

$x^2 + y^2 + z^2 = a^2$ and the xy- plane

7) Evaluate $\iiint xyz dy dx dz$ over the domain bounded by the coordinate planes and

the plane

$$x + y + z = 1$$

8) Find the volume bounded by the cylinder $x = 9 - y^2$ and the planes

$z = y$, $x = 0$, $z = 0$ in the first octant .

PREVIOUS QUESTIONS OF GATE

$$\int_0^8 \left(\int_{\frac{y}{2}}^{\left(\frac{y}{2}\right)+1} \left(\frac{2x-y}{2}\right) dx \right) dy$$

- 1) To evaluate the double integral, we make the substitution $u = \left(\frac{2x-y}{2}\right)$ and $v = \frac{y}{2}$. The integral will reduce to
[2014]

a) $\int_0^4 \left(\int_0^2 2u du \right) dv$ b) $\int_0^4 \left(\int_0^1 2u du \right) dv$ c) $\int_0^4 \left(\int_0^1 u du \right) dv$
d) $\int_0^4 \left(\int_0^2 u du \right) dv$

- 2) $f(x,y)$ is a continuous function defined over $(x,y) \in [0,1] \times [0,1]$. Given the two constraints $x > y^2$ and $y > x^2$, the volume under $f(x,y)$ is
[2009]

a) $\int_{y=0}^{y=1} \int_{x=y^2}^{x=\sqrt{y}} f(x,y) dx dy$ b) $\int_{y=x^2}^{y=1} \int_{x=y^2}^{x=1} f(x,y) dx dy$
c) $\int_{y=0}^{y=1} \int_{x=0}^{x=1} f(x,y) dx dy$ d) $\int_{y=0}^{y=\sqrt{x}} \int_{x=0}^{x=\sqrt{y}} f(x,y) dx dy$

Signature of the Faculty

HANDOUT ON UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

Class & Sem. : I B.Tech- I Semester

Year: 2020-2021

Branch : CSE

Credits : 3

1. Brief History and Scope of the Subject

The core aspiration of every human being is prosperity and sustained happiness. This can be achieved only by appreciating the essences of values and Skills and this course enables to achieve these values. It facilitates holistic growth by imparting holistic perspective forms which is the basis of value based living in a natural way facilitating holistic perception of harmony at all levels of existence. It enhances the idea of self-exploration and self-realization, identifying the 'I' with the Body i.e. Sanyam and swasthya. It strengthens technological methods both at the level of individual and at the level of society for harmony and eco-friendly systems of humanity.

2. Pre-Requisites

- Positive bent of mind.
- Zeal to know the essence of human existence and Nature.
- Interest to know the Scientific and philosophical approach for identification of 'I'.
- Sensitivity towards social and environmental issue.

3. Course Objectives

- To help students understand the need, basic guidelines, content and process of value education.
- To help students initiate a process of dialog with in themselves to know what they really want to be in their life and profession.
- To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
- To understand the harmony in nature and existence.
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

4. Course Outcomes:

Upon successful completion to the course, the students will be able to

- be aware of themselves and surroundings
- be responsible in life

- develop personality to be happy continuously and proper
- handle the problems with sustainable solutions
- possess human nature in mind
- apply what they have learnt to their own self in real life situations

Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

MAPPING OF COURSE OUTCOMES WITH PO'S & PSO'S

	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1						3		3				3		
CO2						3		3				3		
CO3						3		3				3		
CO4						3		3				3		
CO5						3		3				3		

5. Prescribed Text Books

1. R.R Gaur, R.Sangal and G.P.Bagaria; "A Foundation Course in Human Values and Professional Ethics", 2011, Excel Books, New Delhi.

Reference Books

1. A N Tripathy, 2003, Human Values, New Age International Publishers.
2. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.

6. URLs and Other E-Learning Resources:

www.svuniversity.ac.in/ReadList.aspx?Id=64&Type=SC

www.coep.org.in/page_assets/103/professional_ethics_syllabus.pdf

techanil.blogspot.com/2009/08/human-values-and-ethics-syllabus.html

www.annauniversity.info/Syllabus/ECE200451.htm

www.krishnauniversity.ac.in/.../Syllabus/.../UG%20SYLLABUS/UG%20...

www.newagepublishers.com/servlet/nagetbiblio?bno=001314

www.academia.edu/.../HUMAN_VALUES_AND_PROFESSIONAL_ET...

www.unipune.ac.in/pdf_files/Final%20Book_03042012.pdf

<https://books.google.co.in/books?isbn=1412974577>

7. Relevant CDs, Movies, Documentaries & Other Literature:

1. Value Education website, <http://www.uptu.ac.in>
2. Story of Stuff, <http://www.storyofstuff.com>
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA

8. Lecture Schedule / Lesson Plan

S.No	TOPIC	No of. Periods	No. of Total Periods
	UNIT-I : VALUE EDUCATION		
1)	Significance of Universal Human values	1	8
2)	Value Education – Importance	1	
3)	Self-exploration – Meaning and purpose, Content, Process and Mechanism of self exploration	2	
4)	Basic Human aspirations – Happiness and Prosperity	1	
5)	Right understanding – Understand and Live in Harmony at all levels of living	1	
6)	Natural Acceptance – Natural Acceptance for Harmony at all levels of our living, Human and Animal Consciousness	2	
	UNIT-II : HARMONY IN MYSELF		
7)	Co-existence of the Self and the Body	1	8
8)	Understanding the needs of Self (I') and Body' – Sukh and Suvidha	2	
9)	Understanding the Body as an instrument of 'I'('I' being the Seer, Doer and Enjoyer)	2	
10)	Harmony in 'I' – Sanyam and Svasthya	2	
11)	Correct appraisal of our Physical needs	1	
	UNIT-III : HARMONY IN THE FAMILY AND SOCIETY		
12)	Family as the basic unit of human interaction ,Harmony in the family	1	8
13)	Justice ,Trust - Intention vs Competence	1	
14)	Respect	1	

15)	Respect is differentiation – Problems due to differentiation	1	
16)	Extending relationship from family to society	1	
17)	Comprehensive human goal – identification, Programs for achievement of the goal	1	
18)	Dimensions of Human endeavor – Education, Health, Justice, Production-work, Exchange-storage	1	
19)	Harmony from family order to world family order –Universal human order	1	
	UNIT-IV : HARMONY IN THE NATURE AND EXISTENCE		
20)	Harmony in the nature	1	8
21)	Orders in nature- Material Order, Plant Order, Animal Order, Human Order	2	
22)	Co-existence of units in space	1	
23)	Understanding existence as co-existence	1	
24)	Holistic perception of harmony at all levels of existence	2	
	UNIT-V : IMPLICATIONS OF THE RIGHT UNDERSTANDING		
25)	Values in different dimensions of Human living	1	8
26)	Definitiveness of ethical human conduct –Value, Policy, Character	1	
27)	Development of Human consciousness	1	
28)	Implications of value based living	1	
29)	Identification of comprehensive Human goal	1	
30)	Basis for Humanistic Education and Humanistic constitution.	1	
31)	Humanistic universal order and its implications	1	
32)	Competence in professional Ethics, Holistic technologies and systems-Bhopal gas tragedy	1	
TOTAL			40

Assignment cum tutorial questions

UNIT-I

I. Short Answer Questions

- 1.) What is Value?
- 2.) What is Education?
- 3.) What is Value Education?
- 4.) Define Self Exploration?
- 5.) What is Natural Acceptance?

- 6.) What is Experiential Validation?
- 7.) Differentiate (or) Distinguish between swatva, swatantrata and swarajya.
- 8.) Define happiness.
- 9.) Define prosperity.
- 10.) Explain right Understanding?
- 11.) What are physical facilities?
- 12.) What is animal consciousness?
- 13.) What is Human consciousness?
- 14.) Differentiate Value domain or domain of Wisdom and skill domain.
- 15.) Explain process of value education.
- 16.) Illustrate the content of value education.

Or

What should be the content of value education to make it complete? How do values relate to our day to day living?

- 17.) What is the content of self-exploration?
- 18.) What do the abbreviations given as SVDD, SSDD and SSSS signify?
- 19.) What is happiness
- 20.) What is the meaning of Prosperity? How can you say that you are prosperous?

II. Questions

Long Answer

- 1) What is value education? Why there is a need of value education?
- 2) What are the basic guidelines for value education?
- 3) What is the need for value education

Or

Write a short note on the need for value education in today's scenario.

- 4) Values & skills complement each other. Elaborate.
- 5) Explain process of self-exploration with a diagram.

Or

Process of self exploration leads to realization and understanding. Explain with example.

Or

How can we acquire assurance, aid satisfaction & universality through self exploration?

- 6) Explain the concepts of natural acceptance his experiential validation as the mechanism of self-exploration.
- 7) Illustrate the purpose of self-exploration.
- 8) How can we Verify Proposals on basis of our natural acceptance? Explain with example.

9) What are the requirements to fulfil basic human aspirations?

Or

What is the program to fulfil the basic human aspirations? Explain.

Or

Three things are needed in order to fulfil basic human aspirations right Understanding, right Relationship All physical facilities. Explain meaning of each one of these.

10) What do you mean by animals and human Consciousness? Explain with the help of diagram.

UNIT-II

1. What do you mean by Sukh and Suvidha? (Or) Distinguish between Sukh and Suvidha in detail taking needs of myself as an example.
2. The needs of the self are qualitative. Illustrate.
3. The needs of the body are quantitative. Illustrate.
4. Distinguish between the needs of the Self and the needs of the Body. What are the needs of the 'self' and the 'body'?
5. Do you think that human beings are sum-total of sentiments and physical aspects the 'self' and the 'body'? Explain your answer using examples.
6. 'Human being is the co-existence of the Self and the Body' - Explain this statement taking you as an example.
7. Explain with examples where activities involves both body and 'I' Differentiate between the activities of knowing, assuming, recognizing and fulfilling with the help of an example.
8. What are the consequences of confusing between Sukh and Suvidha?
9. What is the meaning of desire? How do we verify whether our desires are coming from sensations or preconditioning or natural acceptance?
10. How can you say that the activities in 'I' are continuous? Explain how activities in 'I' are continuous.
11. What are the problems that we are facing today because of operating on the basis of pre- conditioned desires and sensation?
12. "I am the seer, doer and enjoyer. The body is my instrument" - Explain. How self enjoys the activities of the body?

13. In what way can we say that the human body is a self organized unit?

UNIT-III

Short answer Questions:

1. What is the meaning of respect? How do we disrespect others due to lack of right understanding of this feeling?
2. Explain the problems faced due to differentiation in relationship.
3. What is the difference between respect and disrespect? Which of the two is naturally acceptable to you?
4. How do you differentiate between intention and competence, when you have to judge the other? Why is it important?
5. List down the foundation value and the complete value in human relationship. Explain each with one example.
6. Enumerate some of the important values which lie at the base of good relationships.
7. In our behavior, we generally observe our intention and others' lack of competence. Does it lead to mutual happiness? What is the alternative? Explain with the help of an example.
8. Write the program to attain comprehensive human goal. Give examples also.
9. What do you mean by comprehensive human goal? Explain. How is it related to your goal in life?
10. Explain the concept of harmony in the family.
11. How the relationships extend from family order to world family order?

Long answer Questions:

1. What is meaning of justice in human relationships? How does it follow from family to world family?

or

What is 'justice'? What are its four elements? Is it a continuous or a temporary need?

or

What is justice? How does it lead to mutual happiness?
2. How do we differentiate in relationships on the basis of body, physical facilities, or beliefs? What problems do we face because of such differentiation?
3. 'Discrimination leads to acrimony in relationships'. Explain. What problems are created when we discriminate?
4. What do you understand by trust? Differentiate between intention and competence with examples.
5. "When we are assured of the intention of the other and find that the competence is lacking, we become a help to the other. When we doubt the intention of the other, we get into opposition." Explain.
6. There is a common saying; if you trust everybody, people will take undue advantage of you. What is the basic error in this statement? Explain.

7. What are the five dimensions of Human Endeavour? How are they helpful in achieving the comprehensive human goal?
8. Explain the comprehensive human goal. How does fearlessness follow from right understanding and prosperity?
9. Right understanding in the individuals is the basis for harmony in the family, which is the building block for harmony in the society. Give your comments.
10. 'Family is the basic unit of human interaction'. Explain.

UNIT-IV

III. Short Answer Questions

1. Define nature.
2. Explain the harmony in nature.
3. What do you mean by co-existence?
4. Define the terms Gathansheel, Gathanpurna, Kriyapurnata and Acharanpurnata.
5. Explain 'Existence is Gathansheel and Gathanpurna and also there is Kriyapurnata and Acharanpurnata in existence'
6. What is sanskaar? Explain its effects or the conformance of the human order.
7. What exactly is implied by the term- 'nature'? Explain.
8. Write a short note on the recyclability and self-regulation in nature.
9. How is the activity in human order is different with that of animal and plant order?
10. Define 'units' and 'space'.
11. Comment on the statement: "Nature is limited and space is unlimited."
12. "Existence is co-existence of mutually interacting units in all-pervasive space". Explain.
13. How can we say that 'nature is Self Organized and in space Self-Organization Is Available.'
14. Explain energized and energy in equilibrium.

IV. Long Answer Questions

1. Explain the natural characteristics of the material and pranic orders. Give examples?
2. What is the natural characteristics (swabhava) of human order? Explain.
3. Define harmony in nature and why is it important. Explain with examples.
4. What are the four orders of nature? Briefly explain them.
5. What do you understand by 'activity'? Write down the activity of the four orders in nature.
6. How will you show interconnectedness and mutual fulfilment in four order of nature with examples.
7. Critically examine the attitude of humans today towards the other three orders of nature. Try to make a proper evaluation of human efforts.
8. Explain the concept of holistic perception of harmony in existence.

UNIT-V

1. Explain the concept of holistic perception of harmony in existence.
2. Explain energized and energy in equilibrium.

3. How does right understanding provide the basis for ethical human conduct?
Give two examples.
4. What are the values in interaction of human beings with the material things?
Give one example of each.
- 5.** Describe briefly the criteria for evaluation of holistic technology. Support your answer with an example.

Signature of the Faculty

UNIT-WISE SYLLABI

Semester I: Functional English

EG3501

Number of credits: 3

Number of periods/hours per week: 3

A. COURSE OBJECTIVES

- a. To equip the students for their present and future academic pursuits involving the following:
 - listening to (and viewing) classroom lectures and other academic presentations with a reasonable degree of accuracy, understanding, and appreciation, and responding to them appropriately;
 - speaking in academic (e.g. classroom discussions) and social contexts with a fair degree of fluency, accuracy and intelligibility, and with due attention to factors such as purpose, audience, context, and culture;
 - reading a wide range of informational and functional texts, including course books and reference materials, from print and non-print sources and using them for a variety of purposes; and
 - writing for academic purposes (e.g. assignments, examination answers) in an organized way following the rules of discourse and using vocabulary and grammar appropriately and accurately; and
- b. To develop in them the communication strategies and social graces necessary for functioning effectively in social, academic, and other situations in which they may be called upon to use English.

B. LEARNING OUTCOMES

Upon successful completion of Functional English, the students will be able to:

- a. speak with a reasonable degree of fluency using communication strategies (i.e. using language appropriately to carry out functions such as greeting, requesting information, seeking confirmation, disagreeing) as well conventions of politeness and courtesy

- b. speak with a reasonable degree of fluency and accuracy in contexts requiring tasks such as narrating and describing
- c. listen to short audio and video clips
 - in standard Indian accent with understanding of the types listed in D (1) (a) below; and
 - in native English accent (British and American), especially clips in which the speakers or voice actors speak slowly, and gain both understanding of messages and sensitivity to native-speaker accents
- d. read fluently comprehending texts of different kinds using multiple strategies to understand explicitly-stated information as well as underlying meanings
- e. write coherent paragraphs with attention to elements of writing such as content, organization, language, style, and mechanics and the conventions of academic writing
- f. write survey reports with attention to conventions of report writing
- g. guard against mistakes Indians typically make in their speech and writing in English

UNIT -1 (11 PERIODS)

S. No.	Components	No. of Periods
1.	Listening: Listening Comprehension – Task 1 (IWE - Chapt II)	1
2.	Speaking: Communication Functions – Conversation between Raghu and Sridhar (IWE - Chapt II)	2
3.	Reading: Reading Comprehension – Task 1 (DPM)	2
4.	Vocabulary: (a) GRE Words – 1.1, (b) Collocations – 2.1 (VB)	2
5.	Grammar: Tenses – Simple Present and Present Continuous (IWE - Chapt II)	2
6.	Writing: Paragraph-Writing (IWE - Chapt II)	2

UNIT -2 (11 PERIODS)

S. No.	Components	No. of Periods
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1.	Listening: Listening comprehension – Task 2 (WR)	1
2.	Speaking: Communication Functions – Exercise (DPM)	2
3.	Reading: Reading Comprehension – Task 2 (DPM)	2
4.	Vocabulary: (a) Words Often Confused – 3.1, (b) One-Word Substitutes – 4.1 (VB)	2
5.	Grammar: (a) Indianism and (b) <i>Have to</i> (IWE - Chapt II)	2
6.	Writing: Paragraph-Writing (IWE - Chapt II)	2

UNIT -3 (12 PERIODS)

S. No.	Components	No. of Periods
1.	Listening: Listening Comprehension – Task 3 (IWE - Chapt III)	1
2.	Speaking: Communication Functions – Conversation between Shreya and Kalpana (IWE - Chapt III)	3
3.	Intensive Reading: Reading Comprehension Task – 3 (DPM) Extensive Reading: <i>The Adventures of Huckleberry Finn</i> by Mark Twain	2
4.	Vocabulary: (a) Idioms – 5.1, (b) Phrasal Verbs – 6.1 (VB)	2
5.	Grammar: Tenses – Simple Past and Present Perfect (IWE - Chapt III)	2
6.	Writing: Paragraph-Writing – Coherence (IWE - Chapt III)	2

UNIT - 4 (12 PERIODS)

S. No.	Components	No. of Periods
1.	Listening: Listening Comprehension – Task 4 (IWE - Chapt IV)	1
2.	Speaking: Communication Functions – Conversation between professor and Mayur (IWE - Chapt IV)	2
3.	Reading: Reading Comprehension – Task 4 (DPM)	2

4.	Vocabulary: (a) GRE words – 1.2, (b) Collocations – 2.2, (c) Words Often Confused – 3.2 (VB)	3
5.	Grammar: Expressing Futurity (IWE - Chapt IV)	2
6.	Writing: Clutter-Free Writing (IWE - Chapt IV)	2

UNIT -5 (11 PERIODS)

S. No.	Components	No. of Periods
1.	Listening: Listening comprehension – Task 5 (WR)	1
2.	Speaking: (a) Communication Functions and (b) Telephone Etiquette – Exercises (IWE - Chapt IV)	2
3.	Intensive Reading: Reading Comprehension – Task 5 (DPM) Extensive Reading: <i>More Tales from Shakespeare</i> by Charles and Mary Lamb	2
4.	Vocabulary: (a) One-Word Substitutes – 4.2, (b) Idioms – 5.2, (c) Phrasal verbs – 6.2 (VB)	2
5.	Grammar: Structure – <i>Going to</i> (IWE - Chapt IV)	1
6.	Writing: Technical Report Writing (DPM)	3

- IWE – *Innovate with English* by T Samson (Foundation)
- Chapt – Chapter
- DPM – Department-produced materials (handouts)
- WR – Web-resources
- VB – *Vocabulary Builder for Students of Engineering and Technology* by Vijaya Lakshmi et al (Maruthi)

Note:

- 1 To be done in 56-58 periods of 50 minutes each.
- 2 Mid I test to be set on Units 1, 2 and 3 and Mid II test on Units 4 and 5.
- 3 Where a section requires more number of periods than suggested above for one component and fewer for another, adjustments may be made in consultation with the Head of the Department.

Signature of the Faculty

HANDOUT ON PROGRAMMING FOR PROBLEM SOLVING

Class & Sem: I B.Tech – I Semester

Year: 2020 - 2021

Branch: CSE

Credits: 3

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1. Brief History and Scope of the Subject

C is a general-purpose, imperative computer programming language, supporting structured programming, variable scope and recursion, while a static type system prevents many unintended operations. By design, C provides constructs that map efficiently to typical machine instructions, and therefore it has found lasting use in applications that had formerly been coded in assembly language, including operating systems, as well as various application software for computers ranging from supercomputers to embedded systems.

C was originally developed by Dennis Ritchie in 1972 at Bell Laboratory, and used to re-implement the Unix operating system. It has since become one of the most widely used programming languages of all time, with C compilers from various vendors available for the majority of existing computer architectures and operating systems. C has been standardized by the American National Standards Institute(ANSI) since 1989 (see ANSI C) and subsequently by the International Organization for Standardization (ISO).

2. Pre-Requisites

- Introduction to computers

3. Course Objectives:

- To emphasize the use of algorithms and flowchart in problem solving.
- To apply C language in problem solving.

4. Course Outcomes:

Students will be able to

- outline problem solving steps and solve sample problems.
- use control statements for writing the programs.
- apply the concepts of arrays and strings in problem solving.
- decompose a problem into functions to develop modular reusable code.
- apply user- defined data types and text I/O operations.

5. Program Outcomes:

Graduates of the Computer Science and Engineering Program will have ability to Engineering Graduates will be able to:

- 1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- 6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- 11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

6. Mapping of Course Outcomes with Program Outcomes:

	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	1										1		
CO2	2	1	3	2								1		
CO3	1	1	2	1								1	1	
CO4	2		3	1								2	2	
CO5	1	2	1	1								1		

7. Prescribed Text Books

- Programming for Problem Solving, Behrouz A. Forouzan, Richard F.Gilberg, Cengage, 2020.
- Programming in C, 2nd Edition Pradip Dey and Manas Ghosh, OXFORD Higher Education.

8. Reference Text Books:

- Programming in C, Reema Thareja, OXFORD.
- C Programming, E Balaguruswamy, 3rd edition, TMH
- R G Dromey, How to Solve it by Computer, Prentice-Hall of India, 1999.

9. URLs and Other E-Learning Resources

- <http://nptel.ac.in/courses/106104128/>
- <http://nptel.ac.in/courses/106105085/>
- https://onlinecourses.nptel.ac.in/iitk_cs_101/

10. Digital Learning Materials:

- <http://www.learn-c.org/>
- <http://www.tutorialspoint.com/cprogramming/>

11. Lecture Schedule / Lesson Plan

Topic	No. of Periods
UNIT-I : PROBLEM SOLVING STEPS AND BASICS OF C	
Problem Solving Steps: Understanding problem, formulating a mathematical model	1
Developing algorithm	1
Flowchart, Coding, Testing and Debugging.	1
General form of a C program	1
Identifiers, Basic data types, Variables	1
Constants, Operators	1
Console I/O statements	1
Expressions, Precedence and Associativity	1
Type Conversion	1
Problem Solving: Sample problems such as evaluating formulae	1
UNIT-II: CONTROL STATEMENTS	
Selection: Making Decisions – Single-way	1
Two-Way Selection	1
Multi-way Selection	1
Dangling else Problem	1
Repetition - Concept of loop, Loops in C: while	1
do-while and for	1
Jump statements - return, goto, break	1
exit and continue	1
Problem Solving: Factorial computation, generation of Fibonacci sequence, reversing digits of an integer, generating prime numbers.	2
UNIT-III: ARRAYS AND STRINGS	
Arrays - Arrays Concepts, Using Arrays in C	1
Array Applications	1
Two-Dimensional Arrays	1
Multidimensional arrays.	1
Strings -Strings Concepts, C Strings	1
String Input/ Output Functions	1
Arrays of Strings	1
String Handling Functions	1
Problem Solving – Computing mean and variance of a set of numbers, reverse the elements in an array, addition and multiplication of two matrices, insert sub-string into main-string, reverse of given string without using string handling functions.	2
UNIT-IV: POINTERS AND FUNCTIONS	
Pointers – Declarations, initialization	1

Pointer Arithmetic	1
Memory allocation Functions	1
Arrays and Pointers	1
Lvalue and Rvalue, Functions – Designing Structured Programs, User-Defined Functions, Standard Functions	2
Parameter Passing Techniques	1
Passing Array to Functions, Passing Pointers to Function	1
Recursion	1
Storage classes	1
Problem solving – Using functions print the sum of all elements of the array using pointers, convert decimal number to binary number using function, calculate the GCD of two non-negative integers using recursion.	2
UNIT–V: USER DEFINED DATATYPES AND FILE HANDLING	
Enumerated, Structure and Union Types: The Type Definition (typedef), Enumerated Types	1
Structure: Declaration, Initialization, accessing structures	1
Operations on Structures, Nested Structures	1
Structure Containing Arrays	1
Pointers and Structures	1
Arrays of Structures, Unions	1
Text Input/ Output - Files, Streams, Standard Library Input/ Output Functions	1
Formatting Input/ Output Functions, Character Input/ Output Functions	1
Random access to files	1
Problem solving – To implement a structure to read and display the name, salary and address of an Employee (Use nested structure for address), Copy the contents of one file to another, count the number of characters, words and lines in a file.	1
Total No. of Periods:	52

Assignment-Cum-Tutorial Questions

UNIT-I

A.Objective Questions

- 1) An algorithm is an effective procedure for solving a problem in a finite number of steps. [True/False]

- 2) Which one is a valid identifier?
 a) my_num b) 1my_num c) my num d) \$my_num
- 3) The size of double in bytes-----
 a) 2 b) 4 c) 10 d) 8
- 4) Which of the following is a string constant?
 a) 'A' b) "A" c) ' ' d) '*'
- 5) Which of the following is not a floating point constant
 a) 20 b) - 4.5 c) 'a' d) pi
- 6) Expression !0 < 2 is evaluated as
 a) 0 b) 1 c) true d) false
- 7) Expression i = (2+3) *10 evaluation depends on a)
 Associativity of () operator b) Precedence of () and * operator
 c) both a and b d)None
- 8) What will be output of the following c program?

```
#include<stdio.h>
int main( )
{
    int _=5;
    int __=10;
    int ___;
    ___=_+__;
    printf("%i",___);
    return 0;
}
```

(A) 5 (B) 10 (C) 15 (D) Compilation error

9. The number of tokens in the following C statement.

```
printf(" The value of i = %d", i);
```

a) 3 b) 7 c) 21 d)none

10. Value of x is

```
int x=18 / 9 / 3 * 2 * 3 * 5 % 10;
```

a) 0 b) 1 c) 2 d) Compile time error

11. What is the output of the following program?

```
int main()
{
```

```

int a = 1;
int b = 1;
int c = a || --b;
int d = a-- && --b;
printf("a = %d, b = %d, c = %d, d = %d", a, b, c, d);
return 0;
}

```

- a) a = 0, b = 1, c = 1, d = 0 c) a = 0, b = 0, c = 1, d = 0
b) c) a = 1, b = 1, c = 1, d = 1 d) a = 0, b = 0, c = 0, d = 0

12. What is the output of the program?

```

main()
{
int x=7;
    x+=2;
    x+=2;
    printf("%d",x);
}

```

- a) 2 b) 5 c) 7 d) compile error

13. What is the output of this C code?

```
#include<stdio.h>
```

```

int main()
{
int a=2,b=5;
a=a^b;
b=b^a;
printf("%d , %d",a,b);
return 0;
}

```

- a) 7, 2 b) 2, 7 c) 7,7 d) 2,2

14. #include <stdio.h>

```

int main()
{
int i = 5, j = 10, k = 15;
printf("%d ", sizeof(k /= i + j));
printf("%d", k);
return 0;
}

```

Assume size of an integer as 4 bytes. What is the output of above program?

- a)4 1 b)4 15 c)2 1 d)none

15. What is the output of this C code?

```
#include <stdio.h>
int main()
{
    int i = (1, 2, 3);
    printf("%d", i);
    return 0;
}
```

- a)1 b)3 c)Garbage value d)Compile time error

16. What is the output of this C code?

```
#include<stdio.h>
int main()
{
    int x=10;
    int y=20;
    x+=y+=10;
    printf(“%d %d”,x,y);
    return 0;
}
```

B.Subjective Questions

1. Define algorithm. Draw flowchart to find the area of rectangle.
2. What are the advantages and disadvantages of using algorithms?
(Dec-2018)
3. Write an algorithm to calculate the roots of the quadratic equation.
(May-2019)
4. Draw the flowchart to multiply two numbers (May-2018)
5. Draw a flowchart to find the perimeter of a circle (May-2018)
6. Give the structure of C program.

(Or)

Explain structure of C-program with an example (Dec-2018)

7. Explain different types of constants used in a C-program with suitable examples.(May-2019)
8. Differentiate pre and post decrement statements with an example.(May-2019)
9. List out C tokens. Give examples for each.

(Or)

List out different C-tokens.(May-2019)

10. Write short notes on data modifiers.
11. Explain about increment and decrement operators.
12. Give rules for order of evaluation.
13. Write a C-program to compute the area of a circle.(Dec-2018)
14. Write an algorithm for finding roots of quadratic equation.
15. Draw a flowchart to calculate first year first semester percentage.
16. Write a program to swap two numbers without using third variable.
17. Describe implicit and explicit type conversions.(Dec-2018)
18. Write a C-program to convert temperature from Fahrenheit to Celsius(May-2018)
19. Evaluate the following expressions:

a) $8 << 2$ b) $1 > 3 \ \&\& \ 4 < 5$ c) $15 > 16 \ || \ 27 > 16$ d) $!10$

C.GATE Questions

1. Consider the following C program:

```
#include <stdio.h>
int main()
{
int m = 10;
int n, n1;
n = ++m;
n1 = m++;
n --;
--n1;
n -= n1;
printf("%d",n);
return 0;
}
```

The output of the program is _____.

GATE CS 2017

2. The attributes of three arithmetic operators in some programming language are given below.

Operator	Precedence	Associativity	Arity
+	High	Left	Binary
-	Medium	Right	Binary
*	Low	Left	Binary

The value of the expression $2 - 5 + 1 - 7 * 3$ in this language is-----.

GATE CS 2016

3. The number of tokens in the following C statement is _____.

```
printf("i = %d, &i = %x", i, &i);
```

- (a) 3 (b) 26 (c) 10 (d) 21

GATE CS 2000

UNIT-II

Section-A

Objective Questions

1. No two case labels can have the same value. [True/False]
2. Based on the given statements select the most appropriate option
Statement I: do..while statement is an entry controlled loop.
Statement II: continue statement is used to go to the next iteration in a loop
a. I&II true b. only I is true c. Only II is true d. Both are false
3. In a for loop, if the condition is missing, then?
a. it is assumed to be present and taken to be false
b. it is assumed to be present and taken to be true
c. it result in the syntax error
d. execution will be terminated abruptly
4. Which of the following statement is used to take the control to the beginning of the loop
a. exit b. continue c. break d. None
5. The _____ statement is used to transfer control to a specified label.
6. A do-while loop is useful when we want the statement within the loop must be executed?
a. Only once b. At least once c. More than once d. None of the above
7. Based on the given statements, select the most appropriate option Statement I : break statement is used to terminate from the program.
Statement II : for statement is an entry controlled loop.
a. I&II true b. only I is true c. Only II is true d. Both are false
8. Which of the following cannot be checked in a switch-case statement?
a. char b. int c. float d. enum
9. The following program fragment

```
if(a=7)
printf(" a is seven");
else
printf(" a is not seven");
```

results in the printing of

- a. a is seven b. a is not seven c. nothing d. garbage

10. The output of the code below is

```
#include <stdio.h>
void main()
{ int x = 0;
  if (x == 0)
      printf("hi");
  else
      printf("how are u");
      printf("hello");
}
```

- a. hi b. how are you c. hello d. hihello

11. The output of the code below is(when 1 is entered)

```
#include <stdio.h>
void main()
{
    double ch;
    printf("enter a value btw 1 to 2:");
    scanf("%lf", &ch);
    switch (ch)
    {
        case 1: printf("1");
                break;
        case 2: printf("2");
                break;
    } }
```

- a. Compile time error b. 1 c. 2 d. None of the above

12. The following program fragment results in

```
int i=107,x=5;

printf((x<7)?"%d":"%c",i);
```

- a. an execution error
- b. a syntax error
- c. printing of k
- d. none of the above

13. The following statements will result in the printing of

```
for( i=3; i<15; i+=3 )
{   printf("%d",i);
    ++i;   }
```

- a. 3 6 9 12
- b. 3 6 9 12 15
- c. 3 7 11
- d. 3 7 11 15

14. What is the output of this C code?

```
#include <stdio.h>

const int a = 1, b = 2;

int main()
{   int x = 1;

    switch (x)
    {   case a:      printf("yes ");
        case b:    printf("no\n");
            break;
    } }
```

- a) yes no
- b) yes
- c) no
- d) Compile time error

15. What is the output of this C code?

```
#include <stdio.h>

int main() {
    do
        printf("In while loop ");
    while (0);
```

```
printf("After loop\n");
}
```

- a) In while loop b) In while loopAfter loop c) After loop d) Infinite loop

16. How many times "India" is get printed?

```
#include<stdio.h>
int main()
{
    int x;
    for(x=-1; x<=10; x++)
    {
        if(x < 5)
            continue;
        else
            break;
        printf("India");
    }
    return 0;
}
```

- A. Infinite times B. 11 times C. 0 times D.10 times

17. What is the output of the code given below? []

```
int main()
{
    printf("%d ", 1);
    goto l1;
    printf("%d ", 2);
    l1:goto l2;
    printf("%d ", 3);
    l2:printf("%d ", 4);
}
```

- A. 1 4 B. Compilation error C. 1 2 4 D. 1 3 4

Section-B

Descriptive Questions

1. Define multi way selection? Explain switch statement with syntax.
2. Write about "else-if ladder" in detail.
(Dec-2018)
3. Illustrate the use of switch statement with an example. **(Dec-2018)**
4. Write the syntax of if-else statement.
(May -2018)

5. Give the syntax and logical flow of “nested if-else” statement with brief explanation.

(May-2018)

6. When dangling else problem occurs? Explain.

(May-2019)

7. Explain for loop structure with sample code.

8. Explain various Iterative statements in C language.

9. Differentiate break and continue statements

10. Write the difference between while and do while.

(Or)

Compare while and do-while loop.

(May-2019)

11. Illustrate various Conditional statements in C language.

12. What is difference between statement break; and exit() in a C program.

Programs:

13. Develop a C-program to find the greatest of four numbers using else-if ladder.

(May-2019)

14. Write a C program to find the roots of quadratic equation.

15. Write a C-program to reverse a given number.

(May-2019)

16. Develop a C-program to check whether the given number is a palindrome or not.

(Dec-2018)

17. Write a program to calculate electricity bill based on the assumed constraints.

18. Write a program to generate all the prime numbers between 1 and n.

19. Write a c-program to print Fibonacci series

20. Write a program to find the LCM and GCD of given two numbers.

21. Write a C-program to find the GCD of two integer values using while loop.

(Dec-2018)

22. Write a program to find the reverse of the given integer.

SECTION-C.

GATE Questions

1. Consider the following program

```
# include<stdio.h>
int main ( )
{
    int i, j, k = 0;
    j = 2 * 3 / 4 + 2.0 / 5 + 8 / 5;
    k -= --j;
    for (i = 0; i < 5; i++)
    {
        switch (i + k)
        {
            case 1:
            case 2: printf ("\n%d", i+k);
            case 3: printf ("\n%d", i+k);
            default: printf ("\n%d", i+k);
        }
    }
    return 0;
}
```

The number of times printf statement is executed is _____.

Gate CS 2015

2. What will be the output of the following C program segment?

```
char inchar = 'A';
switch (inchar)
{
    case 'A':    printf ("choice A");
    case 'B':    printf ("choice B ");
    case 'C':
    case 'D':
    case 'E':
    default:     printf ("No Choice");
}
```

- (a) No choice
- (b) Choice A
- (c) Choice AChoice B No choice
- (d) Program gives no output as it is erroneous

GATE CS 2012

3. Consider line number 3 of the following C-program.

```
int main ( ) { /* Line 1 */
```

```
int i, n; /* Line 2 */
```

```
for (i =0, i<n, i++); /* Line 3 */
```



```
}
```

Identify the compiler's response about this line while creating the object-module:

- (a) No compilation error (b) Only a lexical error
(c) Only syntactic errors (d) Both lexical and syntactic errors

GATE CS 2005

4. Consider the following C program

```
main()
{
    int x, y, m, n;
    scanf ("%d %d", &x, &y);
    /* x > 0 and y > 0 */
    m = x; n = y;
    while (m != n)
    {
        if(m>n)
            m = m - n;
        else
            n = n - m;
    }
    printf("%d", n); }
```

The program computes

- (a) $x + y$ using repeated subtraction
(b) $x \bmod y$ using repeated subtraction
(c) the greatest common divisor of x & y
(d) the least common multiple of x & y

GATE CS 2004

UNIT-III

Section-A

Objective Questions

1. What is right way to initialize array?

- A. `int num[6] = { 2 , 4 , 12 , 5 , 45 , 5 };`
B. `int n{ } = { 2 , 4 , 12 , 5 , 45 , 5 };`
C. `int n{ 6 } = { 2 , 4 , 12 };`
D. `int n(6) = { 2 , 4 , 12 , 5 , 45 , 5 };`

2. An array elements are always stored in _____ memory locations.

- 3.** String concatenation means
- Joins two strings.
 - Extracting a substring out of a string
 - Partitioning the string into two strings
 - Comparing the two strings to define the larger one
- 4.** If the two strings are identical, then strcmp() function returns
- 1
 - 0
 - 1
 - true
- 5.** The library function used to find the last occurrence of a character in a string is
- laststr()
 - strstr()
 - strnstr()
 - strrchr()
- 6.** Which of the following function is more appropriate for reading in a multi-word string?
- scanf()
 - gets()
 - printf()
 - puts()
- 7.** Below is an example of
- ```
int arr[5][3] = { 1 , 2 , 3 , 4 , 5 , 6 , 7 , 8 , 9 , 10 , 11 , 12 , 13 , 14 , 15 };
```
- 2-D Array
  - 1-D Array
  - 4-D Array
  - 3-D Array
- Size of the array need not be specified, when Initialization is run-time
  - It is a declaration
  - Both of the above
  - None of the above
- 8.** What is the output of the following program?

```
int main()
{
 int arr[5];
 arr[0] = 5;
 arr[2] = -10;
 arr[3/2] = 2;
 arr[3] = arr[0];
 printf("%d %d %d %d", arr[0], arr[1], arr[2], arr[3]);
 return 0;
}
```

- a) 5 2 -10 5    b) 5 -10 5 2    c) -10 2 5 5    d) 5 5 2 -10
- 9.** What will be printed after execution of the following code?

```
void main(){
 int arr[10] = { 1 , 2 , 3 , 4 , 5 };
 printf("%d", arr[5]);
}
```

- Garbage Value
- 5
- 6
- 0
- None of these

- 10.** What will be the output of the program ?

```
#include<stdio.h>
void main()
{
 int a[5] = {5, 1, 15, 20, 25};
 int i, j, m;
 i = ++a[1];
 j = a[1]++;
 m = a[i++];
 printf("%d, %d, %d", i, j, m);
}
```

- a) 3,2,15                      b) 2,3 ,20                      c) 2,1,15                      d) 1,2, 5

**11.** What will be the output of the following program?

```
void main(){
 char str1[] = "abcd";
 char str2[] = "abcd";
 if(str1==str2)
 printf("Equal");
 else
 printf("Unequal");
}
```

- A. Equal                      B. Unequal                      C. Error    D.None of these

**12.** What is the index number of the middle element of an array with 29 elements?

- A. 15                      B. 14                      C. 0    D.Programmer-defined'

**13.** What is the output of this C code?

```
#include<stdio.h>
#include<string.h>
void main(){
 int a[2][3] = { 1, 2 , 3 , 4 , 5 };
 int i = 0, j = 0;
 for (i = 0; i < 2; i++)
 for (j = 0; j < 3; j++)
 printf("%d", a[i] [j]);
}
```

- A. 1 2 3 4 5 0                      B. 1 2 3 4 5 junk  
C. 1 2 3 4 5 5                      D. Run-Time Error

**14.** What will be the output of the program ?

```
#include<stdio.h>
```

```
#include<string.h>
void main(){
 char str1[20] = "Hello", str2[20] = " World";
 printf("%s", strcpy(str2, strcat(str1, str2)));
}
```

A. Hello World   B. World   C. WorldHello   D.Hello

**15.** What will be the output of the program ?

```
#include<stdio.h>
void main(){
 printf(5+"Good Morning");
}
```

A. Good Morning      B. M      C. Good      D. Morning

What will be the output of the program ?

```
#include<stdio.h>
#include<string.h>
void main(){
 char str[] = "Problem Solving\0Using C";
 printf("%s", str);
}
```

A. Problem Solving      B. Problem Solving Using C  
C. Using C      D. None of these

**16.**

What is the output of the following program?

```
#include<stdio.h>
main()
{
 int a[3] = {2,5,1};
 printf("%d", a[a[0]]);
}
```

A.0    B. 1    C. 2    D. Compile error

**17.**



(Dec-2018)

- 7) Develop a C program to compare two strings using string handling functions.
- 8) Develop a C program to copy one string to other without using string handling functions.
- 9) Write a C-program to access elements of an array using pointers.

(May-2019)

### SECTION-C

#### GATE Questions

1. what is the output printed if we execute following code void main()

```
{
char a[] = "GATE2011";
 printf("%s", a + a[3] - a[1];

}
```

2. What will be the output of the above program? \_\_\_\_\_

#### GATE CS 2011

2. A program P reads in 500 integers in the range [0,100] representing the scores of 500 students. It then prints the frequency of each score above 50. what would be the best way for P to store the frequencies?

- a) An array of 50 numbers.
- b) An array of 100 numbers.
- c) An array of 500 numbers
- d) A dynamically allocated array of 550 numbers

GATE CS 2005

3. Consider the following declaration of a 'two-dimensional array in C:

```
char a[100][100];
```

Assuming that the main memory is byte-addressable and that the array is stored starting from memory address 0, the address of a[40][50] is

- (a) 4040                      (b) 4050                      (c) 5040                      (d) 5050

GATE CS

2002

4. An  $n \times n$  matrix V is defined as follows

$V[i,j]=i-j$  for all  $i,j, 1 \leq i \leq n; 1 \leq j \leq n;$

The sum of the elements of the array V is

- (a) 0                      (b)  $n-1$                       (c)  $n^2-3n+2$                       (d)  $n^2(n+1)/2$

GATE CS 2000

5. Let A be a two-dimensional array declared as follows:

A: array [1 .... 10] [1 ..... 15] of integer;

Assuming that each integer takes one memory location, the array is stored in row-major order and the first element of the array is stored at location 100, what is the address of the element A[i][j]

- (a)  $15i + j + 84$                       (b)  $15j + i + 84$   
(c)  $10i + j + 89$                       (d)  $10j + i + 89$

GATE CS 1998

### UNIT-IV

## Section-A

### Objective Questions

1. A pointer is
  - a) A keyword used to create variables
  - b) A variable that stores address of an instruction
  - c) A variable that stores address of other variable
  - d) All of the above
  
2. Integer pointer points to a memory block of size:
  - a) 1 byte
  - b) 2 bytes
  - c) 4 bytes
  - d) none of the above

A.
  
3. Using \_\_\_\_\_ we can allocate memory block which is further splitted in to sub blocks and clears their contents to zero?
  - a) malloc( )
  - b) calloc( )
  - c) realloc( )
  - d) freealloc( )
  
4. Which of the following pointer expressions are valid
  - i. ptr+10
  - ii. ptr\*10
  - a) only i is valid
  - b) both i and ii
  - c) only ii
  - d) none
  
6. \_\_\_\_\_ operator is used to get the address and \_\_\_\_\_ to get value at address stored in a pointer variable.
  - a) &,\*
  - b) (address of),(value at)
  - c) (type),-
  - d) ^,&
  
6. The keyword used to transfer control from a function back to the calling function is
  - a) switch
  - b) goto
  - c) go back
  - d) gofrom
  
7. What is the size of a void pointer ?
  - a) 0
  - b) 1
  - c) 2
  - d) NULL
  
8. What is the output of this C code?

```
#include <stdio.h>
void main()
{
char *s = "hello";
char *p = s;
printf("%p\t%p", p, s);
}
```

  - a) Different address is printed
  - b) Same address is printed
  - c) Run time error
  - d) Nothing
  
9. What is the output of this C code?

```
#include <stdio.h>
void main()
{
char *s= "hello";
```

- ```

char *p = s;
printf("%c\t%c", p[0], s[1]);
}

```
- a) Run time error b) h h c) h e d) h l

10. Functions can return any type of values
a) True b) False
11. If a function contains two return statements successively, the compiler will generate warnings. Yes/No ?
a) Yes b) No
12. Usually recursive programs demand more memory when compared to programs with non-recursive functions.
a) True b) False

Section-B

Descriptive Questions

1. Define Function. Explain the Categories of Functions with an example for each.
2. Differentiate pre-defined and user defined functions.
3. Explain user defined functions with examples.

[Dec-2018]

4. List out different string handling functions and explain them with examples.[Dec-2018]
5. Distinguish between parameter passing by value, parameter passing by address with suitable example.
6. Describe general form of functions based on arguments and return type.

[May-2018]

7. What is recursion? Explain with an example?
8. What is Pointer? How Operations can be performed on Pointers?
9. How to declare a pointer? Give syntax with an example.

[May-2018]

10. Implement the Dynamic Memory Allocation concept with an example program

(Or)

Explain various dynamic memory allocation functions with an example program

[May-2019]

11. Illustrate the Chain of pointers with example program.
12. Describe any three string handling functions with examples.

[May-2019]

13. What is pointer? Explain about pointer to pointer.

[May-2018]

14. Explain about array of pointers with an example?

Programs:

15. Write the c program to print sum of all elements of the array using pointers.
16. Write a C-program to access elements of an array using pointers.

[May-2019]

17. Write a C-program to illustrate call by reference.
[Dec-2018]
18. Write the c program for swapping of two numbers using call-by -value and call-by-reference.
19. Write a c program to print factorial of given number using recursion.
20. Write a c program to print GCD of two number using recursion.
21. Write a function to exchange two numbers with and without using temporary variable.
22. Write a recursive program for generating nth number in the fibonacci series.
23. Write a C program to sort a given set of numbers in ascending order using functions

SECTION-C

GATE Questions

1. Consider the following function implemented in C

[GATE-2017]

```
void printxy (int x, int y) {
int *ptr ;
x = 0;
ptr = &x;
y = * ptr;
ptr = l;
print f ("%d, %d," x, y);
}
```

The output of invoking printxy (l, l) is

- (A) 0,0 (B) 0,1 (C) 1,0 (D) 1,1

2. Consider the following program:

```
int f(int *p, int n)
{
if (n <= 1)
return 0;
else
return max(f(p+1,n-1),p[0]-p[1]);
}
int main()
{
int a[] = {3,5,2,6,4};
printf("%d", f(a,5));
}
int max(int a, int b)
{
if(a>b)
return a;
else
```

```
return b;
}
```

The value printed by this program is _____

3. What will be the output of the following C program?

[Gate-2017]

```
void count(int n)
{
static int d=1;
printf("%d ", n);
printf("%d ", d);
d++;
if(n>1) count(n-1);
printf("%d ", d);
}
void main()
{
count(3);
}
```

- (A) 3 1 2 2 1 3 4 4 4
- (B) 3 1 2 1 1 1 2 2 2
- (C) 3 1 2 2 1 3 4
- (D) 3 1 2 1 1 1 2

4. Point out the compile time error in the program given below

```
#include<stdio.h>
int main()
{
int *x;
*x=100;
return 0;
}
```

- a) Error: invalid assignment for x
- b) Error: suspicious pointer conversion
- c) No Error
- d) None Of the Above

5. What will be the output of the following pseudo-code when parameters are passed by reference and dynamic scoping is assumed?

[Gate-2016]

```
int a=3;
void n(x)
{
x = x * a;
printf(“%d”,x);
}
void m(y)
{
a = 1;
```

```

a = y - a;
n(a);
printf(“%d”,a);
}
void main()
{
m(a);
}

```

(A) 6, 2
(B) 6, 6
(C) 4, 2
(D) 4, 4

6. What does the following fragment of C-program print?

```

[ ] void main()
{
char c[] = "GATE2011";
char *p =c;
printf("%s", p + p[3] - p[1]);
return 0;
}

```

(a) 4 b) 2 c) 8 d) Garbage Value

7. Consider the following code

```

[ ]
void get (int n)
{
if (n < 1) return;
get (n-1);
get (n-3);
printf (“%d”, n);
}

```

If get(6) function is being called in main() then how many times will the get() function be invoked before returning to the main()?

(a) 15 (b) 25 (c) 35 (d) 45

8. The value printed by the following program is _____ []

```

void f(int* p, int m)
{
m = m + 5;
*p = *p + m;
return;
}
void main()
{
int i=5, j=10;
f(&i, j);
printf("%d", i+j);
}

```

a)30 (b) 40 (c) 25 (d) 35

9. Consider the following C program segment.

```
#include <stdio.h>
int main( )
{
char s1[7] = "1234", *p;
p = s1 + 2;
*p = '0' ;
printf ("%s", s1);
}
```

What will be printed by the program?

- (a) 12
- (b) 120400
- (c) 1204
- (d) 1034

10. Consider the C function given below.

[GATE-2014]

```
int f(int j)
{
static int i = 50;
int k;
if (i == j)
{
printf("something");
k = f(i);
return 0;
}
else return 0;
}
```

Which of the following is true?

- (A)Compilation fails
- (B)Execution results in a run-time error
- (C)On execution the value printed is 5 more than the address of variable i.
- (D)On execution the value printed is 5 more than the integer value entered.

UNIT-V

Section-A

Objective Questions

1. A structure can be defined inside an union
A. Yes B. No
2. Bitfields are possible in both structures and unions [T/F]
3. What is the keyword used for declaring structure
A. Structure B. User-defined C. struct_tag D. struct

4. Which of the following are themselves a collection of different data types?
A. string **B.** structure **C.** char **D.** All of the mentioned
5. Which operator connects the structure name to its member name?
A. - **B.** dot . **C.** Both (b) and (c) **D.** None
6. Which of the following cannot be a structure member?
A. Another structure **B.** Function **C.** Array **D.** None
7. Number of bytes in memory taken by the below structure is?
struct test
{
 int k;
 char c;
};
- A.** Multiple of integer size **B.** integer size + character size
C. Depends on the platform **D.** Multiple of word size
8. A structure can be nested inside another structure. True / False
9. Size of a union is determined by size of the.
A. First member in the union **B.** Last member in the union
C. Biggest member in the union **D.** Sum of the sizes of all members
10. Members of a union are accessed as_____.
- A.** union_name. member **B.** union--member
C. Both a & b **D.** None of the mentioned
11. A union cannot be nested in a structure. True / False
12. Which of the following data types are accepted while declaring bit-fields?
A. char **B.** float **C.** double **D.** none of the mentioned
13. The elements of union are always accessed using & operator [True/False]
14. Consider the following program segment

```

struct {
    short x[5];
    union {
        float y;
        long z;
    } u;
}

```

```
}t;
```

Assume that the objects of the type short, float and long occupy 2 bytes, 4 bytes and 8 bytes, respectively. The memory requirement for variable t, ignoring alignment consideration, is

a)22 bytes b)14 bytes c)18 bytes d)10 bytes

15. What would be the size of the following union declaration?

```
union uTemp
{
double a;
int b[10];
char c;
}u;
```

(Assuming size of double = 8, size of int = 4, size of char = 1)

A. 4 B. 8 C. 40 D. 80

16. What will be the output of the program?

```
#include<stdio.h>

int main()
{
    struct value
    {
        unsigned int bit1:1;
        unsigned int bit3:4;
        unsigned int bit4:4;
    }bit={ 1, 2, 13};

    printf("%d, %d, %d\n", bit.bit1, bit.bit3, bit.bit4);

    return 0;}

```

a) 1, 2, 13 b) 1, 4, 4 c) -1, 2, -3 d) -1, -2, -13

17. What will be output of following c code?

```
void main()
{
struct employee
{
unsigned id: 8;
unsigned sex:1;
unsigned age:7;
};
struct employee emp1={203,1,23};
clrscr();

```

```
printf("%d\t%d\t%d",emp1.id,emp1.sex,emp1.age);
getch();
}
```

a) 203 1 23 b) 8 1 7 c) error d) none

18. What will be the output of the program if **stud1 = absent**

```
#include<stdio.h>

int main()

{ enum status {pass, fail, absent};

  enum status stud1, stud2, stud3;

  stud1 = pass;

  printf("%d \n", stud1);

  return 0; }
```

a) 0 b) 1 c) 2 d) error

19. What will be the output of the program

```
#include<stdio.h>
struct course
{
    int courseno;
    char coursename[25];
};
int main()
{
    struct course c[] = { {102, "Java"},
                          {103, "PHP"},
                          {104, "DotNet"} };
    printf("%d ", c[1].courseno);
    printf("%s\n", (*(c+2)).coursename);
    return 0;
}
```

a) 103 DotNet b) 102 Java c) 103 PHP d) 104 DotNet

20. What will be output of following c code?

```
void main()
{
struct bitfield
{
signed int a:3;
unsigned int b:13;
```

```

unsigned int c:1;
};
struct bitfield bit1={2,14,1};
clrscr();
printf("%d",sizeof(bit1));
getch();
}

```

- a) 3 b) 2 c) 13 d) 1

21. What will be output of following c code?

```

void main()
{
struct bitfield
{
unsigned a:3;
char b;
unsigned c:5;
int d;
}bit;
clrscr();
printf("%d",sizeof(bit));
getch();
}

```

- a) 3 b) 5 c) 2 d) 8

22. How can we assign and display a value 20 to the variable x by using temp?

```

#include<stdio.h>
struct st
{
int x;
struct st *next;
};
int main()
{
struct st *temp;
_____
_____

return 0;
}

```

23. Which of the following statements correct about the below program?

```

int main()
{ struct emp

```



```

{
    char name[25];
    int age;
    float sal;
};
struct emp e[2];
int i=0;
for(i=0; i<2; i++)
    scanf("%s %d %f", e[i].name, &e[i].age, &e[i].sal);

for(i=0; i<2; i++)
    scanf("%s %d %f", e[i].name, e[i].age, e[i].sal);
return 0; }

```

- A. Error: scanf() function cannot be used for structures elements.
- B. The code runs successfully.
- C. Error: Floating point formats not linked Abnormal program termination.
- D. Error: structure variable must be initialized.

SECTION-B

Descriptive Questions

1. Define structure. Describe structure initialization with an example.
2. What will be the syntax for declaring a structure? [May-2018]
3. Point out the differences between structure and array.
4. How array of structures are defined? Give an example.
5. Define nested structure. How it differs from array of structures?
6. How to copy one structure to another structure of same data type, give an example.
7. Define Union? Differentiate structure and union?

(Or)

Distinguish structure and a union.

[May-2019]

8. Give an example to define structure in a union.

[Dec-2018]

9. Describe the significance of user-defined datatypes.

Programs

10. Write a C program to implement a structure to read and display the Name, date of Birth and salary of n number of employees.
11. Develop a C-program to illustrate the use of unions. [Dec-2018]
12. Write a C-program to implement nested structure. Consider employee details such as employee name, id, and experience as outer structure members, salary details such as Basic, DA, TA as inner structure members. [May-2018]
13. Write a C program to implement a union to read and display the Name, date of Birth and marks of a student.

14. Write a C program to display the Name, Marks in three subjects and total marks of given number of students. (Using array of structures).
15. Write a C-program to read student name, roll number and marks in six subjects for a class of 30 students. Display the student name, roll number and total marks of six subjects for each student. **[May-2019]**
16. Write a C program which uses functions to perform the following operations using Structure:
 - i) Reading a complex number
 - ii) Writing a complex number
 (or)
 Write functions to read, add, subtract and multiplication of two complex numbers. Use structures to represent complex numbers. **[Dec-2018]**
17. Develop a C-program to use structure within union, display the contents of structure members. **[May-2019]**
18. Write a C program that illustrates the accessing and initializing members of a Union.
19. Write a C program to illustrate passing structure members to functions.
20. Write a C program to illustrate passing entire structure to function.

SECTION-C

Gate Questions

1. The following C declarations

[GATE 2000]

```

struct node
{
    int i;
    float j;
};
struct node *s[10];
define s to be
  
```

- A. An array, each element of which is a pointer to a structure of type node
- B. A structure of 2 fields, each field being a pointer to an array of 10 elements
- C. A structure of 3 fields: an integer, a float, and an array of 10 elements
- D. An array, each element of which is a structure of type node.

2. Consider the following C declaration

[GATE CS 2000]

```

struct {
    short s[5];
union {
  
```

```

        float y;
        long z;
    }u;
} t;

```

Assume that objects of the type short, float and long occupy 2 bytes, 4 bytes and 8 bytes, respectively. The memory requirement for variable t, ignoring alignment considerations, is

- A. 22 bytes B.14 bytes C. 18 bytes D.10 bytes

UNIT-VI

Objective Type Questions

1. A file is a collection of records, that are related logically_____
2. Expand EOF
 - A. End Of File
 - B. Exit Of File
 - C. Error in operating File
 - D. None of above
3. FILE data type defined in stdio.h allows us to define a file pointer.

[True/False]

4. What is the operating mode in which file can be read as well as written
 - A. "a" B."r+" C."w+" D. both b&c
4. SEEK_SET signify that the offset is relative to current position in the file when we define the function fseek()
 - A. False B. True C. no valid answer
5. Which of the following opens a file?
 - A.fscanf B.open C.fopen D.create()
6. What does file mode "wb" signify?
 - A. Open a text file for writing
 - B. Open a binary file for appending data
 - C. Create a binary file for writing

D .Create a text file for writing

7. fread() and fwrite() functions are used to handle records in a file [T/F]

8. Which of the following can read input from a file?

A.fscanf B.fgets C.fread D.all the above

9. fclose(fp), fp is the _____ of the file that needs to be closed.In a file containing the line "I am a boy\r\n" then on reading this line into the array str using fgets(). What will str contain?

A."I am a boy\r\n\0" B."I am a boy\r\0"
C."I am a boy\n\0" D."I am a boy"

10. What is the function prototype of fwrite()?

A. A.size_t fwrite(size_t sz, size_t n, File *fp, const void *ptr)
B. B.size_t fwrite(const void *ptr, size_t sz, size_t n, File *fp)
C. C.size_t fwrite(File *fp, const void *ptr, size_t sz, size_t n)
D. D.size_t fwrite(size_t sz, const void *ptr, size_t n, File *fp)

12. Which of the following indicates end of file?

A.fscanf B.ferror C.feof D.all of the options

13. If *fp is the file pointer, long int fseek(FILE *fp) is the prototype of function fseek().

A.false B.true C.no valid answer

14. What does fp point to in the program ?

```
#include<stdio.h>

int main()

{ FILE *fp;

fp=fopen("trial", "r");

return 0; }
```

A.The first character in the file
B.A structure which contains a char pointer which points to the first character of a file.
C.The name of the file.
D.The last character in the file.

15. What does fp point to in the program ?

```
#include<stdio.h>
int main()
{ FILE *fp;

fp=fopen("trial", "r");

return 0; }
```

A.The first character in the file

B.A structure which contains a char pointer which points to the first character of a file.

C.The name of the file.

D.The last character in the file.

16. Match the following

I	II
A.SEEK_SET	i. 0
B.SEEK_CUR	ii. 2
C.SEEK_END	iii. 1

17. To print out a and b given below, which of the following printf() statement will you use?

```
#include<stdio.h>

float a=3.14;

double b=3.14;

A.printf("%f %lf", a, b);

B.printf("%Lf %f", a, b);

C.printf("%Lf %Lf", a, b);

D.printf("%f %Lf", a, b);
```

18. Which files will get closed through the fclose() in the following program?

```
#include<stdio.h>

int main()

{ FILE *fs, *ft, *fp;

fp = fopen("A.C", "r");
```

```
fs = fopen("B.C", "r");
```

```
ft = fopen("C.C", "r");
```

```
fclose(fp, fs, ft);
```

```
return 0; }
```

A."A.C" "B.C" "C.C"

B."B.C" "C.C"

C."A.C"

D.Error in fclose()

SECTION-B

Descriptive Questions

1. What is meant by Random access to files? Explain fseek() ftell() in detail.
2. Give the syntax for opening a file.

[May-2018]

3. Write a C-program to illustrate the use of rewind() and ftell() functions.

[May-2019]

4. Write a C-Program to create a file and Also explain the file operations used in this program
5. Write a c program to create separate files for even and odd numbers in an existing file
6. Explain different types of files in detail
7. Write a c program to merge contents of 2 different files into a single file
8. Explain how fgets() and fputs() work with an example program
9. Explain usage of putw and getw with an example program
10. What is the difference between fscanf() and fgets()?

11. Differentiate read, write and append modes in files. [May-2019]

12. Write a C-program to position the file pointer at required position using fseek().

[Dec-2018]

13. Differentiate getc() and fscanf().

[Dec-2018]

14. Explain different functions for random accessing of files with suitable code.

[May-2018]

Programs

15. Write a c program that uses any 3 file handling functions

16. Write a c program for searching for a record in a file
17. Write a c program illustrating the usage of feof() and ferror()
18. Write a c program for billing checkout counter of a super market
19. Write a c program for preparing consolidated attendance/ marks sheet
20. Write a c program for illustrating usage of fprintf() and fscanf()
21. Write a c program for illustrating fseek() and explain the arguments of fseek()
22. Write a c program for performing string handling operations on file contents.
 23. Write a C-program to display content of file on the screen.[**May-2019**]
 24. Write a C-program to copy content of one file to another file.[**Dec-2018**]

SECTION-C

Gate Questions

Find the error(s) in the following program segment and rewrite the correct program[**GATE-2007**]

```
int main ( )
{
    int * fp;
    int, k;
    fp = fopen ("pizza");
    for (k = 0; k < 30; k++)
        printf ("Jill likes pizza.\n", fp);
    fclose ("pizza");
    return 0;    }
```

Signature of the Faculty

GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, Gudlavalleru – 521 356.

Department of Computer Science and Engineering



2020-21 SEM -I

II-B.Tech Handout

Vision :

To be a Centre of Excellence in computer science and engineering education and training to meet the challenging needs of the industry and society

Mission:

- To impart quality education through well-designed curriculum in tune with the growing software needs of the industry.
- To serve our students by inculcating in them problem solving, leadership, teamwork skills and the value of commitment to quality, ethical behavior & respect for others.
- To foster industry-academia relationship for mutual benefit and growth

Program Educational Objectives :

PEO1: Identify, analyze, formulate and solve Computer Science and Engineering problems both independently and in a team environment by using the appropriate modern tools.

PEO2: Manage software projects with significant technical, legal, ethical, social, environmental and economic considerations.

PEO3: Demonstrate commitment and progress in lifelong learning, professional development, Leadership and Communicate effectively with professional clients and the public

HANDOUT ON DIGITAL LOGIC DESIGN

Class & Sem. : II B.Tech I-Semester Year : 2020-21
Branch : CSE Credits : 3

=====

1. Brief History and Scope of the Subject

In 1947, Bardeen, Braittain and Shockley invented the transistor at Bell Labs. This resulted in solid state switching, that is much faster and more reliable than relays. This enabled the creation of powerful computers. In 1958, Jack Kilby and Robert Noyce invented integrated circuits that enabled more and less expensive digital circuits in a smaller package. These were used in the space program in which weight is an important factor. In 1969, Dick Morley invented the first Programmable Logic Controller (PLC), the MODICOM Model 84. The PLC is designed for the more rugged applications and more power that is required for manufacturing. These devices have replaced by control relays in many manufacturing areas. In 1971, Robert Noyce and Gordon Moore introduced a “Computer on a chip”. It executed 60,000 operations per second which is substantially more than the 5 operations per second for Shannon’s relay logic device. Improvements in integrated circuits and microprocessors have enhanced the functionality of Programmable Logic Controllers. In mid 1970’s through 1980’s, Allen Bradley produced PLC1 through PLC5 series of Programmable Logic Controllers using integrated circuits and microprocessors. In 1980, IBM started production of the IBM Personal Computer (PC) which made computing available to all. The PC is useful for both programming Programmable Logic Controllers and for the analysis and design of digital logic circuits. In addition to computers and the PLC, digital circuits are used in cell phones and other mobile devices, automobiles, medical devices, security systems, household appliances, energy management systems and High Definition Television (HDTV).

A. Recent developments

In 2009, researchers discovered that memristors can implement a boolean state storage similar to a flip flop, implication and logical inversion, providing a complete logic

family with very small amounts of space and power, using familiar CMOS semiconductor processes. The discovery of superconductivity has enabled the development of rapid single flux quantum (RSFQ) circuit technology, which uses Josephson junctions instead of transistors. Most recently, attempts are being made to construct purely optical computing systems capable of processing digital information using nonlinear optical elements.

2. Pre-Requisites

- Programming Language such as C/C++

3. Course Objectives:

- To familiarize with the design of digital logic circuits.

4. Course Outcomes:

CO1: Translate number given in one number system to another number system.

CO2: Apply complements to perform addition and subtraction of signed numbers.

CO3: Reduce Boolean function using Boolean laws, theorems and K-Maps.

CO4: Design combinational logic circuits such as adders, subtractors, decoders, encoders, Mux and De-Mux.

CO5: Prepare characteristic equation and excitation tables of SR, JK, T and D flip-flops.

CO6: Design counters and registers using flip-flops.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

CO1.translate number given in one number system to another number system.	2																	
CO2.apply complements to perform addition and subtraction of signed numbers.	2	2																
CO3.reduce Boolean function using Boolean laws, theorems and K-Maps.	2	2	3	1														
CO4.design combinational logic circuits such as adders, subtractors, decoders, encoders, Multiplexers and De-Multiplexers.	2	2	3	2														1
CO5.prepare characteristic equation and excitation tables of SR, JK, T and D flip-flops.	1	2	1															
CO6.design counters and registers using flip-flops.	2	3	3	2														1

7. Prescribed Text Books

- M. Morris Mano, Michael D Ciletti, Digital Design, PEA, 5th edition.

8. Reference Text Books

- Kohavi, Jha, Switching and Finite Automata Theory, Cambridge, 3rd edition.
- Leach, Malvino, Saha, Digital Logic Design, TMH.
- Roth, Fundamentals of Logic Design, Cengage, 5th edition.

9. URLs and Other E-Learning Resources

URLs:

- [IEEE Xplore: IEE proceedings -Computers and Digital Techniques:](http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=4641395)
<http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=4641395>

[IET Digital Library:](http://digital-library.theiet.org/content/journals/iet-cdt) <http://digital-library.theiet.org/content/journals/iet-cdt>

- [IEEE Xplore: IEEE Design & Test of Computers](http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=54)

<http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=54>

E-Learning Materials:

Journals:

INTERNATIONAL JOURNALS:

- IEEE trans on electronic devices.
- IEEE journal of solid state circuits

NATIONAL JOURNALS:

- ELECTRONICS today
- IETE technical review

10. Digital Learning Materials:

- a. SONET CDs - Switching Theory and Logic design -34
- b. IIT CDs - Principles and Design of Digital Systems- 28, Madras.

11. Lecture Schedule / Lesson Plan

Topic	No. of Periods	
	Theory	Tutorial
UNIT –1: Number Systems		
Binary,octal,decimal & hexadecimal number systems	1	1
Number base conversions	2	
Problems	2	
R's and (r-1)'s COMPLEMENTS	1	1
Subtraction of unsigned binary numbers	2	
Signed binary numbers	1	
Weighted and non weighted codes	2	
UNIT – 2: Logic gates and Boolean Algebra		
NOT, AND,OR, universal gates,Ex-Or and Ex-Nor gates	2	1
Boolean theorems, complement and dual	2	
SOP,POS, two level realization of logic functions using universal gates	2	1
Minimization of logic functions(pos,sop) using boolean theorems	2	
K-map(upto 4-variables), don't care conditions	2	
UNIT – 3: Combinational Logic Circuits-1		

Design of half-adder, full adder	2	1
Half Subtractor, full subtractor	2	
Ripple adders and subtractors using 1's and 2's complement method	2	1
UNIT – 4: Combinational Logic Circuits-2		
Design of decoders, encoders	2	1
Priority Encoder	1	
Multiplexers and De-multiplexers	2	
Higher order Decoders	2	1
Higher order multiplexers and De-multiplexers	2	
Realization of Boolean functions using decoders, Multiplexers	2	
UNIT – 5: Sequential Logic Circuits		
Classification of sequential circuits, latch and flip-flop	2	1
RS-latch using NAND and NOR gates, truth tables	2	
RS, JK, T & D flip-flops, truth and excitation tables	2	
Conversion of flip flops	2	1
Flip-flops with asynchronous inputs(Preset and clear)	2	
UNIT – 6: Registers and counters		
Design of Registers, Bi-directional shift registers	2	1
Universal Shift registers	2	
Design of ripple counters, synchronous counters and variable Modulus counters	2	1
Ring counter and Johnson counter	2	
Total No.of Periods:	56	12

Assignment-Cum-Tutorial Questions

UNIT-I

SECTION-A

Objective Questions

- 1) Representation of 8620 in binary is
 - A. 1000_0111_1110_0000
 - B. 1000_0110_1010_0000
 - C. 1000_0110_0010_0000
 - D. 1011_0110_0010_0000
- 2) 8723 in BCD
 - A. 1000_0111_0010_0011
 - B. 1000_0101_0010_0011
 - C. 1000_0001_0010_0011
 - D. 1000_0111_0110_0011
- 3) No of Characters specified in 6-bit code are
 - A. 61
 - B. 62
 - C. 63
 - D. 64
- 4) End around carry is used to correct the result of additions in which of the following number systems?
 - A. 8 bit Signed Binary.
 - B. 8 bit Ones Complement.
 - C. 8 bit Twos Complement.
 - D. Excess 3 BCD
- 5) ASCII stands for
 - A. African standard code for information interchange
 - B. American standard code for integer interchange
 - C. American standard code for information interchange
 - D. African standard code for integer interchange
- 5) $(734)_8 = ()_{16}$
 - A. C 1 D
 - B. D C 1
 - C. 1 C D
 - D. 1 D C
- 7) -8 is equal to signed binary number
 - A. 10001000
 - B. 00001000
 - C. 10000000
 - D. 11000000
- 8) The excess-3 code of decimal 7 is represented by
 - A. 1100
 - B. 1001
 - C. 1011
 - D. 1010
- 9) Binary code that distinguishes ten elements must contain at least
 - A. Two bits
 - B. Three bits
 - C. Four bits
 - D. Five bits
- 10) Which of the following Twos Complement binary numbers is equivalent to -75_{10}
 - A. 11001011
 - B. 01001100
 - C. 11001100
 - D. 10110101
- 11) 4-bit 2's complement representation of a decimal number is 1000. The number is
 - A. +8
 - B. 0
 - C. -7
 - D. -8

- 12) An equivalent 2's complement representation of the 2's complement number is 1101 is
 A. 110100 B. 001101
 C. 110111 D. 111101
- 13) $842 + 537 =$
 A. 0001 0011 0111 0101 C. 0111 0011 0111 0101
 B. 0001 0111 0111 0101 D. 0001 0011 0111 0111
- 14) 9's complement of 546700 is
 A. 453299 B. 453399 C. 543399 D. 543299
- 15) Decimal 43 in Hexadecimal and BCD number system is respectively
 A. B2, 0100 0011 B. 2B, 0100 0011 C. 2B, 0011 0100
 D. B2, 0100 0100
- 16) 2's complement representation of a 16 bit number (one sign bit and 15 magnitude bits) is FFFF. Its magnitude in decimal representation is
 A. 0 B. 1 C. 32,767 D. 65,535
- 17) The number of bits used to store a BCD digit is:
 A. 2 B. 1 C. 4 D. 8
- 18) Two 2's complement numbers having sign bits x and y are added and the sign bit of the result is z. Then, the occurrence of overflow is indicated by the Boolean function
 A. xyz B. $x'y'z'$ C. $x'y'z+xyz'$
 D. $xy+yz+zx$
- 19) 11001, 1001 and 111001 correspond to the 2's complement representation of which one of the following sets of number?
 A. 25, 9 and 57 respectively B. -6, -6 and -6 respectively
 C. -7, -7 and -7 respectively D. -25, -9 and -57 respectively
- 20) The two numbers represented in signed 2's complement form are $P = 11101101$ and $Q = 11100110$. If Q is subtracted from P, the value obtained in signed 2's complement form is
 A. 100000111 B. 00000111 C. 11111001 D. 111111001

SECTION-B

SUBJECTIVE QUESTIONS

- 1) Convert $(27.315)_{10}$ into the number with base 2, 5, 8 and 16

- 2) Convert $(2AC5.D)_H$ to decimal, octal and binary.
- 3) Represent 54 using 3321, 84-2-1, 5211 and 6311 BCD codes.
- 4) Give the binary, BCD, excess-3, gray code for 0-9 numbers.
- 5) Convert the following number with indicated bases to decimal
 - i. $(1\ 0\ 1\ 1\ 1\ 1)_2$ ii. $(A\ 3\ B)_{16}$ iii. $(2\ 3\ 7)_8$ iv. $(4\ 3)_5$
- 6) Perform the following using 1's and 2's complement
 - (i) add -20 to +26 (ii) add +25 to -15
- 7) Give the details of excess-3 code and gray code using four binary digits. Compare the two codes.
- 8) Determine the value of base X, If
 - i. $(193)_x = (623)_8$ ii $(225)_x = (341)_8$ iii $(211)_x = (152)_8$
- 9) Determine the base of the numbers in each case for the following operations to be correct:
 - i. $14/2=5$, ii. $54/4=13$, iii. $24+17=40$.
- 10) a) Convert gray code 101011 into binary.
 b) Convert binary code 10111011 into gray code.
- 11) Perform the following operation:
 - (a) $(756)_8 - (637)_8 + (725)_{16} = ()_{12}$
 - (b) $24+18$, $48+58$, $175+326$ $589+199$ in BCD
- 12) If $1010_2 + 10_2 = X_{10}$, then what is the value of X?
- 13) The solution to the quadratic equation $X^2 - 11X + 22 = 0$ are $X=3$ and $X=6$. What is the base of the number?
- 14) Test the following:
 - (a) Find 16's complement of C3DF.
 - (b) Convert C3DF to binary.
 - (c) Find the 2's complement of result in (b).
 - (d) Convert the answer in (c) to hexadecimal.
 - (e) Compare with answer in (a).
- 15) Assign the binary code in some orderly manner to the 52 playing cards. Use the minimum number of bits.

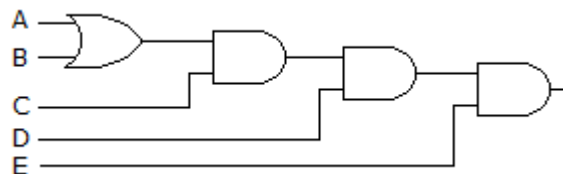
C. Questions testing the analyzing / evaluating ability of students

1) Devise a scheme for converting base 3 numbers directly to base 9. Use your method to convert the following number to base 9: $(1110212.20211)_3$

UNIT-II
SECTION-A

Objective Questions

- The basic logic gate whose output is the complement of the input is the:
A. OR gate
B. AND gate
C. INVERTER gate
D. Comparator
- Logically, the output of a NOR gate would have the same Boolean expression
a. AND gate immediately followed by an INVERTER
b. NAND gate immediately followed by an INVERTER
c. OR gate immediately followed by an INVERTER
d. NOR gate immediately followed by an INVERTER
- The format used to present the logic output for the various combinations of logic inputs to a gate is called:
a. truth table.
b. input logic function.
c. Boolean constant.
d. Boolean variable.
- Derive the Boolean expression for the logic circuit shown below:



A. $C(A + B)DE$

B. $[C(A + B)D + \bar{E}]$

C. $\left[\left[C(A + B)D \right] \bar{E} \right]$

D. $ABCDE$

5. Which Boolean law is described by the equation $A \cdot (B + C) = A \cdot B + A \cdot C$?

- a) Commutative law.
- b) Associative law.
- c) Distributive law.
- d) Complement law.

6. $e \cdot x = x \cdot e = x$ is the

- a. commutative property
- b. inverse property
- c. associative property
- d. identity element

7. To perform product of max terms Boolean function must be brought into

- a. AND terms
- b. OR terms
- c. NOT terms
- d. NAND terms

8. Universal logic gates are:

- a. NAND and NOR
- b. OR and AND
- c. NOT and OR
- d. OR and XOR

9. NAND gate is a combination of:

- a. AND and NOT gates
- b. AND and OR gates
- c. AND and XOR gates
- d. OR and NOR gates

10. What does an EX-OR gate do?

- a. Give a high output when odd number of inputs are high
- b. Give a high output when even number of inputs are high
- c. Give a low output when odd number of inputs are high

- d. Give a low output when even number of inputs are high
11. Determine the values of A, B, C, and D that make the product t
- A. $A = 0, B = 1, C = 0, D = 1$
- B. $A = 0, B = 0, C = 0, D = 1$
- C. $A = 1, B = 1, C = 1, D = 1$
- D. $A = 0, B = 0, C = 1, D = 0$
12. The simplification of the Boolean expression $(ABC) + (ABC)^1$ is
- (A) 0 (B) 1 (C) A (D) BC
13. How many gates would be required to implement the following Boolean expression after simplification? $XY + X(X + Z) + Y(X + Z)$
- (A) 1 (B) 2 (C) 4 (D) 5
14. Applying DeMorgan's theorem to the expression $\overline{\overline{(X + Y)} + \overline{Z}}$, we get _____
- A. $(X + Y)Z$
- B. $(\overline{X} + \overline{Y})Z$
- C. $(X + Y)\overline{Z}$
- D. $(\overline{X} + \overline{Y})\overline{Z}$
15. Use Boolean algebra to find the most simplified SOP expression for $F = ABD + CD + ACD + ABC + ABCD$.
- A. $F = ABD + ABC + CD$
- B. $F = CD + AD$
- C. $F = BC + AB$
- D. $F = AC + AD$
16. Convert the $f(x,y,z) = \sum(1,3,5)$ to the other canonical form
- A) $\pi(0,1,2,3,4,6,7)$ B) $\pi(0,2,4,6,7)$ C) $\pi(0,2,4,6,7)$
- D) $\sum(0,1,2,3,4,6,7)$
17. Simplified expression of $Y = AB^1 + AB + A^1B$
- A) A^1B B) $A^1 + B$ C) $A + B$ D) AB

SECTION-B

SUBJECTIVE QUESTIONS

1. Simplify the Boolean expressions:

a. $AB + A(B + C) + B(B + C)$.

b. $[AB(C + BD) + A\bar{B}]C$

c. $A^1BC + ABC^1 + A\bar{B}C + A^1\bar{B}C^1$

2. Convert each of the following Boolean expressions to SOP and POS form:

a. $(u+xw)(x+u^1v)$

b. $x^1 + x(x+y^1)(y+z^1)$

3. Express the following functions as a sum of min terms and as a product of max terms:

$$F(A,B,C)=B^1C+A^1C+BC$$

Use Boolean algebra to simplify the following expression, then draw a logic circuit for the simplified expression: $A(B + AB) + AC$

4. Reduce the following Boolean expressions to the indicated number of literals

a. $A^1C'+ABC+AC'$ to THREE literals

b. $ABC^1D+A^1BD+ABCD$ to TWO literals

c. $A^1B(D'+CD)+B(A+A^1CD)$ to ONE literals

5. Simplify the following Boolean function using K-map :

a. $F(X,Y,Z)=\sum(0,1,2,5,7)$

b. $F(A,B,C,D)=\sum(4,5,6,7,15)$

6. Simplify the following using De Morgan's theorem $[((AB)^1 C)^1 D]^1$.

7. Show that $(X+Y'+XY)(X+Y')(X'Y)=0$.

8. Realize the Boolean function using logic gates $Y = CD+EF+G$.

9. Implement the following POS function using NOR gates only

a. $F = (X+Z) (Y'+Z) (X'+Y+Z)$

10. Implement the following function

a. $F=(XZ+Y^1Z+X^1YZ)^1$ OR $F^1=XZ+Y^1Z+X^1YZ$ using two level NAND circuit.

11. Simplify the following function and implement with two - level NOR gate
 $F=WX'+Y'Z'+W'YZ'$

12. Simplify the following Boolean function together with the don't care conditions and simplify in SOP form

a. $F(A,B,C,D)=\sum (0,6,8,13,14)$ $d(A,B,C,D)=\sum (2,4,10)$

b. $F(A,B,C,D)=\sum (4,5,6,7,12,13,14)$ $d(A,B,C,D)=\sum (1,9,11,15)$

13. Simplify the following Boolean function to product of sums form:

a. $F(W,X,Y,Z)=\sum (0,1,2,5,8,10,13)$

b. $F(W,X,Y,Z)=\Pi(1,3,5,7,12,13,14,15)$

SECTION-C

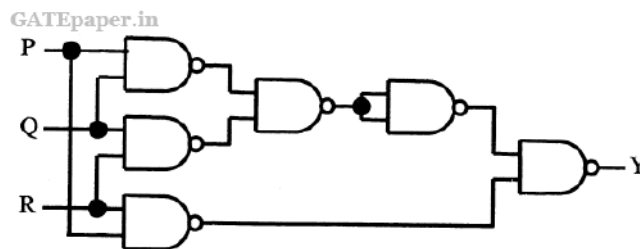
QUESTIONS AT THE LEVEL OF GATE

1. Which one of the following expressions does NOT represent exclusive NOR of x and y?

[Gate 2013]

- a. $xy+x'y'$ b. $x+y'$ c. $x'+y$ d. $x'+y'$

2. The output Y in the circuit below is always '1', when [Gate 2011]

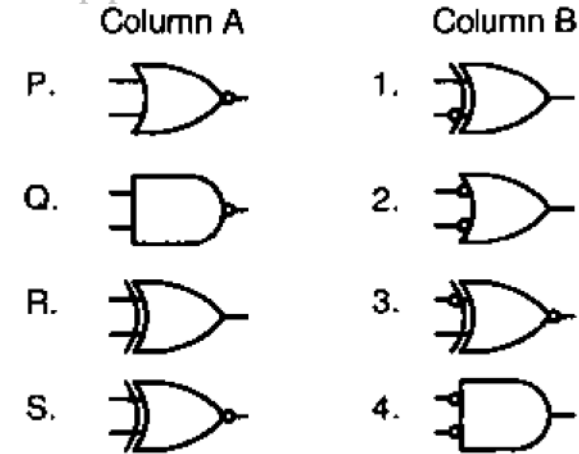


- a. Two or more of the inputs P,Q, R are '0'
- b. Two or more of the inputs P,Q, R are '1'
- c. Any odd number of the inputs P,Q,R is '0'
- d. Any odd number of the inputs P,Q,R is '1'

3. Match the logic gates in Column A with their equivalents in Column B.

[Gate 2010]

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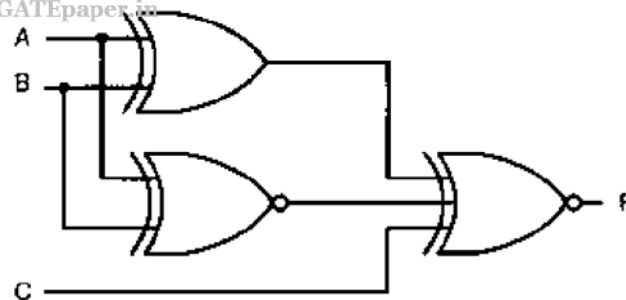


- e. P - 2, Q - 4, R - 1, S - 3
- f. P - 4, Q - 2, R - 1, S - 3
- g. P - 2, Q - 4, R - 3, S - 1
- h. P - 4, Q - 2, R - 3, S - 1

4. For the output F to be 1 in the logic circuit shown, the input combination should be

[Gate 2010]

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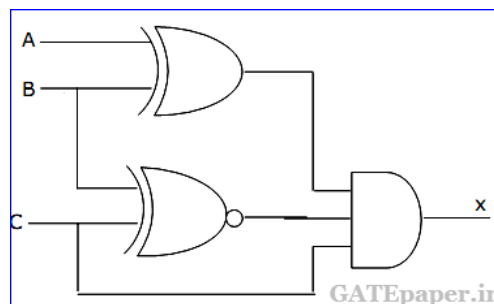
- a. $A = 1, B = 1, C = 0$
- b. $A = 1, B = 0, C = 0$
- c. $A = 0, B = 1, C = 0$
- d. $A = 0, B = 0, C = 1$

5. Evaluate the minimum number of gates required to implement the Boolean function $(AB+C)$ if we have to use only 2-input NOR gates?

[Gate 2009]

6. For the logic circuit shown in the figure, the required input combination (A,B,C) to make the output $X = 1$ is

[Gate 2000]



- a. 1, 0, 1
- b. 0, 0, 1
- c. 1, 1, 1
- d. 0, 1, 1

7. Which function does NOT implement the Karnaugh map given below?

[Gate 2000]

wz →	00	01	11	10
xy ↓				
00	0	x	0	0
01	0	x	1	1
11	1	1	1	1
10	0	x	0	0

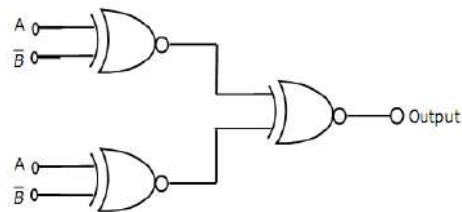
- (a) $(w+x)y$
- (b) $xy + yw$
- (c) $(w+x)(\bar{w}+y)(\bar{x}+y)$
- (d) None of the above

8. The minimum number of 2 input NAND gates required to implement the Boolean function $Z = AB'C$, assuming that A, B and C are available, is

[Gate 1998]

- a. Two
- b. Three
- c. Five
- d. Six

9. The output of the circuit shown in figure is equal to **[Gate 1995]**

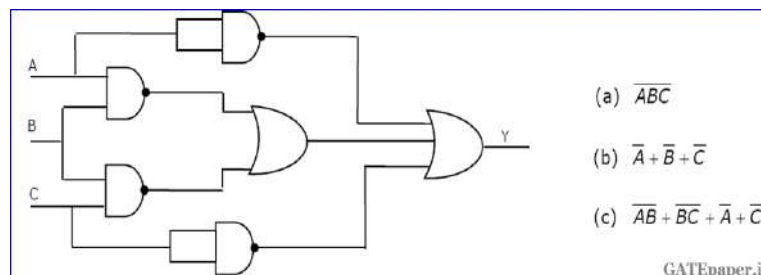


- (a) 0
- (b) 1
- (c) $\bar{A}B + A\bar{B}$
- (d) $(A * B) * (\bar{A} * \bar{B})$

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10. For the logic circuit shown in figure, the output Y is equal to

[Gate 1993]

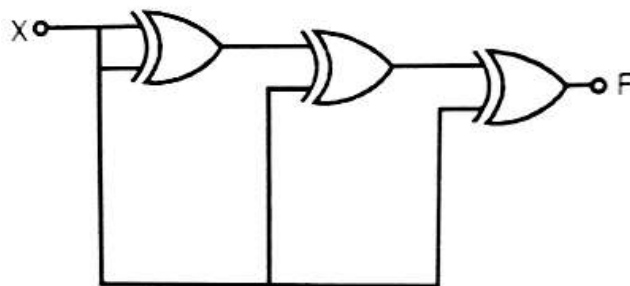


- (a) $\bar{A}BC$
- (b) $\bar{A} + \bar{B} + \bar{C}$
- (c) $\bar{A}\bar{B} + \bar{B}\bar{C} + \bar{A}\bar{C}$

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11. For the circuit shown below, the output F is given by

[Gate 1988]



- (a) $F = 1$
- (b) $F = 0$
- (c) $F = X$
- (d) $F = \bar{X}$

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12. Minimum number of 2 input NAND gates required to implement the function given below is

[Gate 1988]

$$F = (\bar{X} + \bar{Y})(Z + W)$$

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- a.3 b.4 c.5 d.6

UNIT-III
SECTION-A

Objective Questions

1. Combinational circuit has: []
a) memory b) no memory c) flip-flops d) unlers
2. Simplified expression of half adder carry is []
a) $c=xy+x$ b) $c=y+x$ c) $c=xy+y$
d) $c=xy$
3. Full adder performs sum of []
a) 2 bits b) 3 bits c) 4 bits d) 5 bits
4. Which are the fundamental inputs assigned or configured in the full adder circuit ? []
a. Addend, Augend & Sum b. Augend, Sum & Input Carry
c. Addend, Augend & Input Carry d. Addend, Sum & Input Carry
5. Full subtractor is a----- []
A. combinational circuit B. Sequential circuit

C. combinational sequence D. series

6. Most significant bit of arithmetic addition is called []

- a) Overflow b) carry c) output d) zero bit

7. Simplified expression of full adder carry is []

- a). $c=xy+xz+yz$ b). $c=xy+xz$ c). $c=xy+yz$ d). $c=x+y+z$

8. Two bit subtraction is done by []

- a) demux b) mux c) full subtractor d) half subtract

9. A half adder circuit does not have _____ []

11. One way to make a four-bit adder perform subtraction is by:

- a) Inverting the output. b) Inverting the carry-in.
c) Inverting the B inputs. d) Grounding the B inputs.

12. The number of full and half adders required to perform 16-bit addition is:

- a) 8 half adders, 8 full adders b) 1 half adder, 15 full adders
c) 16 half adders, 0 full adders d) 4 half adders, 12 full adders

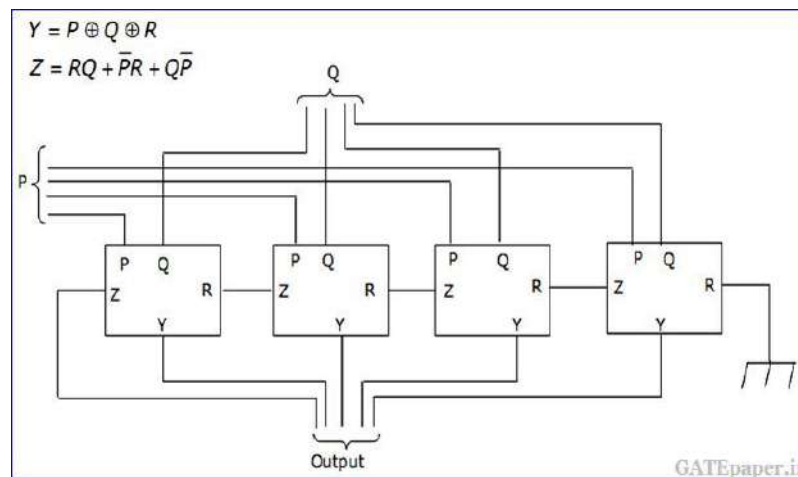
13. Borrow in two bit (x,y) subtraction is 0, as long as

- a) $y > x$ b) $x = y$ **c) $x \geq y$**

14. The circuit shown in the figure has 4 boxes each described by inputs P,Q,R and outputs Y, Z with the following relation. The circuit acts as a

- a) carry in b) carry out c) Two inputs d) all the above

14. The output of combinational circuit depends only on present input.



- A. 1 bit adder giving $P + Q$ B. 1 bit subtractor giving $P - Q$
 C. 4 bit subtractor giving $Q - P$ D. 4 bit adder giving $P + Q + R$

15. How does an arithmetic operation take place in binary adders?

- A. By addition of two bits corresponding to 2^n digit
 B. By addition of resultant to carry from 2^{n-1} digit
 C. both a & b D. none of the above

16. In a half-subtractor circuit with X and Y as inputs, the Borrow (M) and

Difference ($N = X - Y$) are given by

[]

18. Which logic gate is used as a two-bit adder?

- a) OR b) AND c) NAND d) NOR

19. In four bit adder-subtractor circuit, overflow occurs when-----

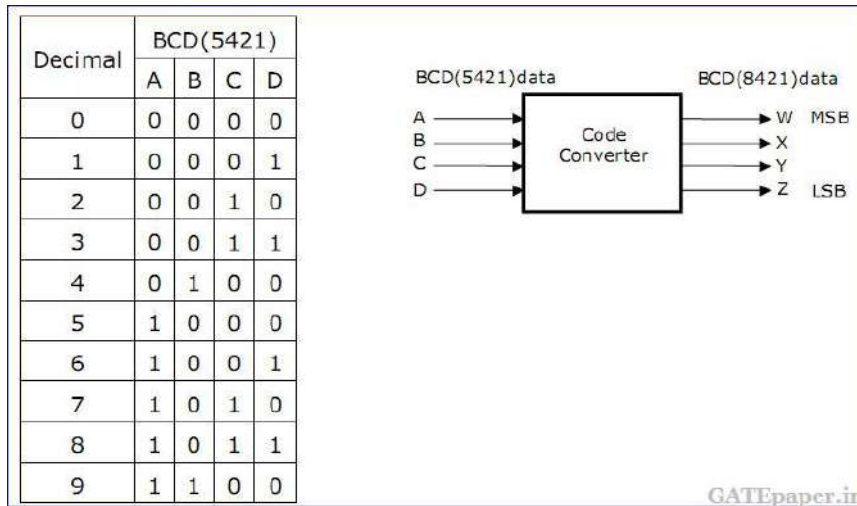
- A) Two input numbers are positive C) Two input numbers are positive
B) One number is positive and another is negative D) all of the above

Section B

Descriptive Questions

1. Explain the design of half adder. $M = XY$
2. Explain the design of full adder. $M = XY, N = X \oplus Y$
3. Explain the design of half subtractor. $M = XY, N = X \oplus Y$
4. Explain the design of full subtractor.
5. Explain the design and working of ripple adder, ripple subtractor and ripple adder/subtractor.
6. Explain serial adder.
7. Design a combinational circuit with three inputs x,y and z and three outputs: A,B and C. When the binary input is 0,1,2 and 3, the binary output is one greater than the input. When the binary input is 4,5,6 and 7, the binary output is two less than the input.
8. Design a combinational circuit that converts a four bit Gray code into a four bit binary code. Implement the circuit with exclusive OR gates.
9. A 'code converter' is to be designed to convert from the BCD (5421) code to normal BCD (8421) code. The input BCD combinations for each digit are given below. A block diagram of the converter is shown in figure.

10. Draw K- map for outputs W, X, Y and Z
11. Obtain minimized expression for the outputs W, X, Y and Z.



12. Design a combinational circuit with three inputs and one output.
- (i). the output is 1 when the binary value of the inputs is less than 3. The output is 0 otherwise.
- (ii). the output is 1 when the binary value of the input is an even number.
13. Design a circuit that has a 3-bit binary input and a single output (Z) specified as follows:
- Z = 0, when the input is less than 5_{10}
 - Z = 1, otherwise
14. Design a circuit that has a 3-bit binary input and a single output that
- output 1 if it is a prime number. eg 2_{10} , 3_{10} , 5_{10} , 7_{10}
 - otherwise output 0.
15. Given two input bits A and B, produce three outputs X, Y, and Z so that
- X is 1 only when only when $A > B$,
 - Y is 1 only when $A < B$, and
 - Z is 1 only when $A = B$

16. Design a circuit with 4 inputs that has outputs with a binary value equal to the number of inputs that are HIGH.

Section C:

1. Using only four-bit adders, construct an eight-bit adder. Each four-bit adder has two four-bit inputs and one five-bit output. Your eight-bit adder should have two eight-bit inputs and a one eight-bit output (don't worry about the ninth output bit).
2. A bank wants to install an alarm system with 3 movement sensors. To prevent false alarms produced by single sensor activation, the alarm will be triggered only when at least two sensors activate simultaneously.

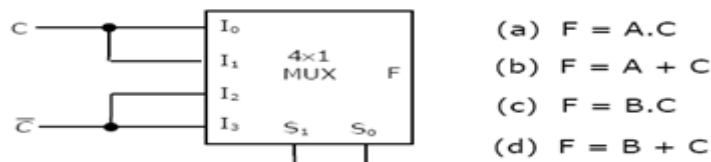
UNIT-IV SECTION-A

Objective Questions

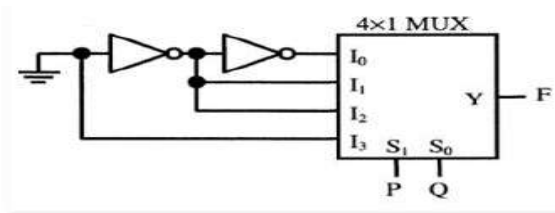
1. How many 3-to-8-line decoders are required for a 1-of-32 decoder (5 to 32 line decoder)?
a) 1 b) 2 c) 4 d) 8
2. How many 1-of-16 decoders are required for decoding a 7-bit binary number?
a) 5 b) 6 c) 7 d) 8
3. A decoder converts _____.
a) non coded information into coded form.
b) coded information into non coded form.
c) HIGH to LOW
d) LOW to HIGH
4. A combinational circuit which is used to change a BCD number into an equivalent decimal number is
a) Decoder b) Encoder c) Multiplexer d) De-multiplexer
5. A decoder with the priority function is called -----.
6. A combinational circuit which is used to change a decimal number into an equivalent BCD number is
a) Decoder b) Encoder c) Multiplexer d) De-multiplexer

7. How many data select lines are required for selecting eight inputs?
 a) 1 b) 2 c) 3 d) 4
8. multiplexer is having _____ output lines.
9. A multiplexer is also known as
 a) a data accumulator b) a data restorer
 c) a data selector d) a data distributor
10. A de-multiplexer is a device that converts some code into a recognizable number or character. [True/False]
11. 1-of-16 decoder has 16 outputs and decodes an input of ___ bits.
 A) two B) three C) four D) six
12. When data input I_6 of a octal-to-binary encoder is active, the data output is
 A) $A = 0$ $B = 1$ $C = 0$ B) $A = 0$ $B = 0$ $C = 1$
 C) $A = 1$ $B = 1$ $C = 0$ D) $A = 1$ $B = 0$ $C = 0$
13. Which device is used in computer hardware to place ALU results into the correct register?
 A) De-multiplexer B) Encoder C) Multiplexer D) Decoder

14. The logic realized by the circuit shown in figure is []



15. Which device is used in computer hardware to select which register is to be gated to the ALU operand inputs?
 A) De-multiplexer B) Multiplexer C) Encoder D) Decoder
16. Without any additional circuitry, an 8:1 MUX can be used to obtain []
 a. Some but not all Boolean functions of 3 variables
 b. All functions of 3 variables but none of 4 variables
 c. All functions of 3 variables and some but not all of 4 variables
 d. All functions of 4 variables
17. The logic function implemented by the circuit below is (ground implies logic 0)



- a. $F = \text{AND}(P, Q)$
- b. $F = \text{OR}(P, Q)$
- c. $F = \text{XNOR}(P, Q)$
- d. $F = \text{XOR}(P, Q)$

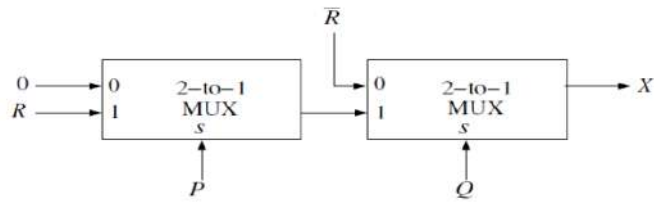
18. What are the minimum number of 2 to 1 MUX required to generate a 2 input AND gate and a 2 input EX-OR gate?
- a. 1 and 2
 - b. 1 and 3
 - c. 1 and 1
 - d. 2 and 2

Section B:

1. Differentiate encoder and decoder.
2. Design 3-to-8 line Decoder.
3. Design 4-to-2 line encoder. Discuss the problems encountered by ENCODER and the ways to rectify them.
4. Design a 8-to-3 line Priority Encoder.
5. Design 4X1 MUX.
6. Design 1X8 De-multiplexer circuit.
7. Design BCD to 7 Segment display decoder.
8. Implement the following functions using a decoder constructed with AND gates
 $F_1(A, B, C) = \sum(1, 4, 6)$ $F_2(A, B, C) = \sum(3, 5)$ $F_3(A, B, C) = \sum(2, 4, 6, 7)$
9. Implement the Boolean function $f(A, B, C, D) = \sum(2, 4, 9, 10)$ with multiplexer having active-HIGH Enable input.
10. Implement the following Boolean function using 8:1 MUX.
 $F(w, x, y, z) = \sum_m(0, 3, 5, 8, 9, 10, 12, 14)$
11. Design a 1X16 De-multiplexer using two 1X8 De-multiplexers having an active-LOW Enable input.

Section C: Questions asked in GATE

1. Consider the two cascaded 2-to-1 multiplexers as shown in the figure.



The minimal sum of products form of the output X is

- (A) $\bar{P}\bar{Q} + PQR$
- (B) $\bar{P}Q + QR$
- (C) $PQ + \bar{P}\bar{Q}R$
- (D) $\bar{Q}\bar{R} + PQR$

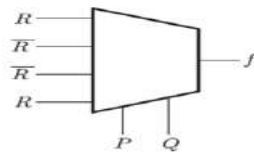
GATE-CS-2016

2. A RAM chip has a capacity of 1024 words of 8 bits each $1K \times 8$. The number of 2×4 decoders with enable line needed to construct a $16K \times 16$ RAM from $1K \times 8$ RAM is

GATE-CS-2013

- (A) 4
- (B) 5
- (C) 6
- (D) 7

3. The Boolean expression for the output f of the multiplexer shown below is



- (A) $\overline{P \oplus Q \oplus R}$
- (B) $P \oplus Q \oplus R$
- (C) $P + Q + R$
- (D) $\overline{P + Q + R}$

GATE-CS-2010

4. How many 3-to-8 line decoders with an enable input are needed to construct a 6-to-64 line decoder without using any other logic gates?

GATE-CS-2007

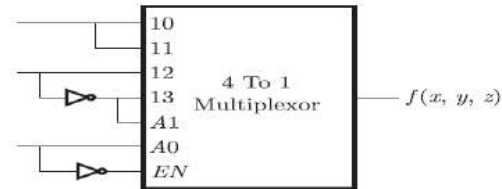
- (A) 7
- (B) 8
- (C) 9
- (D) 10

5. Suppose only one multiplexer and one inverter are allowed to be used to implement any Boolean function of n variables. What is the minimum size of the multiplexer needed?

- (A) $2n$ line to 1 line
- (B) $2n+1$ line to 1 line
- (C) $2n-1$ line to 1 line
- (D) $2n-2$ line to 1 line

GATE-CS-2007

6. Consider the following multiplexor where 10, 11, 12, 13 are four data input lines selected by two address line combinations $A1A0 = 00, 01, 10, 11$ respectively and f is the output of the multiplexor. EN is the Enable input.



The function $f(x, y, z)$ implemented by the above circuit is
 (A) xyz' (B) $xy + z$
 (C) $x + y$ (D) None of the above

GATE-CS-2002

**UNIT-V
SECTION-A**

Objective Questions

1. Draw the block diagram of sequential circuit.
2. Write the differences between latch and flip-flop.
3. A basic S-R flip-flop can be constructed by cross-coupling of which logic gates?

A. XOR or XNOR gates	B. NOR or NAND gates	C. AND or OR gates	D. AND or NOR gates
----------------------	----------------------	--------------------	---------------------
4. The truth table for an S-R flip-flop has how many VALID entries?

A. 4	B. 3	C. 2	D. 1
------	------	------	------
5. The output of SR flip flop when S=1, R=0 is

A. 1	B. 0	C. No change	D. High impedance
------	------	--------------	-------------------
6. Which of the following is correct for a gated D-type flip-flop?

A) Only one of the inputs can be HIGH at a time.	B) The Q output is either SET or RESET as soon as the D input goes HIGH or LOW.	C) The output complement follows the input when enabled.	D) The output toggles if one of the inputs is held HIGH.
--	---	--	--
7. When is a J-K flip-flop made to toggle?

A. J = 0, K = 0	B. J = 1, K = 0	C. J = 0, K = 1	D. J = 1, K = 1
-----------------	-----------------	-----------------	-----------------
8. For JK flip-flop J = 0, K=1, the output after clock pulse will be

- A. 1 B. no change. C. 0 D. high impedance.
9. Define race around condition.
10. Which table describes Input values of the flip flop when its present state and next state are known. A. function table B. truth table C. excitation table D. programming table
11. _____ and _____ are the asynchronous inputs of a flip flop.
12. Flip flops are _____ triggered sequential circuits
13. How are the sequential circuits specified in terms of time sequence?
A. By Inputs B. By Outputs C. By Internal states D. All of the above
14. The behaviour of synchronous sequential circuit can be predicted by defining the signals at _____.
A. Discrete instants of time B. Continuous instants of time
C. Sampling instants of time D. At any instant of time
15. What is the storage capacity of any flipflop?
A. 1 bit B. 2 bits C. 16 bits D. Infinite bits
16. Why do the D flip-flops have designation as 'Data Flipflops'?
A. Due to its capability to receive data from flip-flop
B. Due to its capability to store data in flip-flop
C. Due to its capability to transfer the data into flip-flop
D. All of the above
17. The characteristic equation of D-flipflop implies that _____.
A. The next state is dependent on previous state
B. The next state is dependent on present state
C. The next state is independent of previous state
D. The next state is independent of present state
18. Which memory elements are utilized in asynchronous & synchronous circuits respectively?
A. Time- delay devices & registers B. Time- delay devices & flip-flops
C. Time- delay devices & counters D. Time-delay devices & latches
19. Which sequential circuits generate the feedback path due to the cross-coupled connection from output of one gate to the input of another gate?
A. synchronous B. asynchronous C. both D. none of the above
20. D flip flop is a circuit having
A. 2 NAND gates B. 3 NAND gates C. 4 NAND gates
D. 5 NAND gates
21. If a active high SR latch has 0 on S input and 1 on R input and then R input goes to 0, the latch will be in _____.
A. SET B. RESET C. No Change D. Invalid.
22. Asynchronous inputs will cause the flip-flop to respond immediately with regard to the clock input.
A. TRUE B. FALSE C) can't say D) none of the above

SECTION- B

Subjective Questions

1. Distinguish between combinational circuits and sequential circuits.
2. Draw the circuit diagram of J-K flip flop with NAND gates with positive edge triggering and explain its operation with the help of a truth table.
3. What are the various methods used for triggering flip-flops? What is meant by race around condition in flip-flops?
4. Draw the truth table, logic diagrams of J-K, R-S, D and T type flip flops.
5. Give the Excitation table and characteristic table and characteristic equations of SR, JK, D and T flip flops?
6. Write the procedure to convert one type of flip flop into another type.
7. Convert SR flip-flop into the following type of flip flop
(i) JK (ii) D (iii) T
8. Realize the following flip flops using JK flip flop.
(i) SR (ii) D (iii) T
9. How could a D-type flip-flop be used as following type of flip flops?
(i) SR (ii) JK (iii) T
10. Design the following flip flops using T flip flop.
(i) SR (ii) JK (iii) D

SECTION- C: previous GATE Questions

1. The next state table of a 2 bit saturating up-counter is given below.

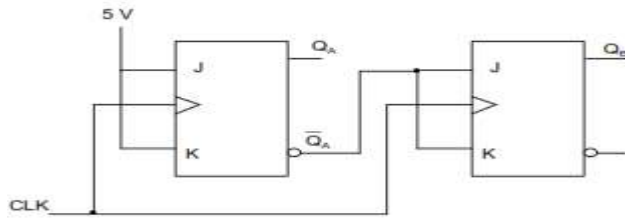
[GATE 2017]

Q_1	Q_0	Q_1^+	Q_0^+
0	0	0	1
0	1	1	0
1	0	1	1
1	1	1	1

- A) $T_1 = Q_0Q_1$ and $T_0 = Q'_0Q'_1$ (B) $T_1 = Q'_1Q_0$ and $T_0 = Q'_1 + Q'_0$
 (C) $T_1 = Q_1 + Q_0$ and $T_0 = Q'_1 + Q'_0$ (D) $T_1 = Q'_1Q_0$ and $T_0 = Q_1 + Q_0$

2. The current state QA QB of a two JK flip-flop system is 00. Assume that the clock rise-time is much smaller than the delay of the JK flip-flop. The next state of the system is

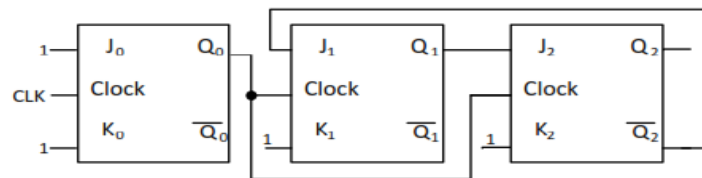
[GATE 2016]



- (A) 00 (B) 01 (C) 11 (D) 10

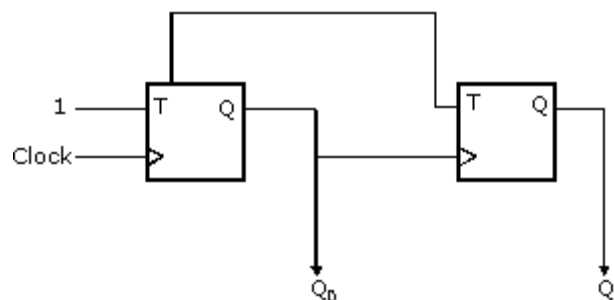
3. The figure shows a digital circuit constructed using negative edge triggered J-K flip flops. Assume a starting state of $Q_2Q_1Q_0=000$. This state $Q_2Q_1Q_0=000$ will repeat after _____ number of cycles of the clock CLK.

[GATE 2015]



4. In the sequential circuit shown below, if the initial value of the output Q_1Q_0 is 00, what are the next four values of Q_1Q_0 ?

[GATE 2010]



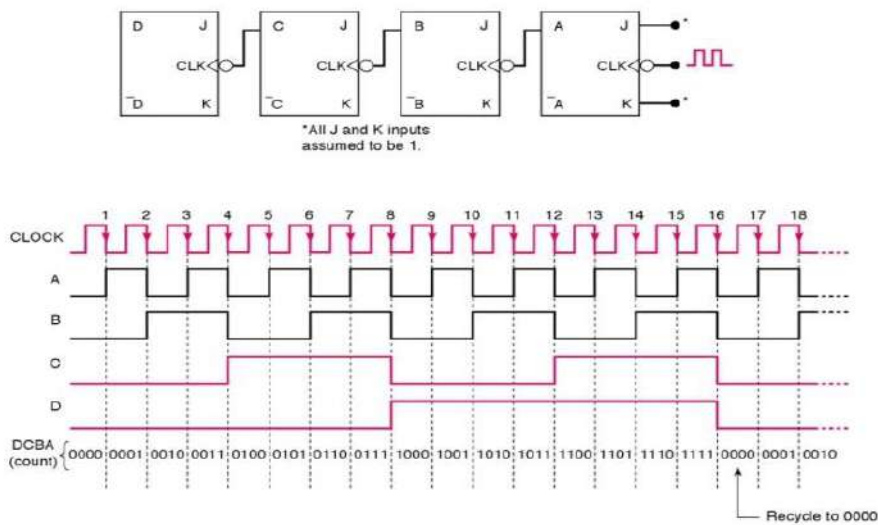
- (A) 11,10,01,00 (B) 10,11,01,00 (C) 10,00,01,11 (D) 11,10,00,01

UNIT-VI SECTION-A

Objective Questions

- A group of binary cells is called
 A. counter B. register C. latch D. flip-flop
- Simplest registers only consists of
 A. Counter B. EPROM C. latch D. flipflop

3. What type of register would shift a complete binary number in one bit at a time and shift all the stored bits out one bit at a time?
- A. SISO B. PIPO C. SIPO D. PISO
4. What is a shift register that will accept a parallel input and can shift data left or right called?
- A. end around B. conversion C. bidirectional universal D. tri-state
5. How many flip-flops are required to make a MOD-32 binary counter?
- A. 3 B. 45 C. 5 D. 6
5. A MOD-16 ripple counter is holding the count 1001_2 . What will the count be after 31 clock pulses?
- A. 1000_2 B. 1010_2 C. 1011_2 D. 1101_2
6. By default counters are incremented by
- A. 1 B. 2 C. 3 D. 4
7. Three decade counter would have
- A. 2 BCD counters B. 3 BCD counters C. 4 BCD counters D. 5 BCD counters
8. A decimal counter has
- A. 5 states B. 10 states C. 15 states D. 20 states
9. Ripple counters are also called
- A. SSI counters B. asynchronous counters
- C. synchronous counters D. VLSI counters
10. Binary counter that count incrementally and decrementally is called
- A. up-down counter B. LSI counters C. down counter D. up counter
11. A ripple counter's speed is limited by the propagation delay of:
- A. all flip-flops and gates B. each flip-flop
- C. the flip-flops only with gates D. only circuit gates
12. When two counters are cascaded, the overall MOD number is equal to the _____ of their individual MOD numbers.
- A. product B. sum C. log D. reciprocal
14. A BCD counter is a _____.
- A. binary counter
- B. full-modulus counter
- C. decade counter
- D. divide-by-10 counter



The counter in the above Figure starts off in the 0000 state, and then clock pulses are applied. Some time later the clock pulses are removed, and the counter FFs read 0011. How many clock pulses have occurred?

9. Construct an appropriate MOD-10 counter

SECTION-C: GATE Questions

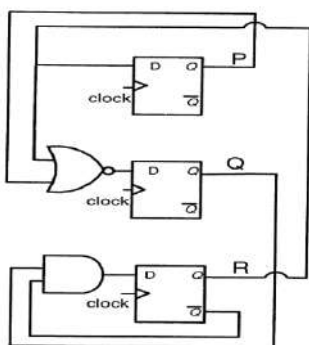
1. We want to design a synchronous counter that counts the sequence 0-1-0-2-0-3 and then repeats. The minimum number of J-K flip-flops required to implement this counter is

[GATE 2016]

- (A) 1 (B) 2 (C) 4 (D) 5

2. Consider the following circuit involving three D-type flip-flops used in a certain type of counter configuration.

[GATE 2011]

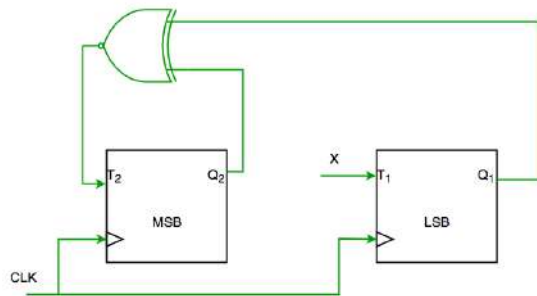


3.If at some instance prior to the occurrence of the clock edge, P, Q and R have a value 0, 1 and 0 respectively, what shall be the value of PQR after the clock edge?

- (A) 000 (B) 001 (C) 010 (D) 011

4.Consider the partial implementation of a 2-bitt counter using T flip-flops following the sequence 0-2-3-1-0, as shown below

[GATE 2004]



To complete the circuit, the input X should be

- (A) Q_2' (B) Q_2+Q_1 (C) $(Q_1 \oplus Q_2)'$ (D) $Q_1 \oplus Q_2$

Signature of the Faculty

CO4: use the concepts of graph theory to provide solutions for routing applications in computer networks.

CO5: apply the recurrence relation for analyzing recursive algorithms.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

MA2508 : DISCRETE MATHEMATICAL STRUCTURES														
Course outcomes	Program Outcomes and Program Specific Outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1. apply the concept of Mathematical logic in software development process.	2	2												
CO 2. use the concept of Pigeonhole principle to derive the $\Omega(n \log n)$ lower bound.	2	3												
CO3. apply the concepts of graph theory in robotics, computer vision and computer graphics.	3	3												
CO 4. use the concepts of graph theory to provide solutions for routing applications in computer networks.	3	3												
CO5. apply the recurrence relation for analyzing recursive algorithms.	2	2												

7. Prescribed Text Books :

- a) J.P.Trembley, R Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, New Delhi.

- b) Mott, Kandel, Baker, Discrete Mathematics for Computer Scientists & Mathematicians, 2nd edition, PHI.
- c) Rosen, Discrete Mathematics and its Application with combinatorics and graph theory: 7th edition, Tata McGraw Hill, New Delhi.

8. Reference Text Books

- a) S.Santha, Discrete Mathematics, Cengage publications.
- b) J K Sharma, Discrete Mathematics, 2nd edition, Macmillan Publications.

9. URLs and Other E-Learning Resources

So net CDs & IIT CDs on some of the topics are available in the digital library.

10. Digital Learning Materials:

- <http://nptel.ac.in/courses/106106094>
- <http://nptel.ac.in/courses/106106094/40>
- <http://nptel.ac.in/courses/106106094/30>
- <http://nptel.ac.in/courses/106106094/32>
- <http://textofvideo.nptl.iitm.ac.in/106106094/lecl.pdf>
- www.nptelvideos.in/2012/11/discrete-mathematical-structures.html

11. Lecture Schedule / Lesson Plan

Topic	No. of Periods	
	Theory	Tutorial
UNIT –1: <u>Mathematical Logic</u> :		
Propositional Calculus: Statements and Notations	1	2
Connectives	1	
Truth Tables	1	
Tautologies	1	2
Equivalence of Formulas	2	
Tautological Implications	1	
Theory of Inference for Statement Calculus	2	2
Consistency of Premises	1	
UNIT – 2: <u>Relations & Functions</u>		
Relations: Properties of Binary Relations	1	2
Equivalence	1	

Compatibility and Partial order relations	2	
Hasse Diagram	1	
Functions : Inverse	1	2
Composite and Recursive functions	2	
Pigeon hole principle and its application	1	
UNIT – 3: <u>Algebraic Structures</u>		
Algebraic Systems and Examples	1	2
general properties	1	
semi group, Monoid	1	
Groups	2	
Subgroups	2	2
Cyclic groups	2	
UNIT – 4: <u>Graph Theory - I:</u>		
Concepts of Graphs	1	2
Sub graphs, Multigraphs	2	
Matrix Representation of Graphs: Adjacency and incidence Matrices	2	2
Isomorphic Graphs	2	
UNIT – 5: <u>Graph Theory - II:</u>		
Paths and Circuits, Eulerian graph	2	2
Planar graphs	2	
Hamiltonian Graph	2	
Chromatic number of a graph	1	
UNIT – 6: <u>Combinatorics and Recurrence Relation:</u>		
Basics of Counting principles (sum rule and product rule)	1	2
Solving linear homogeneous recurrence Relations by substitution	1	
The Method of Characteristic Roots	2	2
Solving Inhomogeneous Recurrence Relations	2	
Total No. of Periods:	48	24

12. Seminar Topics

- Theory of Inference
- Graph isomorphism and applications
- Recurrence relations and applications

UNIT-I

Assignment-Cum-Tutorial Questions SECTION-A

Objective Questions

- 1) Which of the following is a statement.
 - a) how old are you ?
 - b) Jaipur is in Andhra Pradesh
 - c) where are you ?
 - d) god bless you.
- 2) The inverse of $(p \wedge q) \rightarrow (\neg q \wedge \neg p)$ is _____.
- 3) What is the truth value of the statement 'If Charminar is in Hyderabad then $5*3=8$ '.
[T / F]
- 4) If the truth value of q is T then the truth value of $(q \vee r) \wedge q$ is _____.
- 5) The truth value of $2+6=9$ if and only if $9+6=10$ is _____.
- 6) The converse of the statement "If there is a flood then the crop will be destroyed" is _____.
- 7) Symbolic form of the statement 'If I do not have car or I do not wear good dress then I am not a Millionaire' is _____.
- 8) P and Q are two propositions. Which of the following logical expressions are equivalent?
 - I. $P \vee \sim Q$
 - II. $\sim(\sim P \wedge Q)$
 - III. $(P \wedge Q) \vee (P \wedge \sim Q) \vee (\sim P \wedge \sim Q)$
 - IV. $(P \wedge Q) \vee (P \wedge \sim Q) \vee (\sim P \wedge Q)$
 - a) Only I and II
 - b) Only I, II and III
 - c) Only I, II and IV
 - d) All of I, II, III & IV
- 9) Consider the following propositional statements:
 $P_1 : ((A \wedge B) \rightarrow C) \equiv ((A \rightarrow C) \wedge (B \rightarrow C))$

$$\text{i) } (p \rightarrow q) \wedge (\neg p \rightarrow q) \quad \text{ii) } p \rightarrow (\neg q \vee r)$$

3) Construct the truth table for the given statement:

$$(P \rightarrow (Q \rightarrow R)) \rightarrow ((P \rightarrow Q) \rightarrow (P \rightarrow R)).$$

- 4) Construct the truth table for $[(P \vee Q) \wedge \sim R] \leftrightarrow Q$.
- 5) Show that $(P \rightarrow (Q \rightarrow R)) \leftrightarrow (P \rightarrow Q) \rightarrow (P \rightarrow R)$.
- 6) Use truth table to verify the following logical equivalence
 $p \rightarrow (q \wedge r) \leftrightarrow (p \rightarrow q) \wedge (p \rightarrow r)$
- 7) Establish the validity of the argument $p \rightarrow q, q \rightarrow r, p \Rightarrow r$.
- 8) Show that $R \vee S$ follows logically from the premises $C \vee D, (C \vee D) \rightarrow \sim H, \sim H \rightarrow (A \wedge \sim B)$ and $(A \wedge \sim B) \rightarrow (R \vee S)$.
- 9) Determine the validity of the following argument : “ my father praises me only if I can be proud of myself either I do well in sports or I can’t be proud of myself. If I study hard, then I can’t do well in sports. Therefore, if father praises me then I do not study well.”
- 10) Show that the following set of premises is inconsistent :
 “ if the contract is valid then john is liable for penalty. “If john is liable for penalty, he will go bankrupt. If the bank will loan him money, he will not go bankrupt. As a matter of fact, the contract is valid and the bank will loan him money.”
- 11) Prove that the following argument is valid.
 If Rochelle gets the supervisor’s position and works hard, then she’ll get a raise. If she gets the raise, then she’ll buy a new car. She has not purchased a new car. Therefore either Rochelle did not get the supervisor’s position or she did not work hard.

Section – C

1. Which one of the following is NOT equivalent to $p \leftrightarrow q$?

- (A) $(\neg p \vee q) \wedge (p \vee \neg q)$ (B) $(\neg p \vee q) \wedge (q \rightarrow p)$
 (C) $(\neg p \wedge q) \vee (p \wedge \neg q)$ (D) $(\neg p \wedge \neg q) \vee (p \wedge q)$

(GATE2015)

2. Let a, b, c, d be propositions. Assume that the equivalences $a \leftrightarrow (b \vee \neg b)$ and $b \leftrightarrow c$ hold. Then the truth value of the formula $(a \wedge b) \rightarrow (a \wedge c) \vee d$ is always

- (A) True (B) False (C) Same as the truth value of b
 (D) Same as the truth value of d **(GATE 2000)**

3. P and Q are two propositions. Which of the following logical expressions are

- I. $P \vee \sim Q$
 II. $\sim(\sim P \wedge Q)$
 III. $(P \wedge Q) \vee (P \wedge \sim Q) \vee (\sim P \wedge \sim Q)$
 IV. $(P \wedge Q) \vee (P \wedge \sim Q) \vee (\sim P \wedge Q)$

equivalent?

- a) Only I and II b) Only I, II and III
 c) Only I, II and IV d) All of I, II, III and IV

(GATE 2008)

4. Which one of the following Boolean expressions is NOT a

- (A) $((a \rightarrow b) \wedge (b \rightarrow c)) \rightarrow (a \rightarrow c)$
 (B) $(a \leftrightarrow c) \rightarrow (\sim b \rightarrow (a \wedge c))$
 (C) $(a \wedge b \wedge c) \rightarrow (c \vee a)$
 (D) $a \rightarrow (b \rightarrow a)$

tautology?

- a) A b) B c) C d) D

(GATE 2014)

5. Let P, Q and R be three atomic propositional assertions. Let X denote $(P \vee Q) \rightarrow R$ and Y denote

$(P \rightarrow R) \vee (Q \rightarrow R)$. Which one of the following is a tautology?

- a) $X \equiv Y$ b) $X \rightarrow Y$ c) $Y \rightarrow X$ d) $\neg Y \rightarrow X$

(GATE-CS-2005)

UNIT-II SECTION-A

Objective Questions

1. Let $R = \{ (1,1), (2,2), (3,3) \}$ be a relation in the set $A = \{ 1,2,3 \}$ then R is

- a) 2^6 b) 2^8 c) 12 d) 8

12. Let $f: B \rightarrow C$ and $g: A \rightarrow B$ be two functions and let $h = fog$. Given that h is an onto function, which one of the following is True?

- a) f and g should both be onto functions.
 b) f should be onto but g need not be onto
 c) g should be onto but f need not be
 d) both f and g need not be true.

13. The function $f: Z \rightarrow Z$ defined by $f(x) = x^2$ is _____

- a) one-one b) not one-one c) onto d) bijective

14. Which of the following function is not onto?

- a) $f(a, b) = a + b$ b) $f(a, b) = a$ c) $f(a, b) = |b|$ d) $f(a, b) = a - b$

15. Inverse of the function $f(x) = x^3 + 2$ is

- a) $f^{-1}(y) = (y - 2)^{1/2}$ b) $f^{-1}(y) = (y - 2)^{1/3}$ c) $f^{-1}(y) = (y)^{1/2}$ d) $f^{-1}(y) = (y - 2)$

B. Questions testing the ability of students in applying the concepts

1. Define partial order relation. Draw the Hasse diagram for the divisibility relation on the set $A = \{2, 3, 6, 12, 24, 36\}$.

2. Let $X = \{1, 2, 3, 4, 5, 6, 7\}$ and $R = \{(x, y) / x-y \text{ is divisible by } 3\}$ in X . show that R is an equivalence relation?

3. Let A be a given finite set and $r(A)$ its power set. Let \hat{I} be the inclusion relation on the elements of $r(A)$. Draw Hasse diagrams of $\langle r(A), \hat{I} \rangle$ for $A = \{a\}$; $A = \{a, b\}$; $A = \{a, b, c\}$ and $A = \{a, b, c, d\}$.

4. Let $f: R \rightarrow R$ and $g: R \rightarrow R$, where R is the set of real numbers. Find fog and gof , where $f(x) = x^2 - 2$ and $g(x) = x + 4$. State whether these functions are injective, surjective and bijective.

5. Let $f: R \rightarrow R$ be given by $f(x) = x^3 - 2$, Find f^{-1} ?

6. Let $f: Z \rightarrow Z$ be a function defined as $f(x) = x^2 - 3$. Is f a Bijective function? If not why?

7. Explain about initial functions and S.T $f(x, y) = x * y$ is primitive recursive.

8. Let $X = \{1, 2, 3\}$ and f, g, h and s be functions from X to X given by $f = \{ \langle 1, 2 \rangle, \langle 2, 3 \rangle,$

$\langle 3, 1 \rangle \}$, $g = \{ \langle 1, 2 \rangle, \langle 2, 1 \rangle, \langle 3, 3 \rangle \}$, $h = \{ \langle 1, 1 \rangle, \langle 2, 2 \rangle, \langle 3, 1 \rangle \}$ and $s = \{ \langle 1, 1 \rangle, \langle 2, 2 \rangle, \langle 3, 3 \rangle \}$. Find fog , $fohog$, gos , fos .

9. Show that if eight people are in a room, atleast two of them have birthdays that occur on the same day of the week?
10. Apply is pigeon hole principle show that of any 14 integers are selected from the set $S = \{1, 2, 3 \dots 25\}$ there are at least two where sum is 26. Also write a statement that generalize this result.

UNIT – III

Algebraic Structures

A. Questions testing the remembering / understanding level of students

I) Objective Questions

1. How many binary operations are possible on a set with n-elements
 A) 2^n B) 2^{n^2} C) n^{n^2} D) 2^{2^n}
2. Which of the following is a monoid
 A) $(\mathbb{N}, +)$ B) (\mathbb{N}, \times) C) $(\mathbb{Z} - \{1\}, \times)$ D) $(\mathbb{N} - \{1\}, \times)$
3. Which of the following algebraic structure does not form a group
 A) $(\mathbb{Z}, +)$ Integers B) $(\mathbb{R}, +)$ Real numbers
 C) (\mathbb{R}^+, \times) Positive real numbers D) (\mathbb{N}, \times) Natural numbers.
4. Which of the following is not necessarily a property of a group is
 A) Commutativity B) Associativity
 C) Existence of inverse for every element D) Existence of identity.
5. Let the binary operation $a * b = 6ab$ be defined in \mathbb{R} by then identity $e =$
 A) $\frac{1}{6}$ B) $\frac{1}{4}$ C) $\frac{1}{3}$ D) $\frac{1}{2}$
6. The binary operation \oplus on a set of integers is defined as $x \oplus y = x^2 + y^2$. Which one of the following statements is TRUE
 A) Commutative but not Associative B) Both Commutative and Associative
 C) Associative but not Commutative D) Neither Commutative nor Associative
7. The set $G = \{1, 2, 3, 4, 5\}$ under multiplication modulo 6 is
 A) An algebraic structure B) A non abelian group

2. Let $P = \{ \{a\}, \{b\}, \{d\}, \{a, b\}, \{a, d\}, \{c, d\}, \{a, c, d\}, \{b, c, d\} \}$ be the Poset under set inclusion as order. The greatest lower bound of $\{ \{a, c, d\}, \{b, c, d\} \}$ is
 A) $\{d\}$ B) $\{c, d\}$ C) $\{a\}$ D) $\{b\}$
3. If G is a group of integers under addition and H is the subset consisting of all multiples of 3 then
 A) H is a subgroup of G
 B) H is not a subgroup of G as associative property does not hold
 C) H is not a subgroup of G as H does not contain the identity element
 D) None
4. Which of the following Binary operation is associative
 A) $In (N, \star), a \star b = a^2b$ B) $In (Z, \star), a \star b = a^b$
 C) $In (N, \star), a \star b = a$ D) $In (N, \star), a \star b = a - b$
5. Which of the elements of the poset $(\{2, 4, 5, 10, 12, 20, 25\}, /)$ are maximal and which are minimal
 (a) 12, 20; 2, 5 (b) 12, 20, 25; 2, 5 (c) 2, 5 ;12, 20 (d) 2, 5; 12, 20, 25
6. Determine which of the following poset is not a lattice
 (a) $(\{1, 5, 25, 125\}, /)$ (b) $(\{1, 3, 6, 9, 12\}, /)$ (c) (Z, \geq) (d) None
7. In lattice the operations of 'meet' and 'join' are
 (a) Commutative and associative only
 (b) Idempotent and distributive only
 (c) Commutative, associative and idempotent
 (d) None
8. Which of the following statement is true
 (a) A poset in which every pair of elements has a lub and glb is called lattice
 (b) In any lattice minimal and maximal elements are not unique
 (c) In any lattice, if lub and glb elements are present then they are unique
 (d) All are true
9. For the poset $(\{1\}, \{2\}, \{4\}, \{1, 2\}, \{1, 4\}, \{2, 4\}, \{3, 4\}, \{1, 3, 4\}, \{2, 3, 4\}, \leq)$, lub of $\{\{2\}, \{4\}\}$ is _____
10. For the poset $(\{1\}, \{2\}, \{4\}, \{1, 2\}, \{1, 4\}, \{2, 4\}, \{3, 4\}, \{1, 3, 4\}, \{2, 3, 4\}, \leq)$, glb of $\{\{1, 3, 4\}, \{2, 3, 4\}\}$ is _____

II) Descriptive Questions

1. Define Lattice. Verify that the poset $(\{1, 5, 25, 125\}, /)$ is a lattice or not.
2. A binary operation $*$ is defined on set of integers Z by $a * b = a + b - ab$, for all a and b in Z . Show that $(Z, *)$ is a semi group.
3. Show that the fourth roots of unity forms a group under usual multiplication and find out inverse of each element.

4. Consider the group $G = \{1, 2, 4, 7, 8, 11, 13, 14\}$ under multiplication modulo 15. Construct the multiplication table of G ?
5. If G is a group such that $(ab)^m = a^m b^m$ for three consecutive integers m for all $a, b \in G$, show that G is abelian.
6. The set of integers Z , is an abelian group under the composition defined by \oplus such that $a \oplus b = a + b + 1$ for $a, b \in Z$. Find i) the identity of (Z, \oplus) and ii) Inverse of each element of Z .
7. Consider the group, $G = \{1, 2, 4, 7, 8, 11, 13, 14\}$ under multiplication modulo 15:
 - (a) Construct the multiplication table of G . (b) Find the values of: 2^{-1} , 7^{-1} and 11^{-1} .
 - (c) Find the orders and subgroups generated by 2, 7, and 11.
8. The set 'S' of all ordered pairs (a, b) of real numbers for which the operation \times defined by $(a, b) \times (c, d) = (ac, bc+d)$ is a group. Find (i) the identity of (G, \times) and (ii) Inverse of each element of G .

UNIT – IV

Graph Theory – I

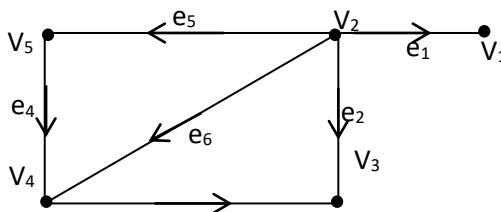
A. Questions testing the remembering / understanding level of students

I) Objective Questions

1. If there is an edge between any two vertices then those vertices are called _____
2. Prove that the sequence 5,5,3,3,2,2 is graphic. Draw the graph.
3. How many vertices will have the graph, if it contains 21 edges, 3 vertices of degree 4 and the other vertices of degree 3?
4. Define Regular, connected graphs?
5. Define (i) Trivial graph (ii) Eulerian graph.
6. A vertex of degree zero is called _____
7. In any graph the number of vertices of odd degree is _____
8. Draw the cycle graph of order 5 ?
9. Draw the wheel graph of order 4 ?
10. Draw the graph which is both cycle and bipartite graph?

II) Descriptive Questions

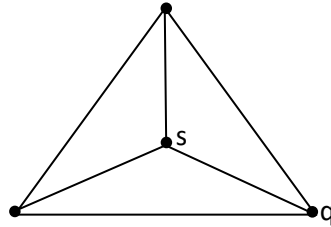
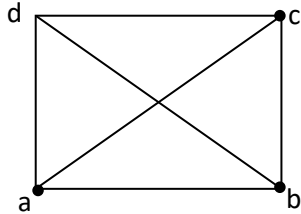
1. Find all indegree and outdegree of the nodes of the following graph



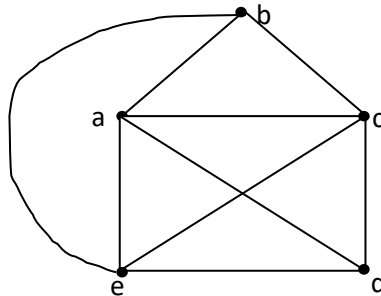
2. Is the following sequence is degree sequence? If so, find the graph?

1,1,2,2,2,3,3,4?

3. Check the following graphs are Isomorphic or not?



4. Check the following graph is Eulerian graph or not? If so find Eulerian trail or Eulerian circuit.

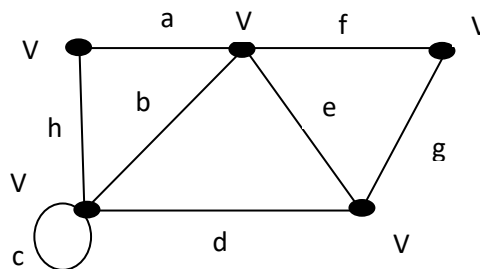


5. Find the number of edges in K_n ?
 6. Draw a graph with six vertices which is Eulerian graph.

B. Question testing the ability of students in applying the concepts.

I) Level One Questions:

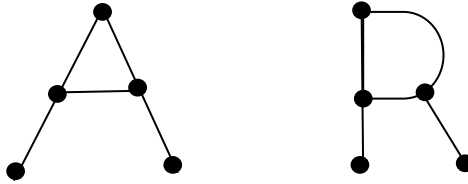
- In a simple graph with $p+1$ vertices, the maximum degree of any vertex is
 a) $p+1$ b) p c) $p-1$ d) $p-2$
- Which of the following degree sequences cannot represent an undirected graph?
 i. $\{3,4,2,2\}$ ii. $\{3,1,2,2\}$ iii. $\{1,4,2,2,3,5\}$ iv. $\{5,5,4,4\}$
 a) iv only b) i and iii c) iii only d) ii and iv
- Consider the following graph, which of the following is true



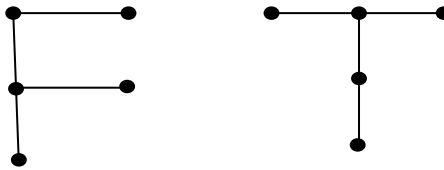
- a) $v_1a v_2b v_3d v_4$ is a path b) $v_2b v_3d v_4ev_2$ is a circuit
 c) $v_1a v_2b v_3c v_3 d v_4ev_2f v_5$ is a walk d) all the above

4. Which among the following pairs are Isomorphic

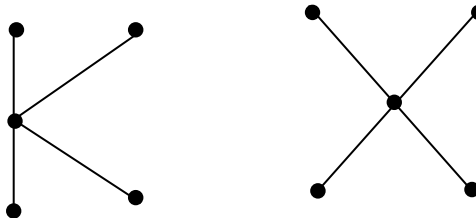
I.



II.



III.



- a) I only b) I and II only c) II and III only d) All I, II and III

5. The minimum number of edges in a connected graph having 19 vertices is

- a) 19 b) 20 c) 17 d) 18

6. Which of the following statements is/are true for undirected graph

P: Number of odd degree vertices is even

Q: Sum of degrees of all vertices is even

- a) P only b) Q only c) Both P and Q d) Neither P and Q

7. In an Euler graph, all vertices are of

- a) Odd degree b) Same degree c) Even degree d) Different degrees

8. A pendent vertex has degree equal to

- a) 0 b) 1 c) 2 d) 3

9. How many edges are there in a graph with v vertices each of degree d

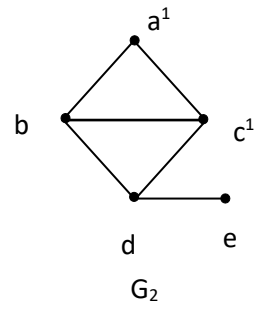
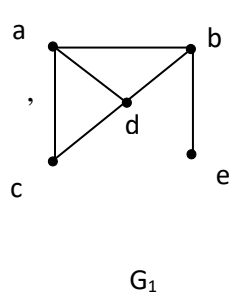
- a) vd b) $vd/2$ c) $(v+d)/2$ d) none

10. Maximum number of edges in a simple graph having n vertices?

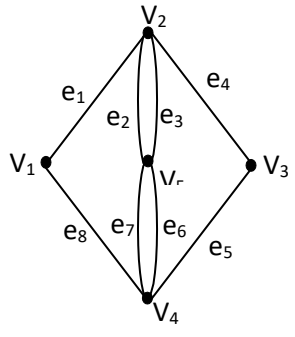
- a) n b) $n-1$ c) $n/2$ d) $n(n-1)/2$

II) Descriptive Questions

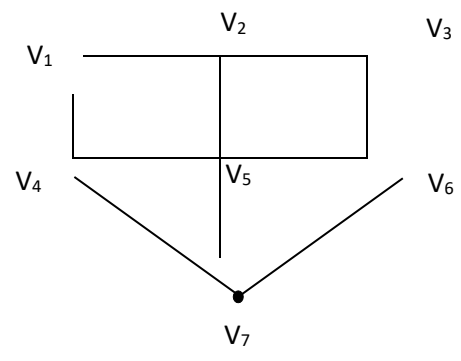
1. When we say that the graphs G_1 and G_2 are isomorphic and verify whether the following graphs are isomorphic or not.



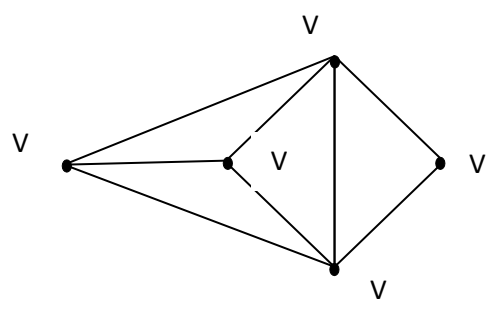
2. Write the adjacency and incidence matrices for the following graph. Also determine whether the graph contains Eulerian circuit or not. If does, then write the Eulerian circuit.



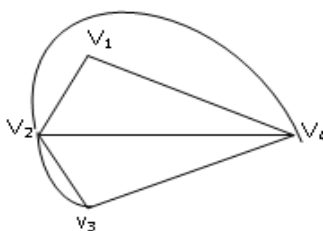
3. Find the spanning tree for the following graph by using DFS.



4. Define chromatic number. Find the chromatic number for the following graph.



5. Find the Euler path to the following graph.

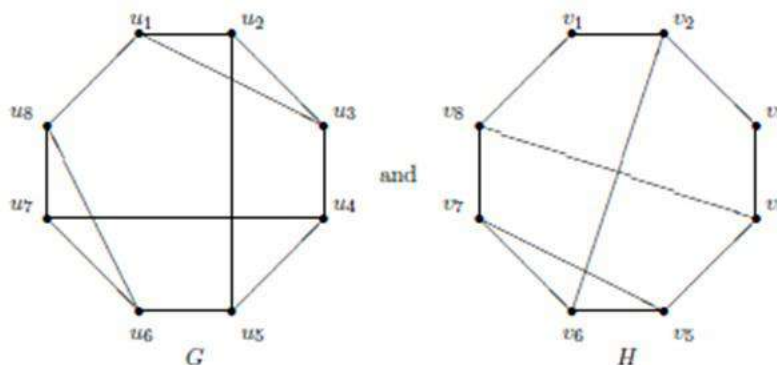


6. Draw the graphs of $K_{2,5}$ and $K_{3,3}$.

7. Consider the digraph $G = (V, E)$ where $V = \{a, b, c, d, e\}$ and $E = \{(a,c), (b,a), (b,b), (b,c), (c,d), (c,e), (d,c), (d,d), (e,b)\}$. Draw the graph G and a spanning tree of the graph G . Also find the degrees of vertices in G .

8. Define graph. Let G be a non directed graph of order 9 such that each vertex has degree 5 or 6. Prove that at least 5 vertices have degree 6 or at least 6 vertices have degree 5.

9. Determine the following graphs isomorphic or not? Justify your



answer.

UNIT – 5 GRAPH THEORY -2

A. Questions testing the remembering / understanding level of students

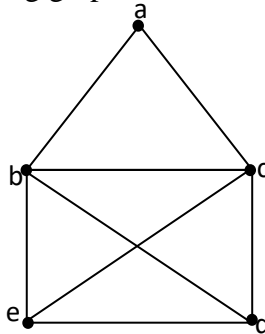
I) Objective Questions

1. Define Hamiltonian path and cycle?
2. Define planar graph?
3. Define chromatic number?
4. Euler formula for planar graphs is _____
5. Chromatic number for wheel graph w_n is _____
6. Define spanning tree?
7. Give an example of a graph which is Hamiltonian but not Eulerian graph?

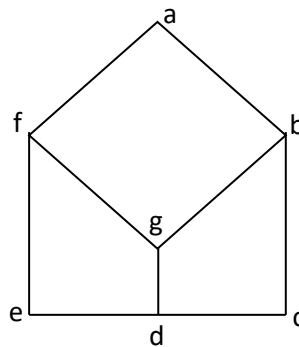
8. The Hamiltonian cycle for the complete bipartite $K_{2,3}$ is _____
9. The chromatic number of a graph $k_{m,n}$ is _____
10. The chromatic number of a wheel graph of six vertices is _____

II) Descriptive Questions

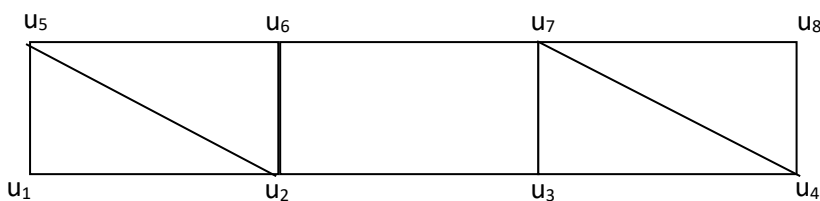
1. Prove that the following graph has Hamiltonian cycle.



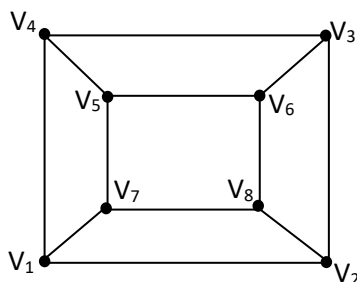
2. Find whether the following graph has Hamiltonian cycle or not? Is the graph hamiltonian graph?



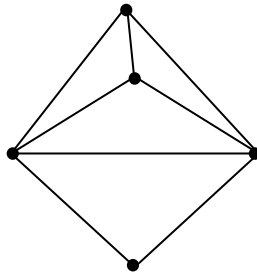
3. Find whether the following graph has Hamiltonian cycle?



4. Find the Hamilton circuit for the following graph?

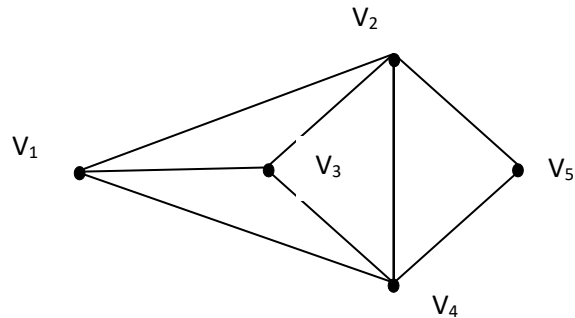


5. Find the chromatic number of the following graph



6.

Define chromatic number. Find the chromatic number for the following graph.



7. Draw the bipartite graph $K_{3,3}$ and find its chromatic number.

8. Prove whether K_4 and K_5 are planar or non-planar.

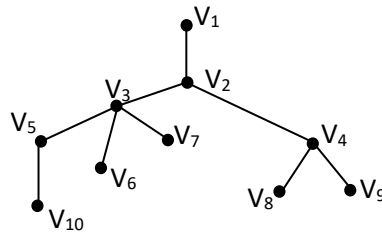
B. Question testing the ability of students in applying the concepts.

I) Level One Questions:

1. Suppose G is a connected planar graph with 12 regions of degree 3 then the no. of vertices = _____

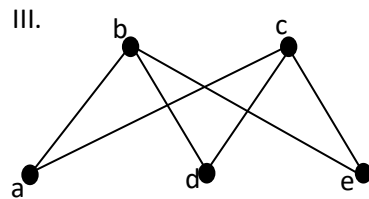
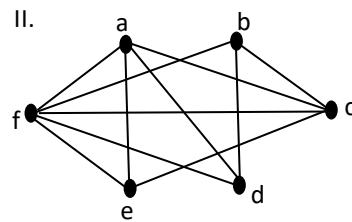
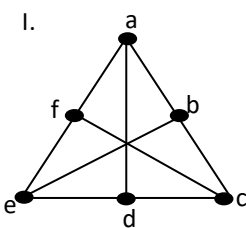
- a) 4 b) 8 c) 12 d) 10

2. The depth of a rooted tree is _____



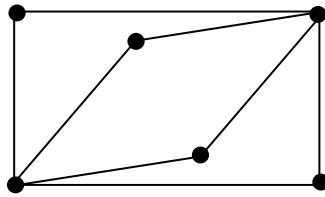
- a) 2 b) 3 c) 4 d) 5

3. Which of the following can be represented as plane graphs



- a) I only b) I and II only c) II and III only d) None

4. Which among the following is true about the graph given below

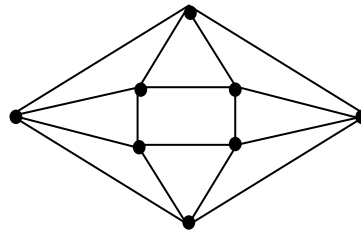


- a) Eulerian and Non Hamiltonian b) Hamilton and Non Eulerian
 c) Non Eulerian and Non Hamiltonian d) None

5. Let G be the non planar graph with minimum possible number of edges. Then G has

- a) 9 edges and 5 vertices b) 9 edges and 6 vertices
 b) 10 edges and 5 vertices d) 10 edges and 6 vertices

6. The minimum number of colors required to color the following graph such that no two adjacent vertices are assigned the same color is



- a) 2 b) 3 c) 4 d) 5

7. The chromatic number of a complete graph of five vertices is

- a) 3 b) 4 c) 5 d) 7

8. A tree with 12 vertices has _____ edges

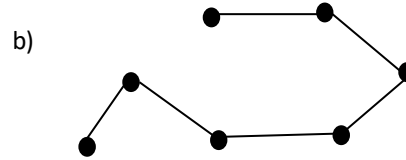
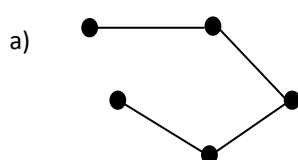
- a) 10 b) 11 c) 12 d) 13

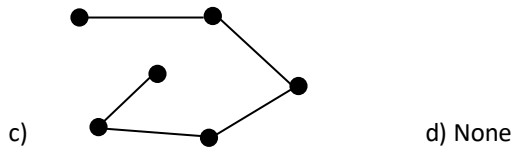
9. Which of the following is true

- I. Every tree with at least one edge must have at least two pendent vertices
 II. Every tree is a planar graph
 III. Every tree is bipartite

- a) I only b) II and III only c) I, II and III only d) I and II only

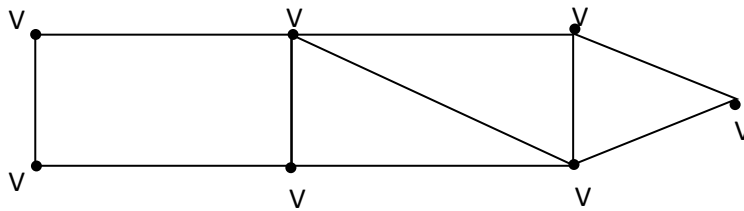
10. The spanning tree for W_5 is



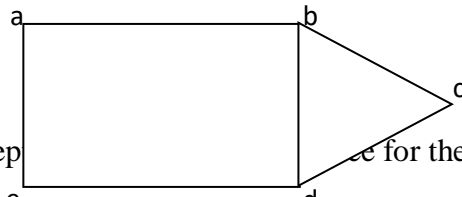


II) Descriptive Questions

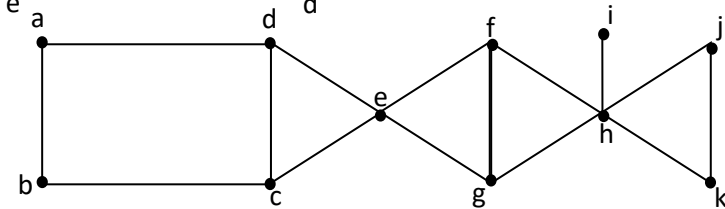
1. Using BFS algorithm find spanning tree of the graph.



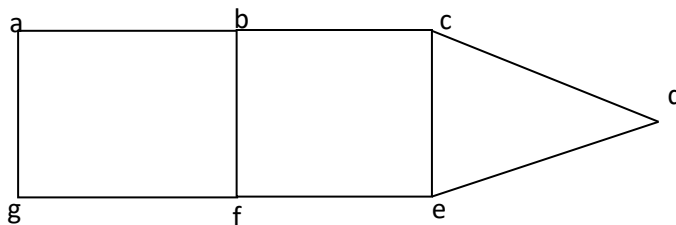
2. Find spanning tree of the following graph by using BFS algorithm.



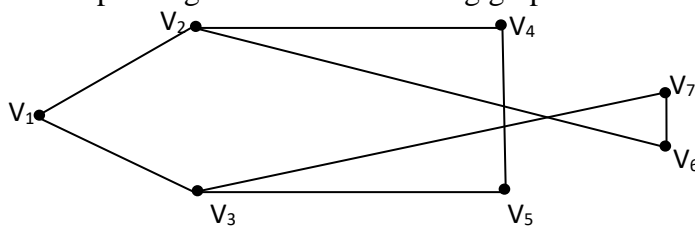
3. Find the depth for the following graph.



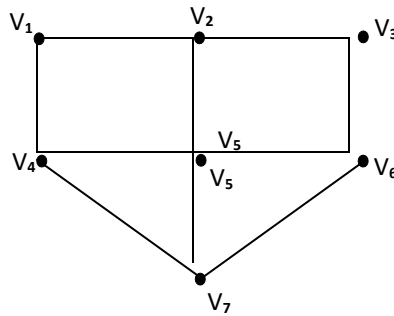
4. Find spanning tree for the following graph using DFS?



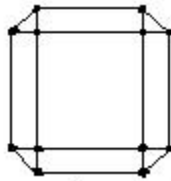
5. Find the BFS spanning tree for the following graph



6. Find the spanning tree for the following graph by using DFS.



7. Consider the digraph $G = (V, E)$ where $V = \{a, b, c, d, e\}$ and $E = \{ (a,c), (b,a), (b,b), (b,c), (c,d), (c,e), (d,c), (d,d), (e,b) \}$. Draw the graph G and a spanning tree of the graph G . Also find the degrees of vertices in G .
8. Consider the digraph $G = (V, E)$ where $V = \{a, b, c, d, e\}$ and $E = \{ (a,c), (b,a), (b,b), (b,c), (c,d), (c,e), (d,c), (d,d), (e,b) \}$. Draw the graph G and a spanning tree of the graph G . Also find the degrees of vertices in G .
9. Verify Euler's formula for following graph.



Unit – VI

Recurrence Relations

A. Questions testing the remembering / understanding level of students

I) Objective Questions

1. Explain in brief about Recurrence relation?
 2. Show that the sequence $\{a_n\}$ is a solution of recurrence relation $a_n = -3a_{n-1} + 4a_{n-2}$ if $a_1 = 1$?
 3. Find all the solutions of the recurrence relation $a_n = 7a_{n-1} - 12a_{n-2} + 5^n$
-
4. The particular solution of the recurrence relation $a_n = 7a_{n-1} + 8a_{n-2} + (5n + 7)7^n$ is of the form
-

5. The particular solution of the recurrence relation $a_n = 13a_{n-1} - 56a_{n-2} + 80a_{n-3} + (3n^2 + 10n + 8)4^n$ is of the form _____
6. A factory manufactures of two wheelers, In the first month only one vehicle is produced, In the second month three vehicles are produced, In the third month five vehicles are produced and so on. Then the recurrence relation for the number of vehicles produced in the nth month is _____
7. A person deposits 1500/- in a bank that yields an interest of 5% p.a compounded yearly. Then the solution of the recurrence relation for the amount he would get at the end of n years is _____
8. The solution of the recurrence relation $a_n = 3a_{n-1} - 3a_{n-2} + a_{n-3}$ with initial condition $a_0 = 1$
 $a_1 = 3$ and $a_2 = 7$ is
9. If $r^2 - c_1r - c_2 = 0$ has only one root r_0 then the general solution of the recurrence relation $a_n = c_1a_{n-1} + c_2a_{n-2}$ is
(a) $a_n = \alpha_1 r_0^n - \alpha_2 n r_0^n$ (b) $a_n = \alpha_1 r_0^n + \alpha_2 r_0^n$ (c) $a_n = \alpha_1 r_0^n + \alpha_2 n r_0^n$ (d) None
10. Find the recurrence relation for the number of way to make a word of length n using the letters a,b,c such that no two b's are together.

II) Descriptive Questions

1. Solve the recurrence relation $a_n = 2(a_{n-1} - a_{n-2})$ for $n \geq 2$.
2. Solve the Recurrence Relation $a_n - 3a_{n-1} + 2a_{n-2} = 0$, $a_0 = 1$, $a_1 = 2$
3. Solve the recurrence relation $a_n - 7a_{n-1} + 10a_{n-2} = 0$ for $n \geq 2$.
4. Solve the recurrence relation $a_n - 6a_{n-1} + 12a_{n-2} - 8a_{n-3} = 0$ for $n \geq 3$.
5. Solve the recurrence relation $a_n - 9a_{n-1} + 26a_{n-2} - 24a_{n-3} = 0$ for $n \geq 3$
6. Solve the recurrence relation $a_n - 8a_{n-1} + 21a_{n-2} - 18a_{n-3} = 0$ for $n \geq 3$
7. Solve $u_n = 3u_{n-1}$, $n \geq 1$
8. Solve $a_n = a_{n-1} + n$ where $a_0 = 2$ by substitution.
9. What is solution of the recurrence relation $a_n = a_{n-1} + 2a_{n-2}$ with $a_0 = 2$ and $a_1 = 7$?
10. Solve the recurrence relation $a_n = a_{n-1} + a_{n-2}$ where $n \geq 2$, $a_0 = 1$, $a_1 = 1$

B. Question testing the ability of students in applying the concepts.

I) Level One Questions:

1. The recurrence relation satisfied by the sequence $a_n = 3n$ can be
a) $a_n = a_{n-1} + 5$ b) $a_n = a_{n-1} + 3$ c) $a_n = 2a_{n-1} + 6$ d) $a_n = a_{n-1} + 7$
2. Which of the following is a linear homogenous recurrence relation?
a) $a_n = a_{n-1} + 3^n$ b) $a_n = a_{n-1} + 5^n$ c) $a_n = 4a_{n-1} + 4.5^n$ d) all the above
3. Which of the following is a linear homogenous recurrence relation with constant

coefficients

- a) $a_n = 3a_{n-4}$ b) $a_n = 4a_{n-4} + 5^n$ c) $a_n = 4a_{n-1} + 3a_{n-2}^2$ d) all the above
4. The number of bacteria in a colony doubles in every hour. The recurrence relation for the number of bacteria after n^{th} hours is
 a) $a_n = 4a_{n-1}$ b) $a_n = 3a_{n-1}$ c) $a_n = 2a_{n-1}$ d) $a_n = 6 a_{n-1}$
5. The solution of the recurrence relation $a_n = a_{n-1} + 3$ with initial condition $a_0 = 5$ is
 a) $2n+5$ b) $3n-5$ c) $5n+3$ d) $3n+5$
6. The characteristic equation of the recurrence relation $a_n = 10a_{n-1} - 16 a_{n-2}$ is
 a) 8,2 b) -8,-2 c) 4,6 d) -4,-6
7. The solution for the recurrence relation $a_n = 8a_{n-1} - 16 a_{n-2}$ with initial conditions $a_0 = 1$,
 and $a_1 = 12$ is
 a) $a_n = 5^n + 2n(4^n)$ b) $a_n = 4^n + 6^n$ c) $a_n = 4^n + 2n(4^n)$ d) $a_n = 7^n + 2n(6^n)$
8. Let f_n be the sequence satisfied that $f_n = f_{n-1} + f_{n-2}$, find the explicit formula for f_n with initial conditions $f_0 = 2, f_1 = 3$
 a) $\left(\frac{\sqrt{5}+1}{2}\right)^n + \left(\frac{\sqrt{5}-1}{2}\right)^n$ b) $\left(\frac{\sqrt{5}+1}{2}\right)^n + \left(\frac{-\sqrt{5}+1}{2}\right)^n$ c)
 $\left(\frac{2}{\sqrt{5}}+1\right)^n + \left(\frac{\sqrt{5}+1}{2}\right)^n$ d) none
9. The recurrence relation $T(n) = 2T(n-1) + n$, $T(1) = 1, n \geq 2$ equals to
 a) $2^{n+1} - n - 2$ b) $2^n - n$ c) $2^{n+1} - 2n - 2$ d) $2^n + n$
10. The solution of the recurrence relation $a_n = 4a_{n-1} + 3n$ is
 (a) $a_n = \alpha 4^{n-1} + n + \frac{4}{3}$ (b) $a_n = \alpha 4^n - n - \frac{4}{3}$ (c) $a_n = \alpha 4^{n-1} - n + \frac{4}{3}$ (d)
 $a_n = \alpha 4^n + n - \frac{4}{3}$

II) Descriptive Questions

- Solve the recurrence relation $u_n = 4u_{n-1} - 4u_{n-2} + 2^n$ with $u_0 = 1, u_1 = 1$
- Solve the Recurrence Relation $u_n + 5u_{n-1} + 6u_{n-2} = 3n^2 - 2n + 1, u_0 = 1, u_1 = 1$
- Solve $na_n + (n-1)a_{n-1} = 2^n$ where $a_0 = 1$
- Solve the recurrence relation $a_n - 7a_{n-1} + 10a_{n-2} = 0, n \geq 2, a_0 = 10, a_1 = 41$.
- Solve the recurrence relation $u_{n+2} - u_{n+1} - 12u_n = 10, u_1 = 13, u_0 = 0$.
- Solve the recurrence relation $u_{n+2} + 4u_{n+1} + 3u_n = 5(-2)^n, u_0 = 1, u_1 = 0$

7. Find a particular solution for recurrence relation using the method of determined coefficients $a_n - 7a_{n-1} + 12a_{n-2} = 2n$
8. Find a particular solution for recurrence relation using the method of determined coefficients $a_n - 5a_{n-1} = 3^n$?
9. Solve the recurrence relation $a_n - 6a_{n-1} + 8a_{n-2} = 4n$ where $a_0 = 8$ and $a_1 = 22$?

Signature of the Faculty

HANDOUT ON DATA STRUCTURES

Class & Sem. : II B. Tech – I Semester Year: 2020-21
Branch: CSE Credits: 3

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1. Brief History and Scope of the Subject

A data structure is a particular way of storing and organizing data in a computer so that it can be used efficiently. Different kinds of data structures are suited to different kinds of applications, and some are highly specialized to specific tasks. For example, B-trees are particularly well-suited for implementation of databases, while compiler implementations usually use hash tables to look up identifiers. Data structures are used in almost every program or software system. Data structures provide a means to manage huge amounts of data efficiently, such as large databases and internet indexing services. Usually, efficient data structures are a key to designing efficient algorithms. Some formal design methods and programming languages emphasize data structures, rather than algorithms, as the key organizing factor in software design.

2. Pre-Requisites

- Knowledge of any programming language that supports pointers for referencing.

3. Course Objectives:

- To gain knowledge of linear and non-linear data structures.
- To familiarize with different sorting and searching techniques

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

- Demonstrate the working process of sorting (bubble, insertion, selection and heap) and searching (linear and binary) methods using a programming language.
- Design algorithms to create, search, insert, delete and traversal operations on linear and non-linear data structures.
- Evaluate the arithmetic expressions using stacks.
- Choose appropriate collision resolution techniques to resolve collisions.

- Compare array and linked list representation of data structures.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a

member and leader in a team, to manage projects and in multidisciplinary environments.

12.Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

CT2505 : DATA STRUCTURES														
Course outcomes	Program Outcomes and Program Specific Outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1: demonstrate the working process of sorting (bubble, insertion, selection and heap) and searching (linear and binary) methods using a programming language.	3	1	2									2		2
CO2:design algorithms to create, search, insert, delete and traversal operations on linear and non-linear data structures.	2	2	3	2								1	1	
CO3: evaluate the arithmetic expressions using stacks.	2	3	1									1		
CO4: choose appropriate collision resolution techniques to resolve collisions.	2	3										1	1	
CO5: compare array and linked list representation of data structures.	2	2											1	

7. Prescribed Text Books

- a. Debasis samanta, Classic Data Structures, PHI, 2nd edition, 2011.

- b. Richard F, Gilberg , Forouzan, Data Structures, 2nd edition, Cengage

8. Reference Text Books

- a. Seymour Lipschutz, Data Structure with C, TMH.
 b. G. A. V. Pai, Data Structures and Algorithms, TMH, 2008.
 c. Horowitz, Sahni, Anderson Freed, Fundamentals of Data Structure in C, University Press, 2nd edition

9. URLs and Other E-Learning Resources

- a. [https://www.courserA\)org/learn/data-structures](https://www.courserA)org/learn/data-structures)
 b. <http://www.studytonight.com/data-structures/>
 c. <http://www.indiabix.com/technical/data-structures/>
 d. [http://nptel.aC\)in/courses/106102064/1](http://nptel.aC)in/courses/106102064/1)
 e. <http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithm/s/2#>

Lecture Schedule / Lesson Plan

Topic	No. of Periods	
	Theory	Tutorial
UNIT – 1: Searching and Sorting		
Concepts of data structures, Overview of data structures	1	1
Linear search	1	
Binary search	1	
Internal sorting: Basic concept	1	1
Bubble sort	1	
Insertion sort	1	
Selection sort	1	
	7	2
UNIT –2: Linked Lists		
Linked Lists- Basic concepts	1	1
Single linked list-operations	4	
Circular linked list	2	
Double linked list	4	1

	11	2
UNIT – 3: Stacks and Queues		
Stack introduction, Array and Linked List representations of stack	2	1
Operations on stacks using array and linked list	4	
Evaluation of arithmetic expression	3	
Queue introduction, Array and Linked List representations of queue	2	1
Operations on queues using array and linked list	3	
Circular queue introduction	1	
	15	2
UNIT – 4: Trees		
Basic tree concepts, Properties	2	1
Representation of Binary Trees using Arrays, linked lists	1	
Binary Tree Traversals (recursive)	1	
Binary search trees: Basic concepts, Search, insertion operations	2	1
Deletion Operation (Examples only)	1	
Creation of binary search tree from in-order and pre (post) order	1	
	8	2
UNIT – 5: Heap Trees and Graphs		
Heap Trees: Basic Concept, Operations	2	1
Graphs-Basic concepts, Representations of graphs	2	1
Graph traversals Breadth First Search (BFS), Depth First Search (DFS)	4	
	8	2
UNIT - 6: Hashing		
Hashing: Basic concepts, hashing functions (division method, multiplication method)	3	1
Collision resolution techniques- open hashing	1	1

Closed hashing (Linear Probing, Quadratic Probing, Double Hashing)	3	
	7	2
Total Number of Hours	56	12

Assignment-Cum-Tutorial Questions

UNIT-I

SECTION-A

Objective Questions

1. Find the location of the element with a given value is___?
 - A) Traversal B) Searching
 - C) Sorting D) None of above
2. Which of the following is false?
 - A) A linear search begins with the first array element
 - B) A linear search continues searching, element by element, either until a match is found or until the end of the array is encountered
 - C) A linear search is useful when the amount of data that must be search is small
 - D) For a linear search to work, the data in the array must be arranged in either alphabetical or numerical order
3. Which characteristic will be used by binary search but the linear search ignores is _____.
 - A) Order of the elements of the list B) Length of the list
 - C) Maximum value in list D) Type of elements of the list
4. Choose the false statement.
 - A) A binary search begins with the middle element in the array
 - B) A binary search continues having the array either until a match is found or until there are no more elements to search
 - C) If the search argument is greater than the value located in the middle of the binary, the binary search continues in the lower half of the array
 - D) For a binary search to work, the data in the array must be arranged in either alphabetical or numerical order
5. Which of the following is *not* a limitation of binary search algorithm?

- A) Must use a sorted array
- B) Requirement of sorted array is expensive when a lot of insertion and deletions are needed
- C) There must be a mechanism to access middle element directly
- D) Binary search algorithm is not efficient when the data elements more than 1500
6. What is the complexity of searching an element from a set of n elements using Binary search algorithm is
- A) $O(n)$ B) $O(\log n)$ C) $O(n^2)$ D) $O(n \log n)$
7. Label the process of arranging values in an ordered manner is called as _____.
8. In which sorting technique, consecutive adjacent pairs of elements in the array are compared with each other.
- A) Bubble sort B) Selection Sort C) Insertion Sort D) None
9. Identify the number of comparisons required to sort a list of 10 numbers in *pass 2* by using *Bubble Sort* is_____.
- A) 10 B) 9 C) 8 D) 7
- 10 Consider an array of elements $arr[5] = \{99,22,55,44,33\}$, what are the steps done while doing bubble sort in the array.
- A) 22 55 44 33 99 33 22 44 99 55 22 44 99 33 55 44 22 55 33 99
- B) 22 55 44 33 99 22 44 33 55 99 22 33 44 55 99
- 22 33 44 55 99
- B) 55 44 33 99 22 44 22 33 99 55 55 33 99 22 44
- C) 99 55 44 33 22
- D) None of the above
11. Which sorting technique sorts a list of elements by moving the current data element past the already sorted values with the preceding value until it is in its correct place.
- A) Insertion sort B) Bubble Sort C) Selection Sort D) None
12. Identify the number of passes required by insertion sort for the list size 15.
- A) 15 B) 16 C) 14 D) 13

13. Which of the following sorting algorithms in its implementation gives best performance when applied on an array which is sorted or almost sorted (maximum 1 or two elements are misplaced).
- A) Insertion sort B) Bubble Sort C) Selection Sort D) None
14. Consider an array of elements $arr[5] = \{5,4,3,2,1\}$, what are the steps of insertions done while doing insertion sort in the array.
- A) 4 5 3 2 1 3 4 5 2 1 2 3 4 5 1 1 2 3 4 5
 B) 5 4 3 1 2 5 4 1 2 3 5 1 2 3 4 1 2 3 4 5
 C) 4 3 2 1 5 3 2 1 5 4 2 1 5 4 3 1 5 4 3 2
 D) 4 5 3 2 1 2 3 4 5 1 3 4 5 2 1 1 2 3 4 5
15. Consider the array $A[] = \{6,4,8,1,3\}$ apply the insertion sort to sort the array . Consider the cost associated with each sort is 25 rupees, what is the total cost of the insertion sort when element 1 reaches the first position of the array?
- A) 50 B) 25 C) 75 D) 100
16. Consider a situation where swap operation is very costly. Which of the following sorting algorithms should be preferred so that the numbers of swap operations are minimized in general?
- A) Bubble Sort B) Selection Sort C) Insertion Sort
 D) None
- 17 Which one of the following in-place sorting algorithms needs the minimum number of swaps?
- A) Insertion Sort B) Bubble Sort C) Selection Sort D) All of the above
18. Discover the comparisons needed to sort an array of length 5 if a straight selection sort is used and array is already in the opposite order?
- A) 1 B) 10 C) 5 D) 20
19. Determine the advantage of bubble sort over other sorting techniques?
- a) It is faster b) Consumes less memory
 c) Detects whether the input is already sorted
 d) All of the mentioned

SECTION-B

SUBJECTIVE QUESTIONS

1. Given a telephone directory and a name of the subscriber, choose search method you would suggest for finding the telephone number of the given subscriber.
2. Apply linear search for an element 18 and 100 in the following list.
36, 72, 19, 45, 18, 22, 12, 55
3. Apply binary search for an element 54 and 100 in the following list.
13, 27, 91, 54, 81, 6, 51, 59, 45, 69
4. Make use of bubble sort for the following elements.
30, 52, 29, 87, 63, 27, 19, 54
5. Make use of insertion sort for the following elements.
59, 19, 54, 96, 81, 801, 45, 72, 64, 92
6. Make use of selection sort for the following elements.
36, 12, 81, 45, 90, 27, 72, 18
7. Explain bubble sort algorithm.
8. Explain insertion sort algorithm.
9. Explain selection sort algorithm.
- 10 Explain non recursive linear search algorithm.
- 11 Explain recursive binary search algorithm.
- 12 Develop a C program using for loop to find all the occurrences of a given key in a given list using linear search. The algorithm should display locations of all the occurrences of the given key. Discuss with an example.

SECTION-C

QUESTIONS AT THE LEVEL OF GATE

1. Consider the C function given below. Assume that the array listA contains $n (> 0)$ elements, sorted in ascending order. **(GATE-CS-2014)**

```
int ProcessArray(int *listA, int x, int n)
```

```
{    int i, j, k;
```

```
    i = 0;
```

```
    j = n-1;
```

```
    do
```

```

{   k = (i+j)/2;
    if (x <= listA[k])
        j = k-1;
        if (listA[k] <= x)
            i = k+1;
    } while (i <= j);
    if (listA[k] == x)
        return(k);
    else
        return -1;
}

```

Which one of the following statements about the function ProcessArray is CORRECT?

- (A) It will run into an infinite loop when x is not in listA.
- (B) It is an implementation of binary search.
- (C) It will always find the maximum element in listA.
- (D) It will return -1 even when x is present in listA.

2. Consider the following C program that attempts to locate an element x in an array Y[] using binary search. The program is erroneous.

(GATE CS 2008)

1. f(int Y[10], int x) {
2. int i, j, k;
3. i = 0; j = 9;
4. do {
5. k = (i + j) / 2;
6. if(Y[k] < x) i = k; else j = k;
7. } while(Y[k] != x && i < j);
8. if(Y[k] == x) printf ("x is in the array ");
9. else printf (" x is not in the array ");
10. }

On which of the following contents of Y and x does the program fail?

- (A) Y is [1 2 3 4 5 6 7 8 9 10] and $x < 10$
- (B) Y is [1 3 5 7 9 11 13 15 17 19] and $x < 1$
- (C) Y is [2 2 2 2 2 2 2 2 2 2] and $x > 2$
- (D) Y is [2 4 6 8 10 12 14 16 18 20] and $2 < x < 20$ and x is even

3. In the above question, the correction needed in the program to make it work properly is **(GATE CS 2008)**

- (A) Change line 6 to: if (Y[k] < x) i = k + 1; else j = k-1;
- (B) Change line 6 to: if (Y[k] < x) i = k - 1; else j = k+1;
- (C) Change line 6 to: if (Y[k] <= x) i = k; else j = k;
- (D) Change line 7 to: } while ((Y[k] == x) && (i < j));

4. The average number of key comparisons done in a successful sequential search in a list of length it is **(GATE CS 1996)**

- (A) $\log n$ (B) $(n-1)/2$ (C) $n/2$ (D) $(n+1)/2$

UNIT-II

SECTION-A

Objective Questions

1. The logical or mathematical model of a particular organization of data is defined as _____.
2. An ordered collection of finite, homogeneous data elements where the linear order is maintained by means of links or pointers is defined as _____.
3. In single linked list each node contain minimum of two fields. One field is data field to store the data and select for what purpose the second field is used to store _____?
a) Pointer to character b) Pointer to integer
c) Pointer to next node d) None
4. Identify the memory allocation process in Linked list
a)Dynamic b)Compile Time c)Static d)None of these
5. A variant of linked list, identify in which last node of the list points to the first node of the list is?
a)Singly linked list b) Doubly linked list

- c)Circular linked list d) Multiply linked list
6. In doubly linked lists, identify which type of traversal can be performed?
 a)Only in forward direction b) Only in reverse direction
 c)In both directions d) None
7. A variant of the linked list, identify in which none of the node contains NULL pointer is?
 a)Singly linked list b) Doubly linked list
 c)Circular linked list d) None
8. Identify non-linear Data Structure from the following []
 a. Array b. Stack c. Graph d. Linked list
- 9.A node in single linked list can reference the previous node. [True/False]
10. Choose, Which type of structure is used to create a linked list? []
 a) Nested structure b) Self referential structure
 c) Array of structure d)pointers to structure
11. Predict, Which type of linked list occupies more memory? []
 a)SLL b) DLL c)CLL d)None
12. Compute how many pointers need to modify in inserting a node at the beginning of the single linked list
 a) 1 b) 2 c) 3 d) 0
13. What does the following function do for a given Linked List with first node as head?

```
void fun1(struct node* head)
{
  if(head == NULL)
    return;

  fun1(head->next);
  printf("%d ", head->data);
}
```

 a) Prints all nodes of linked lists
 b) Prints all nodes of linked list in reverse order
 c) Prints alternate nodes of Linked List
 d) Prints alternate nodes in reverse order
14. Deleting a node at any position (middle) of the single linked list needs to modify _____ pointers.
 a) 1 b) 2 c) 3 d) 0
15. A double linked list is declared as follows: [] struct
 dlist

```

{
    struct dllist *fwd, *bwd;
    int data;
}

```

Where fwd and bwd represents forward and backward links to adjacent elements of the list. Which among the following segments of code deletes the element pointed to by X from the double linked list, if it is assumed that X points to neither the first nor last element of the list?

- a. X -> bwd -> fwd = X -> fwd;
X -> fwd -> bwd = X -> bwd
- b. X -> bwd -> fwd = X -> bwd;
X -> fwd -> bwd = X -> fwd
- c. X -> bwd -> bwd = X -> fwd;
X -> fwd -> fwd = X -> bwd
- d. X -> bwd -> bwd = X -> bwd;
X -> fwd -> fwd = X -> fwd

15. Which among the following segment of code inserts a new node pointed by X to be inserted at the beginning of the double linked list. The start pointer points to beginning of the list?

- a. X -> bwd = X -> fwd;
X -> fwd = X -> bwd;
- b. X -> fwd = start;
start -> bwd = X;
start = X;
- c. X -> bwd = X -> fwd;
X -> fwd = X -> bwd;
start = X;
- d. X -> bwd -> bwd = X -> bwd;
X -> fwd -> fwd = X -> fwd

16. Does C perform array out of bound checking? What is the output of the following program?

```

int main()
{
    int i;
    int arr[5] = {0};
    for (i = 0; i <= 5; i++)
        printf("%d ", arr[i]);
    return 0;
}

```

- a) Compiler Error: Array index out of bound.
 - b) The always prints 0 five times followed by garbage value
 - c) The program always crashes.
 - d) The program may print 0 five times followed by garbage value, or may crash if address (arr+5) is invalid.
17. Which boolean expression indicates whether the numbers in two nodes (p and q) are the same. Assume that neither p nor q is null.
- a) p == q
 - c) p.data == q.data

- b) p.link == q.link d) None of the above.
18. Which of the following statement is true []
- I. Using single linked list it is not possible to traverse the list in backward direction.
- II. To find the predecessor it is required to traverse the list from the first node in case of single linked list.
- a) I only b) II only c) Both I and II
d) None of the above
19. Suppose each set is represented as a linked list with elements in arbitrary order. Which of the operations among union, intersection, membership, cardinality will be the slowest?
- a) union only b) intersection, membership
c) membership, cardinality d) union, intersection
20. The following C function takes a singly linked list as input argument. It modifies the list by moving the last element to the front of the list and returns the modified list. Some part of the code is left blank.

```

Typedefstruct node
{
    Intvalue;
    Structnode *next;
}Node;
Node *move_to_front(Node *head)
{
    Node *p, *q;
    If ((head == NULL: || (head->next == NULL))
        Return head;
    Q = NULL;
    p = head;
    While (p->next !=NULL)
    {
        Q = p;
        P = p->next;
    }
    -----
    Return head;
}

```

Choose the correct alternative to replace the blank line.

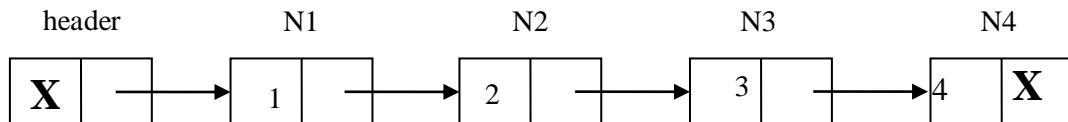
- a) q = NULL; p->next = head; head = p;
b) q->next = NULL; head = p; p->next = head;
c) head = p; p->next = q; q->next = NULL;
d) q->next = NULL; p->next = head; head = p;

SECTION-B

SUBJECTIVE QUESTIONS

1. Explain about delete operation in singly linked list.

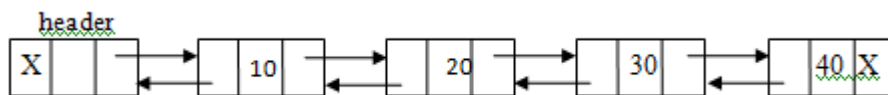
2. Compare single linked list and circular single linked list.
3. Write an algorithm to perform deletion operation on circular linked list.
4. Write an algorithm to perform insertion operation on a double linked list.
5. Write an algorithm to perform deletion operation on a double linked list.
6. Write short notes on data structures.
7. **Consider the following single linked list.**



Demonstrate the following operations on this list and draw the updated single linked list after each operation.

1. Insert 5 at end
2. Insert 6 at begin
3. Insert 9 after 2
4. Delete 6
5. Delete 5
6. Delete 3

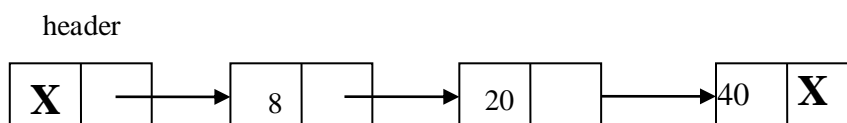
8. Consider the following double linked list.



Illustrate the following operations on this list and draw the updated single linked list after each operation.

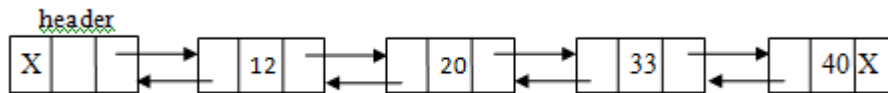
1. Insert 50 at end
2. Insert 60 at begin
3. Insert 90 after 20
4. Delete 60
5. Delete 50
6. Delete 30

9. Consider the following single linked list.



Insert the following elements into the list **2,15,30,50**. Such that the list will be in **ascending** order and draw the updated single linked list after each insertion operation.

10. Consider the following double linked list.



Insert the following elements into the list **2,15,30,50**. Such that the list will be in **ascending** order and draw the updated single linked list after each insertion operation.

11. Write a program to implement insert operation in a doubly linked List.
12. Write a program to perform deletion operation in the middle of a doubly linked list.
13. Develop a program to delete an element of a single linked list.
14. Develop a program to merge two single linked lists into one list so that the resultant list will be in ascending order.

SECTION-C

QUESTIONS AT THE LEVEL OF GATE

1. Consider the function f defined below.

(GATE 2003)

```

struct item
{
    int data;
    struct item * next;
};
int f(struct item *p)
{
return( (p == NULL) || (p->next == NULL) || (( P->data <= p->next->data) &&
f(p->next)) );
}

```

For a given linked list p, the function f returns 1 if and only if

- a) the list is empty or has exactly one element

- b) the elements in the list are sorted in non-decreasing order of data value
 c) the elements in the list are sorted in non-increasing order of data value
 d) not all elements in the list have the same data value.
2. A circularly linked list is used to represent a Queue. A single variable p is used to access the Queue. To which node should p point such that both the operations enQueue and deQueue can be performed in constant time?
(GATE 2004)
 a) rear node
 b) front node
 c) not possible with a single pointer
 d) node next to front
3. In the worst case, the number of comparisons needed to search a singly linked list of length n for a given element is
(GATE 2002)
 a) $\log_2 n$ b) $n/2$ c) $\log_2 n - 1$ d) n

UNIT-III

SECTION-A

Objective Questions

- 1) To add and remove nodes from a queue _____ access is used.
 a) LIFO, Last In First Out b) FIFO, First In First Out
 c) Both a and b d) None
- 2.) Which one of the following is an application of Queue Data Structure?
 a) When a resource is shared among multiple consumers. b) When data is transferred asynchronously
 c) Load Balancing
 d) All of the above
- 3.) Which of the following is not the type of queue?
 a) Ordinary queue b) Single ended queue
 c) Circular queue d) Priority queue
- 4.) Suppose a circular queue of capacity $(n - 1)$ elements is implemented with an array of n elements. Assume that the insertion and deletion operation are carried out using REAR and FRONT as array index variables, respectively. Initially, REAR = FRONT = 0. The conditions to detect queue full and queue empty are

a) Full: $(REAR+1) \bmod n == FRONT$, empty: $REAR == FRONT$

b) Full: $(REAR+1) \bmod n == FRONT$, empty: $(FRONT+1) \bmod n == REAR$

C) Full: $REAR == FRONT$, empty: $(REAR+1) \bmod n == FRONT$

d) Full: $(FRONT+1) \bmod n == REAR$, empty: $REAR == FRONT$

6) What is the need for a circular queue?

a) effective usage of memory

b) easier computations

c) all of the mentioned

d) none

6. What is the space complexity of a linear queue having n elements?

a) $O(n)$

b) $O(n \log n)$

c) $O(\log n)$

d) $O(1)$

7). In linked list implementation of a queue, where does a new element be deleted?

a) At the head of linked list

b) At the tail of the linked list

c) At the centre position in the linked list

d) None of the above

8.) In a circular queue, how do you increment the rear end of the queue?

a) $rear++$

b) $(rear+1) \% CAPACITY$

c) $(rear \% CAPACITY)+1$

d) $rear--$

9. In linked list implementation of a queue, front and rear pointers are tracked. Which of these pointers will change during an insertion into a NONEMPTY queue?

a) Only front pointer

b) Only rear pointer

c) Both front and rear pointer

d) None of the mentioned

10. The value of REAR is increased by 1 when

a. An element is deleted in a queue

b. An element is traversed in a queue

c. An element is added in a queue

d. None

11) What is the time complexity of pop() operation when the stack is implemented using an array?

a) $O(1)$

b) $O(n)$

c) $O(\log n)$

d) $O(n \log n)$

12) Which of the following is true about linked list implementation of stack?

a) In push operation, if new nodes are inserted at the beginning of linked list, then in pop operation, nodes must be removed from end.

b) In push operation, if new nodes are inserted at the end, then in pop operation, nodes must be removed from the beginning.

c) Both of the above

d) None of the above

- 13) Suppose a stack is to be implemented with a linked list instead of an array. What would be the effect on the time complexity of the push and pop operations of the stack implemented using linked list (Assuming stack is implemented efficiently)?
- $O(1)$ for insertion and $O(n)$ for deletion
 - $O(1)$ for insertion and $O(1)$ for deletion
 - $O(n)$ for insertion and $O(1)$ for deletion
 - $O(n)$ for insertion and $O(n)$ for deletion
- 14.) Which of the following permutation can be obtained in the same order using a stack assuming that input is the sequence 5, 6, 7, 8, 9 in that order?
- 7, 8, 9, 5, 6
 - 5, 9, 6, 7, 8
 - 7, 8, 9, 6, 5
 - 9, 8, 7, 5, 6
- 15.) If the sequence of operations – push (1), push (2), pop, push (1), push (2), pop, pop, push (2), pop are performed on a stack, the sequence of popped out values
- 2,2,1,1,2
 - 2,2,1,2,2
 - 2,1,2,2,1
 - 2,1,2,2,2
- 16) The postfix form of the expression $(A + B) * (C * D - E) * F / G$ is?
- $AB + CD * E - FG /**$
 - $AB + CD * E - F ** G /$
 - $AB + CD * E - * F * G /$
 - $AB + CDE * - * F * G /$
- 17) The postfix form of $A * B + C / D$ is?
- $* AB / CD +$
 - $AB * CD / +$
 - $A * BC + / D$
 - $ABCD + / *$
18. The prefix form of $A - B / (C * D ^ E)$ is?
- $- / * ^ A C B D E$
 - $- A B C D * ^ D E$
 - $- A / B * C ^ D E$
 - $- A / B C * ^ D E$
- 19.) The result of evaluating the postfix expression 5, 4, 6, +, *, 4, 9, 3, /, +, * is?
- 600
 - 350
 - 650
 - 588
- 20.) Which of the following data structures can be used for parentheses matching?
- n-ary tree
 - queue
 - priority queue
 - stack

SECTION-B

SUBJECTIVE QUESTIONS

- Explain the prefix and post fix notation of $(a + b) * (c + d)$?
- Define what is stack? Why do we use stack ? And what are the operations performed on stacks?
- Convert the expression $(a+b)/d - ((e-f)\%g)$ into reverse polish notation using stack and show the contents of stack for every operation.
- Evaluate the expression $12/3*6+6-6+8\%2$ using stack.
- Convert the expression $a+b*c/d\%e-f$ into postfix expression using stack.

6. Implement queue using arrays?
7. Implement queue using Linked List?
8. What is Queue? discuss the types of Queues ?And explain why we are going for circular queue?
9. List out Applications of Stacks?
10. List out applications of queues?

SECTION-C

QUESTIONS AT THE LEVEL OF GATE

1. Consider the following pseudocode that uses a stack

```

declare a stack of characters
while ( there are more characters in the word to read )
{
    read a character
    push the character on the stack
}
while ( the stack is not empty )
{
    pop a character off the stack
    write the character to the screen
}

```

What is output for input "geeksquiz"?

What is output for input "geeksquiz"?

(A) geeksquizgeeksquiz

(B) ziuqskeeg

(C) geeksquiz

(D) ziuqskeegziuqskeeg

2. Assume that the operators +, -, × are left associative and ^ is right associative. The order of precedence (from highest to lowest) is ^, ×, +, -. The postfix expression corresponding to the infix expression $a + b \times c - d \wedge e \wedge f$ is

A. $abc \times + def \wedge \wedge -$

B. $abc \times + de \wedge f \wedge -$

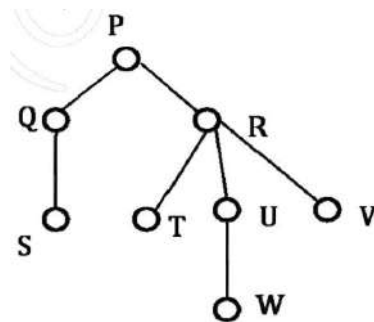
C. $ab + c \times d - e \wedge f \wedge$

D. $- + a \times bc \wedge \wedge def$

3. The following postfix expression with single digit operands is evaluated using a stack:

(C) SQPTWUVR

(D) SQPTRUWV



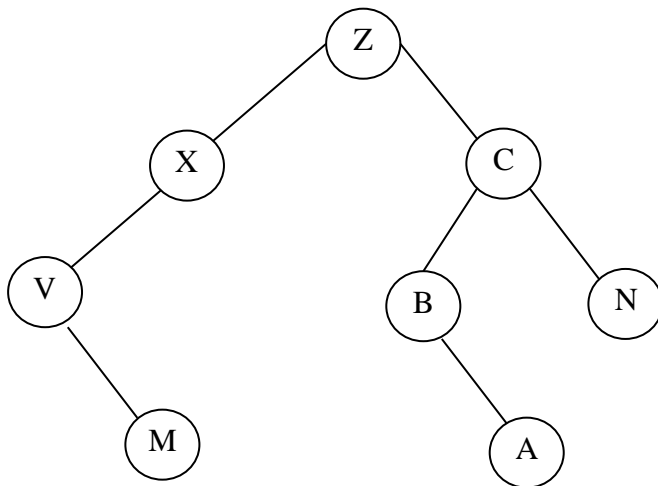
Explanation:

The only confusion in this question is, there are 3 children of R. So when should R appear – after U or after T? There are two possibilities: SQPTRWUV and SQPTWURV. Only 1st possibility is present as an option A, the 2nd possibility is not there. Therefore option A is the right answer.

SECTION-B

Descriptive Questions

1. Write recursive algorithms for Binary Search Tree Traversals.
2. What is the inorder, preorder and postorder for the following binary tree?



3. Construct Binary Tree for the following tree traversals.

Inorder: W U R O P I T Y E

Preorder: P O U W R I Y T E

What is the Post order traversal for the above constructed binary tree?

Ans: W R U O T E Y I P

4. Construct Binary Tree for the following tree traversals.

Inorder: N Z V A M C B S X D

Postorder: Z A V N C S D X B M

What is the **Preorder** traversal for the above constructed binary tree?

Ans: M N V Z A B C X S D

5. Create Binary Search with the following elements.

20 30 15 25 42 61 72 18 10 8

What is the **Inorder** traversal for the above constructed Binary Search tree?

Ans: 8 10 15 18 20 25 30 42 61 72

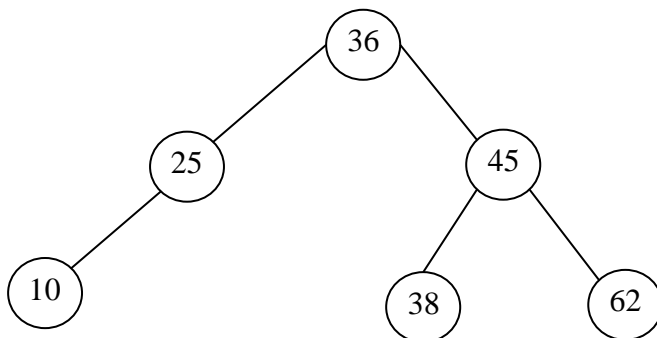
6. Create Binary Search with the following elements.

100 90 110 80 95 125 115 108 104 76 49 62

What is the **Inorder** traversal for the above constructed Binary Search tree?

Ans: 49 62 76 80 90 95 100 104 108 110 115 125

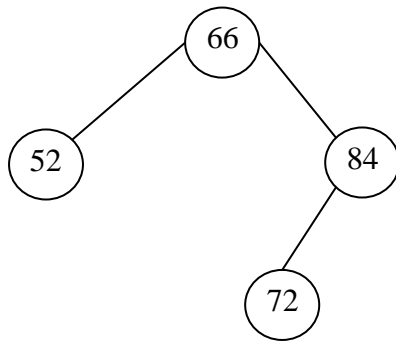
7. Consider the following Binary Search Tree and perform the following sequence of operations.



Insert the elements 55, 68, 49, 18, 28, 27, 30. Now **delete** the elements 55, 45, 36, 10 and 18. Finally what is the root node?

Ans: 38

8. Consider the following Binary Search Tree and perform the following sequence of operations.



Insert the elements 89, 46, 48, 26, 76, 98, 100. Now **delete** the elements 84, 48, 52 and 66. Finally what is the root node?

Ans: 72

Section - C

- Consider a binary tree T that has 200 leaf nodes. Then, the number of nodes in T that have exactly two children are? **(GATE 2016)**
 (A) 201 (B) 100 (C) 199 (D) 50
- The maximum number of binary trees that can be formed with three unlabelled nodes is: _____ **(GATE 2007)**
 (A) 1 (B) 5 (C) 4 (D) 3
- The height of a binary tree is the maximum number of edges in any root to leaf path. The maximum number of nodes in a binary tree of height h is: **(GATE 2007)**
 (A) $2^h - 1$ (B) $2^{(h-1)} - 1$
 (C) $2^{(h+1)} - 1$ (D) $2^{*(h+1)}$
- The inorder and preorder traversal of a binary tree are *d b e a f c g* and *a b d e c f g*, respectively. The postorder traversal of the binary tree is: **(GATE 2007)**
 (A) *d e b f g c a* (B) *e d b g f c a*
 (C) *e d b f g c a* (D) *d e f g b c a*
- Consider the label sequences obtained by the following pairs of traversals on a labelled binary tree. Which of these pairs identify a tree uniquely? **(GATE CS 2004)**
 - preorder and postorder
 - inorder and postorder
 - preorder and inorder

iv) level order and postorder

- (A) (i) only (B) (ii), (iii) only (C) (iii) only (D) (iv) only
6. Let **LASTPOST**, **LASTIN** and **LASTPRE** denote the last vertex visited in a postorder, inorder and preorder traversal. Respectively, of a complete binary tree. Which of the following is always true? (**GATECS 2000**)
- (A) **LASTIN = LASTPOST** (B) **LASTIN = LASTPRE**
(C) **LASTPRE = LASTPOST** (D) None of the above
7. While inserting the elements 71, 65, 84, 69, 67, 83 in an empty binary search tree (BST) in the sequence shown, the element in the lowest level is?
(GATE 2015)
- (A) 65 (B) 67 (C) 69 (D) 83
8. Suppose the numbers 7, 5, 1, 8, 3, 6, 0, 9, 4, 2 are inserted in that order into an initially empty *binary search tree*. The binary search tree uses the usual ordering on natural numbers. What is the in-order traversal sequence of the resultant tree?
(GATE CS 2003)
- (A) 7 5 1 0 3 2 4 6 8 9 (B) 0 2 4 3 1 6 5 9 8 7
(C) 0 1 2 3 4 5 6 7 8 9 (D) 9 8 6 4 2 3 0 1 5 7
9. Which of the following is/are *correct* inorder traversal sequence(s) of binary search tree(s)?
(GATE 2016)
- I. 3, 5, 7, 8, 15, 19, 25
II. 5, 8, 9, 12, 10, 15, 25
III. 2, 7, 10, 8, 14, 16, 20
IV. 4, 6, 7, 9 18, 20, 25
- (A) I and IV only (B) II and III only (C) II and IV only
(D) II only
10. Postorder traversal of a given binary search tree, T produces the following sequence of keys **10, 9, 23, 22, 27, 25, 15, 50, 95, 60, 40, 29**. Which one of the following sequences of keys can be the result of an in-order traversal of the tree T?
(GATE CS 2004)
- (A) 9, 10, 15, 22, 23, 25, 27, 29, 40, 50, 60, 95
(B) 9, 10, 15, 22, 40, 50, 60, 95, 23, 25, 27, 29
(C) 29, 15, 9, 10, 25, 22, 23, 27, 40, 60, 50, 95
(D) 95, 50, 60, 40, 27, 23, 22, 25, 10, 9, 15, 29

11. The following numbers are inserted into an *empty binary search tree* in the given order: 10, 1, 3, 5, 15, 12, 16. What is the height of the binary search tree (the height is the maximum distance of a leaf node from the root)?

(GATE CS 2004)

- (A) 2 (B) 3 (C) 4 (D) 6

12. The *preorder* traversal sequence of a *binary search tree* is 30, 20, 10, 15, 25, 23, 39, 35, and 42. Which one of the following is the postorder traversal sequence of the same tree?

(GATE 2013)

- (A) 10, 20, 15, 23, 25, 35, 42, 39, 30
(B) 15, 10, 25, 23, 20, 42, 35, 39, 30
(C) 15, 20, 10, 23, 25, 42, 35, 39, 30
(D) 15, 10, 23, 25, 20, 35, 42, 39, 30

12. Let T be a binary search tree with 15 nodes. The minimum and maximum possible heights of T are:

(GATE-CS-2017 -Set 1)

Note: The height of a tree with a single node is 0.

- (A) 4 and 15 respectively (B) 3 and 14 respectively
(B) 4 and 14 respectively (D) 3 and 15 respectively

13. Let T be a tree with 10 vertices. The sum of the degrees of all the vertices in T is _____.

(GATE-CS-2017 - Set 1)

- (A) 18 (B) 19 (C) 20 (D) 21

Explanation:

Given, $v =$ Total vertices = 10 $e = v - 1 = 9$ Degree = $2 * e = 18$ Therefore, option A is correct.

14. The pre-order traversal of a binary search tree is given by 12, 8, 6, 2, 7, 9, 10, 16, 15, 19, 17, 20. Then the post-order traversal of this tree is:

(GATE-CS-2017 -Set 2)

- (A) 2, 6, 7, 8, 9, 10, 12, 15, 16, 17, 19, 20
(B) 2, 7, 6, 10, 9, 8, 15, 17, 20, 19, 16, 12
(C) 7, 2, 6, 8, 9, 10, 20, 17, 19, 15, 16, 12
(D) 7, 6, 2, 10, 9, 8, 15, 16, 17, 20, 19, 12

UNIT-V

SECTION-A

Objective Questions

1. A _____ is a heap where the value of each parent is less than or equal to the values of its children.
2. Consider any array representation of an n element binary heap where the elements are stored from index 1 to index n of the array. For the element stored at index i of the array ($i \leq n$), the index of the left child and right child are _____

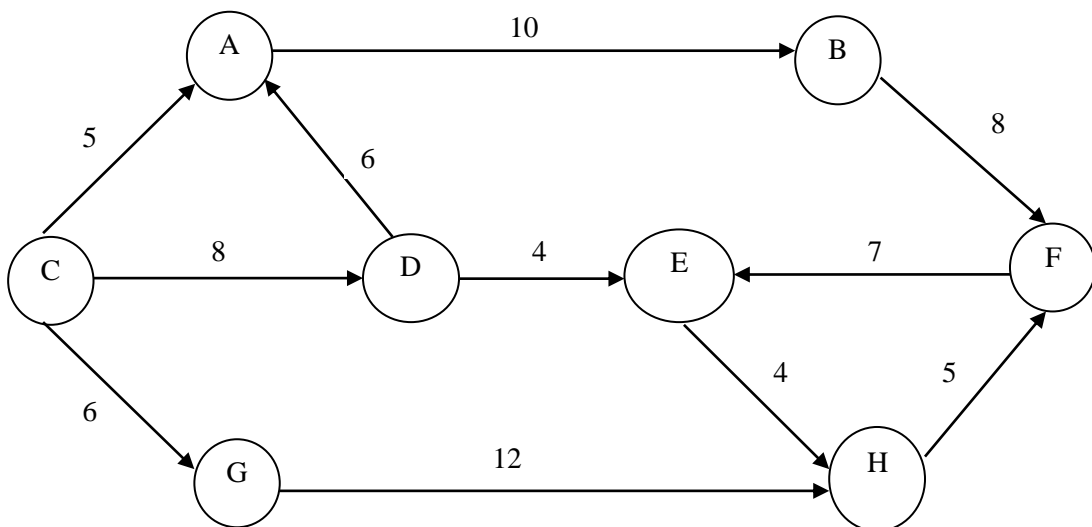
A) $2i+1, 2i$

B) $2i+1, \text{floor}(i/2)$

C) $2i, \text{floor}(i/2)$

D) $2i, 2i+1$

Consider the following graph and answer to the questions 3 to 9



3. The above graph is _____

A) Complete Graph

B) Weighted Graph

C) Multi Graph

D) None of the above

4. In the above graph which of the following is a pendant vertex?

A) vertex B

B) vertex D

C) vertex E

D) None of the above

5. In the above graph indegree and outdegree of vertex H is ____

- A) indegree - 2 outdegree - 0 B) indegree - 3 outdegree - 0
 C) indegree - 3 outdegree - 1 D) indegree - 2 outdegree - 1

6. The above graph is a _____

- A) Connected Graph B) Simple Graph
 C) Cyclic graph D) None of the above

7. The node A is adjacent to _____ node.

- A) B B) C C) D D) None

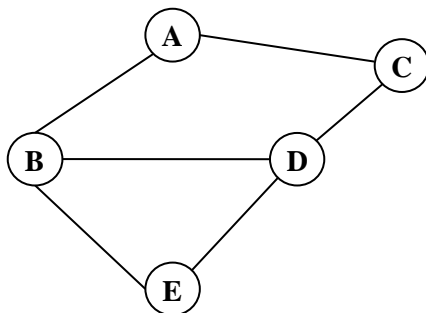
8. In the above graph there is a self loop with vertex _____

- A) E B) G C) H D) None

9. In a graph if $e=(u,v)$ means

- A) u is adjacent to v but v is not adjacent to u.
 B) e begins at u and ends at v
 C) u is node and v is an edge.
 D) both u and v are edges.

Consider the following graph to answer the questions 10 to 10



10. The above graph is a _____

- A) Weighted graph B) Simple graph
 C) Acyclic Graph D) None

11. The adjacent vertices of node A are _____

- A) B, D, E B) B, D, C C) E, D D) None

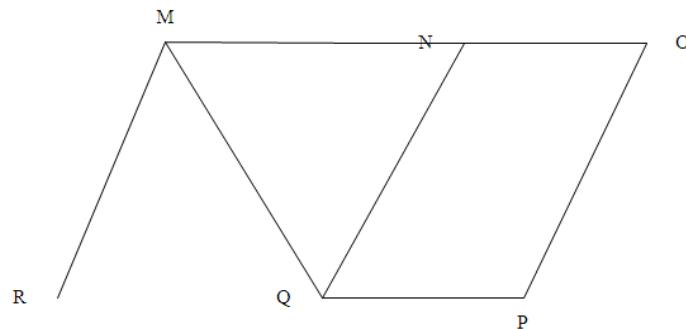
12. The above graph is a _____

- A) Connected graph B) Complete graph
 C) Both A&B D) None

13. For an undirected graph with n vertices and e edges, the sum of the degree of each vertex is equal to

- A) 2n B) $(2n-1)/2$ C) 2e D) $e^2/2$

14. A graph with n vertices will definitely have a parallel edge or self loop, if the total number of edges are
- (A) more than n (B) more than $n+1$
 (C) more than $(n+1)/2$ (D) more than $n(n-1)/2$
15. The maximum degree of any vertex in a simple graph with n vertices is_____
16. An adjacency matrix representation of a graph cannot contain information of _____
- (A) Nodes (B) edges (C) Direction of edges (D) parallel edges
17. How many undirected graphs (not necessarily connected) can be constructed out of a given set $V = \{V_1, V_2, \dots, V_n\}$ of n vertices ?
- (A) $n(n-1)/2$ (B) 2^n (C) $n!$ (D) $2^{(n(n-1)/2)}$
18. The data structure required for Breadth First Traversal on a graph is _____
- (A) Queue (B) Stack (C) Array (D) Tree
19. Which of the following statements is/are TRUE for an undirected graph?
- P: Number of odd degree vertices is even
 Q: Sum of degrees of all vertices is even
- A) P Only (B) Q Only
 C) Both P and Q (D) Neither P nor Q.
20. The Minimum no. of edges in a connected cyclic graph on n vertices is____?
- (A) $n-1$ (B) n (C) $n+1$ (D) None of the above
21. The no. of simple graphs on n labeled vertices is_____
- (A) n (B) $n(n-1)/2$ (C) $2^{n(n-1)/2}$ (D) $n(n+1)/2$
22. The BFS Algorithm has been implemented using Queue Data Structure. One possible order of visiting nodes in the following graph is



(A) MNOPQR

(B) NQMPOR

(C) QMNPRO

(D) QMNPOR

SECTION-B

Descriptive Questions

1. Show the result of inserting the keys: 14, 5, 12, 6, 4, 8, 9, 13, 11, 2, 18, 30 one at a time into an initially empty Max heap with neat diagrams.
2. Show the result of inserting the keys: 10, 12, 8, 14, 6, 5, 1, 3 one at a time into an initially empty Min heap. Apply deleteMin operation on the resulting min heap
3. Construct a Max heap for the following keys: 4, 67, 23, 89, 12, 8, 7, 44, 78, 64, 70. Apply deleteMax operation on the resulting max heap
4. Sort the following keys using Heap sort: 5, 8, 11, 3, 9, 2, 10, 1, 45, 32.
5. Write adjacency matrix representation of graph with an example.
6. Write linked representation of graph with an example.
7. Write set representation of graph with an example.
8. Write DFS Algorithm & Write BFS Algorithm.
9. Consider the graph given below
 - a) Write the adjacency matrix of G1.
 - b) Give Linked list representation of G1.
 - c) Give Set representation of G1.
 - d) Is the graph complete?
 - e) Is the graph strongly connected?
 - f) Find out the degree of each node.
 - g) Is the graph regular?

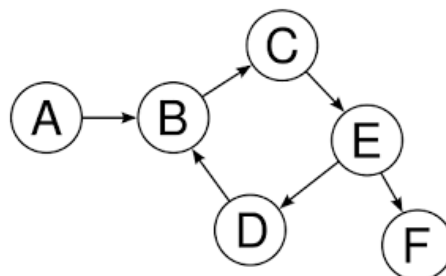
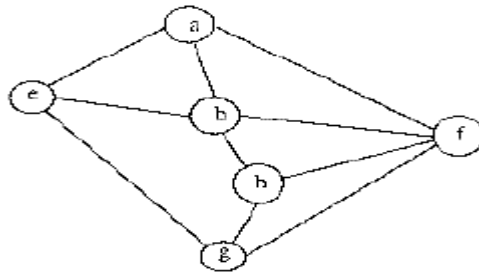


Fig. Graph G1

10. Consider the following adjacency matrix, draw the weighted graph.

$$\begin{pmatrix} 0 & 4 & 0 & 2 & 0 \\ 0 & 0 & 0 & 7 & 0 \\ 0 & 5 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 3 \\ 0 & 0 & 1 & 0 & 0 \end{pmatrix}$$

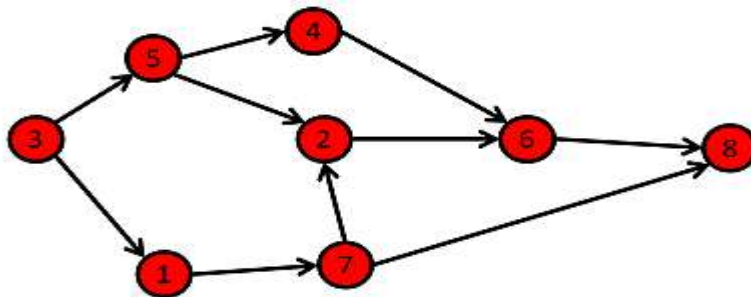
11. Consider the following graph



Among the following sequences i) a b e g h f ii) a b f e h g
 iii) a b f h g e iv) a f g h b e

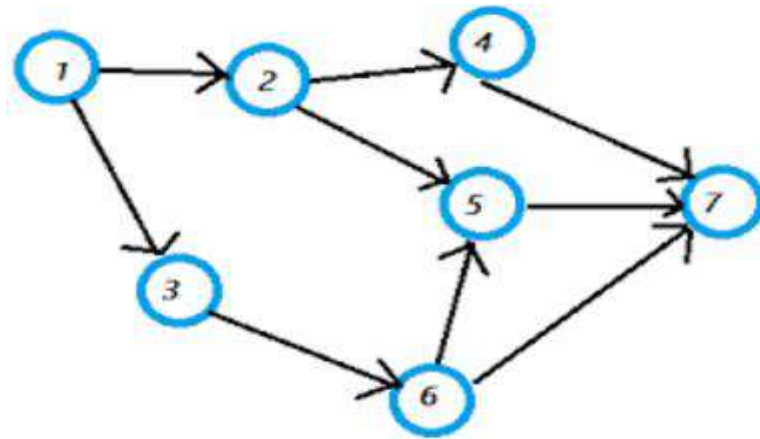
Which are depth first traversals of the above graph?

12. Consider the following graph



What is breadth first traversal of the above graph if starting vertex is 3?

13. Consider the following graph



What is the depth first traversal of the above graph if starting vertex is 1?

Section C

Questions asked in GATE

1. Consider any array representation of an n element binary heap where the elements are stored from index 1 to index n of the array. For the element stored at index i of the array ($i \leq n$), the index of the parent is _____

(GATE-CS-2001)

- A) $i-1$ B) $\text{floor}(i/2)$ C) $\text{ceiling}(i/2)$ D) $(i+1)/2$

2. In a Binary max heap containing n numbers, the smallest element can be found in time

(GATE 2006)

- A) $O(n)$ B) $O(\log n)$ C) $O(\log \log n)$ D) $O(1)$

3. Which of the following sequences of array elements forms a heap?

A) {23, 17, 14, 6, 13, 10, 1, 12, 7, 5} (GATE IT 2006)

B) {23, 17, 14, 6, 13, 10, 1, 5, 7, 12}

C) {23, 17, 14, 7, 13, 10, 1, 12, 5, 7}

D) {23, 17, 14, 7, 13, 10, 1, 5, 6, 12}

4. Consider a binary max-heap implemented using an array. Which one of the following array represents a binary max-heap? (GATE CS 2009)

A) 25,12,16,13,10,8,14

B) 25,14,16,13,10,8,12

C) 25,14,12,13,10,8,16

D) 25,16,12,13,10,8,12

5. What is the content of the array after two delete operations on the correct answer to the previous question?
(GATE CS 2009)

A) 14,13,12,10,8

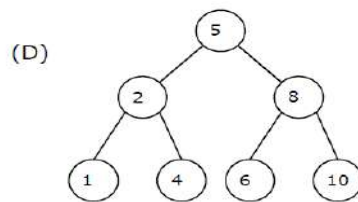
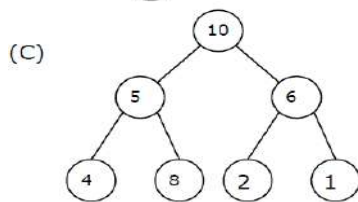
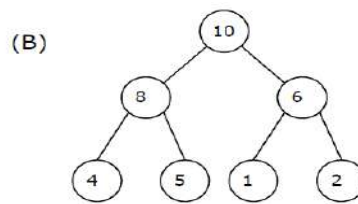
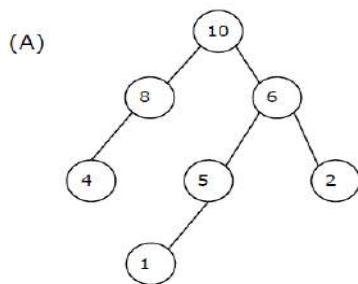
B) 14,12,13,8,10

C) 14,13,8,12,10

D) 14,13,12,8,10

6. A max-heap is a heap where the value of each parent is greater than or equal to the values of its children. Which of the following is a max-heap?

(GATE CS 2011)



7. A priority queue is implemented as a Max-Heap. Initially, it has 5 elements. The level-order traversal of the heap is: 10, 8, 5, 3, 2. Two new elements 1 and 7 are inserted into the heap in that order. The level-order traversal of the heap after the insertion of the elements is:

(GATE-CS-2014)

(A) 10, 8, 7, 3, 2, 1, 5

(B) 10, 8, 7, 2, 3, 1, 5

(C) 10, 8, 7, 1, 2, 3, 5

(D) 10, 8, 7, 5, 3, 2, 1

8. Consider a max heap, represented by the array: 40, 30, 20, 10, 15, 16, 17, 8, 4. Now consider that a value 35 is inserted into this heap. After insertion, the new heap is

(GATE-CS-2015)

A) 40, 30, 20, 10, 15, 16, 17, 8, 4, 35

B) 40, 35, 20, 10, 30, 16, 17, 8, 4, 15

C) 40, 30, 20, 10, 35, 16, 17, 8, 4, 15

D) 40, 35, 20, 10, 15, 16, 17, 8, 4, 30

9. A 3-ary max heap is like a binary max heap, but instead of 2 children, nodes have 3 children. A 3-ary heap can be represented by an array as follows: The root is stored in the first location, $a[0]$, nodes in the next level, from left to right, is stored from $a[1]$ to $a[3]$. The nodes from the second level of the tree from left to right are stored from $a[4]$ location onward. An item x can be inserted into a 3-ary heap containing n items by placing x in the location $a[n]$ and pushing it up the tree to satisfy the heap property. Which one of the following is a valid sequence of elements in an array representing 3-ary max heap?

(GATE 2006)

A) 1, 3, 5, 6, 8, 9

B) 9, 6, 3, 1, 8, 5

C) 9, 3, 6, 8, 5, 1

D) 9, 5, 6, 8, 3, 1

10. Suppose the elements 7, 2, 10 and 4 are inserted, in that order, into the valid 3-ary max heap found in the above question, which one of the following is the sequence of items in the array representing the resultant heap?

(GATE CS 2006)

A) 10, 7, 9, 8, 3, 1, 5, 2, 6, 4

B) 10, 9, 8, 7, 6, 5, 4, 3, 2, 1

C) 10, 9, 4, 5, 7, 6, 8, 2, 1, 3

D) 10, 8, 6, 9, 7, 2, 3, 4, 1, 5

11. Consider the following array of elements. $\langle 89, 19, 50, 17, 12, 15, 2, 5, 7, 11, 6, 9, 100 \rangle$. The minimum number of interchanges needed to convert it into a max-heap is

(GATE-CS-2015)

A) 4

B) 5

C) 2

D) 3

12. An operator $\text{delete}(i)$ for a binary heap data structure is to be designed to delete the item in the i -th node. Assume that the heap is implemented in an array and i refers to the i -th index of the array. If the heap tree has depth d (number of edges on the path from the root to the farthest leaf), then what is the time complexity to re-fix the heap efficiently after the removal of the element?

(GATE 2016)

A) $O(1)$

B) $O(d)$ but not $O(1)$

C) $O(2^d)$ but not $O(d)$

D) $O(d \cdot 2^d)$ but not $O(2^d)$

13. A complete binary min-heap is made by including each integer in $[1, 1023]$ exactly once. The depth of a node in the heap is the length of the path from the root of the heap to that node. Thus, the root is at depth 0

(GATE 2016)

- A) 6 B) 7 C) 8 D) 9

14. Which of the following statements is/are TRUE for undirected graphs?

P: Number of odd degree vertices is even.

Q: Sum of degrees of all vertices is even (GATE 2013)

- A) P only B) Q only C) Both P and Q D) Neither P nor Q

15. Let G be a simple undirected planar graph on 10 vertices with 15 edges. If G is a connected graph, then the number of bounded faces in any embedding of G on the plane is equal to _____

(GATE2012)

- A) 3 B) 4 C) 5 D) 6

16. Which one of the following is TRUE for any simple connected undirected graph with more than 2 vertices?

(GATE 2009)

- A) No two vertices have the same degree.
B) At least two vertices have the same degree.
C) At least three vertices have the same degree.
D) All vertices have the same degree.

UNIT-VI

SECTION-A

Objective Questions

1. The mapping of keys to indices of a hash table is done using _____
2. _____ is the formula used for Multiplication hash function
3. Define Bucket in a hash table
4. Define Home Bucket in a hash table
5. Given a Hash table of size $m=17$ then its range of indices are _____
6. Load factor (α) = _____

3. Show the result of inserting the keys: 12, 44, 13, 88, 23, 94, 11, 39, 16 into a hash table of size $m = 13$ with the primary hash function as $h(k) = k \% m$ using Linear Probing
4. Show the result of inserting the keys: 12, 44, 13, 88, 23, 94, 11, 39, 20 into a hash table of size $m = 11$ with the primary hash function as $h(k) = k \% m$ using Quadratic Probing
5. Show the result of inserting the keys: 15, 11, 25, 16, 36, 47, 22 into a hash table of size $m = 11$ using Double hashing with $h_1(k) = k \% m$ and $h_2(k) = R - (k \bmod R)$ where $R < m$ and is prime
6. Consider inserting the keys: 20, 29, 45, 49, 52, 59, 65 into a hash table of size $m = 10$ using the primary hash function as $h(k) = k \% m$. Illustrate the result of inserting these keys using quadratic probing with $h^1(k) = (h(k) + i + 3i^2) \bmod m$
7. Consider inserting the keys 10, 22, 31, 4, 15, 28, 17 into a hash table of length $m = 11$ using the primary hashing function $h(k) = k \bmod m$. Illustrate the result of inserting these keys using Double hashing with rehashing function $h^1(k) = (h(k) + i(1 + k \bmod (m - 1))) \bmod m$.
8. Consider inserting the keys 7, 18, 48, 10, 36, 25, 47 into a hash table of size $m = 10$ using linear probing. Apply hash table restructuring and show the resulting new Hash table.

Section C

Questions asked in GATE

1. Which one of the following hash functions on integers will distribute keys most uniformly over 10 buckets numbered 0 to 9 for i ranging from 0 to 2020?

[gate 2002]

- | | |
|----------------------------------|--------------------------------|
| (A) $h(i) = i^2 \bmod 10$ | (B) $h(i) = i^3 \bmod 10$ |
| (C) $h(i) = (11 * i^2) \bmod 10$ | (D) $h(i) = (12 * i) \bmod 10$ |

2. Given a hash table T with 25 slots that stores 2000 elements, the load factor α for T is _____

- A) 80 B) 0.0125 C) 8000 D) 1.25

3. A hash function h defined $h(\text{key}) = \text{key} \bmod 7$, with linear probing, is used to insert the keys 44, 45, 79, 55, 91, 18, 63 into a table indexed from 0 to 6. What will be the location of key 18? **[gate2007]**

- (A) 3 (B) 4 (C) 5 (D) 6

4. Which of the following statement(s) is TRUE? **[gate 2008]**

1. A hash function takes a message of arbitrary length and generates a fixed length code.
2. A hash function takes a message of fixed length and generates a code of variable length.
3. A hash function may give the same hash value for distinct messages.

- (A) I only (B) II and III only
(C) I and III only (D) II only

5. A hash table of length 10 uses open addressing with hash function $h(k) = k \bmod 10$, and linear probing. After inserting 6 values into an empty hash table, the table is as shown below.

0	
1	
2	42
3	23
4	34
5	52
6	46
7	33
8	
9	

Which one of the following choices gives a possible order in which the key values could have been inserted in the table?

- (A) 46, 42, 34, 52, 23, 33 (B) 34, 42, 23, 52, 33, 46
(C) 46, 34, 42, 23, 52, 33 (D) 42, 46, 33, 23, 34, 52

6. Consider a hash function that distributes keys uniformly. The hash table size is 20. After hashing of how many keys will the probability that any new key hashed collides with an existing one exceed 0.5 . **[gate 2009]**

- (A) 5 (B) 6 (C) 7 (D) 10

7. A hash table has space for 100 records. What is the probability of collision before the table is 10% full?

[gate 2015]

- A). 0.45 B). 0.5 C). 0.3 D). 0.34

8. Consider a 13 element hash table for which $f(\text{key}) = \text{key} \bmod 13$ is used with integer keys. Assuming linear probing is used for collision resolution, at which location would the key 103 be inserted, if the keys 661, 182, 24 and 103 are inserted in that order?

[gate 2016]

- (A) 0 (B) 1 (C) 11 (D) 12

9. Consider a hash table with 9 slots. The hash function is $h(k) = k \bmod 9$. The collisions are resolved by chaining. The following 9 keys are inserted in the order: 5, 28, 19, 15, 20, 33, 12, 17, 10. The maximum, minimum, and average chain lengths in the hash table, respectively, are **[Gate 2017]**

- (A) 3, 0, and 1 (B) 3, 3, and 3 (C) 4, 0, and 1 D) 3, 0, and 2

9. Consider a hash table of size seven, with starting index zero, and a hash function $(3x+4)\text{mod}7$. Assuming the hash table is initially empty, which of the following is the contents of the table when the sequence 1, 3, 8, 10 is inserted into the table using closed hashing? Note that - denotes an empty location in the table.

[gate 2007]

A) 8, -, -, -, -, -, 10

B) 1, 8, 10, -, -, -, 3

(B) 1, -, -, -, -, -, 3

(D) 1, 10, 8, -, -, -, 3

Signature of the Faculty

HANDOUT ON MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Class & Sem. : II B.Tech – I Semester Year: 2020-21

Branch:CSE Credits : 2

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1. Brief History and Scope of the Subject

Managerial economics is the application of economic principles to decision-making in business firms or of other management units. The basic concepts are derived mainly from micro economic theory, which studies the behavior of individual consumers, firms, and industries, but new tools of analysis have been added. Statistical methods, for example, are becoming increasingly important in estimating current and future demand for products. The methods of operations research and programming provide scientific criteria for maximizing profit, minimizing cost, and selecting the most profitable combination of products. Decision-making theory and game theory, which recognize the conditions of uncertainty and imperfect knowledge under which business managers operate, have contributed to systematic methods of assessing investment opportunities.

2.Pre-Requisites

- Basic knowledge on Production and Operations carried out in an organization.
- Able to generalize the surroundings.

3.Course Objectives

- To familiarize with the importance of Managerial Economics and know its significant role in achieving business objectives.
- To interpret and analyze the financial performance of a business unit.

4.Learning Outcomes

Upon successful completion of the course, the students will be able to

- Evaluate the economic concepts and apply them in various changing situations in industry.
- Predict the demand for a product of a company and analyze various factors influencing demand elasticity.

- Apply various aspects of production and cost analysis in business decision making.
- Gain knowledge on various forms of business organisations and their establishment.
- Propose various pricing strategies for different products or services.
- Apply the accounting rules in determining the financial results and prepare financial statements.
- Evaluate various investment opportunities in business.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

services																	
CO6:apply the accounting rules in determining the financial results and prepare financial statements.				3								3					
CO7:evaluate various investment opportunities in business												3					

7.Prescribed Text Books:

1. A R Aryasri, “Managerial Economics and Financial Analysis”, 2nd edition, TATA McGraw Hill.
2. H. Craig Peterson, Sudhir K. Jain and W. Cris Lewis, “Managerial Economics“, 4th edition, Pearson Education.

8.Reference Books

1. R. L. Varshney, “Managerial Economics”, Sultan Chand.
2. Ambrish Gupta, “Financial Accounting for Management-An Analytical Perspective”, 5th edition, Pearson Education.
3. Yogesh Maheshwari, “Managerial Economics”, PHI Learning Pvt. Ltd.

9.URLs and Other E-Learning Resources

Some important topics in Management, Economics, Financial Management and Accountancy can be seen in the website and down loaded i.e.

- <http://www.yourarticlelibrary.com/managerial-economics/managerial-economics-meaning-scope-techniques-other-details/24730>
- www.emeraldinsight.com
- <http://scitation.aip.org/leo/>

10.Digital Learning Materials:

E-Journals:

- Journal of management of engineering
<http://scitation.aip.org/meo/>
- Leadership & Management in engineering
<http://scitation.aip.org/leo/>

Print-Journals:

- Journal of Indian Management
- Indian Journal of Marketing
- Industrial Engineering

Magazines:

- The Economist
- For Eastern Economic Review
- Business Today
- Auto India
- Survey of Indian Industry

11.Lecture Schedule / Lesson Plan

Topic	No. of Periods	
	Theory	
UNIT –1		
Managerial Economics & its definition	1	8
Nature & Scope of ME	1	
Demand, Demand Determinants & Demand Function	1	
Law of Demand, Exceptions	1	
Elasticity of Demand & types	2	
Demand Forecasting methods	2	
UNIT – 2		
Theory of Production & Cobb Douglas Production Function	1	8
Iso-Quants & Iso-Costs, MRTS	1	
Least cost combination of inputs, Law of returns to scale	2	
Cost Concepts	2	
Problems on Breakeven Analysis	2	
UNIT – 3		
Markets & types of competition structures	1	5
Perfect Competition, Monopoly, Monopolistic, other markets	2	
Methods of Pricing	2	
UNIT – 4		
Business Organizations & their types, Features of Sole trader	1	6

Partnership, Joint stock Company	3	
Public Enterprises & their forms	2	
UNIT – 5		
Introduction to Accountancy	2	9
Types of Accounts, Journal	2	
Ledgers, Trial Balance	2	
Problems on Trading , Profit & Loss Account and Balance sheet	3	
UNIT – 6		
Capital & its significance, Introduction to Capital budgeting	1	6
Traditional Methods with problems	2	
Modern Methods with problems	3	
Total No. of Periods:		42

12.Seminar Topics

- Pricing Policies – Seminar\GD
- Sole Proprietorship – Seminar
- Monopoly gives career opportunities or not – GD

Assignment-Cum-Tutorial Questions

UNIT-I

SECTION-A

Objective Questions

1. Managerial Economics is close to_____ economics.
2. Managerial Economics is more of _____ in nature.
3. Any activity aimed at earning or spending money is called _____ activity”.
4. When a great change in price leads small change in the quantity demand, we call it _____.
5. The theory of firm is also called as_____.

6. When $PE = 1$ (Price Elasticity of Demand is one), we call it _____.
7. Estimation of future possible demand is called _____.
8. Demand for a commodity depends on the relative price of its _____
9. An upward sloping demand curve is called _____.
10. The degree of responsiveness of quantity demanded to a change in price of the product is known as _____

Multiple Choice Questions: (10 to 15)

1. The rise in price of two wheeler leads to fall in demand for fuel and vice-versa. These goods are _____.
- (a) Substitutes (b) Complimentary goods
(c) Giffen goods (d) Veblen goods.
2. When a great change in price leads to small change in the quantity demand, we call it _____.
- (a) Elastic Demand (b) Positive Demand
(c) Inelastic Demand (d) None
3. In the short run, firms can adjust their production by changing their
- (a) fixed factors (b) variable factors
(c) semi- fixed factors (d) both (a) and (b)
4. In case of Giffen goods the demand curve
- (a) Slopes downwards (c) slopes upwards
(b) Intersects supply curve (d) meets cost curve.
5. Demand for a commodity depends on _____.
- (a) Price of that commodity (b) Price of related commodity
(c) Income (d) All of the above
6. If the price elasticity of demand for a good is 0.75, the demand for the good can be described as:
- (a) Normal (c) elastic
(b) Inferior (d) inelastic.
7. Economists typically assume that the owners of firms wish to
- (a) Produce efficiently. (c) Maximize sales revenues.
(b) Maximize profits. (d) All of these.

8. Isoquants that are downward-sloping straight lines imply that the inputs
- Are perfect substitutes.
 - Are imperfect substitutes.
 - Cannot be used together.
 - Must be used together in a certain proportion.
9. Demand forecasting is important for _____.
- Price Control
 - Business Planning
 - Competitive Strategy
 - All of Above
10. "Coffee and Tea are the _____ goods".
- Relative
 - Complementary
 - Substitute
 - None
11. Consumers Survey method is one of the Survey Methods to forecast the _____.
- Sales
 - Revenue
 - Demand
 - Production
12. Demand for a commodity refers to _____.
- Desire for a Commodity
 - Need for a commodity
 - Quantity demanded of that commodity
 - Quantity of the commodity demanded at a certain price during any particular period of time.

Section B

Descriptive Questions

- "Managerial Economics is integration of economic theory and with business practice for the purpose of facilitating decision making and forward planning" explain.
- Discuss the factors affecting demand.
- Explain law of demand. What do you mean by shifts in demand curve?
- What is meant by elasticity of demand? Explain the different types of elasticity.
- Discuss the various techniques of demand forecasting?
- Explain exceptional demand curve with suitable examples.
- What are the various factors that influence the demand for a mobile hand set?
- How do you forecast the demand for washing machines?

Problems

9. If the price of a product is 1000/- and the quantity demand is 10,000 units. When the price falls to 800/- and the quantity demanded rises to 16,000units, calculate the price elasticity of demand.
10. Determine the Advertising elasticity of demand given that
 - The quantity demanded for product M is 10,000 units per day at a monthly advertising budget of Rs.10,000
 - The monthly advertising budget is slashed to Rs.5000; the quantity demanded will fall down to 30,000 units per day.

UNIT-II

SECTION-A

Objective Questions

1. When different combinations of inputs yield the same level of output is known as _____.
2. _____ is a 'group of firms producing the same or slightly different products for the same market or using same raw material'
3. When Total Fixed Cost (TFC) and Total Variable Cost (TVC) are added, we get _____.
4. The quantities of output through a given _____ are equal.
5. The costs that are to be paid currently if the asset were to be replaced to be are called _____.
6. The rate at which one input factor is substituted with the other to attain a given level of output is called _____
7. Addition to costs as a result of change in the level of business activity is called _____.
8. Production function mathematically can be written as_____.
9. P/V ratio is also known as_____.
10. Conversion of inputs into output is called as _____.

Multiple Choice Questions: (10 to 15)

1. When a firm expands its size of production by increasing all factors, it secures certain advantages, known as_____

- (a) Optimum Size (b) Diseconomies of Scale
 (c) Economies of Scale (d) None
2. When Proportionate increase in all inputs results in less than Equal Proportionate increase in output, then we call _____
 (a) Increasing Returns to Scale (b) Constant Returns to Scale
 (c) Decreasing Returns to Scale (d) None
3. The point of no profit and no loss is _____
 (a) Maximum point (b) Minimum point
 (c) Break-Even point (d) Average point
4. The price of pen is Rs.18/- and the variable cost to produce 1 unit is Rs.7/-.calculate contribution per unit?
 (a) 10 (b) 11 (c) 21 (d) 25
5. A curve showing equal amount of outlay with varying Proportions of two inputs are called _____.
 (a) Total Cost Curve (b) Variable Cost Curve
 (c) Isocost Curve (d) Marginal Cost Curve
6. _____ cost is the additional cost to produce an additional unit of output.
 7. (a) Incremental (b) Sunk (c) Marginal (d) Total
8. The cost incurred to purchase machinery worth Rs.1,00,000/- is _____ Cost
 (a) Incremental (b) Variable (c) Fixed (d) Total.
9. Telephone charges or Electricity charges are ____ costs.
 (a) Fixed (b) Variable (c) Semi-Fixed and Semi variable (d) Total.
10. The line representing the least cost combination of inputs for different levels of output is called the _____.
 (a) Straight line (b) Expansion path.
 (c) Engel line (d) output path

SECTION-B

SUBJECTIVE QUESTIONS

1. Explain the operation of law of diminishing returns and its business implications.
2. Explain Cobb-Douglas Production function.
3. How come Iso-Quants and Iso cost analysis help in Production decision making.
4. Break even analysis is highly important in output Decision making. Discuss?

5. Define cost. Explain the different cost concepts used in the process of cost analysis.
6. Explain the following with reference to production functions
 - a. MRTS
 - b. Least cost combination of Inputs

Problems:

1. The information about Raj & Co are given below:
 PV ratio : 20%
 Fixed Cost : Rs. 36,000/-
 Selling Price per Unit: Rs. 150/-
 Calculate (i) BEP in rupees (ii) BEP in Units.
2. Mrs. Venu and co. is producing Water purifiers. The cost incurred in the production are as below
 a) Fixed cost Rs.1, 20,000/- b) Variable cost per unit is Rs.400/-
 When the organization is selling each unit Rs.800/-find the Break-even point in volume and sales.

UNIT-III

SECTION-A

Objective Questions

1. In Monopoly market environment, seller is the _____.
2. The price at which demand and supply of a commodity equal is known as _____.
3. _____ is a form of market organization in which there is only one seller of the commodity.
4. Perfect competition consists of many firms producing goods that are _____.
5. _____ is a market where large number of buyers and sellers deal in differentiated product.
6. A monopolistic can continue to sell as long as his marginal revenue _____ marginal cost.
7. Charging very high price in the beginning and reducing it gradually is called _____.
8. The system of charging the customer both at the time of taking him into the organization and providing him services is called _____.
9. Tenders are based on _____ pricing.

10. Under _____, Initially The prices kept low while in _____ it is kept high

Multiple Choice Questions:

1. Based on which of the following, the market can be divided into perfect markets and imperfect markets

- (a) Degree of concentration (c) Degree of differentiation
(b) Degree of condition (d) Degree of competition

2. The price of a product is determined by the _____ of that product.

- (a) Demand and supply (c) Place and time
(b) (b) Production and sales (d) Cost and income

3. Monopoly is not desirable as

- (a) Efficient allocation of resources is not possible.
(b) Lessens the gap of rich and poor.
(c) Extends the slope for research and development.
(d) It leads to exploitation of consumers.

4. Which of the following is the best example of a perfectly competitive market?

- (a) diamonds (c) soft drinks
(b) Athletic shoes (d) farming.

5. Railways is an example of

- (a) Oligopoly. (c) Monopolistic
(b) Monopoly (d) Perfect

6. To achieve more market power, firms can:

- (a) Differentiate their products from the products of their rivals.
(b) Reduce their costs of production.
(c) Raise their profit margin on prices.
(d) Advertise that they charge low prices

7. The difference between a market and an industry is that

- (a) Industries consist of firms producing the same good while markets consist of industries producing substitute goods.
(b) Industries consist of markets producing the same good while markets consist of firms producing substitute goods.

- (c) Industries are collections of markets while markets are collections of firms.
- (d) Firms make up a market while markets make up an industry.
8. New product pricing strategy through which companies set lower prices to gain large market share is classified as
- (a) optional product pricing
- (b) skimming pricing
- (c) penetration pricing
- (d) captive product pricing.
9. Which of the following refers to the practice of selling the same product at different prices to different buyers?
- (a) Product Differentiation
- (b) Price Discrimination
- (c) Price Differentiation
- (d) Product Discrimination.
10. The practice of Bundling two or more different products together and selling them at a single bundle price is called _____
- (a) Two- part pricing
- (b) Commodity bundling
- (c) Block Pricing
- (d) Transfer pricing

SECTION-B

SUBJECTIVE QUESTIONS

1. What is a market? Explain about types of Markets?
2. Discuss the differences between Monopoly and Perfect competition.
3. What is price? Explain different types of pricing.
4. Explain the characteristics of Monopoly and Monopolistic markets.
5. Discuss Features of Market structures.

UNIT-IV

SECTION-A

Objective Questions

1. The liability extending to the personal property of the trader is called _____
2. Joint Stock Company has _____ Liability.

3. Company is treated as _____ Person.
4. The shares of a _____ company can be transferred.
5. Maximum number of persons required to form a partnership in case of non-banking Business _____.
6. Forms of Public Enterprises are _____.
7. The stages in the formation of a joint stock company are _____ and _____.
8. Which one of the following is not a factor affecting the choice of a business organization?
(a) Liability (b) Agreement (c) Quick Decision making (d) flexibility
9. An agreement to share profit implies _____.
(a) To share only profits
(b) To share only negative profits
(c) To share both profits and losses
(d) Neither to share profits nor losses
10. "People may come and people may leave, but I go on forever" is applicable to _____ Business organization.
(a) Sole proprietorship (b) Partnership
(c) Company (d) Joint Hindu Family
11. In the absence of agreement the partners are entitled to share the profits
(a) Proportionate to capital brought in (c) equally
(b) Proportionate to their drawings
(d) based on their admission.
12. Certificate of commencement of business should be obtained by _____ company to start its functions.
(a) Private (b) Statutory (c) Public (d) Chartered
13. _____ is not required to private company to start its functions.
(a) Certificate of incorporation (b) Registration
(c) Certificate of commencement of business (d) None
14. _____ partner can enjoy profits but no liability for losses.

- (a) Active (b) Sleeping (c) Minor (d) Nominal
15. In public sector unit's ownership is in the hands of _____
 (a) Private persons (b) Public (c) Government (d) None
16. If either state government or central government or both have got not less than 51% of share in the organization. Then that is called__
- (a) Private organization (b) Partnership organization
 (c) Government organization (d) Joint sector organization

Section B

1. Discuss the factors affecting the choice of form of business organization.
2. Define a joint stock company & explain its basic features, advantages & disadvantages
3. Explain in basic features of Government Company from of public enterprise.
4. What do you mean by sole proprietorship? Explain its merits and limitations.
5. Define partnership form of business. Explain its salient features.
6. Explain the formation of Joint Stock Company.
7. What is partnership deed and explain the different types of partners.
8. Explain the advantages and disadvantages of partnership form of organisation.

UNIT-V

SECTION-A

Objective Questions

1. How many types of accounts are maintained to record all types of business transactions?
 (a) Five (b) four
 (c) Three (d) Two
2. Which connects the link between Journal and Trial Balance?
 (a) Trading Account (b) Profit & Loss account
 (c) Ledger (d) Balance sheet
3. "Bank overdraft" is a _____.
 (a) Asset (b) Expense
 (c) Liability (d) Income
4. _____ is a person who owes money to the firm.
 (a) Creditor (b) Owner

- (c) Debtor (d) Share holder
5. _____ is called as 'Book of Original Entry'.
- (a) Ledger (b) Trial Balance
(c) Journal (d) Trading account
6. Debit what comes in; Credit what goes out is _____ account principle?
- (a) Nominal (b) Personal
(c) Real (d) None
7. The process of entering transactions in to Ledger accounts known as _____.
- (a) Journal entry (b) First entry
(c) Posting (d) None
8. Debit Expenses and Losses; Credit Incomes and Gains is _____ account Principle
- (a) Personal (b) Real
(c) Nominal (d) None
9. "Gross Profit" can be found out by preparing _____.
- (a) Profit and Loss account (b) Balance sheet
(c) Trading account (d) Trial balance
10. "Net Profit" can be found out by preparing _____.
- (a) Trading account (b) Trial balance
(c) Profit and Loss account (d) Balance sheet

Question testing the ability of students in applying the concepts.

1. "Outstanding wages" is treated as _____.
- (a) Asset (b) Expense
(c) Liability (d) Income
2. Which assets can be converted into cash in short period?
- (a) Fixed Assets (b) Intangible Assets
(c) Current Assets (d) Fictitious Assets
3. Profit and Loss account is prepared to find out the business _____.
- (a) Gross result (b) Financial position
(c) Net result (d) Liquidity position

4. The statement reveals the financial positions of a business at any given date is called

- (a) Trading account (b) Profit and loss account
(c) Balance sheet (d) Trial balance

5. "Prepaid Insurance Premium" is treated as _____.

- (a) Gain (b) Income
(c) Asset (d) Liability

6. In which Concept "Business is treated separate from the Proprietor?"

_____.

- (a) Cost concept (b) Dual aspect concept
(c) Business entity concept (d) Matching concept

7. In which Book-keeping system, business transactions are recorded as two separate accounts at the same time?

- (a) Single entry (b) Triple entry
(c) Double entry (d) None

8. kamal bought goods for Rs. 30 lakhs and sold of the goods for Rs.36 lakhs and incurred expenses amounting to Rs.5 lakhs during a given year. he counted a net profit of Rs.16 lakhs. which accounting concept did he follow?

- (a) business entity concept (b) accounting period concept
(c) matching concept (d) going concern concept

9. Management accounting starts where _____ ends. (a) cost accounting (b) standard costing

(c) financial accounting (d) accounting concepts and conventions

10. Final account comprises_____

- (a) Ledger, Trial Balance (b) Trading, Profit Accounts
(c) Profit & Loss Accounts (d) Trading, Profit & Loss Accounts

Section B

1. What do you mean by accounting? Write about the branches of accounting?
2. What do you understand by Journal?
3. Explain the following adjustments & illustrate suitably with assumed data.
 - a. Closing stock

- b. Outstanding expenses
 - c. Prepaid income
 - d. Bad debts
4. Explain about Trading and Profit & Loss A/Cs and Balance Sheet.
 5. State how accounting is useful to different types of users.
 6. Explain about the Double Entry system of Book Keeping.
 7. Explain the Accounting Cycle.
 8. How do you classify the accounts? Explain the rule of debit and credit with respect to different types of accounts.
 9. Journalize the following transactions in the books of Rama Krishna

1. Commence business with cash rs.10,000
2. paid into bank rs.8,000
3. Bought goods for cash rs.500
4. Bought furniture by cheque rs.500.
5. withdrawn from bank rs.900
6. He sold goods to Gopal Rs.500
7. Bought goods from Ram for rs.510
8. Paid trade expenses rs.200
9. Received cash from Gopal and allowed discount rs.10- 490
10. paid wages rs.70
11. paid Ram in full settlement rs.500
12. paid rent rs.150
13. Interest on capital rs.500

10. Journalize the following transactions & post them to ledger.

1. Ram invites Rs.10, 000 in cash
2. He bought goods worth rs.2, 000 from shyam
3. He bought a machine for rs.5, 000 from lakshmanon account.
4. He paid to Lakshman Rs. 2,000.
5. He sold goods for cash Rs. 3,000.

6. He sold goods to A on account Rs.4, 000.
7. He paid to shyam Rs.1, 000.
8. He received amount from A Rs.2, 000.

11. Journalize the following transactions in the books of Ravi and post them into ledgers:

Particulars	Amount
2008 March 1 Started business with cash	4,50,000
March 1 Purchase of goods from ram	3, 20,000
March10 Paid rent for the month	2,000
March11 Purchase of Machine	1, 00,000
March12 Paid salaries	12,000
March15 Paid to ram	1, 00,000
March20 Sold goods to shyam	20,000
March25 Received from shyam	30,000
March31 Received cash from cash sales	2, 50,000
March31 Wages paid	5,000

12. Prepare Trading, Profit and loss account and Balance sheet for the year ending 31/3/2003 after taking into consideration the following information.

	Rs.		Rs.
Furniture	15000	Insurance	6000
Capital A/C	54000	Rent	22000
Cash in hand	3000	Sundry debtors	60000
Opening stock	50000	Sales	600000
Fixed deposits	134600	Advertisement	10000
Drawings	5000	Postages and telephone	3400
Provision for bad debts	3000	Bad debts	2000
Cash at Bank	10000	Printing and tationary	9000
Purchases	300000	General charges	13000
Salaries	19000	Sundry creditors	40000
Carriage inwards	41000	Deposit from customers	6000

Adjustments:

- a) Closing stock as on 31st March was Rs. 10000.

b) Salary of Rs. 2000 is yet to be paid to an employee

Closing Stock was Values at Rs. 90,000	Particulars	Amount
Capital		1,00,000
Plant & Machinery		1,60,000

13. Trail Balance of Bharat is given below. Prepare the Trading Account and Profit and Loss Account for the year ending 31st December, 2005 and Balance Sheet as on that date

Particulars	Debit Rs.	Credit Rs.
Drawings and Capital	10,550	1,19,400
Plant & Machinery	38,300	
Sundry Debtors and Creditors	62,000	59,360
Wages	43,750	
Purchases and Sales	2,56,590	356700
Opening Stock	95,300	
Salaries	12,880	
Insurance	930	
Cash at Bank	18,970	
Interest on Loan	14,370	
Discount allowed	4,870	
Furniture	12,590	
Loan Payable		79,630
Land & Buildings	43,990	
	6,15,090	6,15,090

Sales	3,54,000
Purchases	1,20,000
Returns outwards	1,500
Returns inwards	2,000
Opening stock	60,000
Discount allowed	700
Discount Received	1,600
Bank Charges	150
Sundry Debtors	90,000
Sundry Creditors	50,000
Salaries	13,600
Manufacturing Wages	20,000
Carriage inwards	1,500
Carriage outwards	2,400
Provision for bad debts	1,050
Rent, rates and taxes	20,000
Advertisements	4,000
Cash	1,800
Bank	12,000
Closing stock	70,000

14. Prepare trail balance from the following information

The following are the particulars of Ledger Account balances taken from the books of Bhaskar for the year ending 31st March 2005. You are required to prepare Trading Account and Profit and Loss Account and Balance Sheet as on that date.

Particulars	Debit Rs.	Credit Rs.
Capital		1,00,000
Bills receivables and Bills Payable	4,00,000	7,00,000
Sundry Debtors and Creditors	75,000	50,000
Cash	15,000	
Bank	25,000	
Business Premises	2,50,000	
Loan Payable		25,000
Opening stock	40,000	
Purchase & Returns	60,000	8,000
Sales & Returns	37,000	2,75,000
Wages	35,000	
Salaries	65,000	
Rent, Taxes and rates	15,000	
Depreciation	5,000	
Furniture	78,000	
Advertisement	58,000	
	11,58,000	11,58,000

Adjustments:

1. Closing Stock was Values at Rs. 80,000
2. Write off Bad Debts of Rs. 5,000 out of sundry debtors.
3. Prepaid Insurance amounted Rs. 1,000

UNIT-VI

SECTION-A

Objective Questions

1. The capital budgeting process involves _____
 - (a) identifying potential investments
 - (b) analyzing the set of investment opportunities, and identifying those that will create shareholder value
 - (c) implementing and monitoring the selected investment projects
 - (d) all of the above
2. The preferred technique for evaluating most capital investments is _____.
 - a. payback period
 - b. discount payback period

- Use of the IRR method implicitly assumes that the project's cash inflows are reinvested at the internal rate of return.

Section - B

- What is capital budgeting. What are the factors to be considered in taking investment decisions?
- Explain the components of Working Capital
- Explain the methods of capital budgeting.
- Define Accounting rate of return & payback period method. Compare & contrast the two.
- Briefly explain NPV and IRR.

II) Problems:

- Initial investment for a project is 20 lakhs. The project life is 6 years and the cash inflow for 6 years is as given below.

Year	Cash inflow
1	3,50,000
2	4,00,000
3	5,00,000
4	5,50,000
5	6,00,000
6	5,00,000

The cost of capital is 13%. Compute NPV, IRR and PBP.

- The Alpha Co Ltd ., is considering the purchase of a new machine. Two alternative machines (A and B) have been suggested, each having an initial cost of Rs. 4,00,000 and requiring Rs. 20,000 as additional working Capital at the end of 1st year. Earnings after taxation are expected to be as follows:

Years	Cash Inflows	
	Machine A	Machine B
1	40,000	1,20,000
2	1,20,000	1,60,000
3	1,60,000	2,00,000
4	2,40,000	1,20,000
5	1,60,000	80,000

The company has a target of return on capital of 10% and on this basis, you are required to compare the profitability of the machines and state which alternative you consider as financially preferable.

3. A firm whose cost of capital is 10% is considering two mutually exclusive projects X and Y, the details of which are:

	Project X	Project Y
Investment	70,000	70,000
Year	Cash Flows	
1	10,000	50,000
2	20,000	40,000
3	30,000	20,000
4	45,000	10,000
5	60,000	10,000
Total Cash Flows	1,65,000	1,30,000

Compute the Net Present Value at 10% Profitability Index and Internal Rate of Return for two projects.

Signature of the Faculty

HANDOUT ON OBJECT ORIENTED PROGRAMMING THROUGH JAVA

Class & Sem. : II B.Tech-I Semester
Branch : CSE

Year: 2020-21
Credits: 3

1. Brief History and Scope of the Subject

- The Java platform was developed at Sun in the early 1990s with the objective of allowing programs to function regardless of the device they were used on, sparking the slogan "Write once, run anywhere" (WORA). Java is regarded as being largely hardware- and operating system-independent. Java was initially promoted as a platform for client-side *applets* running inside web browsers. Early examples of Java applications were the Hot Java web browser and the Hot Java Views suite. However, since then Java has been more successful on the server side of the Internet.
- The platform consists of three major parts: the Java programming language, the Java Virtual Machine (JVM), and several Java Application Programming Interfaces (APIs).
- Java is an object-oriented programming language. Since its introduction in late 1995, it became one of the world's most popular programming languages.
- Java programs are compiled to byte code, which can be executed by any JVM, regardless of the environment. The Java APIs provide an extensive set of library routines. These APIs evolved into the *Standard Edition* (Java SE), which provides basic infrastructure and GUI functionality; the *Enterprise Edition* (Java EE), aimed at large software companies implementing enterprise-class application servers; and the *Micro Edition* (Java ME), used to build software for devices with limited resources, such as mobile devices.
- On November 13, 2006, Sun announced it would be licensing its Java implementation under the GNU General Public License; it released its Java compiler and JVM at that time. Java 8 was released on 18 March 2014 and included some features that were planned for Java 7 but later deferred.

2.Pre-Requisites

Basic knowledge on programming language constructs.

3.Course Objectives:

- To familiarize with the concepts of object oriented programming
- impart the knowledge of AWT components in creation of GUI

4.Course Outcomes:

CO1 : Apply object oriented approach to design software .

CO2 : Create user defined interfaces and packages for a given
problem

CO3 : Develop code to handle exceptions.

CO4 : Implement multi tasking with multi threading.

CO5 : Develop applets for web applications.

CO6 : Design and develop GUI programs using AWT components

5.Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1.Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2.Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3.Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4.Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

CO6: design and develop GUI programs using AWT components.	2	2	3	2									2	2	2
--	---	---	---	---	--	--	--	--	--	--	--	--	---	---	---

7.Prescribed Text Books

- Herbert Schildt, “Java The Complete Reference”, TMH, 7th edition.
- Sachin Malhotra, Saurabh choudhary, “Programming in JAVA”, Oxford, 2nd edition.

8.Reference Text Books

- Joyce Farrel, Ankit R.Bhavsar, “JAVA for Beginners”, Cengage Learning, 4th edition.
- Y.Daniel Liang, “Introduction to Java Programming”, Pearson, 7th edition.
- P.Radha Krishna, “Object Oriented Programming Through Java”, Universities Press

9.URLs and Other E-Learning Resources

CDs :

Subject: object oriented system design

Faculty: Prof. A.K. Mazundar

IIT, Kharagpur

Units : 36

Websites:

www.java.sun.com

www.roseindia.net/java

www.javabeginner.com/learn-java/introduction-to-java-programming

www.tutorialspoint.com/java/index.htm

10.Digital Learning Materials:

<http://nptel.ac.in/courses/106103115/36>

<http://www.nptelvideos.com/video.php?id=1472>

<http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-00-introduction-to-computer-science-and-programming-fall-2008/video-lectures/lecture-14/>

<http://192.168.0.49/videos/videosListing/435> (our library IP)

11.Lecture Schedule / Lesson Plan

Topic	No. Of Periods
UNIT-I: Fundamentals of OOP and Java	
Need of OOP	1
Principles of OOP Languages	1
Procedural Languages vs OOP	1
Java Virtual Machine	1
Java Features	1
Variables, primitive data types	1
Identifiers, keywords, literals, operators	1
Arrays, type conversion and casting	1
UNIT- II: Class Fundamentals & Inheritance	
Class Fundamentals, Declaring Objects	1
Methods, Constructors	1
this keyword	1
Overloading methods and constructors	1
access control	1
Inheritance Basics, types	1
Using super keyword	1
Method overriding, Dynamic method dispatch	1
Abstract classes, using final with inheritance	1
Object class	1

UNIT –III: Interfaces and Packages	
Interfaces: Defining an interface, Implementing interfaces	2
Nested interfaces	1
Variables in interfaces and extending interfaces	1
Packages: Defining, Creating and Accessing a Package	3
UNIT – IV: Exception Handling & Multithreading	
Exception-Handling	1
Exception handling fundamentals, uncaught exceptions	1
Using try and catch, Multiple catch clauses	1
Nested try statements, throw	1
throws, finally	1
User-defined exceptions	1
Multithreading: Introduction to multi tasking	2
thread life cycle	1
Creating threads	1
Synchronizing threads	2
thread groups	1
UNIT – V: Applets & Event Handling	
Applets: Concepts of Applets	1
Differences between applets applications, life and cycle of an	1
Applet	1
Creating applets	1
Event Handling: Events, Event sources	1
Event classes, Event Listeners, Delegation event model	2

Handling mouse and keyboard events	2
Adapter classes	1
UNIT – VI: AWT	
The AWT class hierarchy	1
User interface components- label, button	2
Checkbox, checkboxgroup	1
Choice, list, textfield	1
Scrollbar	1
Layout managers – Flow, Border	1
Grid, Card, GridBag layout	2
Total No.of Periods:	56

12. Seminar Topics

- Forms of Inheritance
- AWT hierarchy
- Applet life cycle
- Menu Creation

UNIT-I

Assignment-Cum-Tutorial Questions

SECTION-A

Objective Questions

1. Java programs are _____ []
(a) Compiled (b) Interpreted
(c) Both Compiled & Interpreted (d) None of these
2. The outcome of a Java Compiler is _____ file []
3. .class (b) .obj (c) .exe (d)None of these
4. If an expression contains double, int, float, long, then whole
a. expression will promoted into which of these data types? []
b. (a) long (b) int (c) double (d) float
5. Which of these can be returned by the operator & . []
a. (a) int (b)boolean (c)char (d) int or boolean
6. Consider the statement $c=a-(b*(a/b))$. Here c contains ____
(a) Difference of a and b (b)Sum of a and b
(c) Quotient of a/b (d) Remainder of a/b
7. With $x = 1$, which of the following are legal lines of Java code for changing the value of x to 2
i. (1) $x++$; (2) $x=x+1$; (3) $x+=1$; (4) $x=+1$
(a) 1, 2 & 3 (b) 1 & 4 (c) 1, 2, 3 & 4 (d) 3 & 2
8. What is the output of the following program? []
9. class increment {
 public static void main(String args[]){
 double var1 = 1 + 5;
 double var2 = var1 / 4;
 int var3 = 1 + 5;
 int var4 = var3 / 4;
 System.out.print(var2 + " " + var4); } }

- (a) 1 1 (b) 0 1 (c) 1.5 1 (d) 1.5 1.0

10. Consider the following statements

```
byte b;      // statement1
```

```
int i=100;      // statement2
```

```
b=i;      // statement3
```

Which of the above 3 statements will cause a compilation error:

- (a) statement 1 (b) statement 2 (c) statement3 (d) none

11. What is the output of the following program? []

```
class conversion {  
    public static void main(String args[]) {  
        double a = 295.04;  
        int b = 300;  
        byte c = (byte) a;  
        byte d = (byte) b;  
        System.out.println(c + " " + d); } } }
```

- (a) 38 43 (b) 39 44 (c) 295 300 (d) 295.04 300

12. What does this code print? []

```
int arr[] = new int [5];
```

```
System.out.print(arr);
```

- (a) 0 (b) value stored in arr[0] (c) 00000 (d) None

13. What is the output of this program? []

```
class bitwise_operator {  
    public static void main(String args[]) {  
        int a = 3;  
        int b = 6;  
        int c = a | b;  
        int d = a & b;  
        System.out.println(c + " " + d); } } }
```

- (a) 7 2 (b) 7 7 (c) 7 5 (d) 5 2

14. What is the output of this program? []

```
class Modulus {  
    public static void main(String args[]) {  
        double a = 25.64;  
        int b = 25;  
        a = a % 10;  
        b = b % 10;  
        System.out.println(a + " " + b); } }
```

- (a) 5.6400000000000001 5 (b) 5.6400000000000001 5.0
(c) 5 5 (d) 5 5.6400000000000001

15. What is the output of this program? []

```
class Output {  
    public static void main(String args[]) {  
        int a = 1;    int b = 2;  
        int c;    int d;  
        c = ++b;  
        d = a++;    c++;  
        b++;  
        ++a;  
        System.out.println(a + " " + b + " " + c); } }
```

- (a) 3 2 4 (b) 3 2 3 (c) 2 3 4 (d) 3 4 4

16. Which of these can be returned by the operator & . []

- (a) int (b) boolean (c) char (d) int or boolean

SECTION-B

SUBJECTIVE QUESTIONS

- 1) Summarize the Need of OOP.
- 2) List and explain the Principles of OOP paradigm

3) Differentiate Procedure Oriented Programming (POP) with Object Oriented Programming (OOP).

4) List and explain the Features of java.

5) Outline the role of JVM in making Java platform independent.

6) Consider the statements below:

```
byte b; // statement1
```

```
int a; // statement2
```

```
a=b; // statement3
```

```
b=a; // statement4
```

Comment about statement 3 and statement4.

7) Write a java program to do linear search on a list of integers

8) Write a java program to check whether a given number is prime or not.

9) Write a java to multiply 2 numbers without using * operator.

[**HINT:** use the operator + and loop statement]

10) Write a java program to sort given list of integers in ascending order.

UNIT-II

SECTION-A

Objective Questions

1. Which of the following is the correct syntax for creating Object

(a) Classname objName=new Classname;

(b) Classname objName=new Classname();

(c) Classname objName=Classname();

(d) objName classname=new objName();

2. _____ is a keyword that refers to the current object that invoked the method.

3. _____ is the process of reclaiming the runtime unused memory automatically.

4. _____ is the process of defining 2 or more methods within same class that have same name but different parameter declarations.

(a) Method overriding

(b) Method overloading

(c) Method hiding

(d) None of the above

5. Which of these is correct way of inheriting class A by class B?

(a) class B class A { } (b) class B inherits class A { }

(c) class B extends A { } (d) class B extends class A { }

6. Run-time polymorphism is achieved by using_____

(a) Method Overloading (b) Constructor Overloading

(c) Method Overriding (d) this keyword

7. _____ is the Super class for all the classes in Java

8. What is the output of this program?

```
class box{
int width;
int height;
int length;
int vol;
box(){
width = 5;
height = 5;
length = 6; }
void volume() {
vol = width*height*length; } }
class constructor_output {
public static void main(String args[]) {
box obj = new box();
obj.volume();
System.out.println(obj.vol); } }
```

(a) 100 (b) 150 (c) 200 (d) 250

9. Consider the following code

```
class A {
private int i;
public int j; }
class B extends A {
```

```

int k;
void show() {
k=i+j;
System.out.println("sum of " +i+ "and" +j+"="+k); }
public static void main(String arg[]) {
B b1=new B(); } }

```

(a)B gets only the member j through inheritance from A

(b)B gets both i, j through inheritance from A

(c)A is the sub class and B is the super class

(d)None of the above

10. what is the output of this program?

```

class overload {
int x;
int y;
void add(int a) {
x = a + 1; }
void add(int a, int b) {
x = a + 2; } }
class Overload_methods {
public static void main(String args[]) {
overload obj = new overload();
int a = 0;
obj.add(6,7);
System.out.println(obj.x); } }

```

(a) 5 (b)8 (c)7 (d) 6

11. The following code prints _____

```

class A {
int i;
int j;

```


13. What is the output of the following Java program?

```
class Test {  
    int i;    }  
class MainDemo {  
    public static void main(String args[]) {  
        Test t = new Test();  
        System.out.println(t.i);    }    }
```

- (a) 0 (b) garbage value (c) compiler error (d) runtime error

14. What is the output of the following Java program?

```
class Point {  
    int m_x, m_y;  
    public Point(int x, int y) {  
        m_x = x;    m_y = y;    }  
    public static void main(String args[]) {  
        Point p = new Point();    } }
```

- (a) 1
(b) garbage value
(c) compiler error
(d) runtime error

SECTION-B

SUBJECTIVE QUESTIONS

1. Define class. Write the steps for creating class and object? Explain it with an example?
2. Define constructor? Can we overload a constructor? If so, explain with an example?
3. Explain the usage of following keywords with examples?
a) this b) super c) final
4. List Different types of Inheritance? Explain with example programs?
5. To read an integer n and then print the nth table as below:

1 x n = n

$$2 \times n = 2n$$

.....

$$10 \times n = 10n$$

6. To read the details of a student like name, age, phone number in a method called `getData()` and then write another method called `putData()` to display the details.
7. To find factorial of a given number using recursion?
8. (a) Implement Method overloading with the following example?
(b) To overload a method `area()` which computes the area of a geometrical figure based on number of parameters. If number of parameters is 1 and is of type float it should calculate the area of circle, if it is of type int it should calculate area of square. If the number of parameters is 2 and they are of type float calculate area of triangle, if they are of int calculate area of rectangle.
9. Implement dynamic method dispatch with an example.
10. Define Abstract class. Differentiate abstract method and concrete method?

UNIT-III

SECTION-A

Objective Questions

1. _____ keyword is used for implement the interface in JAVA
2. Which of these keywords is used to define interfaces in JAVA []
(a) implement (b) interface (c) Both a & b (d) None of these
3. The methods of interface are _____ by default. []
(a) abstract (b) static (c) final (d) none of these
4. The variables of interfaces are final and static by default (**True / False**)
5. A class can implements _____ interfaces
(a) only one (b) one or more than one

- (c) maximum two (d) minimum two
6. An interface contains _____
- (a) The method definitions (b) The method declaration
- (c) Both a & b (d) None
7. Which of the following is correct way of implementing an interface salary by class manager?
- (a) class manager extends salary { }
- (b) class manager implements salary { }
- (c) class manager imports salary { }
- (d) None of the mentioned
8. Is it possible to create object of an interface ? **(True / False)**
9. Which of these keyword is used to define packages in JAVA ?
- (a) pkg (b) Pkg (c) package (d) Package
10. Which of the following is correct way of importing an entire package 'pkg' ?

- (a) import pkg. (b) import Pkg.
- 9c) import pkg.* (d) import Pkg.*

11. Package consists of ?
- (1) classes (2) methods (3) variables (4) All of the above
- (a) 1 and 2 (b) 2 and 3 (c) only 1 (d) 4

12. Is it possible to access the private class outside the package ?
(True / False)

13. Package is the first statement in java program ? **(True / False)**

14. What is the output of this program?

```
interface calculate {
void cal(int item); }

class display implements calculate {
int x;

public void cal(int item) {
x = item * item;    } }

class interfaces {
public static void main(String args[]) {
```

```
display arr = new display;  
arr.x = 0;  
arr.cal(2);  
System.out.print(arr.x); } }
```

(a) 0 (b) 2 (c) 4 (d) None of the mentioned

15. Determine output of the following code:

```
interface A { }  
class C { }  
class D extends C { }  
class B extends D implements A { }  
public class Test extends Thread{  
    public static void main(String[] args){  
B b = new B();  
if (b instanceof A)  
    System.out.println("b is an instance of A");  
if (b instanceof C)  
    System.out.println("b is an instance of C"); } }
```

(a) Nothing.

(b) b is an instance of A.

(c) b is an instance of C

(d) b is an instance of A followed by b is an instance of C

16. Which of the above line will give compilation error?

```
interface Test {  
    int p = 10; //line 1  
    public int q = 20; //line 2  
    public static int r = 30; //line 3  
    public static final int s = 40; //line 4 }
```

a) 1 b) 3 c) 4 d) None of these

17. What is the output for the below code?

```
interface A{  
  
public void printValue(); }  
  
public class Test {  
  
public static void main (String[] args) {  
  
    A a1 = new A() {  
  
        public void printValue(){  
  
            System.out.println("A"); } };  
  
    a1.printValue(); } }  

```

(a) Compilation fails due to an error on line 3 (b) A
(c) Compilation fails due to an error on line 8 (d) null E) None of these

18. What will be the output for the below code ?

```
public interface TestInf {  
  
int i =10; }  
  
public class Test {  
  
    public static void main(String... args) {  
  
        TestInf.i=12;  
  
        System.out.println(TestInf.i); } }  

```

(a) Compile with error (b) 10 (c) 12 (d) Runtime Exception

19. Which of the given statement is not true about an Java Package ?

(a) package can be defined as a group of similar types of classes and interface.

(b) Package are used in order to avoid name conflicts and to control access of classes and interface.

(c) A package cannot not have another package inside it.

(d) Java uses file system directory to store package

20. You can import only static members of a class present in some other package using ?

(a) import keyword

(b)import static keyword

(c)package keyword

(d)static import keyword

SECTION-B

SUBJECTIVE QUESTIONS

1. What is an interface? How it is used to create constants and define functions.
2. Explain about defining and implementing interfaces with example program.
3. Differentiate between class and interfaces
4. Write a short note on i) variable in interfaces ii) Nested interfaces
5. Can we extend interfaces? Support your argument.
6. Can JAVA does support multiple inheritance? Justify your answer.
7. Explain the concept of applying interfaces?
8. Define package? Write the procedure to create and import user defined package.
9. Explain different access specifiers supported by JAVA with an example program.
- 10.What is CLASSPATH? Explain its role in finding packages.

Write a java program to

1. Compute the area of rectangle using interfaces
2. Implement Multiple Inheritance using interface
3. Show how a class implements two interfaces.
4. show that the variables in an interface are implicitly static and final and methods are automatically public
5. Implements the extended interfaces
6. Create a package to display the given string in reverse order.
7. Create a package for Book details giving Book Name, Author Name, Price and Year of Publishing.
8. Write a java program to Create and access a user defined package where the package contains a class named CircleDemo, which in turn contains a method

called circleArea() which takes radius of the circle as the parameter and returns the area of the circle.

UNIT-IV

SECTION-A

Objective Questions

1. Identify the parent class of all the exception in java is []
a)Throwable b)Throwc) Exception d)Throws
2. What are the two types of exception available in java ?
a)Checked and compiled b) Un Checked and compiled
c)Checked and Un Checked d) Compiled and non- compiled
3. The two subclasses of Throwable are []
a)Error and AssertionError
b)Error and Exception
c)Checked and UnChecked Exception
d)Error and Runtime Exception
4. Choose the correct option regarding notifyAll() method. []
a) Wakes up one threads that are waiting on this object's monitor
b) Wakes up all threads that are not waiting on this object's monitor
c)Wakes up all threads that are waiting on this object's monitor
c) None of the above
5. Identify the keyword when applied on a method indicates that only one thread should execute the method at a time.
a)volatile b) synchronized c) native d) static
6. The built-in base class in Java, which is used to handle all exceptions is
a)Raise b)Exception c)Error d)Throwable
7. Which of the following exceptions is thrown when one thread has been interrupted by another thread?
a)ClassNotFoundException

b)IllegalAccessException

c)InstantiationException

d)InterruptedException

e)NoSuchFieldException

8. Which of the following Exception classes in Java is used to deal with an exception, where an assignment to an array element is of incompatible type?

a)ArithmeticException

b)ArrayIndexOutOfBoundsException

c)IllegalArgumentException

d)ArrayStoreException

e)IllegalStateException

9. A programmer has created his own exception for balance in account <1000. The exception is created properly, and the other parts of the programs are correctly defined. Though the program is running but error message has not been displayed. Why did this happen?

a)Because of the Throw portion of exception.

b)Because of the Catch portion of exception.

c)Because of the main() portion.

d)Because of the class portion.

e)None of the above

10. Choose the correct option for the following program

```
class demo
```

```
{  
    void show() throws CalssNotFoundExcepion{ }  
}
```

```
class demo2 extends demo
```

```
{  
    void show() throws IllegalAccessException, classNotFoundExcepion,  
    ArithmeticException  
    {    System.out.println("In Demo1 show");
```

```

}

        public static void main(String arg[])
    {
try{    demo2    d=new demo2();
        d.show();
        }
catch(Exception e) {}
        }
    }

```

a.Does not compile

b.Compiles successfully

c.Compiles successfully and prints "In Demo1 show"

d.Compiles but does not execute.

11. If the assert statement returns false, what is thrown? []

a)Exception b) Assert c) assertion d) assertion Error

12. Choose the best possible answer for the following program

```

class demo
{
    void show() throws ArithmeticException
        { }
}

class demo2 extends demo
{
    void show()
        { System.out.println("In Demo1 show");
        }
}

public static void main(String arg[])
{
    demo2 d=new demo2();
        d.show();
} }

```

a.Does not compile

b.Compiles successfully

c.Compiles successfully and prints "In Demo1 show"

b.Compiles but does not execute.

13. How can Thread go from waiting to runnable state?

a)notify/notifAll

b)When sleep time is up

c)Using resume() method when thread was suspended

d)All

14. Predict the output of the following program

```
class A implements Runnable{
    public void run(){
        try{
            for(int i=0;i<4;i++){
                Thread.sleep(100);
                System.out.println(Thread.currentThread().getName());
            }
        }catch(InterruptedException e){
        }
    }
}

public class Test{
    public static void main(String argv[]) throws Exception{
        A a = new A();
        Thread t = new Thread(a, "A");
        Thread t1 = new Thread(a, "B");
        t.start();
        t.join();
        t1.start();
    }
}
```

a) A A A A B B B B

b) A B A B A B A B

- c) Output order is not guaranteed d) Compilation succeed but Runtime Exception

15. What will be output of the following program code?

```
public class Test implements Runnable{
    public void run(){
        System.out.print("go");
    }
    public static void main(String arg[]) {
        Thread t = new Thread(new Test())
        t.run();
        t.run();
        t.start();
    }
}
```

- a) Compilation fails.
b) An exception is thrown at runtime
c) "go" is printed
d) "gogo" is printed

16. Choose the correct option for Deadlock situation

- a) Two or more threads have circular dependency on an object
b) Two or more threads are trying to access a same object
c) Two or more threads are waiting for a resource
d) None of these

17. Predict the output of following Java program

```
class Main {
    public static void main(String args[]) {
        try {
            throw 10;
        }
        catch(int e) {
            System.out.println("Got the Exception " + e);
        }
    }
}
```

- a) Got the Exception 10
b) Got the Exception 0

c)Compiler Error

d)None of the above

18. What is the output of the following program

```
class Test extends Exception { }  
  
class Main {  
    public static void main(String args[]) {  
        try {  
            throw new Test(); }  
        catch(Test t) {  
            System.out.println("Got the Test Exception");  
        }  
        finally {  
            System.out.println("Inside finally block ");  
        }  
    }  
}
```

a)Got the Test Exception Inside finally block

b)Got the Test Exception

c)Inside finally block

d)Compile error.

19. What is the output of the following program

```
class Test  
{  
    public static void main(String[] args)  
    {  
        try  
        {  
            int a[]={ 1, 2, 3, 4};  
            for (int i = 1; i <= 4; i++)  
            {  
                System.out.println ("a[" + i + "]=" + a[i] + "n");  
            }  
        }  
        catch (Exception e)
```

```

    {
        System.out.println ("error = " + e);
    }
    catch (ArrayIndexOutOfBoundsException e)
    {
        System.out.println ("ArrayIndexOutOfBoundsException");
    }
}
}
}

```

- a) Compiler error
- b) Run time error
- c) ArrayIndexOutOfBoundsException
- d) Error Code is printed
- e) Array is printed

20. Predict the output of the following program.

```

class Test
{
    int count = 0;
    void A() throws Exception
    {
        try
        {
            count++;
            try
            {
                count++;
            }
            try
            {
                count++;
                throw new Exception();
            }
        }
        catch(Exception ex)
        {
            count++;
            throw new Exception();
        }
    }
}

```

```

        }
        catch(Exception ex)
        {    count++;
        } }
    catch(Exception ex)
    {    count++;
    } }
void display()
{
    System.out.println(count);
}
public static void main(String[] args) throws Exception
{
    Test obj = new Test();
    obj.A();
    obj.display();
}
}

```

- a)4 b)5 c)6 d)Compile Error

SECTION-B

Descriptive Questions

1. Define Exception? What are the three categories of exceptions? Also discuss the advantages of exception handling
2. Explain the keywords used in exception handling.
3. Implement a multiple exception handling for the following problem
 Read n+1 strings to string array and prints their lengths to get Array Index Out Of Bounds Exception and Null Pointer Exception
4. Write a java program to calculate the student total marks and percentage for class test with six subjects. The marks should be 0 to 10 only, if marks entered not in the range then raise an exception Marks Not In Range Exception.(Create user defined exception and throw it).
5. Can a try block be written without a catch block? Justify.

6. Can we nest a try statement inside another try statement. Write the necessary explanation and example for this.
7. Differentiate multi tasking and multithreading.
8. Draw a neat sketch of thread life cycle.
9. What is synchronization and how do we use it in java.
10. Write a Java program to create two threads from main such that one thread calculates the factorial of a given number and another thread checks whether the given number is prime or not.
11. Write a Java program to print the messages in the following sequence

For every 3 seconds “ Welcome” message

For every 2 seconds “Hello” message

For every 5 seconds “ Bye” message

UNIT-V

Section - A

Objective Questions

1. A Java _____ is a program that is executed by a Web browser
2. An HTML document uses the _____ tag to identify Java applets
3. What is the name of the method that is only called once whenever an applet is loaded into the Java Virtual Machine?
(a)start (b) Applet (c)Action Event (d)init
4. The _____ method of an applet is used to draw graphics and is invoked automatically when the applet runs.
5. A _____ has methods that tell what will happen when it receives an event
6. When the user clicks a button, the event will be handled by an
object of type _____.
(a)Action Listener (b)Event Handler
(c) Button Listener (d)Action Handler
7. _____ class provides an empty implementation of all methods in an event listener interface.
8. Which of these packages contains all the event handling interface
(a) java.lang (b) java.awt (c) java.awt.event (d) java.event
9. The Applet class is in _____package
(a) java.applet (b) java.awt (c) java.io (d) java.util
10. Which of these methods are used to register a keyboard event listener?
(a) KeyListener() (b) addKistener()

- (c) addKeyListener() (d) eventKeyListener()
11. Which of these methods are used to register a mouse motion listener? (a) addMouse() (b) addMouseListener() (c) addMouseMotionListner() (d) eventMouseMotionListener()
12. Which of these events will be generated if we close an applet's window? (a) Action Event (b) Component Event (c) Adjustment Event (d) Window Event
12. Which of these is super class of all Adapter classes? (a) Applet (b) Component Event (c) Event (d) Input Event

SECTION -B

SUBJECTIVE QUESTIONS

- 1) Explain about the life cycle of an applet with an example
- 2) Differentiate between applets and applications.
- 3) Write the steps involved in creating an applet with an example
- 4) Can we pass parameters to an Applet? If so, justify your answer with an example.
- 5) Explain in detail about Delegation event model and various events, event sources that are available in Java?
- 6) Demonstrate keyboard event handling with an example
- 7) Explain Mouse Event Class in detailed with an example
- 8) Write about Adapter classes and their importance in Event Handling
- 9) Write a program to Pass the parameters: Employee Name and ID Number to an applet
- 10) Create an Applet that displays the message like "Hai Friends How are you..?" using <param >tag.
- 11) Create an applet having the background color as black and the foreground color as white.

UNIT-VI

SECTION-A

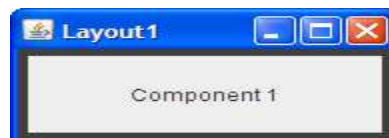
Objective Questions

1. AWT stands for []
(a) Applet Windowing Toolkit

- (b) Abstract Windowing Toolkit
 (c) Absolute Windowing Toolkit
 (d) None of the above
2. Which object can be constructed to show any number of choices in the visible window?
 (a) Labels (b) Choice (c) List (d) Checkbox
3. Which class provides many methods for graphics programming?
 (a) java.awt (b) java.Graphics []
 (c) java.awt.Graphics (d) None of the above
4. _____Layout arranges the components as a deck of cards such that only one component is visible at a time
 (a) Card Layout (b)Border layout (c)Flow Layout (d)Grid Layout
5. At the top of the AWT hierarchy is the_____ class.
 (a) Window (b) Component (c) Panel (d)Frame
6. AWT classes are contained in the _____ package
 (a) java.awt (b) java.Awt
 (c) java.classes.awt (d) java.pacakge.awt
7. Border Layout class has __regions to add components to it
 (a) 4 (b)7 (c)5 (d)8
8. By default Flow Layout uses _____justification.
 (a)Left (b)Right (c)Center (d)Top
9. By default page-up and page-down increment of scrollbar is__
 (a)5 (b)10 (c)7 (d)6

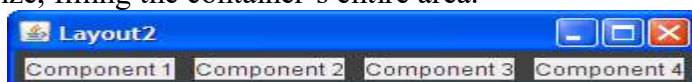
In each of the following questions, choose the layout manager(s) most naturally suited for the described layout.

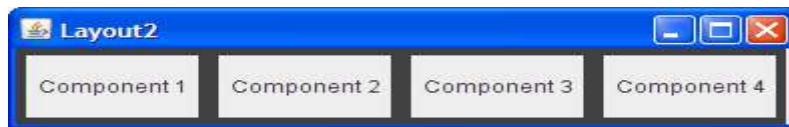
10. The container has one component that should take up as much space as possible
 []



- a). Border Layout (b). Grid Layout (c). Grid Bag Layout
 d). a and b (e). b and c

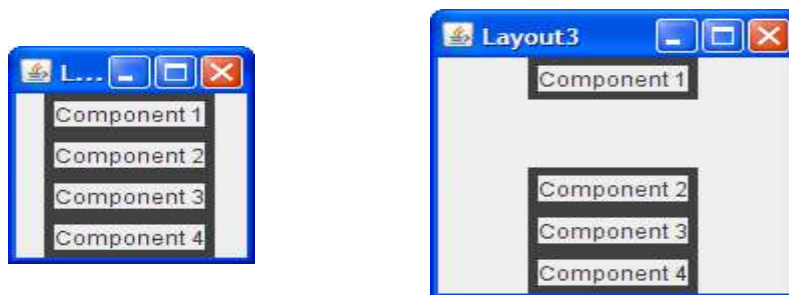
11. The container has a row of components that should all be displayed at the same size, filling the container's entire area.





- a). Flow Layout b). Grid Layout c). Box Layout d). a and b

12. The container displays a number of components in a column, with any extra space going between the first two components.



- a). Flow Layout b). Box Layout c). Grid Layout d). Border Layout

13. The container can display three completely different components at different times, depending perhaps on user input or program state. Even if the components' sizes differ, switching from one component to the next shouldn't change the amount of space devoted to the component.



- a) . Spring Layout b). Box Layout c). Card Layout d). Grid Bag Layout

SECTION-B

Descriptive Questions

1. Explain in detail AWT class hierarchy.
2. Explain the following Components with an example
A) Label B) Button
3. Differentiate between Checkbox and Check box Group. Explain them with an Example
4. Explain with an example how to add Choice and List Controls to the container.
5. Explain with an example the following Scrollbar user Interface component
6. What are layout managers? Explain their importance and List them.
7. Explain with an example Border Layout layout Manager
8. Write a short note on Flow and Card Layouts. Give examples
9. Write an AWT program to create check boxes for different courses belonging to a university such that the courses selected would be displayed.
10. Create a list of vegetables. If you click on one of the items of the list, the item should be displayed
11. Write a java program to show how the radio buttons can be used to change the background color of the applet window

Signature of the Faculty

GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
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Department of Computer Science and Engineering



2020-21 SEM -I

III-B.Tech Handout

Vision

To be a Centre of Excellence in computer science and engineering education and training to meet the challenging needs of the industry and society

Mission:

- To impart quality education through well-designed curriculum in tune with the growing software needs of the industry.
- To serve our students by inculcating in them problem solving, leadership, teamwork skills and the value of commitment to quality, ethical behavior & respect for others.
- To foster industry-academia relationship for mutual benefit and growth

Program Educational Objectives :

PEO1: Identify, analyze, formulate and solve Computer Science and Engineering problems both independently and in a team environment by using the appropriate modern tools.

PEO2: Manage software projects with significant technical, legal, ethical, social, environmental and economic considerations.

PEO3: Demonstrate commitment and progress in lifelong learning, professional development, Leadership and Communicate effectively with professional clients and the public

HANDOUT ON COMPILER DESIGN

Class & Sem : III B.Tech-I Semester

Year: 2020-21

Branch : CSE

Credits: 3

1. Brief history and scope of the subject

The first compiler was written by Grace Hopper, in 1952, for the A-0 System language. The term compiler was coined by Hopper. The A-0 functioned more as a loader or linker than the modern notion of a compiler. The first auto code and its compiler were developed by Alick Glennie in 1952 for the Mark 1 computer at the Manchester and is considered by some to be the first compiled programming language. The FORTRAN team led by John W. Backus at IBM is generally credited as having introduced the first complete compiler, in 1957.

The first ALGOL 58 compiler was completed by the end of 1958 by Friedrich L. Bauer, Hermann Bottenbruch, Heinz Rutishauser, and Klaus Samelson for the Z22 computer. By 1960, an extended Fortran compiler, ALTAC, was available on the Philco 2000, so it is probable that a Fortran program was compiled for both IBM and Philco computer architectures in mid-1960. The first known demonstrated cross-platform high-level language was COBOL. In a demonstration in December 1960, a COBOL program was compiled and executed on both the UNIVAC II and the RCA 501.

The COBOL compiler for the UNIVAC II was probably the first to be written in a high-level language, namely FLOW-MATIC, by a team led by Grace Hopper.

2. Pre-Requisites

Student should be familiar with the subject Formal Languages and Automata Theory.

3. Course Objectives

- To familiarize with lexical analyzer and different parsers.
- To introduce various storage allocation strategies, code generation and code optimization techniques.

4. Course Outcomes

Upon successful completion of the course, the students will be able to

- list out compilation process steps of a language.
- use regular languages to identify the tokens of a programming language.
- design a parser to verify the syntax of a programming language.
- compare top down parser with bottom up parser
- create symbol table to access identifier information
- apply code optimization techniques to enhance the efficiency of the intermediate code.
- write a program for the execution of DAG to generate the code.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

CT2518 : COMPILER DESIGN	
Course outcomes	Program Outcomes and Program Specific Outcome

	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12		P S O 1	P S O 2
CO1: list out compilation process steps of a language.	1														
CO2:use regular languages to identify the tokens of a programming language.	2	1			1							1			
CO3: design a parser to verify the syntax of a programming language.	3	3	3		1							1			
CO4: compare top down parser with bottom up parser	2	2										1			
CO5: create symbol table to access identifier information	2	1	2									1			
CO6: apply code optimization techniques to enhance the efficiency of the intermediate code.	2		2									2			
CO7: write a program for the execution of DAG to generate the code.	2	1	2									1			

7. Prescribed Text Books

1. Alfred V Aho, Monical S Lam, Ravi Sethi, Jeffrey D. Ullman, “Compilers, Principles Techniques and Tools”, 2nd edition, Pearson.
2. V. Raghavan, Principles of compiler design, 2nd edition, TMH.

8. Reference Text Books

1. Kenneth C Loudon, “Compiler construction, Principles and Practice”, 1st edition, Cengage.
2. Yunlinsu, “Implementations of Compiler, A new approach to Compilers including the algebraic methods”, Springer.
3. Jean-Paul Trembly, Paul G. Sorenson, “The theory and practice of Compiler writing”, 1st edition, McGraw-Hill.
4. Nandini Prasad, “Principles of compiler design”, 2nd edition, Elsevier.

9. URLs and Other E-Learning Resources

- <http://www.nptel.iitm.ac.in/downloads/106108052/>
- <http://www.cs.ualberta.ca/~amaral/courses/680>

. <http://www.learnerstv.com>

10. Digital Learning Materials:

- <http://jntuk-coeerd.in>
- <http://ocw.mit.edu>
- . www.diku.dk/~torbenm/Basics/basics_lulu2.pdf

11. Lecture Schedule / Lesson Plan

Topic	No. of Periods	
	Theory	Tutorial
UNIT –I: Lexical Analysis		
Introduction, overview of language processing	1	1
Preprocessors, compiler, assembler, interpreters, linkers and loaders	1	
Structure of a compiler-Analysis-Synthesis model of a compiler	1	
phases of a compiler	1	1
Lexical Analysis – Role of Lexical Analysis	1	
Token, patterns and Lexemes	1	
Regular expressions for reserved words, identifiers, operators	1	
Transition diagram for recognition of tokens, reserved words and identifiers	1	
Lexical analyzer program	1	
Total	9+2(T)	
UNIT – II: Top-down Parsing		
Syntax analysis, role of a parser, classification of parsing techniques	2	1
Brute force approach, Recursive descent parsing	1	
Elimination of ambiguity, elimination of left factoring, elimination of left recursion	2	
First and Follow, LL (1) grammars	1	1

Model of predictive parsing, pre-processing steps for predictive parsing	1	
Construction of predictive parsing table	2	
Non-recursive predictive parsing program	1	
Total	10+2(T)	
UNIT – III: Bottom-up Parsing		
Bottom-up parsing approach, Types of Bottom-up parsers, shift- reduce Parsing	1	1
LR parsers: LR(0) Grammar, LR(0) parser, LR(0) items, SLR parsing table and string checking	3	
LR(1) items, CLR parsing Table and string checking	3	1
LALR Parsing table and string checking	1	
Operator precedence parser	1	
Dangling ELSE Ambiguity, Comparison of all bottom-up parsers with top-down parsers	1	
Total	10+2(T)	
UNIT – IV: Semantic Analysis		
Role of Semantic analysis, SDT	1	1
Evaluation of semantic rules	1	
Symbol Tables- use of symbol tables, contents of symbol table, operations on symbol table	1	
Block structured symbol table	2	1
Non block structured symbol table	2	
Runtime environment-Storage organization-static allocation	1	
Stack allocation	1	
Heap management, Differences between static and dynamic storage organization, heap and stack allocation	1	
	10+2(T)	

Total		
UNIT – V: Intermediate Code Generation		
Intermediate code- Three address code- quadruples and triples	2	1
Abstract syntax trees	1	
Partition into basic blocks	1	
Flow Graph Construction	1	
DAG construction and its applications	1	
Machine independent code optimization: Common sub expression elimination ,Constant folding, copy propagation, dead code elimination	2	
Loop optimization- strength reduction, code motion	1	1
Total	9+2(T)	
UNIT – VI: Code Generation		
Code generation: issues in code generation	1	1
Generic code generation	1	
Code generation from DAG	2	
Machine dependent code optimization : Peephole optimization	1	1
Register allocation and assignment	1	
Total	6+2(T)	
Total No. of Periods:	54	12(T)

UNIT-I

Assignment-Cum-Tutorial Questions

SECTION-A

Objective Questions

1. The output of a pre-processor is []
 - a) absolute machine language program
 - b) relocatable machine language program
 - c) assembly language program
 - d) a high level language program
2. A compiler running on computers with small memory would normally be []
 - a) a multi-pass compiler
 - b) single pass compiler
 - c) a compiler with less number of phases
 - d) none of these
3. In a compiler, grouping of characters into tokens is done by _____.
4. A computer program that translates a program statement by statement into machine language is called a _____.
5. Front end of compiler does not include the phase []
 - a) semantic analysis
 - b) intermediate code generation
 - c) code optimization
 - d) lexical analysis
6. Back end of compiler includes those phases that depend on []
 - a) target machine
 - b) source language
 - c) both a and b
 - d) None of the above
7. Assembly language _____ []
 - a) is usually the primary user interface
 - b) requires fixed format commands
 - c) is a mnemonic form of machine language
 - d) is quite different from the SCL interpreter
8. Relocating loaders perform four functions in which order? []
 - a) Allocation, linking, relocation, loading
 - b) Loading, linking, relocation, allocation
 - c) Allocation, loading, relocation, linking
 - d) None of the above

9. _____ is a sequence of characters in the source program that is matched to some pattern for a token.
10. r^+ represents _____.
11. Which of the following phase of compilation process is an optional phase? []
- a) lexical analysis phase b) Syntax analysis phase
- c) Code optimization d) Code generation
12. In some programming languages, an identifier is permitted to be a letter followed by a number of letter or digits. If L and D denote the set of letters and digits respectively, which of the following expression denotes an identifier? []
- a) $(LUD)^*$ b) $L(LUD)^*$ c) $[LUD]^*$ d) $L[LUD]^*$
13. Which of the following is the name of the data structure in a compiler that is responsible for managing information about variable and their attributes? []
- a) Symbol table b) Attribute grammar
- c) Stack d) syntax tree
14. Match the following []

LIST-1

LIST-2

- | | |
|------------------|--|
| A. pre-processor | 1) Resolving external reference |
| B. Assembler | 2) loading the program |
| C. Loader | 3) producing relocatable machine code |
| D. Linker | 4) allow user to define shorthand for longer construct |

- | | A | B | C | D |
|----|---|---|---|---|
| a) | 4 | 3 | 2 | 1 |
| b) | 3 | 4 | 1 | 2 |
| c) | 4 | 3 | 1 | 2 |
| d) | 4 | 2 | 3 | 1 |

SECTION-B

SUBJECTIVE QUESTIONS

1. What is the role of Lexical analyzer in a compiler?

2. Differentiate between Compiler and Interpreter.
3. Construct the transition diagram for relational operators and identifiers in 'C'.
4. Explain the various phases of a compiler. Show the translations for an assignment statement `position=initial+rate *60`, clearly indicate the output of each phase.
5. Define Regular expression with notation.
6. Identify the lexemes that make up the tokens in the following program segment. Indicate corresponding token and pattern.

```
void swap(int i, int j)
{
int t;
t=i;
i=j;
j=t;
}
```

7. Define compiler? List out its functions?
8. What is the role of Lexical analyzer in a compiler?
9. Explain the reasons why lexical analysis is separated from syntax analysis.
10. Define lexeme, token, pattern.
11. Draw a block diagram of phases of a compiler and indicate the main functions of each phase.
12. What is LEX? Give LEX specification to identify identifiers & keywords of C language.
13. Discuss about functions of pre-processor.
14. Consider the following C statement and determine the type of compiler error:
`int *p, *a[][3]; float 34var;`

- i) Syntax error ii) lexical error iii) semantic error iv) linker error

SECTION-C

GATE QUESTIONS

1. Which one of the following statements is FALSE? [GATE CS 2018]
 - a) Context-free grammar can be used to specify both lexical and syntax rules
 - b) Type checking is done before parsing.
 - c) High-level language programs can be translated to different Intermediate Representations.
 - d) Arguments to a function can be passed using the program stack.
2. In a compiler, keywords of a language are recognized during [GATE CS 2011]

d) Both statements 1 and 2 are false.

14. $A \rightarrow A \alpha \mid \beta$ is left recursive then its equivalent production are []

a) $A \rightarrow \beta R, R \rightarrow \alpha R \mid \epsilon$ b) $A \rightarrow \alpha R, R \rightarrow \beta R \mid \epsilon$

c) $A \rightarrow \alpha R \mid \epsilon, R \rightarrow \beta R \mid \beta$ d) None of these

15. Which of the following derivation does a top-down parser use while parsing an input string? The input is assumed to be in LR order

a) LMD b) LMD in reverse c) RMD d) RMD in reverse

16. Which of the following is true about the grammar $S \rightarrow aSa \mid bS \mid c$?

a) Ambiguous and LL(1) b) Unambiguous and LL(1) []

c) Left recursive and LL(1) d) Left factoring and LL(1)

17. The grammar $A \rightarrow AA \mid (A) \mid \epsilon$ is not suitable for predictive-parsing because the grammar is a) ambiguous b) left-recursive []

c) right-recursive d) an operator-grammar

18. Consider the following grammar:

$S \rightarrow aABC$ $A \rightarrow BC$ $B \rightarrow c \mid d$ $C \rightarrow d \mid \epsilon$

What is FOLLOW (C)?

a) { $\$$ } b) {c,d} c) {c,d, $\$$ } d) {c,d, ϵ } []

19. Consider the following grammar: []

$S \rightarrow aABC$ $A \rightarrow BC$ $B \rightarrow c \mid \epsilon C \rightarrow d \mid \epsilon$

What is FIRST (C)?

a) { $\$$ } b) {c,d} c) {c,d, $\$$ } d) {c,d, ϵ }

SECTION-B

SUBJECTIVE QUESTIONS

1. Construct syntax tree for the expression $a=b*-c+b*-c$

2. List out the rules for First and Follow?

3. Construct predictive parsing table for the following grammar.

$E \rightarrow E+T/T, T \rightarrow T*F/F, F \rightarrow (E)/id$

4. Define the term Left factoring.

5. Given the grammar

$S \rightarrow (L) la$

$L \rightarrow L,S IS$

a) Make necessary changes to make it suitable for LL(1) parsing. Construct FIRST and FOLLOW sets.

b) Construct the predictive parsing table. Show the moves made by the predictive parser on the input (a,(a , a)).

6. Which one of the following grammar is ambiguous?

A) $S \rightarrow S0 \mid 1$ B) $S \rightarrow 0S \mid 1$ C) $S \rightarrow SS \mid 0 \mid 1$ D) $S \rightarrow SS+ \mid a$

7. The following grammar is Ambiguous or not?

$A \rightarrow AaB \mid a$ $B \rightarrow aB \mid a$

8. Construct recursive descent parsing for the following grammar.

$S \rightarrow cAd$ $A \rightarrow ab \mid a$

9. Eliminate left factoring from the following grammar.

$S \rightarrow bAd \mid bAe \mid ed$ $A \rightarrow e \mid bA$

10. Eliminate the left-recursion in the following grammar.

$S \rightarrow A \mid B$ $A \rightarrow Aa \mid \epsilon$ $B \rightarrow Bb \mid Sc \mid \epsilon$

11. Define left-factoring. Do the left-factoring for the given grammar

$S \rightarrow iEtS \mid iEtSeS \mid a$ $E \rightarrow b$

12. Define Right Most Derivation with example.

13. a) Compute FIRST and FOLLOW for the grammar and construct predictive parsing table.

$S \rightarrow iCtSS' \mid a$ $S' \rightarrow eS \mid \epsilon$ $C \rightarrow b$

b) Consider the predictive parsing table from above question and show the sequence of moves made by the parser for $w=abba$.

14. Explain algorithms to find FIRST and FOLLOW and find FIRST and FOLLOW of following grammar:

$S \rightarrow aBbSA \mid d$ $A \rightarrow eS \mid \epsilon$ $B \rightarrow f$

15. Consider the following grammar:

$S \rightarrow L = R$

$S \rightarrow R$

$L \rightarrow * R$

$L \rightarrow id$

$R \rightarrow L$

Construct LL(1) parsing table for the above grammar. State whether the above mentioned grammar is LL(1) or not and give reasons for either cases.

SECTION-C

GATE QUESTIONS

1. Consider the following grammar: [GATE 2017]

$P \rightarrow xQRS$ $Q \rightarrow yz \mid z$ $R \rightarrow w \mid \epsilon$ $S \rightarrow y$

What is FOLLOW (Q)?

b) {R} b) {w} c) {w,y} d) {w, \$}

2. Consider the grammar defined by the following production rules, with two operators * and + [GATE 2014]

$S \rightarrow T * P$, $T \rightarrow U \mid T * U$, $P \rightarrow Q + P \mid Q$

$Q \rightarrow Id$, $U \rightarrow Id$

Which one of the following is TRUE? []

- A. + is left associative, while * is right associative
- B. + is right associative, while * is left associative
- C. Both + and * are right associative
- D. Both + and * are left associative

3. For the grammar below, a partial LL(1) parsing table is also presented along with the grammar.

Entries that need to be filled are indicated as E1, E2, and E3. ϵ is the empty string,

\$ indicates end of input, and, | separates alternate right hand sides of productions [GATE 2012]

$$S \rightarrow aAbB \mid bAaB \mid \epsilon$$

$$A \rightarrow S$$

$$B \rightarrow S$$

	a	b	\$
S	E1	E2	$S \rightarrow \epsilon$
A	$A \rightarrow S$	$A \rightarrow S$	error
B	$B \rightarrow S$	$B \rightarrow S$	E3

- (A) $\text{FIRST}(A) = \{a, b, \epsilon\} = \text{FIRST}(B)$
 $\text{FOLLOW}(A) = \{a, b\}$
 $\text{FOLLOW}(B) = \{a, b, \$\}$
- (B) $\text{FIRST}(A) = \{a, b, \$\}$
 $\text{FIRST}(B) = \{a, b, \epsilon\}$
 $\text{FOLLOW}(A) = \{a, b\}$
 $\text{FOLLOW}(B) = \{\$\}$
- (C) $\text{FIRST}(A) = \{a, b, \epsilon\} = \text{FIRST}(B)$
 $\text{FOLLOW}(A) = \{a, b\}$
 $\text{FOLLOW}(B) = \emptyset$
- (D) $\text{FIRST}(A) = \{a, b\} = \text{FIRST}(B)$
 $\text{FOLLOW}(A) = \{a, b\}$
 $\text{FOLLOW}(B) = \{a, b\}$

4. Consider the data same as above question. The appropriate entries for E1, E2, and E3 are

[GATE 2012]

- (A) E1: $S \rightarrow aAbB$, $A \rightarrow S$
E2: $S \rightarrow bAaB$, $B \rightarrow S$
E3: $B \rightarrow S$
- (B) E1: $S \rightarrow aAbB$, $S \rightarrow \epsilon$
E2: $S \rightarrow bAaB$, $S \rightarrow \epsilon$
E3: $S \rightarrow \epsilon$
- (C) E1: $S \rightarrow aAbB$, $S \rightarrow \epsilon$
E2: $S \rightarrow bAaB$, $S \rightarrow \epsilon$
E3: $B \rightarrow S$
- (D) E1: $A \rightarrow S$, $S \rightarrow \epsilon$
E2: $B \rightarrow S$, $S \rightarrow \epsilon$
E3: $B \rightarrow S$

- a) A b) B c) C d) D

5. A grammar G is LL(1) if and only if the following conditions hold for two distinct productions

[NET 2014]

$$A \rightarrow \alpha \mid \beta$$

I. $\text{First}(\alpha) \cap \text{First}(\beta) \neq \{a\}$ where a is some terminal symbol of the grammar.

II. $\text{First}(\alpha) \cap \text{First}(\beta) \neq \epsilon$

III. $\text{First}(\alpha) \cap \text{Follow}(A) = \emptyset$ if $\epsilon \in \text{First}(\beta)$

- a) I and II b) I and III c) II and III d) I, II and III

UNIT-III

A. Objective Questions

- Which of the following derivations does a bottom-up parser use while parsing an input string? The input is assumed to be scanned in left to right order.
 - Leftmost derivation
 - Leftmost derivation traced out in reverse

- c. Rightmost derivation
 - d. Rightmost derivation traced out in reverse
2. Which of the following describes a handle (LR-parsing) appropriately?
- a. It is the position in a sentential form where the next shift or reduce operation will occur
 - b. It is non-terminal whose production will be used for reduction in the next step
 - c. It is a production that may be used for reduction in a future step along with a position in the sentential form where the next shift or reduce operation will occur
 - d. It is the production p that will be used for reduction in the next step along with a position in the sentential form where the right hand side of the production may be found
3. Shift reduce parsing belongs to a class of
- a. bottom up parsing
 - b. top down parsing
 - c. recursive parsing
 - d. predictive parsing
4. Which one of the following is TRUE at any valid state in shift – reduce parsing?
- a. Viable prefixes appear only at the bottom of the stack and not inside
 - b. Viable prefixes appear only at the top of the stack and not inside
 - c. The stack contains only a set of viable prefixes
 - d. The stack never contains viable prefixes
5. LALR grammars are subset of LR(1). [True/False]
6. Which of the following is the most powerful parsing method?
- a. SLR
 - b. LALR
 - c. CLR
 - d. LL(1)
7. What is the precedence between ‘(‘ and ‘)’?
- a. <
 - b. =
 - c. >
 - d. blank
8. Operator precedence parser is _____ type of parser.
9. Operator precedence parser can parse ambiguous grammars. [True/False]
10. YACC builds up _____ parsing table
- a. SLR
 - b. LALR
 - c. CLR
 - d. LL(1)
11. For the grammar $S \rightarrow SS+ \mid SS^* \mid a$, identify the handle for the first reduction step for the string “ aa^*a^+ ”
- a. a
 - b. $SS+$
 - c. SS^*
 - d. $S+S$
12. Consider the grammar $S \rightarrow +SS \mid *SS \mid a$.
For a sentence $+*aaa$, the handles in the right-sentential form of the reduction are
- a. $a, *SS, +SS, a$ and a
 - b. $a, +SS, *SS, a$ and a
 - c. $a, +*Saa, +*SSa, a$ and a
 - d. $a, a, *SS, a$ and $+SS$

13. Let the number of states in SLR(1), LR(1) and LALR(1) parsers for the grammar be n_1 , n_2 and n_3 respectively. The following relationship holds good

- a. $n_1 < n_2 < n_3$ b. $n_1 = n_3 < n_2$ c. $n_1 = n_2 = n_3$ d. $n_1 \geq n_3 \geq n_2$

14. Consider the following grammar.

$S \rightarrow dA \mid aB$

$A \rightarrow bA \mid c$

$B \rightarrow bB \mid c$

Consider the following LR(0) items corresponding to the grammar above.

- (i) $S \rightarrow d.A$ (ii) $A \rightarrow .bA$ (iii) $A \rightarrow .c$

Given the items above, which of them will appear in the same set in the canonical sets-of-items for the grammar?

- a. (i) and (ii) b. (ii) and (iii) c. (i) and (iii) d. (i), (ii) and (iii)

15. What is the maximum number of reduce moves that can be taken by a bottom-up parser

for a grammar with no epsilon- and unit-production (i.e., of type $A \rightarrow \epsilon$ and $A \rightarrow a$)

to parse a string with n tokens?

- a. $n/2$ b. $n-1$ c. $2n-1$ d. $2n$

16. The grammar $S \rightarrow aSa \mid bS \mid c$ is?

- a. LL(1) but not LR(1) b. LR(1) but not LL(1)
c. Both LL(1) and LR(1) d. Neither LL(1) nor LR(1)

17. Consider SLR(1) and LALR(1) tables for CFG. Which of the following is false?

- a. Goto of both tables may be different
b. Shift entries are identical in both tables
c. Reduce entries in tables may be different
d. Error entries may be different

B. Descriptive Questions

1. What is Bottom-up parsing?
2. Define Handle with an example.
3. Explain Shift-Reduce parser. What are its drawbacks?
4. Why LR parsing is good and attractive?
5. What is an operator grammar? Explain with an example.
6. Define LR grammar. Explain the model of LR parser.
7. Write the steps involved for construction of SLR parser.
8. Construct Shift-Reduce parser for the following grammar

$S \rightarrow aABb$

$A \rightarrow c \mid aB$

$B \rightarrow d \mid bA$

9. Identify whether the given grammar is LL (1) or SLR (1).
 $S \rightarrow AaAb \mid BbBa$
 $A \rightarrow \epsilon$
 $B \rightarrow \epsilon$
10. Apply SLR parsing technique for the following grammar
 $S \rightarrow SA \mid A$
 $A \rightarrow a$
11. Construct SLR parser for the following grammar
 $S \rightarrow SS+ \mid SS^* \mid a$
12. Construct CLR parser for the following grammar
 $S \rightarrow SS+ \mid SS^* \mid a$
13. Construct LALR parser for the following grammar
 $S \rightarrow SS+ \mid SS^* \mid a$
14. Construct LALR parser for the following grammar
 $S \rightarrow SA \mid A$
 $A \rightarrow a$
15. Construct Operator precedence parsing table for the following grammar
 $P \rightarrow SbP \mid S \mid SbS$
 $S \rightarrow WbS \mid W$
 $W \rightarrow L^*W \mid L$
 $L \rightarrow id$

C. Gate Questions

1. Among simple LR (SLR), canonical LR, and look – ahead LR (LALR), which of the following pairs identify the method that is very easy to implement and the method that is the most powerful, in that order?
(GATE CS 2015)
- a. SLR, LALR b. Canonical LR, LALR
c. SLR, canonical LR d. LALR, canonical LR
2. An LALR(1) parser for a grammar G can have shift-reduce (S-R) conflicts if and only if
(GATE CS 2015)
- a. the SLR(1) parser for G has S-R conflicts
b. the LR(1) parser for G has S-R conflicts
c. the LR(0) parser for G has S-R conflicts
d. the LALR(1) parser for G has reduce-reduce conflicts
3. Consider the following grammar G **(GATE CS 2015)**
 $S \rightarrow F \mid H$
 $F \rightarrow p \mid c$
 $H \rightarrow d \mid c$
- Where S, F, and H are non – terminal symbols, p, d, and c are terminal symbols. Which of the following statements (s) is/are correct?
S1: LL(1) can parse all strings that are generated using grammar G

- S2: LR(1) can parse all strings that are generated using grammar G
- only S1
 - only S2
 - Both S1 and S2
 - Neither S1 nor S2
4. A canonical set of items is given below **(GATE CS 2014)**
- $$S \rightarrow L. > R$$
- $$Q \rightarrow R.$$
- On input symbol $<$ the set has
- a shift-reduce conflict and a reduce-reduce conflict.
 - a shift-reduce conflict but not a reduce-reduce conflict.
 - a reduce-reduce conflict but not a shift-reduce conflict.
 - neither a shift-reduce nor a reduce-reduce conflict.
5. An LALR(1) parser for a grammar G can have shift-reduce (S-R) conflicts if and only if
- the SLR(1) parser for G has S-R conflicts **(GATE CS 2008)**
 - the LR(1) parser for G has S-R conflicts
 - the LR(0) parser for G has S-R conflicts
 - the LALR(1) parser for G has reduce-reduce conflicts
6. Which of the following grammar rules violate the requirements of an operator grammar?
- P, Q, R are non terminals, and r,s,t are terminals **(GATE CS 2004)**
- $P \rightarrow QR$
 - $P \rightarrow QsR$
 - $P \rightarrow \epsilon$
 - $P \rightarrow QtRr$
7. Which of the following statements is false? **(GATE CS 2001)**
- An unambiguous grammar has same leftmost and rightmost derivation
 - An LL(1) parser is a top-down parser
 - LALR is more powerful than SLR
 - An ambiguous grammar can never be LR(k) for any k

UNIT – IV

A. Objective Questions

- If a parent node takes a value from its children is called _____ attributes.
- Every S-attributed definition is L-attributed definition. [True | False]
- The interdependencies among attributes are shown by _____ graph.
- Symbol Table can be used for:
 - Checking type compatibility
 - Suppressing duplication of error message
 - Storage allocation
 - All of these
- A programming language which allows recursion can be implemented with static storage allocation. [True | False]
- The two basic operations that are often performed in the symbol table are
 - Set and reset
 - Set and insert
 - Insert and lookup
 - Reset and lookup

7. In ordered symbol tables, the entries in the table are lexically ordered on the

- a) variable name
- b) variable type
- c) variable size
- d) All of the above

8. Information needed by a single execution of a procedure is managed using a contiguous block of storage called_____.

9. The static binding occurs during:

- a) Compile time
- b) Linking time
- c) Run time
- d) Pre-processing time

10. The dynamic binding occurs during _____

- a) Compile time
- b) Linking time
- c) Run time
- d) Pre-processing time

11. Type checking is normally done during

- a) Lexical analysis
- b) Syntax directed translation
- c) Syntax analysis
- d) Code generation

12. Consider the following Syntax Directed Translation Scheme (SDTS), with nonterminals {S, A} and terminals {a, b}

- $S \rightarrow aA$ {print 1}
- $S \rightarrow a$ {print 2}
- $A \rightarrow Sb$ {print 3}

Using the above SDTS, the output printed by a bottom-up parser for the input aab is

- a) 1 3 2
- b) 2 2 3
- c) 2 3 1
- d) Syntax error

13. $A \rightarrow BC$ {B.s=A.s}

- a) S-attributed
- b) L-attributed
- c) Both
- d) None

14. Consider the following translation scheme.

- $S \rightarrow ER$
- $R \rightarrow *E$ {print(“*”);} $R \mid \epsilon$
- $E \rightarrow F + E$ {print(“+”);} $\mid F$
- $F \rightarrow (S) \mid id$ {print(id.value);}

Here id is a token that represents an integer and id.value represents the corresponding integer value. For an input ‘2 * 3 + 4’, this translation scheme prints []

- a) 2 * 3 + 4
- b) 2 * +3 4
- c) 2 3 * 4 +
- d) 2 3 4+*

15. Synthesized attribute can be easily simulated by a

- a) LL grammar
- b) LR grammar
- c) Ambiguous grammar
- d) None of the above

16. A parse tree is an annotated parse tree if:

- a) it shows attribute values at each node.
- b) there are no inherited attributes.

- c) it has synthesized nodes as terminal nodes.
- d) every non-terminal nodes is an inherited attribute.

B. Descriptive Questions

1. Define synthesized and inherited attributes with an example.
2. Construct a annotated parse tree for the expression $7*4+5/n$?
3. Write an SDD for construction of syntax trees.
4. Write short notes on Syntax directed translation with an example.
5. Explain the concept of syntax directed definition and its usage.
6. What is an S-attributed definition and L-attributed definition? Explain with an example.
7. Explain any one syntax-directed translation schemes.
8. Describe the general structure of an activation record. Explain the purpose of each item in the activation record.
9. Explain Operations on symbol tables for block structured and non-block structured languages. What is an unordered symbol table?
10. Write short notes on Symbol table organization for block structured languages.
11. What are the various attributes of a symbol table?
12. Explain tree structured symbol tables.
13. Explain stack implemented tree-structured symbol tables.
14. Explain stack implemented Hash-structured symbol tables.
15. Explain static storage allocation strategy.
16. Explain in detail, the strategy for reducing fragmentation in heap memory.
17. Differentiate between Static and dynamic storage allocation strategies.

C. GATE Questions

1. Consider the program given below, in a block-structured pseudo-language with lexical scoping and nesting of procedures permitted.

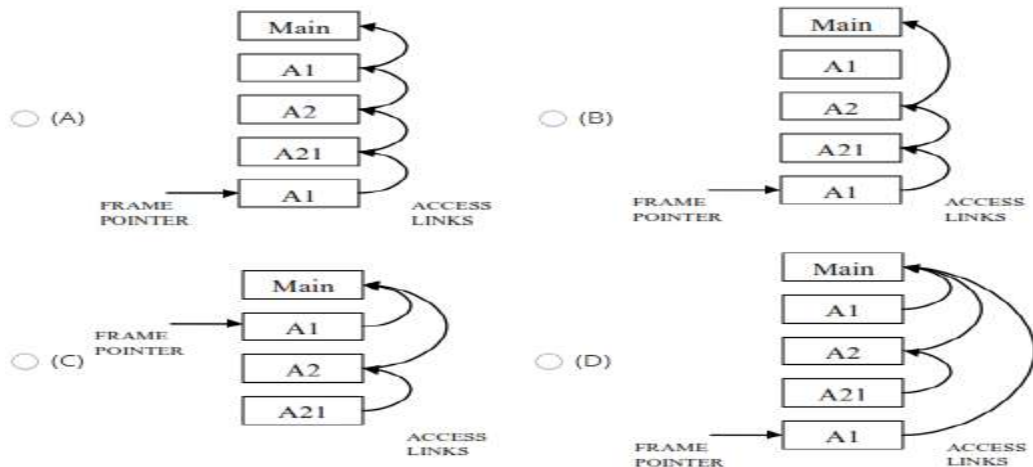
```

Program main;
  Var ...
  Procedure A1;
    Var ...
    Call A2;
  End A1
  Procedure A2;
    Var ...
    Procedure A21;
      Var ...
      Call A1;
    End A21
    Call A21;
  End A2
  Call A1;
End main.

```

Consider the calling chain: Main \rightarrow A1 \rightarrow A2 \rightarrow A21 \rightarrow A1

The correct set of activation records along with their access links is given by
[GATE 2012]



2. Which languages necessarily need heap allocation in the runtime environment?

[GATE 2010]

- Those that support recursion
 - Those that use dynamic scoping
 - Those that allow dynamic data structures
 - Those that use global variables
3. Consider the grammar with the following translation rules and E as the start symbol.

$$E \rightarrow E1 \# T \quad \{E.value = E1.value * T.value\}$$

$$| T \quad \{E.value = T.value\}$$

$$T \rightarrow T1 \& F \quad \{T.value = T1.value + F.value\}$$

$$| F \quad \{T.value = F.value\}$$

$$F \rightarrow num \quad \{F.value = num.value\}$$

Compute E.value for the root of the parse tree for the expression:

2 # 3 & 5 # 6 & 4.

[GATE 2004]

- 200
 - 180
 - 160
 - 40
4. Consider the following Syntax Directed Translation Scheme (SDTS), with non terminals { E, T, F } and terminals { 2, 4 }

$$E \rightarrow E * T \quad \{E.VAL = E.VAL * T.VAL;\}$$

$$E \rightarrow T \quad \{E.VAL = T.VAL;\}$$

$$T \rightarrow F - T \quad \{T.VAL = F.VAL - T.VAL;\}$$

$$T \rightarrow F \quad \{T.VAL = F.VAL;\}$$

$$F \rightarrow 2 \quad \{F.VAL = 2;\}$$

$$F \rightarrow 4 \quad \{F.VAL = 4;\}$$

Using the above SDTS, the total number of reductions done by a bottom-up parser for the input 4-2-4*2 is
[GATE 2000]

- 10
 - 9
 - 11
 - 13
5. A shift reduce parser carries out the actions specified within braces immediately after reducing with the corresponding rule of grammar

$S \rightarrow xxW (\text{PRINT } "1")$

$S \rightarrow y \{ \text{print } " 2 " \}$

$S \rightarrow Sz \{ \text{print } " 3 " \}$

What is the translation of xxxxyzz using the syntax directed translation scheme described by the above rules? [GATE 1995]

- a) 23131 b) 11233 c) 11231 d) 33211

UNIT – V

A. Objective Questions

1. The intermediate codes that are in linear representation are _____ and _____.
2. The conversion of all labels in three address statements to addresses of instructions is known as _____.
3. _____ representation of three address code uses temporary variables.
4. _____ representation makes the source language program independent.
5. One of the purposes of using intermediate code in compilers is to []
 - a. Make parsing and semantic analysis simpler.
 - b. Improve error recovery and error reporting.
 - c. Increase the chances of reusing the machine-independent code optimizer in other compilers.
 - d. Improve the register allocation.
6. Some code optimizations are carried out on the intermediate code because []
 - a. they enhance the portability of the compiler to other target processors
 - b. program analysis is more accurate on intermediate code than on machine code
 - c. the information from dataflow analysis cannot otherwise be used for optimization
 - d. the information from the front end cannot otherwise be used for optimization
7. The optimization technique which is typically applied on loops is
 - A. Removal of invariant computation
 - B. Peephole optimization
 - C. Constant folding
 - D. All of these
8. The identification of common sub-expression and replacement of run-time computations by compile-time computations is
 - a. Local optimization
 - b. Loop optimization

c. Constant folding

d. data flow analysis

9. Dead-code elimination in machine code optimization refers to:

- a. Removal of all labels.
- b. Removal of values that never get used.
- c. Removal of function which are not involved.
- d. Removal of a module after its use.

10. Code optimization is responsibility of:

- a. Application programmer programmer
- b. System
- c. Operating system
- d. All of the above

11. The polish notation of the expression $x+y*z$ is

- a. $xyz*+$
- b. $x+yz*$
- c. $xyz+*$
- d. $*+xyz$

12. The three address code for the statement $x+-y*(-y+z)$ is

- a. $t1=y, t2=t1+z, t3=t1*t2, t4=x+t3$
- b. $t1=-y, t2=x+t1, t3=t1+z, t4=t2*t3$
- c. both a and b are valid
- d. none

13. Replacing the expression $2*3.14$ by 6.28 is

- a. Constant folding
- b. Induction variable
- c. Strength reduction
- d. Code reduction

B. Descriptive Questions

1. What are the various types of intermediate code representation?
2. What are the applications of DAG?
3. Explain in detail about loop optimization techniques.
4. Explain in detail the procedure that eliminates global common sub expression with an example.
5. What is flow graph? Write an algorithm to partition a sequence of three-address statements into basic blocks
6. Explain about dead code elimination, constant folding and copy propagation with an example.
7. Convert the given infix expression into postfix expression.
 $(a + b) * (c + d) (a + b + c)$
8. Translate the expression $-(a+b)*(c+d)+(a+b+c)$ into three address code, quadruples, triples and indirect triples.
9. Generate the three address code for an expression $x := a + b * c + d$;
10. Draw the DAG for the statement $a=(a*b+c)-(a*b+c)$.
11. Construct the DAG for the following basic block
 1. $a = b + c$
 2. $b = a - d$

3. $c = b + c$

4. $d = a - d$

12. Write intermediate code for the following source code: for i from 1 to 10 do for j from 1 to 10 do $a[i, j] = 0.0$; for i from 1 to 10 do $a[i, i] = 1.0$; and identify basic blocks.

C. GATE/NET/SLET

1. Consider the following code segment.

[GATE 2016]

```
x = u - t;  
y = x * v;  
x = y + w;  
y = t - z;  
y = x * y;
```

The minimum number of total variables required to convert the above code segment to static *single assignment* form is _____.

2. The least number of temporary variables required to create a three-address code in static single assignment form for the expression $q + r/3 + s - t * 5 + u * v/w$ is _____.

[GATE 2015]

3. Which one of the following is FALSE?

[GATE 2014]

- A basic block is a sequence of instructions where control enters the sequence at the beginning and exits at the end.
- Available expression analysis can be used for common subexpression elimination.
- Live variable analysis can be used for dead code elimination.
- $x = 4 * 5 \Rightarrow x = 20$ is an example of common subexpression elimination.

4. Consider the basic block given below.

[GATE 2014]

```
a = b + c  
c = a + d  
d = b + c  
e = d - b  
a = e + b
```

5. The minimum number of nodes and edges present in the DAG representation of the above basic block respectively are
- 6 and 6
 - 8 and 10
 - 9 and 12
 - 4 and 4
6. For a C program accessing $X[i][j][k]$, the following intermediate code is generated by a compiler. Assume that the size of an integer is 32 bits and the size of a character is 8 bits.

[GATE 2014]

```

t0 = i * 1024
  t1 = j * 32
  t2 = k * 4
  t3 = t1 + t0
  t4 = t3 + t2
  t5 = X[t4]

```

Which one of the following statements about the source code for the C program is CORRECT?

- X is declared as “int X[32][32][8]”
- X is declared as “int X[4][1024][32]”
- X is declared as “char X[4][32][8]”
- X is declared as “char X[32][16][2]”

7. Consider the following C code segment.

[GATE 2006]

```

for (i = 0, i < n; i++)
{
  for (j=0; j < n; j++)
  {
    if (i%2)
    {
      x += (4*j + 5*i);
      y += (7 + 4*j);
    }
  }
}

```

8. Which one of the following is false?

- The code contains loop invariant computation
- There is scope of common sub-expression elimination in this code
- There is scope of strength reduction in this code
- There is scope of dead code elimination in this code

UNIT – VI

A. Objective Questions

- _____ phase is responsible for generating the target code.
- Instructions involving only register operands are faster than those memory operands. [True | False]
- _____ and _____ programs are needed to link the modules and load the programs into the memory for execution.
- _____ is the process of deciding which intermediate representation values to keep in registers.

5. _____ is the process of deciding which register should hold a given intermediate representation value.
6. Use of _____ reduces the cost of instruction.
7. _____ maintains a pointer to the list that contains the information about what is currently available in the registers.
8. _____ keeps track of locations of each variable.
9. The input of the code generation phase is
 - a. Source code
 - b. Target code
 - c. Intermediate code
 - d. None of the above
10. Name the programs that are needed to run the code that is in relocatable form
 - a. Assemblers and loaders
 - b. Loaders and Linkers
 - c. Assemblers and linkers
 - d. None
11. Which of the following machine idioms perform the task equivalent to $a=a+1$?
 - a. INC
 - b. SFT
 - c. Both are valid
 - d. None
12. Name the descriptor required to keep track of content of registers
 - a. Address
 - b. Register
 - c. Both
 - d. Any of the above
13. Name the descriptor used to keep track of the availability of the value for the variable
 - a. Address
 - b. Register
 - c. Both
 - d. Any of the above
14. Output of code generator is _____
 - a. Source code
 - b. Intermediate code
 - c. Assembly code
 - d. None of these
15. Peep-hole Optimization is a form of
 - a. Local Optimization
 - b. Constant Folding
 - c. Copy Propagation
 - d. None of these
16. What is the cost of the instruction `Mov r5, r3`?
 - a. 1
 - b. 2
 - c. 3
 - d. 4

B. Descriptive Questions

1. What are the object code forms? Explain in brief about the issues in code generation?
2. What is peephole optimization? Explain its characteristics.
3. What is address descriptor and register descriptor?
4. Explain the Generic code generation algorithm.
5. Explain code generation from DAG.
6. Explain about inter procedural optimization with an example.
7. Explain about labelling algorithm with an example.
8. Explain instruction scheduling with an example.
9. Describe various register allocation optimization techniques with suitable examples.

C. GATE/NET/SET Questions

1. Some code optimizations are carried out on the intermediate code because
[GATE 2008]
 - a. They enhance the portability of compiler to other target processors.
 - b. Program analysis is more accurate on intermediate code than on machine code
 - c. The information from data flow analysis cannot otherwise be used for optimization
 - d. The information from the front end cannot otherwise be used for optimization.

Signature of the Faculty

HANDOUT ON COMPUTER NETWORKS

Class & Sem. : III B.Tech – I Semester

Year : 2020-21

Branch : CSE

Credits : 3

1. Brief History and Scope of the Subject

A **computer network** or **data network** is a telecommunications network which allows computers to exchange data. In computer networks, networked computing devices exchange data with each other using a data link. The connections between nodes are established using either cable media or wireless media. The best-known computer network is the Internet. Network computer devices that originate, route and terminate the data are called network nodes. Nodes can include hosts such as personal computers, phones, servers as well as networking hardware. Two such devices can be said to be networked together when one device is able to exchange information with the other device, whether or not they have a direct connection to each other. Computer networks differ in the transmission medium used to carry their signals, the communications protocols to organize network traffic, the network's size, topology and organizational intent. Computer networks support an enormous number of applications such as access to the World Wide Web, video, digital audio, shared use of application and storage servers, printers, and fax machines, and use of email and instant messaging applications as well as many others.

2. Pre-Requisites

Basic knowledge on computer hardware and software components.

3. Course Objectives:

- To introduce the fundamental concepts of computer networking
- To familiarize with networking concepts to work on various Protocols of ISO/OSI and TCP/IP.

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

CO 1: compare protocol models (OSI, TCP/IP) and select suitable protocol for network design.

CO 2: design a network by deciding relevant multiplexing and switching technique to improve performance of the network.

CO 3: apply flow control, error control techniques and protocols to verify the correctness of data in the communicated network.

CO 4: specify and identify deficiencies in MAC sublayer protocols.

CO 5: apply routing and congestion control algorithms to deliver data packets across the networks.

CO 6: use communication protocols like IP, TCP, UDP, DNS, HTTP, FTP across the Internet.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1.Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2.Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3.Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4.Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5.Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6.The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7.Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9.Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

CT2519 : COMPUTER NETWORKS														
Course outcomes	Program Outcomes and Program Specific Outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1: compare protocol models (OSI, TCP/IP) and select suitable protocol for network design.	2	1										1		
CO2: design a network by deciding relevant multiplexing and switching technique to improve performance of the network.	3	2	3	1		2						2		
CO3: apply flow control, error control techniques and protocols to verify the correctness of data in the communicated network.	3	1	2	1		1						2		1
CO4: specify and identify deficiencies in MAC sublayer protocols.	2											1		
CO5: apply routing and congestion control algorithms to deliver data packets across the networks.	3	1	2	1		1						2		1

CO6: use communication protocols like IP, TCP, UDP, DNS, HTTP, FTP across the Internet.	2		1			1						1			1
---	---	--	---	--	--	---	--	--	--	--	--	---	--	--	---

7. Prescribed Text Book

- a) Andrew S Tanenbaum, “Computer Networks”, Pearson, 4th edition.
- b) Behrouz A Fourzan, “Data communications and networking”, TMH, 4th edition.
- c) Mayank Dave, “Computer Networks”, Cengage

Reference Text Books

- a) Larry L Peterson and Bruce S Davie, Computer networks, A system Approach, Elsevier, 5th edition

URLs and Other E-Learning Resources

- a. Data Communication introduction : www.cne.gmu.edu
- b. Protocol Standards: www.ietf.org

8. Digital Learning Materials:

- <http://nptel.ac.in/courses/106105081>
- <http://nptel.ac.in/courses/106105080/>
- <http://nptel.ac.in/courses/106106091/>
- <https://www.youtube.com/watch?v=tP9y0bVUYCA>
- <https://www.youtube.com/watch?v=UXMIxCYZu8o>
- <http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-033-computer-system-engineering-spring-2009/video-lectures/lecture-11/>
- <http://freevideolectures.com/Course/2276/Computer-Networks#>
- <http://homepages.herts.ac.uk/~comqrgd/docs/network-notes/network-notes.pdf>
- <http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf>
- <http://www.pucomp.org/2008/07/data-communications-ppt-from-forouzan.html>
- <http://www.technolamp.co.in/2010/08/computer-networks-tanenbaum-powerpoint.html>

9. Lecture Schedule / Lesson Plan

Topic	No. of Periods	
	Theory	Tutorial
UNIT –1: Introduction		
Data Communications: Components, data flow	2	2

Network criteria, network topologies	2	
Categories of networks	1	
ISO-OSI model	2	
TCP/IP protocol suite	1	
UNIT – 2:		
Multiplexing: Frequency division multiplexing	1	1
Synchronous time division multiplexing	2	
Statistical time division multiplexing	1	1
Introduction to switching: Circuit Switched Networks	1	
Datagram Networks	1	
Virtual Circuit Networks	2	
UNIT – 3:		
Design issues, framing, error control, Flow control	1	1
error detection and correction- CRC, checksum, hamming code	3	
Elementary data link layer protocols- unrestricted simplex protocol	1	
simplex stop and wait, simplex protocol for noisy channel	2	
Sliding window protocols-one bit, Go back N	2	1
selective repeat sliding protocol	1	
HDLC and PPP	2	
UNIT – 4:		
Medium Access Control Sub Layer : ALOHA,	1	1
CSMA, CSMA/CD	3	
IEEE standards-standard Ethernet	2	1
wireless LAN	1	
bridges	1	
UNIT – 5:		
Network Layer: Routing algorithms- shortest path routing	2	1
distance vector Routing	1	
Link State Routing	1	
Hierarchical Routing	1	1

Congestion control algorithms-congestion control in virtual circuit subnets	1	
datagram subnet	1	
leaky bucket, token bucket.	1	
The network layer in the Internet: The IP protocol, IPAddresses-IPv4,	2	1
IPv6	1	
UNIT – 6:		
Transport layer: Transmission Control Protocol (TCP)- services, segment header	1	
connection establishment, termination, transmission policy	2	
congestion control.	1	
User Datagram Protocol (UDP)- header format.	1	
Application layer: The Domain Name System (DNS),	1	1
electronic mail-architectureSMTP, POP3	1	
FTP, HTTP.	1	
Total No.of Periods:	56	14

10. Seminar Topics

- OSI Reference Model
- TCP/IP protocol suite
- Differences between OSI and TCP/IP models

UNIT-I Assignment-Cum-Tutorial Questions SECTION-A

Objective Questions

- The topology with highest reliability is
 - Bus topology
 - Star topology
 - Ring Topology
 - Mesh Topology
- Protocols are
 - Agreements on how communication components and DTE's are to communicate

- b) Logical communication channels for transferring data
- c) Physical communication channels used for transferring data
- d) None of above

3. In OSI model dialogue control and token management are responsibilities of

- a) Session Layer
- b) Network layer
- c) Transport layer
- d) Data link layer

4. The method of communication in which transaction takes place in both directions, vice versa called

- a) Simplex
- b) Four wire circuit
- c) Full duplex
- d) half-duplex

5. Choose the best matching between Group 1 and Group 2.

Group-1

- P. Data link layer
- Q. Network layer
- R. Transport layer

Group-2

- 1. Ensures reliable transport of data over a physical point-to-point link
- 2. Encoder/decodes data for physical transmission
- 3. Allows end-to-end communication between two processes
- 4. Routes data from one network node to the next

- a. P-1, Q-4, R-3
- b. P-2, Q-4, R-1
- c. P-2, Q-3, R-1
- d. P-1, Q-3, R-2

6. In Internet protocol stack, when data is sent from device A to device B, the 5th layer to receive data at B is

- a) Application layer
- b) Transport layer
- c) Link layer
- d) Session layer

7. Which of the following technique is used for encapsulation

- a. a technique used in best-effort delivery systems to avoid endlessly looping packets
- b. a technique used by protocols in which a lower level protocol accepts a message from a higher level protocol and places it in the data portion of the low level frame.
- c. One of the pieces that results when an IP gateway divides an IP datagram into smaller pieces for transmission across a network that cannot handle the original datagram size
- d. All of the above

8. Match the following :

List - I

List - II

(a) Data link layer

(i) Encryption

(C) Semantics of the information transmitted

(D) Synchronization

13. For n devices in a network, number of duplex-mode links are required for a mesh topology.

(A) $n(n + 1)$ (B) $n(n - 1)$

(C) $n(n + 1)/2$ (D) $n(n - 1)/2$

14. Match the following:

List - I

- a. Physical Layer
- b. Datalink Layer
- c. Network Layer
- d. Transport Layer
- e. Application Layer

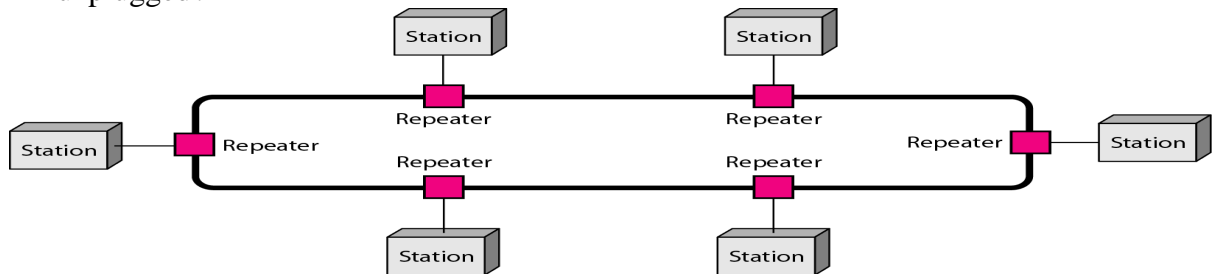
List - II

- i. Allow resources to network access
- ii. Move packets from one destination to other
- iii. Process to process message delivery
- iv. Transmission of bit stream
- v. Formation of frames

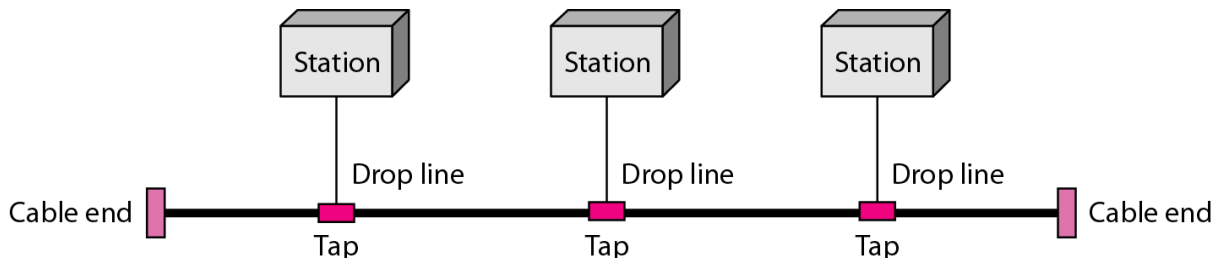
Codes:

- | | | | | | |
|-----|----|-----|----|-----|-----|
| | a | b | c | d | e |
| (A) | iv | v | ii | iii | i |
| (B) | v | iv | i | ii | iii |
| (C) | i | iii | ii | v | iv |
| (D) | i | ii | iv | iii | v |

15. In the ring topology in the given figure, what happens if one of the stations is unplugged?



16. In the bus topology in the given figure, what happens if one of the stations is unplugged?



SECTION-B

SUBJECTIVE QUESTIONS

1. Identify the five components of a data communications system
2. Name the four basic network topologies, and cite an advantage of each type.
3. Discuss the classification of Networks according to their size.
4. Draw and explain in detail about ISO-OSI reference model.
5. Draw and explain in detail about TCP/IP model.
6. Compare and contrast OSI and TCP/IP models.
7. Differentiate between LAN, MAN and WAN.

SECTION-C

GATE Questions:

1. The protocol data unit(PDU) for the application layer in the Internet stack is
 - a. Segment
 - b. Datagram
 - c. Message
 - d. Frame

[GATE 2012]

2. In the following pairs of OSI protocol layer/sub-layer and its functionality, the INCORRECT pair is
 - a. Network layer and Routing
 - b. Data Link Layer and Bit synchronization
 - c. Transport layer and End-to-end process communication
 - d. Medium Access Control sub-layer and Channel sharing

[GATE 2014]

UNIT-II

SECTION-A

Objective Questions

- 1) The sharing of a medium and its link by two or more devices is called _____
 - a) Fully duplexing
 - b) Multiplexing
 - c) Both a and b
 - d) None of the mentioned
- 2) Multiplexing is used in _____

- 3) a) Packet switching b) Circuit switching
 c) Data switching d) None of the mentioned
- 4) Which multiplexing technique transmits digital signals ?
 a) FDM b) TDM c) WDM d) None of the mentioned
- 5) Multiplexing can provide
 a) Efficiency b) Privacy c) Anti jamming d) Both a and b
- 6) The state when dedicated signals are idle are called
 a) Death period b) Poison period
 c) Silent period d) None of the mentioned
- 7) In TDM, slots are further divided into
 a) Seconds b) Frames c) Packets d) None of the mentioned
- 7) In TDM Data rate management is done by which of these strategies
 a) Multilevel multiplexing b) Multi-slot allocation c) Pulse stuffing
 d) all of the above
- 8) Method(s) to move data through a network of links and switches
 a) Packet switching b) Circuit switching
 c) Line switching d) Both a and b

9. _____ is an analog multiplexing technique that combines analog signals

10. _____ is an analog multiplexing technique to combine optical signals.

Multiple Choice Questions

- 1) If there are n signal sources of same data rate than TDM link has _____ slots
 a) n b) n/2 c) n*2 d) 2^n
- 2) If link transmits 4000 frames per second, and each slot has 8 bits, the transmission rate of circuit this TDM is
 a) 32kbps b) 500bps c) 500kbps d) None of the mentioned
- 3) In TDM, the transmission rate of the multiplexed path is usually _____ the sum of the transmission rates of the signal sources.
- 4) a) Greater than b) Lesser than
 c) Equal to d) Equal to or greater than
- 5) What are the phases in circuit switching?

- a) Setup, data transfer, teardown
 - b) request-connect, data sending-acknowledgment, request-disconnect
 - c) send-connect, data transfer, request-disconnect
 - d) none of above
- 6) Which of these statements is true about packet switching networks?
- a) Resource allocation is done for a packet beforehand
 - b) Bandwidth is reserved on the links
 - c) Scheduled processing for a packet
 - d) Resource allocation is done on demand
- 7) What are the components of a packet switch?
- a) input ports, output ports, a router processor, a switching fabric
 - b) input ports, output ports, a router processor.
 - c) input ports, output ports, a switching fabric
 - d) input ports, output ports, a router processing, a switching fabric, a memory chip
- 8) How switching is performed in the internet?
- a) data gram approach to circuit switching at datalink layer
 - b) Virtual circuit approach to message switching at network layer
 - c) datagram approach to message switching at datalink layer
 - d) datagram approach to packet switching at network layer
- 9) Which of these is correct for synchronous Time Division Multiplexing
- a) Data rate of link is n times faster and the unit duration is n times longer
 - b) Data rate of link is n times slower and the unit duration is n times shorter
 - c) Data rate of link is n times slower and the unit duration is n times longer
 - d) Data rate of link is n times faster and the unit duration is n times shorter

- 9) Multiplexing technique that shifts each signal to a different carrier frequency
a) FDM b)TDM c)Either a or b d) Both a and b
- 10) Which of these multiplexing techniques is digital for combining several low-rate channels into high-rate one
a)FDM b)WDM c)TDM d) None of the above

SECTION-B

SUBJECTIVE QUESTIONS

1. Describe the functioning of FDM
2. Discuss the various approaches to packet-switching
3. Compare and contrast a circuit-switched network and a packet switched network
4. Draw the diagram of a datagram network with four switches. And explain how will it work
5. Explain the process of TDM with an example.

Problems:

1. Assume that a voice channel occupies a bandwidth of 4 kHz. We need to multiplex 10 voice channels with guard bands of 500 Hz using FDM. Calculate the required bandwidth.
2. Two channels, one with a bit rate of 100 kbps and another with a bit rate of 200kbps, are to be multiplexed. How it can be achieved? What is the frame rate? What is the frame duration? What is the bit rate of the link?

SECTION-C

Questions testing the analyzing / evaluating ability of students

1. Assume that a voice channel occupies a bandwidth of 4kHz. We need to combine three voice channels into a link with a bandwidth of 12kHz, from 20 to 32 kHz. Show the configuration, using the frequency domain. Assume there are no guard bands.

UNIT-IV

Objective Questions

1. In _____ each station sends a frame whenever it has a frame to send.
a. pure ALOHA b. slotted ALOHA c. both (a) and (b) d. neither (a) nor (b)
2. In pure ALOHA, the vulnerable time is _____ the frame transmission time.
a. the same as b. two times c. three times d. none of the above
3. The maximum throughput for pure ALOHA is _____ per cent.
a. 12.2 b. 18.4 c. 36.8 d. none of the above
4. The vulnerable time for CSMA is the _____ propagation time.
a. the same as b. two times c. three times d. none of the above
5. In the _____ method, after the station finds the line idle, it sends its frame immediately. If the line is not idle, it continuously senses the line until it finds it idle.
a. nonpersistent b. 1-persistent c. p-persistent d. none of the above
6. In the _____ method, a station that has a frame to send senses the line. If the line is idle, it sends immediately. If the line is not idle, it waits a random amount of time and then senses the line again.
a. nonpersistent b. 1-persistent c. p-persistent d. none of the above
7. In the _____ method, after the station finds the line idle it sends or refrain from sending based on the outcome of a random number generator. If the line is busy, it tries again.
a. nonpersistent b. 1-persistent c. p-persistent d. none of the above
8. _____ augments the CSMA algorithm to detect collision.
a. CSMA/CA b. CSMA/CD c. either (a) or (b) d. both (a) and (b)
9. In the _____ method, a station that has a frame to send senses the line. If the line is idle, it sends immediately. If the line is not idle, it waits a random amount of time and then senses the line again.
a. nonpersistent b. 1-persistent c. p-persistent d. none of the above
10. To avoid collisions on wireless networks, _____ was invented.
a. CSMA/CA b. CSMA/CD c. either (a) or (b) d. both (a) and (b)
11. Ethernet frame consists of
a) MAC address b) IP address c) both (a) and (b) d) none of the mentioned

12. What is start frame delimiter (SFD) in ethernet frame?

- a) 10101010 b) 10101011 c) 00000000 d) 11111111

13. High speed ethernet works on _____ a)
coaxial cable b) twisted pair cable c) optical fiber d) none of the mentioned

14. Term that is used to set standards to enable intercommunication among equipment from a variety of manufacturers is called

- a) Project 802 b) Project 8802 c) Project 2088 d) Project 208

15. BSS stands for

- a) Basic Signal Set b) Basic Service Set c) Beacon Service Set
d) Basic Strong Set

Subjective Questions

1. What is pure ALOHA and slotted ALOHA?
2. Explain briefly the differences between 1-persistent, non-persistent, and p-persistent of CSMA?
3. Explain Carrier Sense Multiple Access with Collision Detection (CSMA/CD).
4. Explain various classes of IEEE 802.X Standard Ethernet.
5. What is the need for bridges? Explain the working of 802.x to 802.y bridges in detail.
6. Discuss in detail about standard Ethernet?

Problems

1. A slotted ALOHA Network transmits 200-bit frames using a shared channel with a 200 kbps bandwidth. Find the throughput if the system produces

- i. 1000 frames per second
- ii. 500 frames per second
- iii. 250 frames per second

2. A network using CSMA/CD has a bandwidth of 10 Mbps. If the maximum propagation time is 25.6 μ s, what is the maximum size of the frame?

UNIT-V

Objective Questions

1. The router algorithm takes the decision to change the route when
a) router changes
b) topology changes

- c) user changes
- d) transmission time does not change

2. The network layer protocol of internet is

- a) ethernet
- b) internet protocol
- c) hypertext transfer protocol
- d) none of the mentioned

3. The network layer concerns with

- a) bits
- b) frames
- c) packets
- d) none of the mentioned

4. In link state routing, after the construction of link state packets new routes are computed using

- a) Bellman Ford algorithm
- b) DES algorithm
- c) Dijkstra's algorithm
- d) Leaky bucket algorithm

5. Count-to-Infinity problem occurs in

- a) distance vector routing
- b) short path first
- c) link state routing
- d) hierarchical routing

6. In distance vector routing algorithm, the routing tables are updated

- a) by exchanging information with the neighbours
- b) automatically
- c) using the backup database
- d) by the server

7. In Congestion Control, a bit can be set in a packet moving in direction opposite to congestion in

- a) Implicit Signaling
- b) Backward Signaling
- c) Source Signaling
- d) Data Signaling

8. A packet which is sent by a node to source to inform it of congestion is called

- a) Congestion Packet
- b) Change Packet
- c) Choke Packet
- d) Control Packet

9. In _____ congestion control, policies are applied to prevent congestion before it happens.

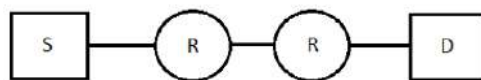
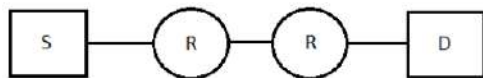
- a) open-loop b) closed-loop c) either (a) or (b) d) neither (a) nor (b)

10 _____ is a characteristic that a flow needs. Lack of it means losing a packet or acknowledgment, which entails retransmission

- (a) Reliability b) Delay c) Jitter d) Bandwidth

Subjective Questions

1. With an example explain the distance vector routing algorithms used in computer networks.
2. State and Justify “Link state routing shows better performance than the Distance vector routing”, and explain it comprehensively.
3. With an example explain the Hierarchical routing algorithms used in computer networks.
4. What is Count to infinity problem? Explain with suitable example.
5. Explain congestion control in Datagram subnets.



2. Change the following IP addresses from binary notation to dotted-decimal notation.

i. 01111111 11110000 01100111 01111101

ii. 10101111 11000000 11111000 00011101

3. Change the following IP addresses from dotted-decimal notation to binary notation.

11. is a process-to-process protocol that adds only port addresses, checksum error control, and length information to the data from upper layer
a)TCP b)UDP c) IP d)ARP

Subjective Questions

1. Explain briefly services of transport layer.
2. What are the five basic functions supported in e-mail systems? Explain.
3. Discuss in detail about the connection establishment and release in TCP.
4. Explain the prevention polices of congestion
5. Explain in detail about Connection management
6. Define HTTP and How is an HTML document structured?
7. What are the three states in POP3 protocol? Explain each state.
8. Explain the structure of TCP Header format.
9. Explain the format of UDP header.
10. Are the TCP Connections are half- duplex? How the Connections will release in TCP?

Problems:

1. In an connection, the value of cwnd is 2500 and the value of rwnd is 4500. The host has sent 2000 bytes which has not acknowledged . How many bytes can be sent?
2. A TCP connection is using a window size of 10 000 bytes, and the previous acknowledgment number was 22 001. It receives a segment with acknowledgment number 24 001. Draw a diagram to show the situation of the window before and after
3. A client uses UDP to send data to a server. The data are 16 bytes. Calculate the efficiency of this transmission at the UDP level (ratio of useful bytes to total bytes).

Signature of the Faculty

HANDOUT ON SOFTWARE ENGINEERING

Class& Sem. : III B.Tech – I Semester

Year : 2020-21

Branch : CSE

Credits : 3

=====

1. Brief History and Scope of the Subject

Software engineering is the branch of computer science that creates practical, cost-effective solutions to computing and information processing problems, preferentially by applying scientific knowledge, developing software systems in the service of mankind. This course covers the fundamentals of software engineering, including understanding system requirements, finding appropriate engineering compromises, effective methods of design, coding, and testing, team software development, and the application of engineering tools. The course will combine a strong technical focus with a capstone project providing the opportunity to practice engineering knowledge, skills, and practices in a realistic development setting with a real client.

2. Pre-Requisites

- Familiar with the fundamental concepts of computers.

3. Course Objectives:

- Illustrate basic taxonomy and terminology of the software engineering.
- Plan and monitor the control aspects of project.

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

CO1: explain the basic concepts of Software Engineering.

CO2: select the suitable process model based on the client requirements.

CO3: calculate software proficiency in terms of cost and schedule.

CO4: list the specifications of end-user according to business needs.

CO5: choose the appropriate architectural style for a given Scenario.

CO6: infer the system model for a sample case study.

CO7: deduce test cases by following different testing methodologies.

CO8: Explore the basic concepts of software engineering.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12.Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6.Mapping of Course Outcomes with Program Outcomes:

CT2517 : SOFTWARE ENGINEERING															
Course outcomes	Program Outcomes and Program Specific Outcome														
	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	P S O 1	P S O 2	
CO1. explain the basic concepts of Software Engineering.	1			2			3			1		2		2	
CO 2.select the suitable process model based on the client requirements.	2	2	1			1						2	2	2	1
CO3. calculate software proficiency in terms of cost and schedule.	3											2	2	1	1
CO 4. list the specifications of end-user according to business needs	2					2						1	1	1	2
CO5. choose the appropriate architectural style for a given Scenario.	2	2	1			1						2	2	1	1
CO 6. infer the system model for a sample case study.	2	1		1		1						2	2	2	2
CO7. deduce test cases by following different testing methodologies.	1		2									2	2	2	2

7.Prescribed Text Books

- a. Pankaj Jalote, “A Concise Introduction to Software Engineering”, Springer International Edition.
- b. Roger S. Pressman, “Software Engineering”, 7th edition, TMH.

8.Reference Text Books

- a. K.K Aggarwal and Yogesh Singh, “Software Engineering”, 3rd Edition, New Age Publications.
- b. Sommerville, “Software Engineering”, 8th edition, Pearson.

9.URLs and Other E-Learning Resources

- a. <https://www.learningware.in>
- b. <http://www.learnerstv.com/engineering.php>
- c. <http://www.mhhe.com/pressman>
- d. <http://www.software-engin.com>
- e. <http://www.sei.cmu.edu>
- f. <http://www.scitools.com>
- g. <http://www.galorath.com>

10.Digital Learning Materials:

- <https://onlinecourses.nptel.ac.in>

11.Lecture Schedule / Lesson Plan

Topic	No. of Periods	
	Theory	Tutorial
UNIT –1: Introduction to Software Engineering		
The evolving role of software	1	1
Changing nature of software	2	
Software myths	2	
The software problem: cost, schedule and quality	2	1
Scale and change	1	
	8	2
UNIT – 2: Software Process		
Process and project	1	1

Software development process models: waterfall model	2	
Prototyping , Iterative development	2	
Relational unified process, Extreme programming and agile process.	3	1
	8	2
UNIT – 3: Planning a software project		
Effort estimation	2	1
Project schedule and staffing	2	
Quality planning	2	1
risk management planning	2	
	8	2
UNIT – 4: Software requirement analysis and specification		
Introduction, Value of good SRS	2	1
Requirement process, Requirement specification	3	1
functional specification with use cases	3	
	8	2
UNIT – 5: Software Architecture and Design		
Role of software architecture, architecture views	2	
Components and connector view, architecture styles for C & C view	3	2
Function-oriented design	2	
Object oriented design	2	1
Metrics for design	2	
	11	3
UNIT – 6: Coding and Unit testing		
Programming principles and guidelines	2	1
Testing concepts, testing process	2	
Black-box testing, white-box testing	3	2
Metrics for testing	2	
	9	3
Total No. of Periods:	52	14

11. Seminar Topics

- Eye Tracking Software
- Agile Supply Chain
- Reconfigurable Manufacturing System
- Micro Air Vehicle
- Adhoc Wireless Networks
- Software Testing
- Liquid Lens
- Monorail
- Artificial Eye
- Biometric Voting System
- Infrared Plastic Solar Cell
- Solar Mobile Charger

UNIT-I
Assignment-Cum-Tutorial Questions
SECTION-A

Objective Questions

- 1) What is Software?
 - a) Software is set of programs.
 - b) Software is documentation and configuration of data.
 - c) Both a and b
 - d) None of the mentioned
- 2) What are the characteristics of software?
 - a) Software is developed or engineered; it is not manufactured in the classical sense.
 - b) Software doesn't "wear out".
 - c) Software can be custom built or custom build.
 - d) All mentioned above
- 3) The process of developing a software product using software engineering principles and methods is referred to as, _____.
 - a) Software myths
 - b) Scientific Product
 - c) Software Evolution
 - d) None of the above
- 4) Software consists of _____.
 - a) Set of instructions + operating procedures

- b) Programs + documentation + operating procedures
 - c) Programs + hardware manuals
 - d) Set of program
- 5) The extent to which the software can continue to operate correctly despite the introduction of invalid inputs is called as
- a) Reliability
 - b) Robustness
 - c) Fault Tolerance
 - d) Portability
 - e) All of the above.
- 6) As per an IBM report, “31%of the project get cancelled before they are completed, 53% overrun their cost estimates by an average of 189% and for every 100 projects, there are 94 restarts”. What is the reason for these statistics?
- a)Lack of adequate training in software engineering
 - b)Lack of software ethics and understanding
 - c)Management issues in the company
 - d) All of the mentioned
- 7) Compilers, Editors software comes under which type of software?
- a) System software b) Application software
 - c) Scientific software d) None of the above
- 8) Which of the following cannot be applied with the software according to Software Engineering Layers?
- a) Process b) Methods
 - c) Manufacturing d) None of the above.
- 9) Choose the correct option according to the given statement.
- Statement 1: Software is a physical rather than a logical system element.
- Statement 2: Computer software is the product that software engineers design and build.
- Statement 3: Software is a logical rather than a physical system element.
- Statement 4: Software is a set of application programs that are built by software engineers.
- a) Statement 1 and 2 are correct.
 - b) Only Statements 2 and 3 are correct.
 - c) Statements 2, 3 and 4 are correct
- 10) From the following which quality deals with maintaining the quality of the software product?
- a) Quality assurance b)Quality control
 - b) Quality efficiency d)None of the above

- 11) Which one of the following is not a symptom of the present software crisis:
- Software is expensive
 - It takes too long to build a software product
 - Software is delivered late
 - Software products are required to perform very complex tasks
- 12) Which one of the following characteristics of software products being developed is not a symptom of software crisis?
- Fail to meet user requirements
 - Expensive
 - Highly interactive
 - Difficult to alter, debug, and enhance
- 13) Why is writing easily modifiable code important? []
- Easily modifiable code results in quicker run time
 - Most real world programs require change at some point of time or other
 - Most text editors make it mandatory to write modifiable code
 - Several developers may write different parts of a large program

SECTION-B

SUBJECTIVE QUESTIONS

- Define Software and Software Engineering? List out the important characteristics of software.
- Discuss the changing nature of the software.
- Identify different Myths and Realities related to software. Explain briefly.
- Describe the major driving forces of a Software Project.
- Illustrate different Software Quality Attributes? Explain briefly.
- Give a conclusion about the statement “Software is easy to change, because Software is flexible”
- Analyze how the Failure Curve of Hardware and Software can be differentiated?
- Categorize some problems that will come up if the methods you currently use for developing small software are used for developing large software systems.
- Suppose a program for solving a problem cost C and industrial strength software for solving that problem costs $10C$. where do you think this extra $9C$ cost is spent? suggest a possible breakdown of this extra cost.

SECTION-C

GATE QUESTIONS

- If you are given extra time to improve the reliability of the final product developing a software product, where would you spend this extra time?

UNIT-II
SECTION-A

Objective Questions

- 1) Which of the following is a characteristic of Agile development? []
 - a) Shared code ownership
 - b) Implement the simplest solution to meet today's problem
 - c) Continual feedback from customer
 - d) test-driven development
 - e) All of the above
- 2) In waterfall model, output of one phase is input to next phase. []
 - a) True
 - b) False
- 3) If requirements are easily understandable and defined then which model is best suited?
 - a) Waterfall Model
 - b) Iterative Development Model
 - c) Prototyping
 - d) Extreme Programming
- 4) Which of the following are advantages of iterative model? []
 - a) Early revenue generation
 - b) Simpler to manage
 - c) Divided workload
 - d) Early feedback
 - e) All the above
- 5) Which phase of the RUP is used to establish a business case for the system []
 - a) Transition
 - b) Elaboration
 - c) Construction
 - d) Inception
- 6.) In XP Increments are delivered to customers every _____ weeks. []
 - a) One
 - b) Two
 - c) Three
 - d) Four
- 7) In a college, students are asked to develop a software. Which model would be Preferable? []
 - a) Waterfall model
 - b) Spiral model
 - c) Agile model
 - d) Code and fix model
- 8) Which of the following life cycle model can be chosen if the development team has less experience on similar projects? []
 - a) Spiral
 - b) Waterfall
 - c) Prototyping
 - d) Iterative Enhancement Model
- 11) Which four framework activities are found in the Extreme Programming(XP)?

- a) analysis, design, coding, testing
 - b) planning, analysis, design, coding
 - c) planning, design, coding, testing
 - d) planning, analysis, coding, testing
- 12) An iterative process of system development in which requirements are converted to a working system that is continually revised through close work between an analyst and user is called_____
- a) Waterfall modeling
 - b) Iterative modeling
 - c) Spiral modeling
 - d) None of these above
- 13) A company is developing an advance version of their current software available in the market, what model approach would they prefer ?
- a) waterfall
 - b) Prototyping
 - c) Iterative Enhancement
 - d) Spiral
- 14) Which one of the following statements most accurately identifies the stakeholders in a software development project?
- a) A stakeholder of the organization developing the software
 - b) Anyone who is interested in the software
 - c) Anyone who is a source of requirements for the software
 - d) Anyone who might be affected by the software

SECTION-B

SUBJECTIVE QUESTIONS

- 1) What is a process model? How do process models differ from one another?
- 2) What is the oldest paradigm for software engineering? Why does the waterfall model sometimes fail?
- 3) Write about the Rational unified process model in detail.
- 4) Compare the waterfall model with the Unified process model.
- 5) Explain about agile methodology & extreme programming as software development process models.
- 6) Describe prototyping model in detail. Discuss how to select a particular process model based on characteristics of a project.
- 7) Categorize the strengths and weaknesses of waterfall, iterative development and prototyping.
- 8) Analyze why does iterative process makes it easier to manage change.
- 9) Is it possible to combine the process models? If so explain with an example.
- 10) Which process model is suitable for medium scale projects, justify it.

SECTION-C

GATE QUESTIONS

1) Match the following:

- | | |
|---|---|
| 1. Waterfall Model | a) Specifications can be developed incrementally |
| 2. Evolutionary Model | b) Requirements compromises are inevitable |
| 3. Component-based Software Engineering | c) Explicit recognition of risk |
| 4. Spiral Development | d) Inflexible partitioning of the project into stages |

(a) 1-a, 2-b, 3-c, 4-d

(b) 1-d, 2-a, 3-b, 4-c

(c) 1-d, 2-b, 3-a, 4-c

(d) 1-c, 2-a, 3-b, 4-d

(Gate CS 2015)

2) Which one of the following is TRUE?

(a) The requirements document also describes how the requirements that are listed in the document are implemented efficiently.

(b) Consistency and completeness of functional requirements are always achieved in practice.

(c) Prototyping is a method of requirements validation.

(d) Requirements review is carried out to find the errors in system design

(GATE CS 2014)

3) What is the appropriate pairing of items in the two columns listing various activities encountered in a software life cycle?

P. Requirements Capture

1. Module Development and Integration

Q. Design

2. Domain Analysis

R. Implementation

3. Structural and Behavioral Modeling

S. Maintenance

4. Performance Tuning

a) P-3, Q-2, R-4, S-1

(b) P-2, Q-3, R-1, S-4

(c) P-3, Q-2, R-1, S-4

(d) P-2, Q-3, R-4, S-1

(GATE CS 2010)

UNIT-IV

A) Objective Questions

1. What is the final outcome of requirements analysis and specification phase?

- a) Drawing the data flow diagram b) The SRS document
c) Coding the project d) The user manual

2. Which of the following is not included in SRS document?

- a) Functional requirements b) Non functional requirements
c) Goals of implementation d) User manual

3. As Software Manager, when you will decide the number of people required for a software project?

- a) Before the scope is determined.
b) Before an estimate of the development effort is made
c) After an estimate of the development effort is made.

- d) None of the above
4. Which of the following is not a 'concern' during the management of a software project?
- a) Money
 - b) Time
 - c) Product quality
 - d) Project/product information
 - e) Product quantity
- 5) How does a software project manager need to act to minimize the risk of software failure?
- a) Double the project team size
 - b) Request a large budget
 - c) Form a small software team
 - d) Track progress
 - e) Request for more period of time.
- 6) Which one of the following is a functional requirement
- a) Maintainability
 - b) Portability
 - c) Robustness
 - d) None of the mentioned
- 7) The Software Requirement Specification(SRS) is said to be _____ if and only if no subset of individual requirements described in it conflict with each other.
- a) Correct
 - b) Consistent
 - c) Unambiguous
 - d) Verifiable
- 8) Which one of the following is NOT desired in a good software requirement specifications(SRS) document?
- a) Functional requirements
 - b) Non-Functional requirements
 - c) Goals of implementations
 - d) Algorithm for software implementation.
- 9) When is the requirement specification activity carried out?
- a) During requirements gathering activity
 - b) Before requirements analysis activity
 - c) Before requirements gathering activity
 - d) After requirements analysis activity
- 10) Which one of the following is not a requirements gathering technique?
- a) Task analysis
 - b) Scenario analysis
 - c) Form analysis

d) SRS document review

B) Descriptive Questions

- 1) Explain briefly the value of good SRS and the Requirements Engineering Process.
- 2) Give the Structure of Software Requirements Specification Document.
- 3) Design a SRS Document for Online Banking System?
- 4) Describe the Functional Specification Technique with use cases.
- 5) What is SRS? Discuss the characteristics of SRS.
- 6) Design a SRS Document for ATM System?
- 7) Design a SRS Document for Library Management System?
- 8) Briefly describe the functional specification with usecase with an example of auction system.

C) Previous Gate Questions

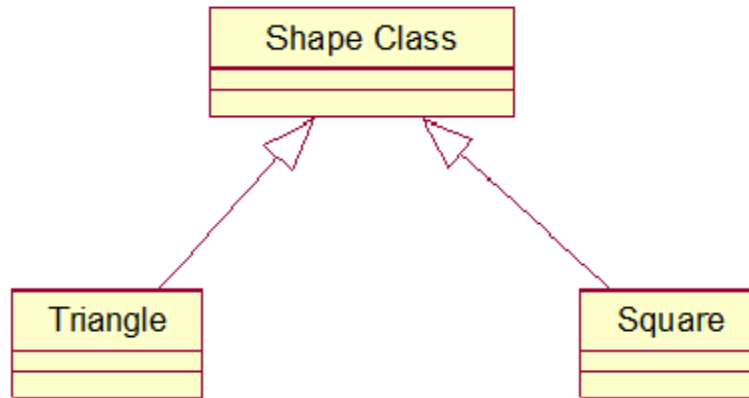
- 1) Which one of the following is NOT desired in a good Software Requirement Specifications (SRS) document? **(GATE 2011)**
 - a) Functional Requirements
 - b) Non-Functional Requirements
 - c) Goals of Implementation
 - d) Algorithms for software implementation
- 2) A Software Requirements Specification (SRS) document should avoid discussing which one of the following? **(GATE 2015)**
 - a) User interface issues
 - b) Non-functional requirements
 - c) Design specification
 - d) Interfaces with third party software
- 3) Software requirement Specification(SRS) is also known as specification of: **(Nielit Scientist-2016)**
 - a) White box testing
 - b) Grey box testing
 - c) Acceptance testing
 - d) Black box testing

UNIT V

A) Objective Questions

- 1) A component model defines standards for
 - a) Properties
 - b) Methods
 - c) Mechanisms
 - d) All of the mentioned
- 2) What makes a good architecture?

- a) The architecture may not be the product of a single architect or a small group
 - b) The architect should have the technical requirements for the system and an articulated and prioritized list of qualitative properties
 - c) The architecture may not be well documented
 - d) All of the mentioned
- 3) To capture and access data from the store by various components we use
- a) Component Connector Structure
 - b) Work-Allocation of Modules
 - c) Component and Hardware Dependency
 - d) Module Dependency Structure
- 4) Identify the architectural style which is most frequently used as web system backend
- a) Client Server Architectural Style
 - b) Shared Data Style
 - c) Peer to-Peer Style / Object Oriented Style
 - d) Publish-Subscribe Style
- 5) Select the architectural style which is used for Events like Mouse Clicking, mouse drag and database events etc
- a) Peer-to-Peer Style
 - b) Client server Style
 - c) shared Data style
 - d) Publish-Subscribe Style
- 6) Which of the following can be considered regarding client and server?
- a) Client and Server is an architectural style
 - b) Client and Server may be considered as an architectural style
 - c) Client and Server is not an architectural style
 - d) None of the mentioned
- 7) Choose the option that does not define Function Oriented Software Design
- a) It consists of module definitions
 - b) Modules represent data abstraction
 - c) Modules support functional abstraction
 - d) None of the above
- 8) What type of relationship is represented by Shape class and Square ?



- a) Realization
- b) Generalization
- c) Aggregation
- d) Dependency

9) Which diagram in UML shows a complete or partial view of the structure of a modelled system at a specific time?

- a) Sequence Diagram
- b) Collaboration Diagram
- c) Class Diagram
- d) Object Diagram

10) Which design defines the logical structure of each module and their interfaces that is used to communicate with other modules.

- a) High level design
- b) Architectural Design
- c) Detailed design
- d) All mentioned above

B) Descriptive Questions

- 1) What is a Software Architecture? Explain important uses of software architecture?
- 2) Write about the Architecture views in detail.
- 3) Briefly explain about Architecture Styles in detail.
- 4) Identify first level factoring activities for design methodology and apply that for ATM.
- 5) Differentiate the Component and Connector views.
- 6) Illustrate architecture diagram for Student Survey System.
- 7) Apply the suitable style for course scheduling.
- 8) Illustrate the Authentication and cache management in the Architecture of survey system.
- 9) Illustrate structure chart of the sort program for
 - a. Representation of different types of Modules.
 - b. Iteration and decision representation.
- 10) What are the metrics that can be used to study complexity of an object-oriented design.
- 11) Draw DFDs for
 - a. ATM and

- b. Word Count problem.

C) Previous GATE/UGC NET Questions:

- 1) _____ of a system is the structure or structures of the system which comprise software elements, the externally visible properties of these elements and the relationship amongst them. [UGC NET JUNE 2013]
- a) Software construction b) Software evolution
c) Software architecture d) Software reuse

UNIT –VI

A) Objective Questions

- White-box testing, sometimes called _____.
- The testing technique that requires preparing test cases to exercise the internal logic of a software module is
a) Behavioural Software Testing b) Black-box Testing
c) Grey-box Testing d) White-box Testing
- White-box testing uses the _____ structure of the procedural design to derive test cases.
b) Behaviour b) Control
c) Ariel d) None of the mentioned
- Which one of the following testing techniques is effective in testing whether a developed software meets its non-functional requirements?
a) Path testing b) Dataflow testing
c) Robust boundary-value testing d) Performance testing
- Which one of the following is a fault-based testing technique?
a) Pair wise testing b) Dataflow testing
c) Path testing d) Mutation testing
- Suppose a certain function takes 5 Integer input parameters. The valid values for each parameter takes an integer value in the range 1..100. What is the minimum number of test cases required for robust boundary value testing?
a) 20 b) 21 c) 30 d) 31
- Scenario coverage testing can be considered to be which one of the following types of testing strategies?
a) Pair-wise testing
b) Decision table-based testing
c) Equivalence partitioning-based testing
d) Boundary value-based testing

8. Which one of the following types of bugs may not get detected in black-box testing, but are very likely to be detected by white-box testing?
- a) Syntax errors b) Behavioral errors
c) Logic errors d) Performance errors
9. Cause-effect test cases are, in effect, designed using which one of the following types of testing techniques?
- a) Decision-table based testing b) Coverage-based testing
c) Fault-based testing d) Path-based testing
10. If a user interface has three checkboxes, at least how many test cases are required to achieve pair-wise coverage?
- a) 3 b) 4
c) 5 d) 6
11. Among the following test techniques, which one of the following is the strongest?
- a) All path coverage testing b) Decision coverage testing
c) Basic condition coverage testing d) MC/DC testing

B) Descriptive Questions

1. Explain different programming principles and guidelines on publicly available standards.
2. (a) Differentiate Error, Fault and Failure.
(b) What is Test Case and Test Criteria?
3. Explain Cause-Effect Graph technique with decision table.
4. Explain about Mutation Testing and write the steps for mutation testing.
5. Analyze boundary value Analysis with formulas.
6. Apply state based testing for any example and draw state model and state table.
7. Identify def, C-use and P-use in data-flow based testing and draw data-flow graph for any example.
8. A program takes an angle as input within the range $[0,360]$ and determines in which quadrant the angle lies. Design test cases using equivalence class partitioning method.
- 9) What would be the Cyclomatic complexity of the following program?

```

int find-maximum(int i, int j, int k){
    int max;
    if(i>j) then
    if(i>k) then max=i;
    else max=k;
    else if(j>k) max=j
    else max=k;
    return(max);
}

```
10. Sketch Reliability Model for failure intensity and also with respect to time.

C) Previous GATE Questions:

4) The following is the comment written for a C function.

```

/* This function computes the roots of a quadratic equation
   a.x^2 + b.x + c = . The function stores two real roots
   in *root1 and *root2 and returns the status of validity
   of roots. It handles four different kinds of cases.
   (i) When coefficient a is zero irrespective of discriminant
   (ii) When discriminant is positive
   (iii) When discriminant is zero
   (iv) When discriminant is negative.
   Only in case (ii) and (iii) the stored roots are valid.
   Otherwise 0 is stored in roots. The function returns
   0 when the roots are valid and -1 otherwise.
   The function also ensures root1 >= root2
   int get_QuadRoots( float a, float b, float c,
                     float *root1, float *root2);

```

A software test engineer is assigned the job of doing black box testing. He comes up with the following test cases, many of which are redundant

Test Case	Input Set			Expected Output Set		
	a	b	c	root1	root2	Return Value
T1	0	0	7	0	0	-1
T2	0	1	3	0	0	-1
T3	1	2	1	-1	-1	0
T4	4	-12	9	1.5	1.5	0
T5	1	-2	-3	3	-1	0
T6	1	1	4	0	0	-1

Which one of the following option provide the set of non-redundant tests using equivalence class partitioning approach from input perspective for black box testing?

- A) T1, T2, T3, T6
- B) T1, T3, T4, T5
- C) T2, T4, T5, T6**
- D) T2, T3, T4, T5

(GATE 2011)

5) The following program is to be tested for statement coverage:

```

begin
    if (a== b) {S1; exit;}
    else if (c== d) {S2;}
        else {S3; exit;}
    S4;
end

```

The test cases T1, T2, T3 and T4 given below are expressed in terms of the properties satisfied by the values of variables a, b, c and d. The exact values are not given. T1 : a, b, c and d are all equal T2 : a, b, c and d are all distinct T3 : a = b and c != d T4 : a != b and c = d Which of the test suites given below ensures coverage of statements S1, S2, S3 and S4?

A) T1, T2, T3

B) T2, T4

C) T3, T4

D) T1, T2, T4

6) Match the following:

List-I

a. Condition coverage

b. Equivalence class partitioning

c. Volume testing

d. Alpha testing

A) a - 2 b - 3 c - 1 d - 4

B) a - 3 b - 4 c - 2 d - 1

C) a - 3 b - 1 c - 4 d - 2

D) a - 3 b - 1 c - 2 d - 4

(GATE 2010)

List-II

1. Black-box testing

2. System testing

3. White-box testing

4. Performance testing

(GATE 2015)

Signature of the Faculty

HANDOUT ON WEB TECHNOLOGIES

Class & Sem. : III B.Tech – I Semester

Year : 2020-21

Branch : CSE

Credits: 3

1. Brief History and Scope of the Subject

- **HTML** : The founder of **HTML** was Tim Berners-Lee and his product was made attractive to the general public by Mosaic browser which was evolved at *NCSA*. It has become extremely popular and well-known in the 1990's when the Internet had been developing rapidly. During this period, HTML was broadened and presented in different modifications. The Internet strongly depends on vendors and page creators who share the joint conventions for HTML. The understanding that success of Web development is based on integration of the rules has helped the Web community to create united specifications for HTML.
- **JavaScript** (sometimes abbreviated JS) is a prototype-based scripting language that is dynamic, weakly typed and has first-class functions. It is a multi-paradigm language, supporting object-oriented, imperative, and functional programming styles.
- **Java Server Pages (JSP)** is a technology that helps software developers create dynamically generated web pages based on HTML, XML, or other document types. Released in 1999 by Sun Microsystems^[1], JSP is similar to PHP, but it uses the Java programming language. To deploy and run Java Server Pages, a compatible web server with a servlet container, such as Apache Tomcat or Jetty, is required. The JSP technology is an *open*, freely available specification developed by Sun Microsystems as an alternative to Microsoft's Active Server Pages (ASP) technology, and a key component of the Java 2 Enterprise Edition (J2EE) specification. Many of the commercially available application servers (such as BEA WebLogic, IBM WebSphere, Live JRun, Orion, and so on) already support JSP technology.
- **PHP**: Hypertext Preprocessor (or simply PHP) is a general-purpose programming language originally designed for web development. PHP development began in 1994 when Rasmus Lerdorf wrote several Common Gateway Interface (CGI) programs in C, which he used to maintain his personal homepage. PHP code may be executed with a command line interface (CLI), embedded into HTML code, or it can be used in combination with various web template systems, web content management systems, and web frameworks.

2. Pre-Requisites:

- Need to have an idea on Object oriented concepts and Java Programming language.
- Need to have a practice on various programming language constructs.
- Should be able to write database queries

3. Course Objectives:

- To familiarize with various technologies like HTML, CSS, JavaScript, XML, JSP and PHP to develop real-time web applications.

4. Course Outcomes:

- identify various HTML tags and their purpose
- develop dynamic web pages using HTML, CSS and Javascript
- use XML to store and transport data
- design web applications using JSP and PHP
- connect to heterogeneous databases using JSP as well as PHP

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1.Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2.Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3.Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4.Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5.Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6.The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

CO4: design web applications using JSP and PHP.	2	2	3	1	3	2								2	2	3
CO5: connect to heterogeneous databases using JSP as well as PHP	1	2	3	2	3									2	2	2

7. Prescribed Text Books:

- Chris Bates, “Web Programming, Building Internet Applications”, 2nd edition, Wiley Dreamtech.
- Kogent Learning Solutions, “Web Technologies, Black book”, Dreamtech press.

8. Reference Text Books:

- Uttam K Roy, “Web Technologies”, Oxford.
- Robert W Sebesta, “Programming the World Wide Web”, 7th edition, Pearson.
- John Duckett, “Beginning Web Programming with HTML, XHTML, and CSS”, 2nd edition

9. URLs and Other E-Learning Resources

- www.w3schools.com
- <https://www.geeksforgeeks.org/web-technology/>
- <https://www.tutorialspoint.com/html/>

10. Digital Learning Materials:

- <https://gec.digimat.in/nptel/courses/video/106105084/L13.html>
- <https://gec.digimat.in/nptel/courses/video/106105084/L14.html>
- <https://gec.digimat.in/nptel/courses/video/106105084/L15.html>
- <https://gec.digimat.in/nptel/courses/video/106105084/L16.html>
- <https://gec.digimat.in/nptel/courses/video/106105084/L17.html>
- <https://gec.digimat.in/nptel/courses/video/106105084/L25.html>
- <https://gec.digimat.in/nptel/courses/video/106105084/L26.html>

11. Lecture Schedule / Lesson Plan (4)

Topics	No. of Periods
UNIT - I: HTML and CSS	
HTML: Basic HTML tags	1
working with lists	2
tables	2

forms	2
frames	2
iframes and images	1
Cascading Style sheets: CSS rules, Selectors	1
types of CSS	2
CSS properties for styling backgrounds, text, fonts	1
CSS properties for cursors and links	1
	15
UNIT - II: JavaScript	
Introduction to javascript	1
variables, data types, operators	1
control flow statements	1
built-in objects	2
functions	1
event handling	2
DHTML with java script	1
	09
UNIT - III: XML	
Basic building blocks	1
validating XML documents using DTD	2
XML schemas	2
XML Parsers: DOM and SAX	2
XSLT	2
	09
UNIT - IV: JSP	
Introduction to web servers	1
the anatomy of a JSP page: directives, actions, scripting elements	2
implicit JSP objects	1
life cycle	1
declaring variables and methods	1
passing control and data between JSP pages	1

sharing session and application data	1
	08
UNIT - V: PHP Programming	
Introduction: Creating and running a PHP script	1
using variables, constants	1
data types and operators	1
control statements	1
arrays	1
functions	1
Forms: Processing a web form	1
validating a web form and enforcing data rules	2
	09
UNIT - VI: Database Connectivity using JSP and PHP	
JDBC drivers	1
database programming using JDBC	1
accessing a database from a JSP page	2
performing various operations on database	2
Introduction to MySQL	1
connecting to MySQL server using PHP	1
performing various operations on database	2
	10
Total	60

12. Seminar Topics:

- Javascript: Control flow Statements
- Database queries

UNIT-I Assignment-Cum-Tutorial Questions SECTION-A

Objective Questions

1. HTML Stands for _____
2. Latest version of HTML in use is _____
A) 4 B).5 C). 6 D). 7

3. HTML Tags are Case Sensitive. (True / false)
4. How to define the link should open in new page in HTML?
 - A). `Click Here`
 - B). ` Click Here `
 - C). ` Click Here `
 - D). ` Click Here `
5. Which of these elements are all `<table>` elements?
 - A). `<table><tr><td>` B). `<table><tr><tt>`
 - C). `<thead><body><tr>` D). `<table><head><tfoot>`
6. The following `<table>` tag attribute specifies the space between Cell Wall and the Content present inside a cell
 - A) Cellspacing B). Cellpadding
 - C) letter-spacing D) word-spacing
7. What is the correct HTML for making a drop-down list
 - A). `<input type="list">` B). `<list>`
 - C). `<select>` D). `<input type="dropdown">`
8. Which of the following is correct HTML for inserting an image? []
 - A). `<image source= "admin.jpg" alt= "This is GEC" />`
 - B). ``
 - C). ``
 - D). `admin.jpg`
9. A HTML form is to be designed to enable purchase of office stationery. Required items are to be selected (checked). Credit card details are to be entered and then the submit button is to be pressed. Which one of the following options would be appropriate for sending the data to the server. Assume that security is handled in a way that is transparent to the form design.
 - A). Only GET
 - B). Only POST
 - C). Either of GET or POST
 - D). Neither GET nor POST
10. How can you open a link in a new browser window?

- A).
 - B).
 - C).
 - D).
11. How can you make an e-mail link?
- A). <mail href +"xxx@y.com">
 - B).
 - C).
 - D). Both (b) and (c)
12. Which is the correct CSS syntax?
- A). body {color: black;} B). {body;color:black;}
 - C). body:color=black; D). {body:color=black;}
13. To add a background color for all h1 elements, which of the following HTML syntax is used
- A) h1 { background-color :#FFFFFF}
 - B) { background-color :#FFFFFF} . h1
 - C) h1 { background-color :#FFFFFF} . h1(all)
 - D) h1. all{bgcolor= #FFFFFF}
14. _____ tag is used to attach External CSS file to a Web Page
- A) a B) link C) href D) Style
15. Which HTML attribute is used to define inline styles?
- A) Style B) id C) Class D) Styles
16. Which of the following statements is TRUE for CSS
- A) An external style sheet is ideal when the style is applied to many pages
 - B) An inline style sheet should be used when a single document has a unique style
 - C) Both A and B above
 - D) An external style sheet can be written in HTML
17. Which of the following property of a anchor element signifies an element on which the user is currently clicking?
- A) :link B) :visited C) :hover D) :active
18. Which of the following property is used to control the scrolling of an image in the background?

- A) background-attachment B) background
 C) background-repeat D) background-position
19. Which CSS property controls the text size?
 A) text-style B) text-size
 C) font-style D) font-size
20. Which of the following property is used to underline, overline, and strikethrough text?
 A) text-indent B) text-align
 C) text-decoration D) text-transform

SECTION-B

SUBJECTIVE QUESTIONS

1. What is HTML? List out Common HTML tags with an example.
2. What are the different types of lists in HTML? Explain how these lists are created in HTML with suitable examples.
3. What is HTML <table> tag? Explain <table> sub-tags with an example.
4. What is a frame? What is the advantage of using a frame? Clearly explain the creation of frames with an example.
5. Explain how frames are created with an example?
6. What is a stylesheet 'class'? What are the advantages of CSS?
7. Define CSS and explain in detail different types of cascading style sheets with examples.
8. Explain the following CSS Properties with example
 - 1). background-attachment 2). background-image
 - 3). text-decoration 4). text-transform
 - 5). font-family 6). font-weight
 - 7). cursor
9. Design the following web page using HTML lists (Hint: Nested List)

-
- ```

1. Fruits
 o Apple
 o Banana
2. Flowers
 A. Rose
 B. Jasmine
3. Drinks
 • COffee:
 Black Hot drink
 • Milk:
 White COld Drink

```

10. Design the following table structure using HTML

| HTML Table |                                                                                                                                                                                                               |                   |  |          |          |          |          |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|--|----------|----------|----------|----------|
| Cell 1     | Cell 2                                                                                                                                                                                                        |                   |  |          |          |          |          |
|            | <table border="1"> <thead> <tr> <th colspan="2">Nested HTML Table</th> </tr> </thead> <tbody> <tr> <td>Cell 2.1</td> <td>Cell 2.2</td> </tr> <tr> <td>Cell 2.3</td> <td>Cell 2.4</td> </tr> </tbody> </table> | Nested HTML Table |  | Cell 2.1 | Cell 2.2 | Cell 2.3 | Cell 2.4 |
|            | Nested HTML Table                                                                                                                                                                                             |                   |  |          |          |          |          |
| Cell 2.1   | Cell 2.2                                                                                                                                                                                                      |                   |  |          |          |          |          |
| Cell 2.3   | Cell 2.4                                                                                                                                                                                                      |                   |  |          |          |          |          |

11. Design the following web page using HTML Frames. Fill all the Frames with different colors



12. Design the following Registration form using HTML

### REGISTRATION FORM

|                 |                                                                                           |
|-----------------|-------------------------------------------------------------------------------------------|
| Name            | <input type="text"/>                                                                      |
| Address         | <input type="text"/>                                                                      |
| Zip Code        | <input type="text"/>                                                                      |
| Country         | <input type="text" value="Please select..."/>                                             |
| Gender          | <input type="radio"/> Male <input type="radio"/> Female                                   |
| Preferences     | <input type="checkbox"/> Red <input type="checkbox"/> Green <input type="checkbox"/> Blue |
| Phone           | <input type="text"/>                                                                      |
| Email           | <input type="text"/>                                                                      |
| Password        | <input type="text"/>                                                                      |
| Verify Password | <input type="text"/>                                                                      |
|                 | <input type="button" value="SEND"/> <input type="button" value="CLEAR"/>                  |

13. Design the following web page using CSS Style sheet Class (Use CSS Text & Font Properties)

THIS PARAGRAPH IS STYLED BY CLASS LEFT

*This Paragraph Is Styled By Class Left*

14. Create a HTML that has five frames. There must be two rows of frames the first with three frames and the other with two frames. The frames in the first row must have equal width. The left frame in the second row must be 50 percent of the width of display. Each of the frames in the top row must display a document that has a form. The left top frame must have two text boxes, each 30 characters wide, labeled Name and Address. The middle top must have five radio buttons with color name labels. The right top frame must have four check boxes, labeled with four kinds of car equipment such as a CD player and air Conditioning. The two bottom frames must have images of two different cars. The top row of frames must use 20 percent of the height of the display.

### SECTION-C

#### GATE QUESTIONS:

1. In a web server, ten WebPages are stored with the URLs of the form <http://www.yourname.com/var.html>; where *var* is a different number from 1 to 10 for each Webpage. Suppose the client stores the Webpage with *var* = 1 (say W1) in the local machine, edits and then tests. Rest of the Webpages remains on the web server. W1 contains several relative URLs of the form "*var.html*" referring to the other Webpages. Which one of the following statements needs to be added in W1, so that all the relative URLs in W1 refer to the appropriate Webpages on the web server?

**GATE-CS 2015**

- A) `<a href: "http://www.yourname.com/", href:"...var.html">`  
B) `<base href: "http://www.yourname.com/">`  
C) `<a href: "http://www.yourname.com/">`  
D) `<base href: "http://www.yourname.com/", range:"...var.html">`
2. Consider a HTML table definition given below:

**GATE-CS-2009**

```
<table border=1>
 <tr> <td rowspan=2> ab </td>
```





appropriate for sending the data to the server. Assume that security is handled in a way that is transparent to the form design.

**GATE-IT-2005**

- A). Only GET
- B). Either of GET or POST
- C) Only POST
- D) Neither GET nor POST

8. Given below are several usages of the anchor tag in HTML. **GATE-IT-2004**

- I. <A HREF = "http://www.gate.ac.in/HTML/BASIC/testpage.html">Test Me</A>
- II. <A HREF = "/BASIC/testpage.html">Test Me</A>
- III. <A HREF = "testpage.html">Test Me</A>
- IV. <A HREF = "testpage.html#test">Test Me</A>

Which of the above are valid?

- (A) I and II only
- (B) I and III only
- (C) I, II and III only
- (D) I, II, III and IV

**UNIT-II**

**SECTION-A**

**Objective Questions**

- 1. \_\_\_\_\_ tag is an extension to HTML that can enclose any number of JavaScript statements.
  - A. <SCRIPT>
  - B. <BODY>
  - C. <HEAD>
  - D. <TITLE>
- 2. Which of the following best describes JavaScript?
  - A. a low-level programming language.
  - B. a scripting language precompiled in the browser.
  - C. a compiled scripting language.
  - D. an object-based scripting language
- 3. JavaScript is designed for following purpose
  - A. To Style HTML Pages
  - B. To Perform Server Side Scripting Operation
  - C. To Execute Query Related to DB on Server
  - D. To add interactivity to HTML Pages
- 4. We can declare all type of variables in JavaScript with the keyword \_\_\_\_\_.
  - A. obj
  - B. jvar
  - C. var
  - D. None of these

5. Is JavaScript a case-sensitive language?  
A. Yes                      B. No
6. Browser object is also called as \_\_\_\_\_ Object.
7. Javascript and Java has similar name because \_\_\_\_\_ is/are true.  
(a) Javascripts syntax is loosely based on Java's syntax  
(b) Javascript is stripped down version of Java  
(c) Java and Javascript are originated from Island of Java

Codes:

- A. only  
B. (a), (b) and (c)  
C. (a) and (b)  
D. (b) and (c)
8. What is the correct JavaScript syntax to write "Hello World"?  
A. `System.out.println("Hello World")`  
B. `println ("Hello World")`  
C. `document.write("Hello World")`  
D. `response.write("Hello World")`
9. How do you create a function in JavaScript?  
A. `function = myFunction()`  
B. `function myFunction()`  
C. `function:myFunction()`  
D. `myFunction()`
10. `<script language="javascript">`  
`function x()`  
`{`  
`document.write(2+5+"8");`  
`}`  
`</script>`  
A. 258    B. Error    C. 7    D. 78
11. What is the correct syntax for referring to an external script called " abc.js"?  
A. `<script href=" abc.js">`    B. `<script name=" abc.js">`  
C. `<script src=" abc.js">`    D. None of the above
12. How to create a Date object in JavaScript?  
A. `dateObjectName = new Date([parameters])`

- B. `dateObjectName.new Date([parameters])`
  - C. `dateObjectName := new Date([parameters])`
  - E. `dateObjectName Date([parameters])`
13. Which is the correct way to write a JavaScript array?
- A. `var txt = new Array(1:"tim",2:"kim",3:"jim")`
  - B. `var txt = new Array:1=("tim")2=("kim")3=("jim")`
  - C. `var txt = new Array("tim","kim","jim")`
  - D. `var txt = new Array="tim","kim","jim"`
14. Which event occurs when the user clicks on an HTML element?
- A. `onclick`
  - B. `onmouseclick`
  - C. `onchange`
  - D. `onmouseover`

## SECTION-B

### SUBJECTIVE QUESTIONS

1. Define JavaScript and Describe Primitive Data Types that JavaScript uses.
2. Differentiate Java with JavaScript
3. Define a variable. Explain different Scoping rules associated with variables in JavaScript with example.
4. What is a function? Explain how parameters are passed to a function in JavaScript.
5. Explain various control statements available with JavaScript.
6. Write the properties and methods of the following JavaScript Objects.
  - a) Document   b) Form   c) Window   d) Browser   e) Math
7. What is an Event? Explain how events are handled in JavaScript with an Example.
8. Write about Dynamic HTML and Differentiate HTML with DHTML.
9. Write a JavaScript that reads an integer and determines and displays whether it is an odd or even number?
10. Write a JavaScript code to Print all numbers from 1 to 100 except multiples of 3
11. Write a JavaScript to check whether given two numbers are equal or not. If not, Display the Largest & Smallest among those two.
12. Write a JavaScript that reads an Integer and determine whether it is Prime Number or not
13. Write a JavaScript that reads an Integer and print its factorial.

14. Write a JavaScript which reads a number given and displays the output in words (Eg:- Given 123, Output should be ONE TWO THREE)
15. Write a JavaScript program to validate Login form consisting of username and password (use regular expressions).
16. Create a JavaScript which has event handlers for the buttons “red”, “blue”, “green”, “yellow” and “orange” which must produce messages stating the chosen favorite color and applies it as a background.

**Signature of the Faculty**

## HANDOUT ON ADVANCED DATA STRUCTURES

Class & Sem. : III B.Tech – I Semester

Year: 2020-21

Branch : CSE

Credits: 3

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### 1. Brief History and Scope of the Subject

In computer science, a **data structure** is a particular way of storing and organizing data in a computer so that it can be used efficiently.

Different kinds of data structures are suited to different kinds of applications, and some are highly specialized to specific tasks. For example, B-trees are particularly well-suited for implementation of databases, while compiler implementations usually use hash tables to look up identifiers.

Data structures are used in almost every program or software system. Data structures provide a means to manage huge amounts of data efficiently, such as large databases and internet indexing services. Usually, efficient data structures are a key to designing efficient algorithms. Some formal design methods and programming languages emphasize data structures, rather than algorithms, as the key organizing factor in software design.

### 2.Pre-Requisites

- Knowledge of any programming language that supports pointers for referencing.
- Knowledge of Basic Data structures

### 3.Course Objectives:

- To explore dictionaries, priority queue, balance trees and pattern matching algorithms.
- To gain knowledge of graph operations, graph algorithms and external sorting

### 4.Course Outcomes:

- Co1:** Illustrate representations of sets and operations on sets and dictionaries.
- Co2:** Construct Priority queues such as min heap and max heap for the given data.

**Co3:** Create AVL, Red Black, Splay, B and B+ Trees for the given data and perform insertion, deletion and search operations on them.

**Co4:** Search for a pattern in the given text using Pattern Matching Techniques.

**Co5:** Demonstrate insertion and search operations on tries and also list its applications.

### **5.Program Outcomes:**

#### **Computer Science and Engineering Graduates will be able to:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to

comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### Program Specific Outcomes (PSOs)

**PSO1 :** Design, develop, test and maintain reliable software systems and intelligent systems.

**PSO2 :** Design and develop web sites, web apps and mobile apps.

### 6. Mapping of Course Outcomes with Program Outcomes:

CS2522 : ADVANCED DATA STRUCTURES (PROFESSIONAL ELECTIVE – I)																
Course outcomes	Program Outcomes and Program Specific Outcome												PSO1	PSO2		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12				
CO1: illustrate representations of sets and operations on sets and dictionaries.	3	1	1													
CO2: construct Priority queues such as min heap and max heap for the given data.	2		2	1								1				
CO3: create AVL, Red Black, Splay, B and B+ Trees for the given data and perform insertion, deletion and search operations on them.	3	2	3	1								2		2	2	
CO4: search for a pattern in the given text using Pattern Matching Techniques.	2		2	1								1		1	1	
CO5: demonstrate insertion and search operations on tries and also list its applications.	2															

### 7. Prescribed Text Books

1. Horowitz, Sahni, Anderson-Freed, "Fundamentals of DATA STRUCTURES in C", 2<sup>nd</sup> edition, University Press.
2. Richard F Gilberg, Behrouz A Forouzan, "Data Structures", Cengage.



## 8. Reference Text Books

1. Mark Allen Weiss, "Data structures and Algorithm Analysis in C", Pearson, 2<sup>nd</sup> edition
2. Debasis Samanta, "Classic Data Structures", PHI, 2<sup>nd</sup> edition.

## 9. URLs and Other E-Learning Resources

- <http://lcm.csa.iisc.ernet.in/dsa/dsa.html>  
[http://utubersity.com/?page\\_id=878](http://utubersity.com/?page_id=878)  
<http://freevideolectures.com/Course/2519/C-Programming-and-Data-Structures>  
<http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithms>

## 10. Digital Learning Materials

- <http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithms/2#>

<http://nptel.ac.in/courses/106102064/1>

## 11. Lecture Schedule / Lesson Plan

Topic	No. of Periods	
	Theory	Tutorial
<b>UNIT –1: Sets and Dictionaries</b>		
Sets: Definition, Terminology, Representation	2	2
Set operations	2	
Dictionaries: Definition, operations, ADT	1	
Representation of Dictionaries, Applications	2	
<b>Total</b>	<b>7</b>	<b>2</b>
<b>UNIT – 2: Priority Queues</b>		
Introduction	1	2
Types of Priority Queues	1	
Implementation methods of priority queues	1	
Binary heap: min heap and max heap	2	
Applications of heap	2	
<b>Total</b>	<b>7</b>	<b>2</b>
<b>UNIT – 3: Balanced Trees – 1</b>		
AVL Trees: Introduction	1	1
AVL Rotations	2	

Maximum Height of an AVL Tree	1	
AVL Tree Insertion operation	2	
AVL Tree Deletion operation	2	
<b>Balanced Trees – 2</b>		
Red Black Trees: Introduction, Properties	1	
Red Black Tree Insertion operation	2	
Red Black Tree Deletion operation	2	2
Splay trees Introduction, splay rotations	1	
Splay trees Insertion operation	2	
Splay trees Deletion operation	2	
<b>Total</b>	<b>18</b>	<b>3</b>
<b>UNIT – 4: B and B+ Trees</b>		
B-Trees Introduction, Properties	1	
B-Trees Insertion examples	2	1
B-Trees Deletion examples	2	
B+Trees Introduction, Properties	1	
B <sup>+</sup> Trees Insertion examples	2	1
B <sup>+</sup> Trees Deletion examples	2	
<b>Total</b>	<b>10</b>	<b>2</b>
<b>UNIT – 5: Pattern matching and Tries</b>		
Introduction	1	
The Boyer –Moore algorithm, examples	2	1
The Knuth-Morris-Pratt algorithm, examples	2	
Applications of Pattern Matching	1	
<b>Total</b>	<b>6</b>	<b>1</b>
<b>UNIT – 6: Tries</b>		
Introduction, advantages of tries	1	1
Digital search tree	2	

Binary trie	2	
Compressed Binary trie	2	1
Patricia, Multi way trie	1	
<b>Total</b>	<b>8</b>	<b>2</b>
<b>Total No.of Periods:</b>	<b>56</b>	<b>12</b>

## UNIT-I

### Assignment-Cum-Tutorial Questions

#### SECTION-A

#### *Objective Questions*

Consider 2 sets A and B, where  $A=\{1,5,8,10\}$  and  $B=\{1,2,3,4,5,6,8,10,12\}$  and answer the following questions

1. The result of  $A \cup B$  \_\_\_\_\_  
 (A)  $\{1,2,3,4,5,6,8,10,12\}$  (B)  $\{1,5,8,10\}$  (C)  $\{ \}$  (D)  $\{1,5,8\}$
2. The result of  $A \cap B$  \_\_\_\_\_  
 (A)  $\{1,2,3,4,5,6,8,10,12\}$  (B)  $\{1,5,8,10\}$  (C)  $\{ \}$  (D)  $\{1,5,8\}$
3. The result of  $A - B$  \_\_\_\_\_  
 (A)  $\{1,2,3,4,5,6,8,10,12\}$  (B)  $\{1,5,8,10\}$  (C)  $\{ \}$  (D)  $\{1,5,8\}$
4. A and B are disjoint sets. **[TRUE/FALSE]**
5. Cardinality of A is \_\_\_\_  
 (A)10 (B) 0 (C)3 (D) 4
6. If a dictionary has no elements then the Size() function returns \_\_\_\_  
 (A)  $\{ \}$  (B) 0 (C)-1 (D)None
7. In dictionaries data will be stored as <key,value> pair. **[TRUE/FALSE]**
8. We cannot construct have dictionaries with duplicate keys. **[TRUE/FALSE]**
9. If a dictionary is having n elements after the deletion operation it contains \_\_\_\_ elements. (A) (n-1)  
 elements if the dictionary contains the element to be deleted  
 (B) n elements if the dictionary doesn't contains the element to be deleted  
 (C)Both (A) & (B)  
 (D) None of the above
10. If isEmpty() returns true, it means that the dictionary contains no elements. **[TRUE/FALSE]**

## SECTION-B

### SUBJECTIVE QUESTIONS

1. Consider the following set,  $S=\{12,14,15,7,9,11,16\}$ . Represent this with **linked list** representation.
2. Consider the following set,  $S=\{12,14,15,7,9,11,16\}$ . Represent this with **Hash Table** representation.
3. Consider the following data:

S.No	Roll Number	Class Test Marks(Max: 10)
1	11	4
2	27	7
3	23	2
4	49	8
5	29	3
6	15	1
7	19	2
8	33	6
9	56	2
10	39	3

Write a set A, which gives the records of the students who got atleast 50% marks in the class test. Use Bit Vector representation.

4. Consider the following array (where the array index range from 1 to 16, also assume that the index represents the set element) representation of a set.

0	-	1	-	1	-	1	-	1	-	7	-	7	-	-	-
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

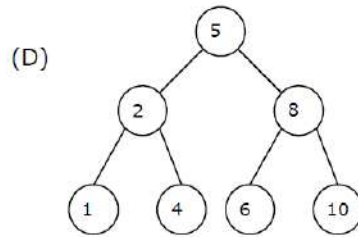
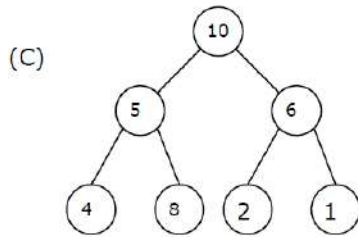
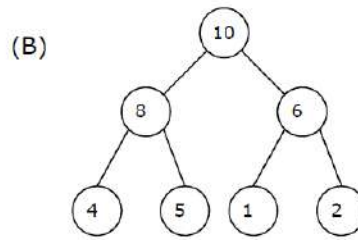
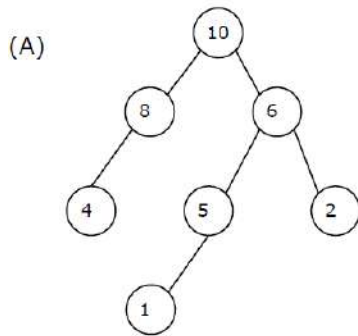
Use this representation and represent this set in tree representation.

5. List and explain the Dictionary ADT.
6. Illustrate Dictionary representation with examples.

**UNIT-II**  
**SECTION-A**

**Objective Questions**

1. Define Priority Queue
2. A \_\_\_\_\_ is a heap where the value of each parent is less than or equal to the values of its children
3. Consider any array representation of an  $n$  element binary heap where the elements are stored from index 1 to index  $n$  of the array. For the element stored at index  $i$  of the array ( $i \leq n$ ), the index of the left child and right child are \_\_\_\_  
  
A)  $2i+1, 2i$       B)  $2i+1, \text{floor}(i/2)$       C)  $2i, \text{floor}(i/2)$       D)  $2i, 2i+1$
4. What are the Time complexities of Insertion and DeleteMax operations on a Max-heap  
A)  $O(n)$  and  $O(\log n)$       B)  $O(\log n)$  and  $O(n)$   
C)  $O(\log n)$  and  $O(\log n)$       D)  $O(n \log n)$  and  $O(\log n)$
5. In case of Min-heap, during insertion of new key if there is any violation of heap ordering property at any node \_\_\_\_\_ is applied
6. Time complexity of Heap sort is \_\_\_\_\_
7. Consider any array representation of an  $n$  element binary heap where the elements are stored from index 1 to index  $n$  of the array. For the element stored at index  $i$  of the array ( $i \leq n$ ), the index of the parent is **(GATE-CS-2001)**  
  
A)  $i-1$       B)  $\text{floor}(i/2)$       C)  $\text{ceiling}(i/2)$       D)  $(i+1)/2$
8. In a Binary max heap containing  $n$  numbers, the smallest element can be found in time **(GATE 2006)**  
  
A)  $O(n)$       B)  $O(\log n)$       C)  $O(\log \log n)$       D)  $O(1)$
9. Which of the following sequences of array elements forms a heap? **(GATE IT 2006)**  
A) {23, 17, 14, 6, 13, 10, 1, 12, 7, 5}  
B) {23, 17, 14, 6, 13, 10, 1, 5, 7, 12}  
C) {23, 17, 14, 7, 13, 10, 1, 12, 5, 7}  
D) {23, 17, 14, 7, 13, 10, 1, 5, 6, 12}
10. Consider a binary max-heap implemented using an array. Which one of the following array represents a binary max-heap? **(GATE CS 2009)**  
  
A) 25,12,16,13,10,8,14      B) 25,14,16,13,10,8,12  
C) 25,14,12,13,10,8,16      D) 25,16,12,13,10,8,12
11. A max-heap is a heap where the value of each parent is greater than or equal to the values of its children. Which of the following is a max-heap? **(GATE CS 2011)**



12. A priority queue is implemented as a Max-Heap. Initially, it has 5 elements. The level-order traversal of the heap is: 10, 8, 5, 3, 2. Two new elements 1 and 7 are inserted into the heap in that order. The level-order traversal of the heap after the insertion of the elements is:

**(GATE-CS-2014)**

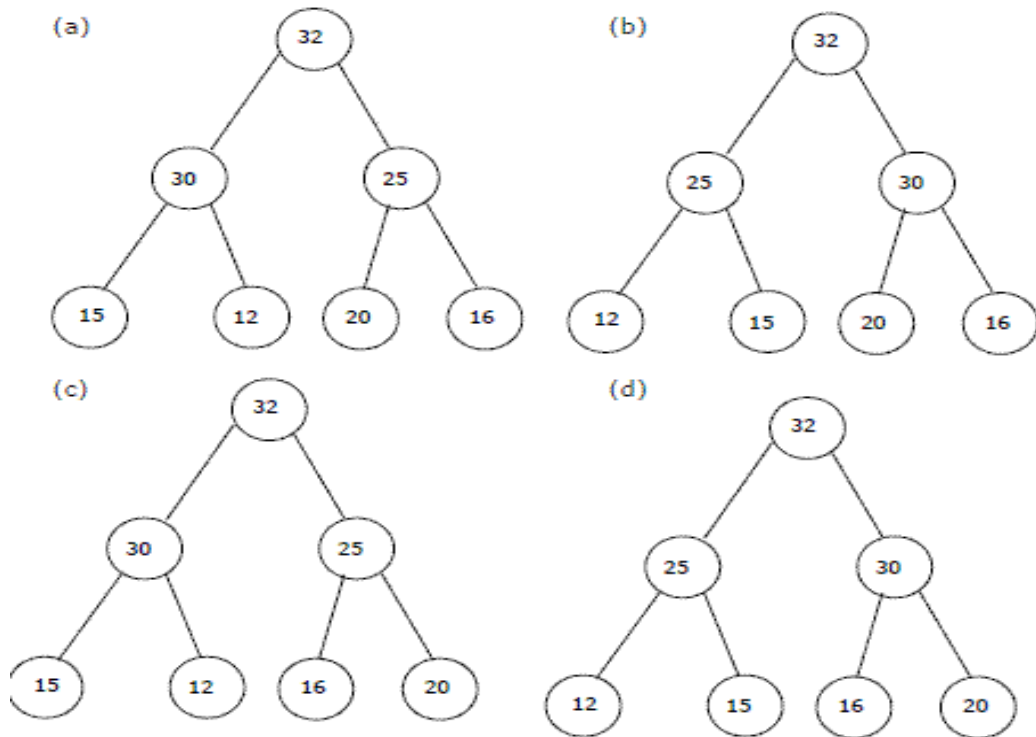
- (A) 10, 8, 7, 3, 2, 1, 5      (B) 10, 8, 7, 2, 3, 1, 5  
 (C) 10, 8, 7, 1, 2, 3, 5      (D) 10, 8, 7, 5, 3, 2, 1

13. Consider a max heap, represented by the array: 40, 30, 20, 10, 15, 16, 17, 8, 4. Now consider that a value 35 is inserted into this heap. After insertion, the new heap is

**(GATE-CS-2015)**

- A) 40, 30, 20, 10, 15, 16, 17, 8, 4, 35      B) 40, 35, 20, 10, 30, 16, 17, 8, 4, 15  
 C) 40, 30, 20, 10, 35, 16, 17, 8, 4, 15      D) 40, 35, 20, 10, 15, 16, 17, 8, 4, 30

13. The elements 32, 15, 20, 30, 12, 25, 16 are inserted one by one in the given order into a Max Heap. The resultant Max Heap is.



## SECTION-B

### SUBJECTIVE QUESTIONS

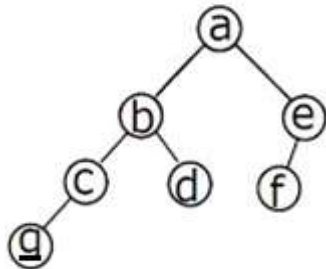
1. Define Binary Heap. Give example and List the properties of Binary Heap.
2. Explain the following with examples:
3. (i) Min-tree (ii) Max-tree (iii) Min-Heap (iv) Max-Heap
4. Construct a Min heap for the following keys: 10, 12, 1, 14, 6, 5, 7, 8, 15, 3, 7, 2
5. Show the result of inserting the keys: 14, 5, 12, 6, 4, 8, 9, 13, 11, 2, 18, 30 one at a time into an initially empty Max heap with neat diagrams
6. Show the result of inserting the keys: 10, 12, 8, 14, 6, 5, 1, 3 one at a time into an initially empty Min heap. Apply deleteMin operation on the resulting min heap.
7. Construct a Max heap for the following keys: 4, 67, 23, 89, 12, 8, 7, 44, 78, 64, 70. Apply deleteMax operation on the resulting max heap
8. What are the basic steps in sorting keys using heap sort and Write the algorithm for Heap Sort.
9. Sort the following keys using Heap sort: 5, 8, 11, 3, 9, 2, 10, 1, 45, 32

### UNIT-III

#### Section A

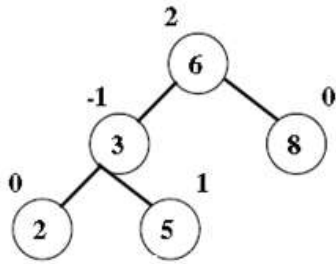
##### 1) Objective Questions

1. What are Height Balanced trees? Give examples
2. Define AVL tree.
3. Balance factor of a Node = \_\_\_\_\_. The balance factor of every node in an AVL tree may be \_\_\_\_\_
4. If a node is not balanced after an insertion or deletion operation, you need to rebalance it. The process of rebalancing a node is called as \_\_\_\_\_
5. \_\_\_\_\_ need to be applied, if an imbalance occurred at node A (Bf = +2) because of inserting a new node x in the Right Sub tree of Left Child of node A  
A) LL rotation    B) RR rotation    C) LR rotation    D) RL rotation
6. The Maximum height of an AVL tree with N nodes is \_\_\_\_\_  
A)  $2\log N$     B)  $1.44\log N$     C) N    D) Depends on implementation
7. The worst case running time of AVL tree for all the operations is \_\_\_\_\_
8. Splay tree is a self balancing data structure (True / False)
9. Define Splaying. What is the benefit of applying splaying on Splay trees?
10. Write any 2 differences between AVL trees and Splay trees.
11. In the balanced binary tree in the figure given below, how many nodes will become unbalanced when a node is inserted as a left child of the node "g"?



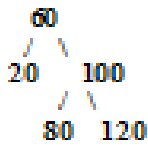
- A) 1                  B) 3                  C) 7                  D) 8
12. On inserting element 4 into the AVL tree given below an imbalance occurs. Which type of rotation is applied to balance it?





- A) LL Rotation    B) RR Rotation    C) LR Rotation    D) RL Rotation

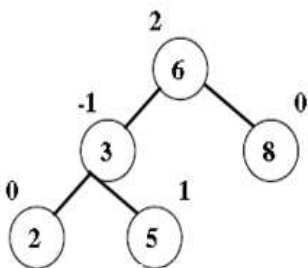
13. Consider the following AVL tree.



Which of the following is updated AVL tree after insertion of 70?

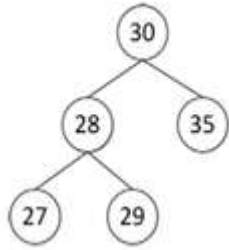
- A)    B)    C)
- D)

14. Upon deleting element 8 from the AVL tree given below an imbalance occurs. Which type of rotation is applied to balance it?



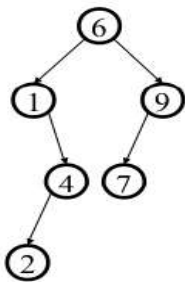
- A) Single left    B) Single right    C) Double left    D) Double Right

15. For the AVL tree below, what is the result AVL tree after we remove the element 35?



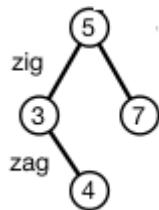
- A) B) C) D) Deletion not possible

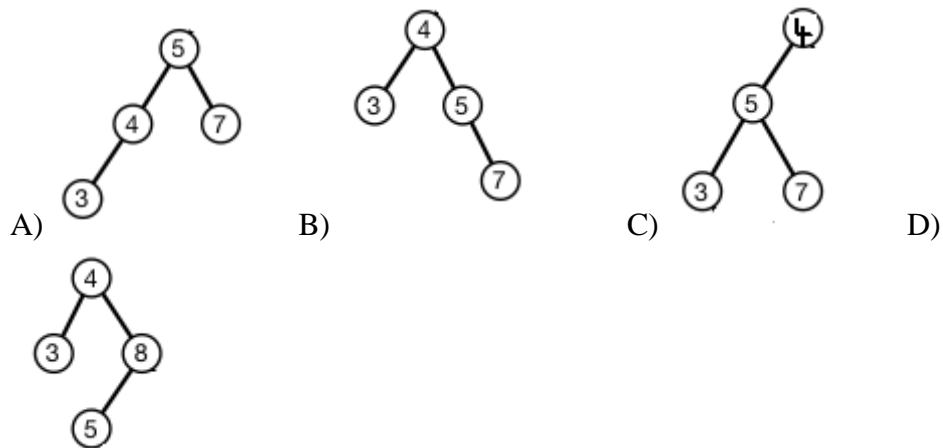
16. When an element 5 is inserted into the Splay tree given below which of the following splaying rotations are applied in sequence



- A) Zig-Zig, Zag B) Zag, Zig-zag C) Zag-Zag, Zig D) Zag-Zig, Zag

17. The resulting splay tree on splaying element 4 in the given tree below

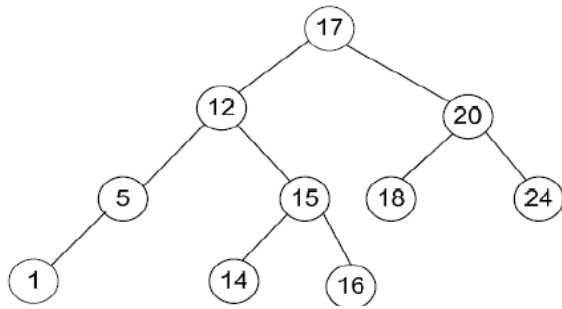




18. Define Red Black Tree.

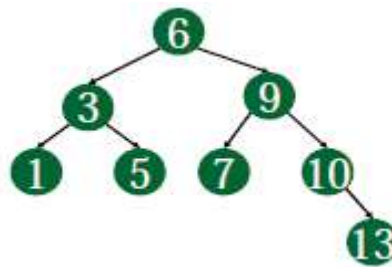
### Section-B

1. Differentiate between AVL tree and a Binary Search Tree? Does AVL tree offers better performance than a Binary Search Tree? Give reasons
2. Define Rotation. Explain different rotations that are applied during insertion operation on an AVL tree with examples.
3. What is an AVL tree? Explain the need for rotation of AVL trees. Construct an AVL Tree for the list 8, 9, 11, 6, 5, 7, 10 by using successive insertions. Illustrate the steps clearly.
4. Illustrate with examples different rotations that are applied during deletion operation on an AVL tree.
5. Define splay tree. Explain with examples different rotations that are applied in case of Splay trees.
6. Explain insertion operation on Splay tree with illustrative examples.
7. Describe how deletion of an element is done in case of Splay tree with illustrative examples.
8. Mark the balance factor of each node on the tree given below and state whether it is height-balanced or not

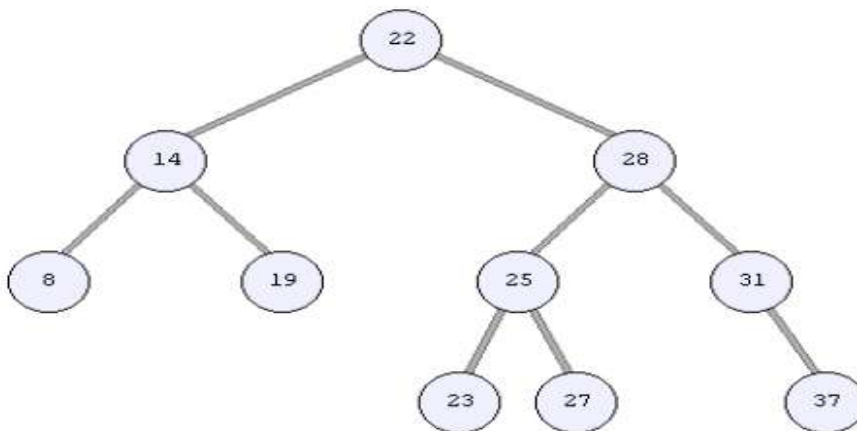


9. Show the AVL tree that results after each of the integer keys 9, 27, 50, 15, 2, 21, and 36 are inserted, in that order, into an initially empty AVL tree. Clearly show the tree that results after each insertion, and make clear any rotations that must be performed.
10. Insert the following sequence of elements into an AVL tree, starting with an empty tree : 15, 20, 24, 10, 13, 7, 30, 36, 25
11. Delete the following keys one after the other from the AVL tree you got in problem 3 above. (i) 10 (ii) 36 (iii) 30
12. Given the following AVL Tree, performs these consecutive operations and draw out the tree in each step:

- Remove(7)
- Insert (11)
- Insert(12)



13. Starting with the AVL tree below, insert the following values: 26, 34, 40, 29, 33, 32. Show the resulting tree after each insertion.



14. Insert sequence of keys: 9, 2, 90, 53, 4, 64, 95, and 59 into an initially empty Splay tree. Clearly show the tree that results after each insertion, and make clear any rotations that must be performed.
15. Delete the node 4 from the tree you got in problem 7 above.
16. Start with an empty red-black tree and insert 30, 40, 50 and 35.
17. Illustrate different imbalances in red-black tree.
18. Describe insertion and deletion operation on in red-black tree

### Section-C

1. What is the maximum height of any AVL-tree with 7 nodes? Assume that the height of a tree with a single node is 0. **(GATE 1998)**

A) 2      B) 3                      C) 4                      (D) 5
2. If an AVL tree has a height of 3, what maximum number of nodes can the tree have? What minimum number of nodes can the tree have? **(GATE 2009)**

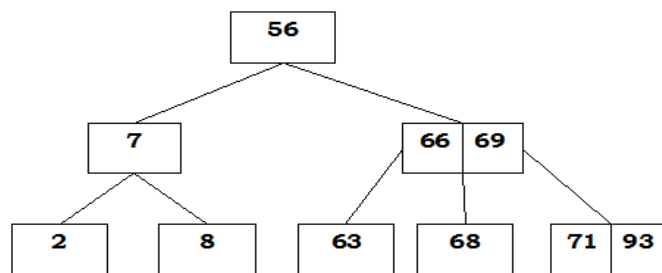
A) 4, 7      B) 7, 4                      C) 5, 7                      D) 5, 8

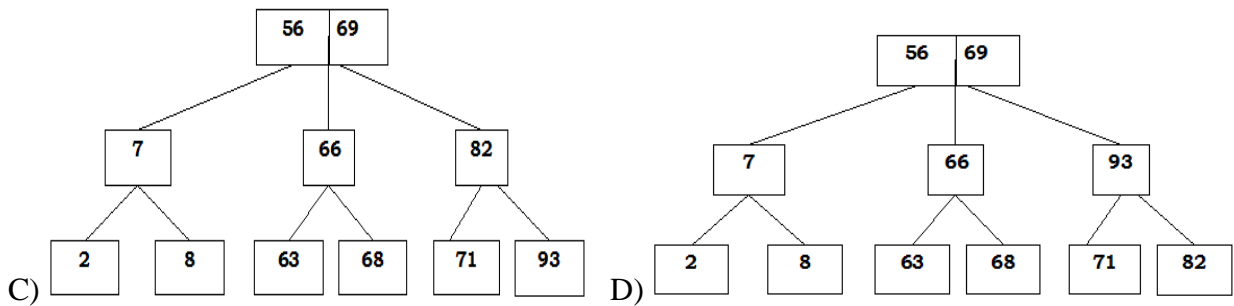
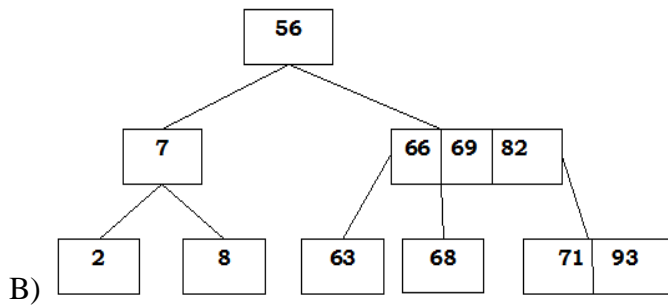
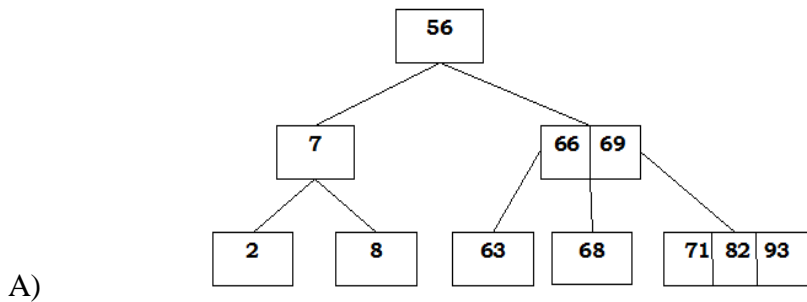
### UNIT-4

#### Section A

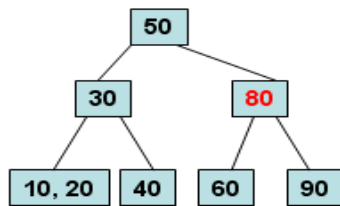
1. In an M-way search tree M stands for \_\_\_\_\_
2. ISAM stands for \_\_\_\_\_
3. Define B-tree.
4. Which statement is true for a B-tree?
  - A) All entries of a node are greater than or equal to the entries in the node's children.
  - B) All leaves are at the exact same depth.
  - C) All nodes contain the exact same number of entries.
  - D) All non-leaf nodes have the exact same number of children.
5. During insertion operation on B-tree if there is a violation of B-tree property then \_\_\_\_\_ is applied.

6. During deletion operation on B-tree if there is a violation of B-tree property then \_\_\_\_\_ or \_\_\_\_\_ is done.
7. In a B tree of order 6, each node can have at least \_\_\_\_\_ child nodes and at most \_\_\_\_\_ child nodes
8. In a 4-way search tree, each node can have at most \_\_\_\_\_ keys and at most \_\_\_\_\_ sub trees.  
 A) 4, 4      B) 3,4      C) 3,3      D) 4,3
9. The maximum and minimum number of child nodes a node can have in a B-Tree of order 7.  
 A) 7, 3      B) 7, 4      C) 6, 3      D) 6, 4
10. In a B-tree of order 5, each node can have at least \_\_\_\_\_ keys and at most \_\_\_\_\_ keys  
 A) 2, 4      B) 1, 4      C) 2, 3      D) 1, 3
11. Suppose that a B-tree has maximum of 10 keys and that a node already contains the integers 1 through 10. If a new value 11, is added to this node, the node will split into two pieces. What values will be in these two pieces?  
 A) The first piece will have only 1 and the second piece will have the rest of the numbers.  
 B) The first piece will have 1 through 5 and the second piece will have 6 through  
 C) The first piece will have 1 through 5 and the second piece will have 7 through  
 D) The first piece will have 1 through 6 and the second piece will have 7 through
12. What is the resulting B-tree of order 3 that is created by inserting 82 into the following B-tree.





13. Delete key 80 from the B tree of order 3 given below. What are the keys that are present in the root node of the resulting tree?



- A) 50      B) 30, 50      C) 40      D) 10, 20

14. Insert the following values in sequence to a B-tree of order 3: 50, 19, 21, 66, 84, 29, and 54. What are the keys that are present in the root node of the resulting tree?

- A) 21      B) 50, 66      C) 50      D) 21, 50

15. A B-tree of order 4 is built from scratch by 10 successive insertions. What is the maximum number of node splitting operations that may take place?

(GATE CS 2008)

- A) 3      B) 4                      C) 5                      D) 6

16. Consider a B+-tree in which the maximum number of keys in a node is 5. What is the minimum number of keys in any non-root node?      **(GATE CS 2010)**

- A) 1      B) 2                      C) 3                      D) 4

17. Define B+ tree.

18. In a B+ tree, actual data is stored only at leaves nodes.      **[True/false]**

19. B+ Trees are considered BALANCED because      **(GATE CS 2016)**

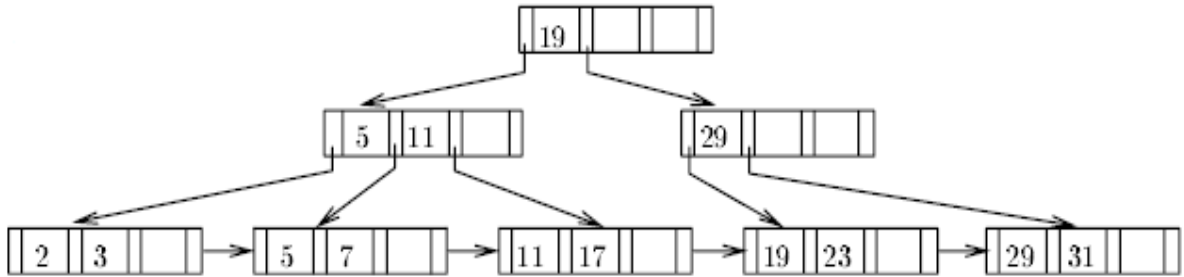
- A) the lengths of the paths from the root to all leaf nodes differ from each other by at most 1.  
B) the number of children of any two non-leaf sibling nodes differ by at most 1.  
C) the lengths of the paths from the root to all leaf nodes are all equal.  
D) the number of records in any two leaf nodes differ by at most 1.

### **Section - B**

1. Compare B-Trees with B<sup>+</sup>Trees. Give examples for each.
2. Define B-Tree and Give an example. List all the properties of B-Tree.
3. Illustrate with examples Insertion operation on B-Tree.
4. Explain in detail deletion operation on B-Tree. Illustrate with examples different possible cases during deletion an element from a B-Tree.
5. Start with an empty B-Tree of order 4 and insert the keys 21, 11, 51, 61, 71, 41, 31, 81, 91, 101 and 111 in this order. Draw the B-Tree of order 4 for each insertion.
6. Show the result of inserting 12, 10, 15, 4, 1, 17, 3, 13, and 8 into an initially empty B-Tree of order 3.
7. Show the result of deleting keys 12, 8, and 15 from the B-Tree obtained in problem 6.
8. Define B<sup>+</sup>Tree. With necessary examples explain Insertion operation on B<sup>+</sup>Tree.
9. Discuss in detail deletion operation on B<sup>+</sup>Tree. Illustrate with examples different possible cases during deletion of an element from a B-Tree.
10. Construct a B<sup>+</sup>Tree for the following set of key values: 2, 3, 5, 7, 11, 17, 19, 23, 29, and 31 Assume that the tree is initially empty and values are added in ascending order. Construct B<sup>+</sup>Trees for the cases where the number of child pointers that one node has is as follows:
  - a) Three
  - b) Four



11. Start with an empty B<sup>+</sup>Tree of order 6 and insert the keys 12, 1, 11, 61, 71, 41, 31, 81, 91, 101 and 111 in this order. Draw the B<sup>+</sup>Tree of order 6 for each insertion.
12. Consider the following B<sup>+</sup>Tree of order 4. Show the form of the tree after each of the following series of operations:

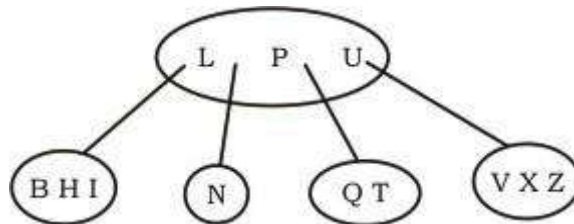


- Insert 9.
- Insert 10.
- Insert 8.
- Delete 23.
- Delete 19.

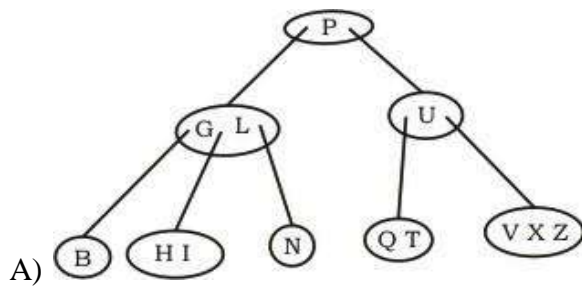
### Section - C

- Consider the following 2-3-4 tree (B tree of order 4) in which each data item is a letter. The usual alphabetical ordering of letters is used in constructing the tree.

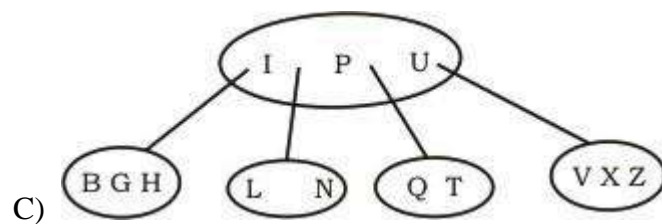
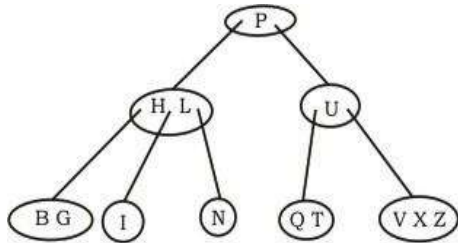
(GATE-CS-2003)



What is the result of inserting G in the above tree?

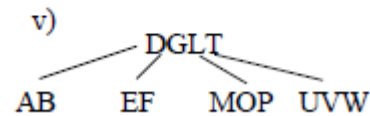
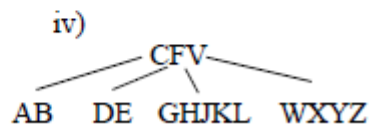
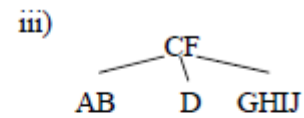
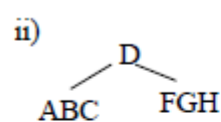
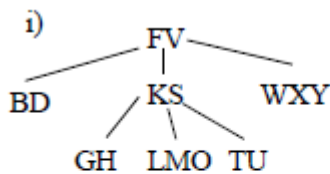


B)



D) None of these

2. Which of the following are legal B-trees for when the minimum branching factor  $t = 3$ ? For those that are not legal, give one or two sentence very clearly explaining what property was violated. (Branching factor is the number of children at each node)



## UNIT-V

### Section A

- In Boyer Moore algorithm \_\_\_\_\_ function will calculate how far the pattern must be shifted if the character is found in the pattern.
  - Failure function
  - Prefix function
  - Last occurrence function
  - First occurrence function
- BMP algorithm scans the characters of the pattern from \_\_\_\_\_ to \_\_\_\_\_.
  - Left, right
  - Right, Left
  - Middle, Right
  - None of the above

3. KMP algorithm scans the characters of the pattern from \_\_\_\_\_ to \_\_\_\_\_  
 A) Left, right                      B) Right, Left  
 C) Middle, Right                      D) None of the above
4. Failure function used in KMP algorithm is also called as \_\_\_\_\_
5. In case of KMP, preprocessing is applied on \_\_\_\_\_  
 A) Text                      B) Pattern                      C) Both A & B                      D) none
6. Compute the failure function for the pattern **ababbabbab**.

### Section - B

1. Define Pattern Matching. Explain with an example different Pattern matching algorithms.
2. Explain Boyer Moore pattern matching algorithm with an example.
3. Check whether the following Pattern is available in Text or not using BMP.  
 Text      → GCTTCTGCTACCTTTTGCGC  
 Pattern   → CCTTTTGC
4. Check whether the following Pattern is available in Text or not using BMP.  
 Text      → haihellogoodmorning  
 Pattern   → hello
5. Check whether the following Pattern is available in Text or not using BMP.  
 Text      → catratratcatrat  
 Pattern   → ratcat
6. Explain Knuth Morris Pratt pattern matching algorithm with an example.
7. Check whether the following Pattern is available in Text or not using KMP.  
 Text      → abcxabcdabxabcdabcdabcy  
 Payern   → abcdabcy
8. Check whether the following Pattern is available in Text or Not using KMP.  
 Text      → abacaabaccabacabaa  
 Pattern   → abacab
9. Check whether the following Pattern is available in Text or not using Failure function  
 Text      → abacaabaccabacabaa  
 Pattern   → abacab

10. Check whether the following Pattern is available in Text or not using Failure function.

Text → abcxabcdabxabcdabcdabcy

Payern → abcdabcy

### Section - C

For the given

Text T: GATCGATCACATCATCACGAAAAA

Pattern P: ATCACATCATCA

1. Apply Boyer Moore Pattern Matching algorithm and analyze the output at each step.
2. Apply Knuth Morris Pratt Pattern Matching algorithm and analyze the output at each step.

### UNIT-VI

#### Section A

1. Trie is a \_\_\_\_\_.
2. In a Digital search tree, the element-to-node assignment is determined by the \_\_\_\_\_ representation of the element keys
3. A Binary trie contains \_\_\_\_\_ nodes and \_\_\_\_\_ nodes.
4. In binary trie, successful search may terminate only at \_\_\_\_\_.
5. A binary trie that has been modified to contain no branch nodes of degree one is called as \_\_\_\_\_.
6. In a Digital search tree, all the keys in the left sub tree of a node at level  $i$  have bit  $i =$  \_\_\_\_\_, where as those in the right sub tree of a node at that level have bit  $i =$  \_\_\_\_\_  
A) 1, 0      B) 0, 1      C) 0, 0      D) 1, 1
7. In a Binary trie at level  $i$ , \_\_\_\_\_ bit of key  $k$  is used.  
A)  $(i+1)^{\text{th}}$       B)  $i^{\text{th}}$       C)  $(i-1)^{\text{th}}$       D)  $(i+2)^{\text{th}}$
7. In a compressed binary trie all branch nodes will have degree \_\_\_\_.  
A) 1      B) 0      C)  $>1$       D)  $\geq 1$
8. In multiway tries the R value must be \_\_\_\_\_.  
A)  $>1$       B)  $<1$       C)  $>2$       D)  $<2$
9. PATRICIA stands for \_\_\_\_\_.

### **Section - B**

11. What is Trie? What are its applications? Explain Binary Trie with an example.
12. Explain about the concept of digital search tree.
13. Differentiate between Binary trie and Compressed Binary trie.
14. Construct a Digital Search tree for the following keys: 1010, 0000, 0100, 1111, 0110, 1110, 0101, 1001
15. Construct a Digital Search tree for the keys 1000, 0010, 0001, 1001, 1100, 0000, 0011
16. Construct a Digital Search tree for the keys 01001, 10100, 11010, 10111, 01000, 01010, 011001 and then delete the keys 10100 and 01010.
17. Construct a Binary trie for the keys 1001, 0100, 0000, 1111, 0110, 0101, 1110
18. Construct a Binary trie for the keys 01010, 10101, 10110, 01001, 00000, 11011, 00110 and then delete the keys 00000, 10101 and 11011
19. Construct a Compressed Binary trie for the keys 0000, 0001, 0010, 1000, 1001, 1100.
20. Construct a Compressed Binary trie for the keys 10100, 01001, 10110, 01101, 00000, 11011 and then delete the keys 01001 and 10110.

**Signature of the Faculty**

## HANDOUT ON C#.NET

III B.Tech – I Semester

Year: 2020-21

Branch: CSE

Credits: 3

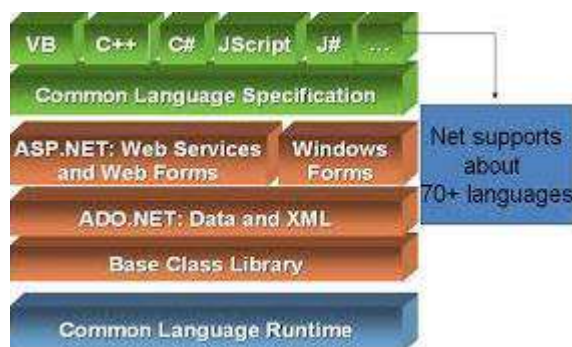
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### 1. Brief History and Scope of the Subject:

The Microsoft .Net is a new internet technology or rather strategy introduced by Microsoft. . Net was originally known as the NGWS (Next Generation Windows Services) which was said to be an Internet based platform of Next Generation Windows Services. Microsoft started development on the .NET Framework in the late 1990s originally under the name of Next Generation Windows Services (NGWS). By late 2001 the first beta versions of .NET 1.0 were released. The first version of .NET Framework was released on 13 February 2002..NET Framework(pronounced dot net) is a software framework developed by Microsoft that runs primarily on Microsoft Windows. It includes a large class library known as Framework Class Library (FCL) and provides language interoperability across several programming languages. Programs written for .NET Framework execute in a software environment known as Common Language Runtime(CLR), an application virtual machine that provides services such as security, memory management, and exception handling. (As such, computer code written using .NET Framework is called "managed code".)

**The following are the list of .Net languages:**

- A sharp.
- Boo
- C Sharp.
- COBOL
- COBRA
- F Sharp.
- F\*
- Iron Lisp.
- Iron Python
- Iron Ruby
- JSharp
- L Sharp
- Oxegene
- VB .Net
- ASP .Net



C# is a general-purpose, modern and object-oriented programming language pronounced as “C Sharp”. It was developed by Microsoft led by **Anders Hejlsberg** and his team within the .NET initiative and was approved by the European Computer

Manufacturers Association (ECMA) and International Standards Organization (ISO). The current version of C# is C# 7.3.

C# has many other reasons for being popular and in demand. Few of the reasons are mentioned below:

**Easy to start:** C# is a high level language so it is closer to other popular programming languages like C, C++, and Java and thus becomes easy to learn for anyone.

**Widely used for developing Desktop and Web Application:** C# is widely used for developing web applications and Desktop applications. It is one of the most popular languages that are used in professional desktop.

**Community:** The larger the community the better it is as new tools and software will be developing to make it better. C# has a large community so the developments are done to make it exist in system and not become extinct.

**Game Development:** C# is widely used in game development and will continue to dominate. C# integrates with Microsoft and thus has a large target audience. The C# features such as Automatic Garbage Collection, interfaces, object oriented etc. makes C# a popular game developing language.

## **2.Course Objectives:**

- To impart the concepts of control structures, classes, objects in .NET
- To demonstrate the concept of exception handling and threads.
- To impart the working style of forms in web applications.
- To edify the connection to a database using web application.

## **3.Course Outcomes:**

Upon successful completion of the course, the students will be able to

**CO1:**Configure the .NET environment for an application.

**CO2:**Compose simple programs in C# using control structures.

**CO3:**Apply the inheritance mechanism to solve simple problems in C#.

**CO4:** Apply the exception handling mechanism to improve the robustness of an Application.

**CO5:**Create user interface components for a .NET application.

**CO6:**Connect web pages with a database.

## **4. Program Outcomes:**

**Computer Science and Engineering Graduates will be able to:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.



## Program Specific Outcomes (PSOs)

**PSO1** : Design, develop, test and maintain reliable software systems and intelligent systems.

**PSO2** : Design and develop web sites, web apps and mobile apps.

## 5. Mapping of Course Outcomes with Program Outcomes:

CS2506 : C#.NET (PROFESSIONAL ELECTIVE – I)																
Course outcomes	Program Outcomes and Program Specific Outcome												PSO1	PSO2		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12				
CO1:configure the .NET environment for an application.	1				2											
CO2:compose simple programs in C# using control structures.	1															
CO3:apply the inheritance mechanism to solve simple problems in C#.	2	2	2												1	
CO4:apply the exception handling mechanism to improve the robustness of an application.	2		1		1										2	
CO5:create user interface components for a .NET application.	2	2	2		1										2	1
CO6:connect web pages with a database.	2				2										1	1

## 6. Prerequisites:

1. Fundamental concepts of OOP
2. Strong Knowledge in Java Programming
3. Basic Idea on Web applications

## 7.Prescribed Text Book:

1. Harsh Bhasin, “**Programming in C#**”, OXFORD UNIVERSITY PRESS.

## 8. Reference Books:

1. Andrew Troelsen, “C# and the .NET Platform”, Second Edition, Apress
2. Publication.
3. Herbert Schildt, “The Complete Reference C# 4.0”.
4. Erik Brown, “Windows Forms Programming With C#.”
5. Peter Sestoft and Henrik I. Hansen, “C# Precisely”, Prentice Hall of India

## 9. URLs and Other E-Learning Resources:

1. <https://msdn.microsoft.com>
2. <https://csharp.net-tutorials.com>
3. <https://www.guru99.com/c-sharp-tutorial.html>
4. <https://www.sololearn.com/Course/CSharp>

## 10. Digital Learning Materials:

1. <http://www.pragimtech.com/c-sharp-video-tutorials.aspx>
2. <https://www.csharpens.com>
3. <http://csharp-video-tutorials.blogspot.com/p/free-c-video-tutorial-for-beginners.html>

## 11. Lecture Schedule / Lesson Plan

Topic		No. of Periods	
		Theory	Tutorial
<b>Unit – I : Introduction to .NET</b>			
1	Basics of .NET Framework –History, Features and Benefits	1	1
2	Components of .NET Framework / .NET Architecture – CLR, CLS, CTS, CL	1	
3	List of .NET Languages and introduction to Microsoft Visual Studio - IDE	1	
4	Basics of C#: Structure of the C# program-Compiling and Executing	1	
5	Syntax of Main and I/O functions	1	
6	Input conversion functions		
7	Command Line arguments		
		<b>5</b>	<b>1</b>
<b>Unit – II : Control Statements</b>			
1	Introduction to data types : Value Type - Primitive types, Arrays Reference Type	1	2
2	Keywords, variables, Operators and Literals in C#	1	
3	Type Casting- Primitive type casting, Boxing and	1	

	Unboxing		
4	Special Operators in C#	1	
5	Conditional Statements- if, if-else, if-else-if ladder, nested if, switch statements with examples	1	
6	Iterative Statements- while, do-while, for, foreach, break, continue statements with examples	1	
		<b>6</b>	<b>2</b>
<b>Unit – III : Classes and Objects</b>			
1	Introduction – design of classes and objects	1	2
2	Array of objects		
3	Constructors and its types	1	
4	“this” keyword and Static members	1	
5	Parameter passing techniques in C#	1	
6	Passing objects to function	1	
7	Basics of object oriented programming		
8	Visibility controls in C#	1	
9	Inheritance and its types	1	
10	Polymorphism in C# : 1. Compile time Polymorphism -Function overloading and operator overloading, 2. Run time Polymorphism -Function overriding, dynamic method dispatch and abstract classes	2	
11	Interfaces - Interface definition and syntaxes, extending interface	1	
		<b>10</b>	<b>2</b>
<b>Unit – IV : Error and Exceptions</b>			
1	Types of Errors and Exceptions	1	1
2	Exception handling mechanism – try, catch, throws and finally	1	
3	Multi-catch statement in C#	1	

4	Creating user defined exceptions	1	
5	Usage of Exception class	1	
		<b>5</b>	<b>1</b>
<b>Unit – V : Windows Forms and Basic Controls</b>			
1	Anchoring and docking features in Windows form	1	
2	Windows Form and its properties	1	
3	Form controls– Label, Text box, Check box, Radio button, Combo box and Button	1	
4	Advanced Controls – Picture box, Progress bar control, Track bar control, Date and Time picker, Timer control.	1	
5	CommonDialog boxes in C#- Open, Save, Font, and Color	1	
		<b>5</b>	<b>1</b>
<b>Unit – VI : Data Connectivity</b>			
1	Role of ADO.NET – Connection Object, Command Object, Data Reader, Data Adapter and Data Set	1	
2	Inserting and updating of records (using MS Access)	1	
3	Role of DataTable and its members	1	
4	Introduction to ASP.NET - Difference between ASP and ASP.NET, Advantages of ASP.NET	1	
5	Creation of Web forms with the controls - Label, Text Box, Radio Button, Drop Down List, Button, and Literal	1	
6	Common HTML tags	1	
7	Creating user form	1	
8	Database creation in SQL Server	1	
		<b>8</b>	<b>2</b>
	<b>Total no. of Periods</b>	<b>39</b>	<b>9</b>

### 13. Seminar Topics:

- Features and Applications of .NET
- Real-time application of C#
- Object orientations with C#
- Components of ADO.NET

## UNIT-I

### Assignment-Cum-Tutorial Questions

#### Section-A

#### Objective Questions

- The **MSIL** code is also called as \_\_\_\_\_  
 a) Byte Code                      b) Common Intermediate Language Code  
 c) both a and b                      d) Un-managed code.
- Entire .NET languages are managed by \_\_\_\_\_  
 a) CLR    b) MSIL                      c) CTS                      d) Compilers
- .NET is Platform Independent** Language.                      [True/False].
- Namespace** is a Collection of \_\_\_\_\_  
 a) .dll and exe    b) Classes and Interfaces    c) Only Classes    d) Methods
- .NET supports which of the following applications.  
 a) Mobile applications                      b) Windows Forms and Console applications  
 c) Web applications                      d) all of the above.
- .NET is a Combination of Several languages                      [True/False].
- What is **COM**  
 a) Commercial Object Model                      b) Component Object Model  
 c) Component Operator Model                      d) Communication
- Reference types are allocated in \_\_\_\_\_  
 a) Stack memory                      b) heap memory                      c) both a and b                      d) none
- Garbage collection is done by                      [implicitly/explicitly]
- Value type variables can be assigned a value directly which are derived from the class

- A) System.value                      B) System.ValueType  
C) General.ValueType                D) Variable.ValueType

11. FCL helps in \_\_\_\_\_

- a)I/O                      b)gathering information about types  
c)security check        d)all of the above

12. Assemblies consists of \_\_\_\_\_

- a) EXE    b) DLL                      c) both (a) and (b)    d) none of the above

13. The code that runs under the rule of CLR is called \_\_\_\_\_

- a) Managed code b) unmanaged code c) unsafe code d) none of the above

14. What is the type of the command line arguments

- a) String[]    b)string[]                      c) int[]                      d) can be any thing

15. What is the entry point for the program execution

- a) namespace b) using system c) Main                      d) class

16. Command line arguments are stored in an array \_\_\_\_\_

17. What is the output of the following code \_\_\_\_\_

```
int a = 10, b = 20, c = 30;
```

```
Console.WriteLine("the given values are:{2},{0},{1}", a, b, c);
```

- a)10,20,30    b) 20,10,30    c) 20, 30,10    d) 30,10,20

18. What is the output of the following code when the values 10 and 20 are passed as command line arguments \_\_\_\_\_

```
Console.WriteLine(args[0] + args[1]);
```

```
Console.WriteLine(Convert.ToInt32(args[0]) + args[1]);
```

```
Console.WriteLine(Convert.ToInt32(args[0]) + Convert.ToInt32(args[1]));
```

- a)30 30 30 b) 30 1020 30 c) 1020 1020 30 d) 30 30 1020

## Section-B

### Subjective Questions

1. Explain briefly about .NET framework components with neat diagram?
2. What are the languages that are supported by the .NET framework?

3. Explain the role of CTS, CLS and CIL in .NET environment?
4. List the features and principles of .NET framework?
5. Explain briefly about the Microsoft Visual Studio IDE?
6. What is the structure of C# program and explain its parts?
7. Discuss the different ways of compiling and executing the C# program?
8. Demonstrate the declaration of main method in C#?
9. List and explain different I/O and input conversion functions in C#?
10. Illustrate the usage of command line arguments?

## UNIT-II

### Section-A Objective Questions

1. Base type of all the data types is \_\_\_\_\_  
 a) Object type            b) string type            c) Value type            d) Reference type
2. State the default values for the following types  
 i) char type \_\_\_\_\_ ii) float type \_\_\_\_\_ iii) double type \_\_\_\_\_ iv) All integers  
 \_\_\_\_\_ v) decimal type \_\_\_\_\_ vi) bool type \_\_\_\_\_ vii) all reference type  
 \_\_\_\_\_  
 viii) enum type \_\_\_\_\_
3. Floating point numbers are \_\_\_\_\_ type by default  
 a) string            b) int            c) float            d) double
4. Which of the following are reference type  
 a) class            b) interface            c) a & b            d) none of the above
5. what is the output of the following code \_\_\_\_\_  

```

int i;
for (i=0;i<= 10)
{
 j++;
}
Console.WriteLine(i+ " " +j);

```

 a) 10 11            b) 11 12            c) 11 10            d) 10 10
6. M at the end represent the value is of \_\_\_\_\_ type  
 a) float            b) double            c) decimal            d) int
7. Correct Declaration of Values to variables 'a' and 'b'?  
 a) int a = 32, b = 40.6;    b) int a = 42; b = 40;  
 c) int a = 32; int b = 40;    d) int a = b = 42;
8. What is the Size of 'char' datatype?  
 a) 8 bit    b) 32 bit    c) 16 bit    d) 64 bit





9. Describe the usage of boxing and unboxing?
10. List out different loop control structures in C# give examples?
11. Demonstrate the switch case with the example program?
12. What is a literal? List all supported literals in C# along with a brief note.
13. List and explain jump statements in C#. Give example under each case.
14. Explain the various operators available in C#.
15. What is boxing and un-boxing in C#? Explain this feature with an example.
16. Illustrate various special operators available in C#. List and explain them.
17. Explain the looping constructs in C# with syntax and examples.

## UNIT-III

### SECTION-A

#### Objective Questions

1. Which of the following is related to Ad-hoc polymorphism
  - a) Function overloading      b) Abstract methods
  - c) Both a and b                d) None of these.
2. What is the main advantage of inheritance
  - a) To provide relation between classes.      b) Code re-usability.
  - c) One name many forms                        d) Message passing
3. What is the need of internal access modifier in C#
  - a) Internal variable is accessed with in class.
  - b) Internal variable accessed outside the class.
  - c) Internal variable accessed with in assembly.
  - d) Internal variable accessed in any assembly.
4. What is the difference between ref and out parameters
  - a) ref is purely related to call by reference and out is stored only output value.
  - b) out is purely related to call by reference and ref is stored only output value.
  - c) C# does not support out keyword.
  - d) Both ref and out keywords are used as call by reference in C#.
5. What is the output of the following Code:
 

```
using System;
class A
{
 static void Main()
 {
```

```

int[] a=new int[]{5,4,3,2,6};
for(int i=0;i<10;i++)
 Console.WriteLine(a[a[a[3]+1]]);
Console.Read();
}
}

```

- a) Illegal    b)4    c) 2    d) 3
6. What is the difference between interface and class
- Interface contains abstract methods. Classes not contain abstract methods.
  - Interface and class are same.
  - Interface needs implements keyword whereas class needs extends keyword.
  - Both interface and class contains abstract methods.
7. What is sealed class in C#
- A class which is declared as constant.
  - A class which is not possible to inherit.
  - A class which is must inherit to another class.
  - It is also type of an interface in C#.
8. What is the output of the following code:

```

using System;
class Aa2
{
 static void Main(string[] args)
 {
 string s="gudlavall\beru Engineering College";
 Console.WriteLine(s.Substring(21));
 Console.Read();
 }
}

```

- a) ing College    b) Engineering College    c) ring College    d)ng College
9. What is the output of the following Code:

```

using System;
public class C
{
 public int a=20;
 public void display()
 {
 Console.WriteLine(a);
 }
 static void Main()
 {
 C v=new C();
 v.display();
 C p=new C();
 }
}

```

```

 p=v;
 p.a=56;
 v.display();
 p.display();
 Console.Read();
 }
}

```

- a) 20 20 56 b) 2056 20 c) 2056 56 d) 20 20 76

10. What is the purpose of object cloning
- To copy the contents of one object to another object.
  - To maintain original object copy with another name.
  - Cloneable objects does not supported in C#
  - Both a and b

## SECTION-B

### Descriptive Questions

- Explain the process of creating classes and objects in C#?
- Describe OOP services inheritance and polymorphism?
- Explain various parameter passing techniques in c#?
- Explain the difference between inheritance and interface?
- Demonstrate abstract classes with an example program in C#.
- Write the need for operator overloading. Explain how to overload binary operators.
- How do you prevent inheritance in C#?
- Discuss method access modifiers in C#.
- Outline the following parameter passing techniques in C#:
  - out
  - ref
  - params
- b) What is reusability of code? How is it achieved in C#?
- Write a C# program which overloads any two binary operators.

## UNIT-IV

### SECTION-A

#### Objective Questions

- ```

class Sample
{
    public static void main(String args[])
    {
        int x = 0;
        int y = 10;
    }
}

```

```
        int z = y/x;
    }
}
```

- a) Compile time error
 - b) Compiles and runs fine
 - c) throws an arithmetic exception
 - d) None of the above
2. Which among the following is NOT an exception?

- a) StackOverflow
- b) ArithmeticOverflow or underflow
- c) IncorrectArithmeticExpression
- d) All of the mentioned

3. What will be the output of the following C# code?

```
class Output
{
    public static void main(String args[])
    {
        try
        {
            int a = 9;
            int b = 5;
            int c = a / b - 5;
            Console.WriteLine("Hello");
        }
        catch(Exception e)
        {
            Console.WriteLine("C");
        }
        finally
        {
            Console.WriteLine("sharp");
        }
    }
}
```

- a) Hello
 - b) C
 - c) Hellosharp
 - d) Csharp
4. Which of this will be executed even if no exceptions are found?
- a) throws
 - b) finally
 - c) throw
 - d) catch

5. Which of these keywords are used for generating an exception manually?

- a) try
- b) catch
- c) throw
- d) check

6. Which of these keywords are used for the block to handle the exceptions generated by try block?

- a) try
- b) catch
- c) throw
- d) check

7. What will be the output of the given code snippet?

class program

```
{
    public static void Main(string[] args)
    {
        try
        {
            int a = args.Length;
            int b = 1 / a;
            Console.WriteLine(a);
        }
        catch (ArithmeticException e)
        {
            Console.WriteLine("1");
        }
        Console.ReadLine();
    }
}
```

- a) 0
- b) 1
- c) Compile Time Error
- d) Run Time Error

8. Which of the following is the wrong statement about exception handling in C#.NET?

- a) finally clause is used to perform clean-up operations of closing network and database connections.
- b) a program can contain multiple finally clauses

- c) the statement in final clause will get executed no matter whether an exception occurs or not
 - d) all of the mentioned
9. Which of the following statements applies to the situation where Exception is not handled in the program?
- a) The Compiler will not allow the program to run the code.
 - b) CLR will terminate the program execution at the point where it encounters an exception.
 - c) CLR will not show any output. However, the code will execute successfully.
 - d) The Code executes successfully, and an error message gets printed.
10. Which of the following statements correctly defines the usage of the <finally> block in exception handling:
- a) Code under the <finally> block gets executed only when try and catch block get executed.
 - b) Code under the <finally> block gets executed only if the catch block is not executed.
 - c) Code under the <finally> block is always executed irrespective of the <try-catch> block is executed or not.
 - d) Code under the <finally> block gets executed only if the catch block is executed.

SECTION-B

Subjective Questions

1. What is an error?
2. List and explain different types of errors in C#?
3. What is an exception?
4. List and explain different types of exceptions in C#?
5. Explain exception handling mechanism in C#?
6. What do you mean by Built-in Exception? List out Built-In Exceptions in C#.
7. Design a C# program which illustrates the try, catch, throw and finally blocks.
8. Write a C# program to illustrate finally block.
9. Explain the difference between error and exception in C#?
10. What is the main use of a finally block in exception handling?
11. What is user exception and how to raise it in C#?
12. What is the base class from which all the exceptions are derived?

13. Does finally get executed if the code throws an error?
14. Design a C# program which illustrates the Multi-catch statement in C#.
15. Write the C# program by following the below rules:
 - a. Create a new user defined exception class “CovidException”
 - b. Read name and temperature as inputs
 - c. If attendance is less than 99 throw CovidException that displays a message “Your health is good. Please follow Covid-19 preventive measures”
 - d. Else display a message “Recommended for Covid-19 Test”
16. Write a C# program for Handling multiple exceptions (FormatException, ArithmeticException):
 - a. Prompt for and read number of integers ‘n’
 - b. Create an array ‘A’ to store ‘n’ integers
 - c. Use ReadLine() to read ‘n’ integers and store them in an array ‘A’
 - d. Sum the integers.
 - e. Print the sum.Exceptions:
 - f. Handle FormatException raised if the input is not an integer.
 - g. Handle ArithmeticException raised if array size ‘n’ is negative.
17. List any four predefined exceptions. And Explain with example programs.
18. Write a C# program to handle DivideByZeroException.
19. What is the use of throw keyword and explain how to throw an exception by considering the below conditions:
 - a. Read age (integer value) as an input from user.
 - b. If the age is less than 18, throw ArithmeticException that displays a message “you are not eligible for voting”
 - c. Otherwise print message “welcome to voting”.
20. Explain any four predefined exceptions in C#.

UNIT-V

SECTION-A **Objective Questions**

1. The _____ are the Graphical User Interface (GUI) components created for web based interactions.

- a) Web forms
 - b) Window Forms
 - c) Application Forms
 - d) None of the above
2. Which property defines constant distance between control and one or more edges of the form?
- a) Anchor
 - b) Dock
 - c) Flat style
 - d) Cursor
3. Which property enables us to attach the controls to the edge of the parent control
- a) Dock
 - b) Anchor
 - c) Size
 - d) Position
4. Which of the following is used to align controls?
- a) Snap Line
 - b) TableLayoutPanel Control
 - c) FlowLayoutPanel Control
 - d) All of the above
5. Which of the following controls helps you to select date as well as time?
- a) Calendar
 - b) DateTimePicker
 - c) Both (a) and (b)
 - d) None of the above

SECTION-B

Subjective Questions

1. Design a login form in C#?
2. Design a form in C# that takes the details of a book from the user. Make two buttons clear and submit. On clicking the clear button the textboxes should be cleared, and on clicking the submit button a message box should be displayed. The message box should display the details of the books entered by the user.
3. Explain the use of DateTimePicker control.

4. List and explain different form controls.
5. Write the code to display the following form.
6. Explain the process of creating menus in a windows-based application.
7. What is an event? Explain common control class event with example window application.
8. What is button control? List the button properties and events, explain with example window application.
9. Outline anchoring and docking features in Windows form.
10. Explain window form properties.

UNIT-VI

1. _____ object is used to fill a DataSet/DataTable with query results in ADO.net.
2. What is DataSet object? It is set to be collection of data with a tabular column representation.
 - a) It is set to be collection of data with a tabular cell representation
 - b) It is set to be collection of data with a tabular row representation
 - c) It is set to be collection of data with a tabular field representation
3. ADO.Net connection object is used to establish a connection between
 - a) Application and Database
 - b) Application and Dataset
 - c) Application and the data source.
 - d) Application and Data object
4. Default timeout for Sql Command.Commandtimeout property
 - a) 10 Seconds
 - b) 20 Seconds
 - c) 30 Seconds
 - d) 40 Seconds

Section – B

1. What is the role of ADO.NET?
2. List and explain different objects in ADO.NET.
3. Write the code to create data set and data table.
4. Draw and explain ADO.NET architecture.
5. Write the steps to insert and update the records in the table (MS Access).
5. Write any five differences between ASP and ASP.NET
6. Write any three differences between Label and Literal.
7. Create a web form using label, button, check box, textbox, and literals.
8. Write the steps to create an SQL database.

Signature of the Faculty

HANDOUT ON DATA SCIENCE

Class& Sem. : III B.Tech – I Semester

Year : 2020-21

Branch : CSE

Credits : 3

=====

1. Brief History and Scope of the Subject

DATA SCIENCE is an inter-disciplinary course that develops methods and software tools for understanding and analyze data. It is a recently developed area in statistics and blends with parallel developments in computer science and, in particular, machine learning. The field encompasses many methods such as the lasso and sparse regression, classification and regression trees, and boosting and support vector machines.

2. Pre-Requisites

- Familiar with the fundamental concepts of computer programming and probability.

3. Course Objectives:

1. To familiarize with statistical methods to analyze data using classification, graphical and computational methods
2. To introduce Data Wrangling approaches and descriptive analytics on large data sets.

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

CO1 Apply statistical methods to data for inferences.

CO2 Analyze data using Classification, Graphical and computational methods.

CO3 Describe Data Wrangling approaches.

CO4 Perform descriptive analytics over massive data.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

| CS2508 : DATA SCIENCE (OPEN ELECTIVE - II) | | | | | | | | | | | | | | |
|--|---|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| Course outcomes | Program Outcomes and Program Specific Outcome | | | | | | | | | | | | | |
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PO 13 | PO 14 |
| CO1:apply statistical methods to data for inferences. | 3 | 2 | 1 | | 1 | | | | | | | 1 | | 1 |
| CO2:analyze data using Classification, Graphical and computational methods | 1 | 3 | 1 | | 2 | | | | | | | 1 | | 1 |
| CO3:describe Data Wrangling approaches. | 1 | | | | 1 | | | | | | | | | 1 |
| CO4:perform descriptive analytics over massive data. | 2 | 3 | 2 | 2 | 2 | | | | | | | 1 | | 1 |

7. Prescribed Text Books

Gareth James, Trevor Hastie, Robert Tibshirani, Daniela Witten, “An Introduction to Statistical Learning with Applications in R”.

8. Reference Text Books

Mark Gardener, “Beginning R The statistical Programming Language”, Wiley.

9. URLs and Other E-Learning Resources

- A. <https://www.atdbio.com/content/14/Transcription-Translation-and-Replication>
- B. <https://www.guru99.com/online-analytical-processing.html>
- C. <https://towardsdatascience.com/how-are-logistic-regression-ordinary-least-squares-regression-related-1deab32d79f5>
- D. <http://www.statisticslectures.com/topics/linearregression/>
- E. <https://towardsdatascience.com/intro-to-data-science-part-3-data-analysis-71a566c3a8c3>
- F. <http://www.statisticslectures.com/topics/linearregression/>
- G. http://onlinestatbook.com/2/graphing_distributions/freq_poly.html
- H. <https://stattrek.com/estimation/confidence-interval.aspx>

10. Digital Learning Materials:

1. <https://onlinecourses.nptel.ac.in>
2. <https://towardsdatascience.com/how-are-logistic-regression-ordinary-least-squares-regression-related-1deab32d79f5>
3. https://www.tutorialspoint.com/r/r_multiple_regression.htm
4. <https://acadgild.com/blog/6-steps-in-data-wrangling>
5. <https://www.alsharif.info/iom530>
6. <http://web.thu.edu.tw/wenwei/www/Courses/statistics/>

11. Lecture Schedule / Lesson Plan

| Topic | No. of Periods | |
|--|----------------|----------|
| | Theory | Tutorial |
| UNIT –1: Introduction | | |
| Introduction , Overview of random variables and distributions | 1 | 1 |
| statistical learning, assessing model accuracy, descriptive statistics, dependent and independent events | 1 | |
| Linear Regression: Simple | 1 | |
| multiple linear regressions | 2 | 1 |
| comparison of linear regression with k-nearest neighbors | 1 | |
| | 6 | 2 |
| UNIT - II: Hypothesis Testing | | |
| Simple Hypothesis testing | 1 | 1 |
| student's t-test, | 2 | |
| paired t and u test, | 2 | 1 |
| correlation and covariance, | 1 | |
| tests for association. | 1 | |
| | 7 | 2 |
| UNIT - III: Graphical Analysis | | |
| Histograms and frequency polygons | 1 | 1 |
| box-plots | 1 | |
| quartiles | 1 | 1 |

| | | |
|---|-----------|-----------|
| scatter plots | 2 | |
| heat maps | | |
| | 6 | 2 |
| UNIT - IV: Computational Methods | | |
| Programming for basic computational methods such as Eigen values and Eigen vectors, | 3 | 1 |
| sparse matrices, QR and SVD | 3 | 1 |
| | 6 | 2 |
| UNIT - V: Data Wrangling | | |
| Data acquisition, | 2 | 1 |
| data formats, | 1 | |
| imputation, . | 1 | |
| the split-apply-combine paradigm. | 1 | |
| | 5 | 1 |
| UNIT - VI: Descriptive Analytics | | |
| Data warehousing and OLAP, data summarization, data de-duplication, | 2 | 1 |
| data visualization using CUBEs. | 2 | |
| data de-duplication, data | 2 | |
| visualization using CUBEs. | 1 | |
| | 7 | 2 |
| Total No.of Periods: | 49 | 11 |

12. Seminar Topics

- Measures of similarity in amino acids sequences
- Cancer informatics ecosystem
- Proteomics and bioinformatics
- Parallel algorithms for bioinformatics applications
- Computational intelligence in bioinformatics

UNIT-I
Assignment-Cum-Tutorial Questions
SECTION-A

Objective Questions

Q1. Which of the one is true about Heteroskedasticity?

- A. Linear Regression with varying error terms
- B. Linear Regression with constant error terms
- C. Linear Regression with zero error terms
- D. None of these

Q2. Which of the following step / assumption in regression modeling impacts the trade-off between under-fitting and over-fitting the most.

- A. The polynomial degree
- B. Whether we learn the weights by matrix inversion or gradient descent
- C. The use of a constant-term
- D. None of the above

Q3. In _____ linear regression a single independent variable is used to predict the value of a dependent variable. ?

- A. **simple**
- B. **multiple**
- C. Both A & B
- D. None of the above

4. In _____ regression two or more independent variables are used to predict the value of a dependent variable.

- A. **simple**
- B. **multiple**
- C. Both A & B
- D. None of the above

5. The difference between the simple and multiple linear regression

is the number of _____ variables.

- A. independent
- B. dependent
- C. Both A & B
- D. None of the above

6. In both cases of simple and multiple linear regression, there is single dependent variable. [T/F]

7. Which of the following are wrong?

1. Descriptive statistics do not involve generalizing beyond the data at hand.

2. Generalizing from our data to another set of cases is the business of inferential statistics,

- A. 1
- B. 2
- C. Both 1 and 2
- D. None

8. Which of the following are wrong?

1. A distribution with the longer tail extending in the positive direction is said to have a [positive skew](#).
2. Positive skew is also described as "skewed to the right."
 - A. 1
 - B. 2
 - C. Both 1 and 2
 - D. None
9. Which of the following implies no relationship with respect to correlation ?
 - a) $\text{Cor}(X, Y) = 1$
 - b) $\text{Cor}(X, Y) = 0$
 - c) $\text{Cor}(X, Y) = 2$
 - d) All of the Mentioned

SECTION-B

SUBJECTIVE QUESTIONS

1. Explain about Random variables and distributions,
2. Discuss about statistical learning,
3. assessing model accuracy,
4. Explain about descriptive statistics,
5. Differentiate dependent and independent events,
6. Discuss about Linear Regression:
7. Differentiate Simple and multiple linear regressions,
8. Compare linear regression with k-nearest neighbors
- 9 Try installing the coin library from within R—note that this will load some additional libraries too.
10. Load the coin library of commands and check to see what commands are available in this library.
11. Load the MASS library (it is already installed) and find help about the bcv command.
12. Check to see which libraries of commands are loaded and ready for use.
13. Clear out the coin library that you loaded earlier.

UNIT-II

SECTION-A

Objective Questions

- 1) The purpose of hypothesis testing is to_____
 - a. test how far the mean of a sample is from zero

- b. determine whether a statistical result is significant
 - c. determine the appropriate value of the significance level
 - d. derive the standard error of the data
- 2) The p-value of a test is the _____
- a. smallest significance level at which the null hypothesis cannot be rejected
 - b. largest significance level at which the null hypothesis cannot be rejected
 - c. smallest significance level at which the null hypothesis can be rejected
 - d. largest significance level at which the null hypothesis can be rejected
- 3) _____ is a method for comparing two samples; looking at the means to determine if the samples are different. This is parametric test and the data should be normally distributed.
- 4) If one-sample test is carried out, μ indicates the mean against which the sample should _____ the _____ tested.
(True/False)
- 5) Create the formula using _____ symbol.
- 6) When you have two samples to compare and the data are non-parametric use _____
- a. U-test b. T-test c. z-test d. P-test
- 7) Correlation find the relation between two continuous variables
(True/False)
- 8) Methods for correlation or covariance _____
- a. pearson b. Spearman c. Kendall d. All
- 9) When you have categorical data you can look for association between categories by using the _____ test.
- a. Student-t b. Yates correction c. Monte Carlo d. chi-squared
- 10) _____ is a type of table in a matrix format that displays the frequency distribution of the variables, table showing the distribution of one variable in rows and another in columns, used to study the correlation between the two variables.

- a. correlation table b. Covariance table c. Contingency table d. None

SECTION-B

SUBJECTIVE QUESTIONS

Data set : Use the data on orchids (orchid, orchid2, orchis, and orchis2) from the Beginning.RData

This comprises two columns relating to two samples:

```
> orchid
      closed  open
1         7     3
2         8     5
3         6     6
4         9     7
5        10     6
6        11     8
7         7     8
8         8     4
9        10     7
10        9     6
```

- 1) Use orchids data carry out a t-test on these data without making any assumptions about the variance
- 2) Use orchids data carry out another two-sample t-test but use the “classic” version and assume the variance of the two samples is equal.
- 3) Use orchids data carry out a one-sample test to compare the data to a mean of 5
- 4) Use orchids data carry out a t-test using the formula syntax; you do not need to make assumptions about the variance:
- 5) In the about data take a subset instruction to carry out a t-test on the open and closed sites

Data set: The mpd data contains two samples white and yellow. These data are matched pair data and each row represents a bi-colored target. The values are for numbers of whitefly attracted to each half of the target.

```
> mpd
```

| | white | yellow |
|---|-------|--------|
| 1 | 4 | 4 |
| 2 | 3 | 7 |
| 3 | 4 | 2 |
| 4 | 1 | 2 |
| 5 | 6 | 7 |
| 6 | 4 | 10 |
| 7 | 6 | 5 |
| 8 | 4 | 8 |

- 6) Use mpd data carry out paired U-test (Wilcoxon matched pair test) on these data
 - 7) Use mpd data carry out a two-sided and paired t-test on the mpd.s data. Set the alternative hypothesis that the difference in means is 1 and show the 99 percent confidence intervals:
 - 8) In the mpd data take the fw data object; this contains two columns, count and speed. Conduct a Pearson correlation on these two variables.
 - 9) Take the swiss data object; this is built into R. Use Kendall's tau correlation to create a matrix of correlations.
 - 10) In the Swiss data look at the fw data object. It has two variables, count and speed. Create a covariance matrix.
 - 11) Convert the covariance matrix into a correlation
- Carry out a basic chi-squared test on these

Signature of the Faculty

HANDOUT ON OPEN SOURCE SOFTWARE

Class & Sem. : III B. Tech – I Semester

Year : 2019-20

Branch : CSE

Credits: 3

1. Brief History and Scope of the Subject

A report by the Standish Group (from 2008) states that adoption of open-source software models has resulted in savings of about \$60 billion per year to consumers.

The free software movement was launched in 1983. In 1998, a group of individuals advocated that the term “Free software” should be replaced by “Open Source Software (OSS)” as an expression which is less ambiguous and more comfortable for the corporate world. Software developers may want to publish their software with an open-source license, so that anybody may also develop the same software or understand its internal functioning.

With open-source software, generally anyone is allowed to create modifications of it, port it to new operating systems and processor architectures, share it with others or, in some cases, market it. Scholars Casson and Ryan have pointed out several policy-based reasons for adoption of open source in particular, the heightened value proposition from open source (when compared to most proprietary formats) in the following categories:

- Security
- Affordability
- Transparency
- Perpetuity
- Interoperability
- Flexibility

The open source label came out of a strategy session held on April 7, 1998 in Palo Alto in reaction to Netscape's January 1998 announcement of a source code release for Navigator. A group of individuals at the session included Tim O'Reilly, Linus Torvalds, Tom Paquin, Jamie Zawinski, Larry Wall, Brian Behlendorf, Sameer Parekh, Eric Allman, Greg Olson, Paul Vixie, John Ousterhout, Guido van Rossum,

Philip Zimmermann, John Gilmore and Eric S. Raymond. They used the opportunity before the release of Navigator's source code to clarify a potential confusion caused by the ambiguity of the word "free" in English.

Many people claimed that the birth of the Internet, since 1969, started the open source movement, while others do not distinguish between open-source and free software movements.

The Free Software Foundation (FSF), started in 1985, intended the word "free" to mean freedom to distribute and not freedom from cost. Since a great deal of free software already was free of charge, such free software became associated with zero cost, which seemed anti-commercial.

The Open Source Initiative (OSI) was formed in February 1998 by Eric S. Raymond and Bruce Perens. With at least 20 years of evidence from case histories of closed software development versus open development already provided by the Internet developer community, the OSI presented the "open source" case to commercial businesses, like Netscape. The OSI hoped that the usage of the label "open source," a term suggested by Peterson of the Foresight Institute at the strategy session, would eliminate ambiguity, particularly for individuals who perceive "free software" as anti-commercial. They sought to bring a higher profile to the practical benefits of freely available source code, and they wanted to bring major software businesses and other high-tech industries into open source.

2. Pre-Requisites:

- Commercial software
- Basic knowledge on programming
- Basic knowledge on Installing software

3. Course Objectives:

- To understand the opportunities for Open Source Software in the global market.
- To familiarize the different steps in implementing the Open Source.

4. Course Outcomes:

CO1: State the need and applications of open source software.

CO2: Compare and Contrast between Open source and commercial software

CO3: Demonstrate LINUX operating systems concepts.

CO4: Create database in MYSQL and perform operations on it.

CO5: Design and develop a web application using PHP.

5.PROGRAM OUTCOMES (POs)

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a

member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

5. Mapping of Course Outcomes with Program Outcomes and Program specific outcomes:

| | PO 1 | PO 2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-----|------|------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 3 | 2 | 2 | 1 | 3 | | 3 |
| CO2 | 3 | 2 | 3 | | 1 | | 2 | 2 | 2 | 2 | 3 | 2 | | 3 |
| CO3 | 3 | 2 | 3 | | 2 | | 2 | 2 | 2 | 2 | 3 | | | 3 |
| CO4 | 3 | 3 | 3 | | 3 | | | 2 | 3 | 3 | 3 | 2 | | 3 |
| CO5 | 3 | 3 | 3 | | 3 | | | 2 | 2 | 3 | 3 | | | 3 |

6. Prescribed Text Books:

- 1) Remy card, Eric Dumas, Franck Mevel, “The Linux kernel book”
 ,Wiley Publications,2003.
- 2) Steve Suchring, “MySQL Bible” , John Wiley, 2002

7. Reference Text Books:

- 1) Rasmus Lerdorf and Levin Tatroe, “ Programming PHP”, O’Reilly, 2002
- 2) Steven Holzner, ”PHP : The Complete Reference”, Second Edition, Tata McGraw Hill Publishing Company Limited, Indian Reprint 2009.
- 3) Vikram Vaswani, ‘MySQL: The Complete Reference”, Second Edition, Tata McGraw Hill Publishing Company Limited, Indian Reprint 2009

8. URLs and Other E-Learning Resources

- a) **Journals:** IEEE/ACM transactions on OSS
- b) Web pages referred will be available on Intranet
 - 1) www.Opendsource.org

2) www.diffen.com

9. Digital Learning Materials:

- 1) <http://nptel.ac.in/courses/117106113>
- 2) http://www.nptelvideos.com/php/php_video_tutorials.php
- 3) <http://freevideolectures.com/Course/2331/Building-Dynamic-Websites/2>
- 4) <http://nptel.ac.in/courses/106106093/33>
- 5) <http://freevideolectures.com/Course/2280/Database-Design/33>

10. Lecture Schedule / Lesson Plan

| Topic | No. of Periods |
|--|----------------|
| | Theory |
| UNIT -I INTRODUCTION | |
| Open Sources-Introduction | 2 |
| Need of Open Sources | 1 |
| Advantages of Open Sources | 1 |
| Applications | 1 |
| UNIT -II LINUX | |
| Introduction & Overview | 1 |
| Kernel and User Mode | 1 |
| Process | 2 |
| Scheduling | 1 |
| Personalities | 1 |
| Cloning | 1 |
| Signals | 2 |
| UNIT-III OPEN SOURCE PROGRAMING LANGUAGES | |
| PHP-Introduction | 1 |
| Programming in Web Environment | 2 |
| variables | 1 |
| Constants | 1 |
| Data types | 1 |
| Operators | 1 |
| statements | 1 |
| Arrays | 2 |
| UNIT -III INTRODUCTION TO MYSQL | |
| Introduction | 1 |
| Setting up account | 1 |
| Starting, Terminating, Writing MySQL Programs | 3 |
| Record selection technology | 2 |
| Working with Strings | 2 |
| Date and Time | 2 |

| | |
|------------------------------------|-----------|
| UNIT -IV WORKING WITH MYSQL | |
| Sorting Query Results | 2 |
| Generating Summary | 1 |
| Working with Metadata | 1 |
| Using Sequences | 1 |
| MySQL and Web | 1 |
| UNIT -V WORKING WITH MYSQL | |
| Sorting query results | 2 |
| Generating summary | 2 |
| Working with Metadata | 1 |
| Using of Sequences | 2 |
| UNIT – VI: ADVANCED PHP | |
| OOP-string Manipulation | 2 |
| PHP and SQL database | 2 |
| PHP Connectivity | 2 |
| Debugging and Error handling | 2 |
| Total No. of Periods: | 56 |

11. Seminar Topics

- LAMP Technology
- PHP example implementation
- Open Source Vs Closed Software
- MySQL and Web

Assignment-Cum-Tutorial Questions UNIT-I

SECTION-A

Objective Questions

1. OSS Stands for_____

| | |
|----------------------------|--------------------------|
| a) Open Source System | b) Open Source Software |
| c) Open Structure Software | d) Open Structure System |

2. Identify the Open Source Web Browsers

| | |
|-------------|----------------------|
| a) Firefox | b) Internet Explorer |
| c) Chromium | d) Both a and c |

3. Identify the Commercial Operating Systems

| | |
|------------------|-----------|
| a)Windows | b) Ubuntu |
| c) Red Hat LINUX | d) UNIX |

4. If your project is short in Budget with considerable deadline, which type of Software is generally preferred?

| | |
|-----------------|----------------------|
| a) Open Source | b) Commercial |
| c) Both a and b | d) None of the above |

5. ERP is a ----- application.
- a) Military
c) Entertainment
b) Academic
d) Business
6. Linux is an example of -----
- a) Open Source OS
b).Commercial Programming Language
c) Open Source Programming Language
d) Commercial OS
7. Which of the following is not a disadvantage of an OSS?
- a) Mostly used Commercial operations
c) Support issues
b) Projects can die
d) Rapid Debugging
8. Identify the commercial web browser from the following
- a) Midori
c) Chromium
b) Firefox
d) Internet Explorer
9. Identify the Open source Antivirus from the following
- a) Kaspersky
c) Calm Win
b) Avast
d) AVG
10. Identify the free office tool
- a) LibreOffice
c) MS Office
b) Open Office
d) None of the above
11. Identify among the following which is not a principal of OSS
- a) Commercial Code
c) Author's Source Code Integrity
b) License Distribution
d) License not restricted to other S/W
12. Find the odd man out from the following
- a) Mac OS b) Windows c) Linux d)Amiga OS
13. An open Source is a Program in Which
- a) Source Code is available for free
c) Modification of Source code is possible
b) Public co-relation is developed
d) All the above.
14. The license of open source software should not have certain restrictions in terms of
- a) Hardware
c) Field
b) Operating system
d) all of the above
15. LibreCAD is an Open Source Software [True/False]
16. Free software movement Started by _____

17. No discrimination against a person or group of persons is a principle of OSS

[True/False]

18. Commercial Software are more secure than Open Source Software

[True/False]

19. Open Source Software requires additional license

[True/False]

20. BSD stands for _____

SECTION B

Subjective questions

1. Define OSS? Explain the advantages of Open Source Software.
2. Explain the needs of Open Source Software.
3. List the principles of Open Source Software.
4. Explain the open Source Movement.
5. Define Free Software.
6. Illustrate the principles of Open Source Software
7. Summarize the history of Open Source Movement.
8. List the Applications of open source software.
9. Explain the disadvantages of Commercial Software.
10. Explain the Need of Open Source Software.
11. Compare the OSS and Commercial Software.
12. Why Open source software is more secure than Commercial software? Justify.

UNIT-II

SECTION-A

Objective Questions

1. LINUX OS is more secure than windows OS. [TRUE / FALSE]
2. ELF Stands for _____
3. For implementing signals, _____ header file is used.
4. A System call is _____.
5. Libraries are useful during _____ of a program.
6. Tail command displays _____ number of line in a file by Default.
7. The process which exists even after complete de-allocation is ___Process.
8. _____ command is used for creating a child.

9. SIGABRT call the function
10. LINUX was developed by
 - a) Dennis Ritchie c)Ken Thompson
 - b) Linus Torvalds d)None
11. Which among the following OS has a free Open Source Code?
 - a) Windows OS c) MAC OS
 - b) LINUX OS d) ALL
12. In which Programming Language, the LINUX Source code is Programmed?
 - a) C b) C,C++ C) C++ d) None
13. Which among the following is a mode in LINUX Operating System?
14. Process Mode b) User Mode c) Kernel Mode d) Both B & C.
15. In Batch Process System, execution is done in _____Order.
 - a) LIFO b) LRU c) FIFO d) LFU
16. A Clone is _____
 - a) Original copy of data b) Reference to Data
 - c) Address Space to data d) Data Duplicate
17. Signals are classified into ____ categories.
 - a) 2 b) 1 c) 3 d) 4

SECTION B

Subjective questions

1. Define the following terms
 - a)User mode.
 - b) Kernel mode.
 - c)Operating System.
 - d) Process and Process ID
 - e)Daemon Process and Orphan Process.
 - f)Scheduling.
2. List the commands Under “File and Directory” Categories.
3. What are the various Kernel functionalities in LINUX OS?
4. Explain the following
 - a) Scheduling and its types
 - b) Process states and types of Processes
 - c) concept of signals in Process communication.
 - d) personalities implemented in LINUX OS.

5. Differentiate fork(),vfork() and clone().
6. Apply the basic commands of files and directories.
7. Demonstrate the following
 - a) sending and receiving signals.
 - b) getpid() and getppid() functions.
8. Discuss in detail about the creation of process
9. Why init process cannot killed by using the kill command.
10. Compare LINUX OS with Windows OS.

UNIT – III

A. Questions testing the remembering / understanding level of students

I. Objective type Questions:

1. MySQL runs on which operating systems

| | |
|------------------------------------|--------------------------------|
| a) Linux and Mac OS-X only | b) Any operating system at all |
| c) Unix, Linux, Windows and others | d) Unix and Linux only |
2. To remove duplicate rows from the result set of a SELECT use the following keyword

| | |
|-----------------|----------------------|
| a) NO DUPLICATE | b) UNIQUE |
| c) DISTINCT | d) None of the above |
3. Which of the following can add a row to a table?

| | |
|-----------|-----------|
| a) Add | b) Insert |
| c) Update | d) Alter |
4. MySQL is

| | |
|--|--|
| a) A Programming language | b) A Relational Database Management System |
| c) A technique for writing reliable programs | d) None of the Above |
5. Which function used to get the current time in MySQL

| | | | |
|--------------|-----------|----------|-----------|
| a) getTime() | b) Time() | c) NOW() | d) NEXT() |
|--------------|-----------|----------|-----------|
6. Which SQL Statement is used to insert a new data in a database?

| | |
|----------------|---------------|
| a) INSERT INTO | b) UPDATE |
| c) ADD | d) INSERT NEW |
7. The result of a SELECT statement can contain duplicate rows.

| | |
|----------|---------|
| a) False | b) True |
|----------|---------|
8. What SQL clause is used to restrict the rows returned by a query?

| | |
|-----------|----------|
| a) AND | b) WHERE |
| c) HAVING | d) FROM |

II. Descriptive Questions

1. Define Database and DBMS.
2. List out the advantages and disadvantages of MySQL?
3. State the difference between DBMS and RDBMS.
4. Explain Record selection technology.
5. Explain now() function.
6. Explain LENGTH() function.
7. Explain CONCAT() function with example
8. Explain CURRDATE() and CURRTIME() functions.
9. Explain DAYOFMONTH() function.

B. Questions testing the ability of students in applying the concepts:

I) Multiple Choice Questions:

1. How many characters are allowed to create database name?
 - a) 55
 - b) 72
 - c) 64
 - d) 40
2. Which of the following commands should be used to create a database named student?
 - a.a) CREATE I student student
 - b) CREATE DATABASE student
 - c) DATABASE /student
 - d) DATABSE student
3. Which one will delete the table data as well as table structure?
 - a)TRUNCATE
 - b)DELETE
 - c)DROP
 - d)None of the above
4. The USE command _____
 - a) Is used to load code from another file
 - b) Has been deprecated and should be avoided for security reasons.
 - c) Should be used to choose the database you want to use once you've connected to MySQL.
 - d) None of the above.
5. Identify the output of the following query
mysql> SELECT RPAD('Srikanth',10,'*');
 - a. Srikanth**
 - b. Srikanth*****
6. Identify the output of the following query
mysql> SELECT LPAD('Srikanth',12,'**');
 - a. ****Srikanth
 - b. *****Srikanth
 - c.Srikanth*****
7. Identify the output of the following query
mysql> SELECT BIN(5);
 - a. 1001
 - b.0111
 - c. 0101
 - d. 0110
8. Identify the output of the following query
mysql> SELECT LOWER(SRikanth);
 - a. SRIKANTH
 - b.srikanth
 - c. sriKANTH
9. Identify the output of the following query
mysql> SELECT REPEAT(OSS,5);
 - a. OSS
 - b.OSSOSSOSSOSSOSS
 - c. OSSOSSOSS
 - d. OSSOSSOSSOSS

II) Problems

1. Explain String Data Types in detail
2. Explain Date and Time Data types in detail
3. Explain Numeric Data Types
4. What is the query to display top 20 rows?
5. Explain about Record Selection technology and apply the same to a sample database?
6. Differentiate CHAR_LENGTH and LENGTH?
7. Explain the different string functions with example.
8. Explain the date and time functions with examples.
9. Write a query to display the difference between two given dates of a month.
10. Write a command to describe the structure of the table in MySQL.

C. Questions testing the analyzing / evaluating ability of students:

1. Create a sample employee database and create employee table with attributes (id, name, salary, dept) and perform desc, insert into, select, update, delete, drop, truncate commands.
2. Create an account in MySQL with the following attributes(username,password) and grant the following permissions. Create, Insert and Select.
Username:Sri
Password:543

UNIT – IV

B. Questions testing the understanding / remembering level of students

I). Objective Questions

1. _____ query gives the name of the database
2. _____ command gives the status of server
3. _____ function count the records of a query results without having duplicates
4. Sequences can be generated by using _____ Attribute
5. When we are using sequences the field or column must be _____
6. LAST_INSERT_ID() function can be used to obtain _____

II). Descriptive questions

1. Define Count () Function
2. Define Aggregate functions
3. Write a Query to sort records in Ascending order and Descending order using order _____ by clause
4. Discuss in brief about aliasing in order by clause
5. Define Sequences in MySQL
6. Define Metadata

C. Question testing the ability of students in applying the concepts.

I). Multiple Choice Questions:

1. What is the attribute to be used while generating /creating a sequence
 - a.UNIQUE
 - b.INCREMENT
 - c.AUTO_INCREMENT
 - d.AUTO
2. On applying "order by" clause what is the result of below query
SELECT * FROM employee ORDER BY name limit 0,5;
 - a.Display the first 5 rows of employee table with name sorted in ascending order
 - b. b.Display the first 5 rows of employee table with name sorted in descending order
 - c.c.Display the first and 5th row of employee table with name sorted in ascending
 - d. Display the first and 5th row of employee table with name sorted in descending
3. Is "GROUP BY" clause is similar to "ORDER BY" clause?
 - a. Yes
 - b. No
 - c. Depends
 - d. None of these
4. What is the meaning of "ORDER BY" clause in MySQL?
 - a. Sorting your result set using column data
 - b. Aggregation of fields
 - c. Both a and b
 - d. None of these
5. What is the significance of "ORDER BY" in the given query?
SELECT Stu_id, fname, lname FROM Student ORDER BY Stu_id
 - a.Data of Stu_id will be sorted
 - b.Data of Stu_id will be sorted in descending order
 - c.Data of Stu_id will be sorted in ascending order
 - d. None of the above
6. Which keyword is used for sorting the data in descending order in Mysql?
 - a. DESC
 - b. ASC
 - c. ALTER
 - d. MODIFY
7. Which keyword is used for sorting the data in ascending order in Mysql?
 - a. DESC
 - b. ASC
 - c. ALTER
 - d. MODIFY
8. What is the meaning of "GROUP BY" clause in Mysql?
 - a. Group data by column values
 - b. Group data by row values
 - c. Both a and b
 - d. None of these
9. "COUNT" keyword belongs to which categories in Mysql?
 - a. Aggregate functions
 - b. Operators
 - c. Clauses
 - d. All of the above
10. Which of the following belongs to an "aggregate function"?
 - a. COUNT

- b. SUM/AVG
- c. MIN/MAX

d. All of the above

II). Problems

1. Explain Date Based sorting with an Example
2. Explain Calendar Day Based sorting with an example
3. Explain sorting sub set of a table with example
4. Define metadata. explain types of meta data
5. Discuss in detail about Summarizing with SUM() and AVG() functions
6. Define Aggregate functions. Explain in detail with examples
7. Discuss in detail about generating summary.

C. Questions testing the analyzing / evaluating ability of students

1. Create Sequences in student database
2. Create the following table and write the following queries

| Emp id | EmpName | Salary | Bonus | Emailid | Deptno |
|--------|----------|--------|-------|-----------------------|--------|
| 501 | Shafi | 35000 | 5000 | shafikhan@gmail.com | 01 |
| 511 | Hema | 50000 | 3000 | Hema117@gmail.com | 02 |
| 521 | sanjana | 45000 | 4000 | Sanju711@gmail.com | 03 |
| 543 | Srikanth | 35000 | 3000 | kingsri543@gmail.com | 05 |
| 553 | Suresh | 50000 | 5000 | suresh08553@gmail.com | 04 |

- a) Write a query to display total salary paying by the company to their employees
- b) Write a query to display the empname, empid who is getting maximum salary
- c) Write a query to display the employee record sorted by their names

UNIT –V

D. Questions testing the understanding / remembering level of students

III). Objective Questions

1. The filesize() function returns the file size in ____.
2. PHP files have a default file extension of
 - a) .html
 - b) .xml
 - c) .PHP
 - d) .ph
3. What PHP stands for?
 - a) Hypertext Preprocessor
 - b) Pre Hypertext Processor
 - c) Pre Hyper Processor
 - d) Pre Hypertext Process

4. A class may contain its own
 - a) variables
 - b) functions
 - c) constants
 - d) all of above
5. _____ is used to access property variables on an object-by-object basis.
6. _____ variable is used to collect data, the data is visible to all.
7. _____ is used to sort an array in descending order.
8. Once a class has been defined, objects can be created from the class with the _____ keyword.
9. We can access an object's properties and methods using the _____ operator

IV). Descriptive questions

1. Explain use of "echo" in PHP?
2. Differences between GET and POST methods?
3. Explain use of count() function in PHP?
4. Explain different types of variables with example.
5. Define data type? Explain different data types in PHP.
6. Define a PHP function? Explain with a suitable example.
7. Define an array. Explain different ways of creating an array with syntax.
8. Explain string concatenation and its uses.
9. Define file. Explain different types of file handling functions
10. Define identifiers and give examples for it.
11. Define reserved words. List those reserved words.

E. Question testing the ability of students in applying the concepts.

III). Multiple Choice Questions:

1. What will be the output of the following php Code?

```
<?php
$num1=2;
$num2=7;
print $num1."+".$num2;
?>
```

- | | |
|--------|---------|
| a.9 | b.2+7 |
| c.2.+7 | d.error |

2. What will be the output of the following php Code?

```
<?php
$num1=2;
$num2=7;
print $num1+$num2;
?>
```

- | | |
|--------|---------|
| a.9 | b.2+7 |
| c.2.+7 | d.error |

3. What will be the output of the following code

10. Assume you would like to sort an array in ascending order by value while preserving key associations. Which of the following PHP sorting functions would you use?
 - a) ksort()
 - b) asort()
 - c) krsort()
 - d) sort()
11. Variables always start with a in PHP
 - a) Pound-sign
 - b) Yen-sign
 - c) Dollar-sign
 - d) Euro-sign
12. Which of the following is not valid PHP code
 - a) \$_10
 - b) \${"MyVar"}
 - c) \$10_somethings
 - d) \$aVaR

IV). Problems

1. Explain different statements in PHP with examples.
2. Explain selection statement and conditional statements with examples.
3. Explain different types of loops with examples.
4. Define Operator. Explain Different types of Operators.
5. Explain Operator Precedence and Operator Associativity.
6. Discuss in detail about invoking functions.
7. Explain GET and POST methods with example for PHP scripts.
8. Explain Object Oriented Concepts in PHP.
9. Explain File Handling and data storage concepts.
10. Write a script to print the following 'oss oss oss' on browser using while loop.
11. Write a script to print the following 'opensource opensource opensource' on browser using do-while loop
12. Write a script to create a multiplication table on browser using nested loops.
13. Write a PHP script to add n numbers using arrays
14. Write a PHP script to the display and arrange array elements in ascending and descending order.
15. Write a PHP script to find GCD of two numbers which displays its output on the browser.
16. Write a PHP script for printing the factorial using recursion and non-recursion
17. Write a PHP Script for deleting, renaming and copying a file
18. Write a PHP script to copy data from one file to another.

D. Questions testing the analyzing / evaluating ability of students

1. Differentiate between local and global variables.
2. Differentiate GET and POST methods with examples

3. Select the best method to enable communication between Client and Server from GET and POST methods.

UNIT –VI

F. Questions testing the understanding / remembering level of students

I). Objective Questions

1. The PHP-3 debugger protocol is _____.
2. The die() function is used to _____.
3. The constant corresponding error value 2 is _____.
4. The end of the string is represented by _____ bytes.
5. A template takes the help of _____ to create large web sites.

II). Descriptive questions

1. Explain the steps of connecting PHP to MySQL database?
2. Explain in brief about LDAP?
3. What is meant by Debugging?
4. What are the different error value reports that are generated?
5. Explain in brief about File System Security.

G. Question testing the ability of students in applying the concepts.

V). Multiple Choice Questions:

1. Which among the following is not a parameter of mysql_connect () statement?
a) server name b) user name
c) host name d) password
2. LDAP stands for _____
a) Light Weight Directory Access Protocol
b) Light Weight Data Access Protocol
c) Light Weight Directory Access Principle
d) Light Weight Directory Access Prototype
3. Which function is used for sending simple mail in server
a) mailer() b) mail()
c) mailing() d) None of the mentioned
4. PHP doesn't have ----- debugger(s)
a) Internal b) External
c) Both a) and b) d) None of the above
5. What is the error value for User-generated notice
a) 8191 b) 4096
c) 1024 d) 512
6. SQL Injection is related to ----- layer?
a) Data base b) Network
c) Transmission d) Data
7. The process that automagically escapes incoming data to the PHP Script is -----
a) Magic Quotes b) Logic Quotes
c) Byte Quotes d) Bit Quotes

8. The easy way to create large sites without much trouble is by using
-----.
- a) Template`
 - b) HTML
 - b) Nameplate
 - d)DHTML

VI). Problems/Programs

1. Write a program to close the MySQL connection with PHP.
2. Write a program that implements LDAP calls.
3. Write the sample code for HTML code on sender's side for transferring an e-mail.
4. Write a PHP program to establish a connection with MySQL
5. Write a PHP program to insert, update and delete data from MySQL
6. Write a PHP program to illustrate \$_POST[].

E. Questions testing the analyzing / evaluating ability of students

1. Differentiate between client side scripting and server side scripting.

Signature of the Faculty

HANDOUT ON CYBER LAWS

Class & Sem. : III B.Tech–I Semester

Year : 2020-21

Branch : CSE

Credits : 3

Brief History and Scope of the Subject

Cyber law is that stream of law where all the cyber-crimes such as theft, fraud, etc. all of which are subject to the Indian Penal Code are addressed by the Information Technology Act, 2000. With advanced technology and changing times, almost all the processes are now going on IT platform. This is giving rise to increase of cyber-crimes in India as well as abroad.

The rapid development of information technology posed certain challenges for the law that are not confined to a particular category of law but arises in diverse areas of law, such as criminal law, intellectual property law, contract and tort. Of late, owing to the rapid development of the internet and the World Wide Web, various unprecedented problems have emerged. These problems concern the issues of free speech, intellectual property, safety, equity, privacy, e-commerce and jurisdiction and are governed by the Cyber Law. The branch of law which regulates the technological aspects of information or information processing is called Cyber Law.

It has a wide and great scope in the corporate field. Students who are experts in cyber law are huge in demand and are paid handsomely. The rapid growth of the information technology has lead to a situation where the existing laws are challenged. It deals with computer hackers and people who introduce viruses to the computer. Cyber Law prevents or reduces the damage from cyber criminal activities by protecting information access, privacy, communications, intellectual property (IP) and freedom of speech related to the use of the Internet, World Wide Web (WWW), email, computers, cell

phones, software and hardware.

1. Pre-Requisites

Student should be familiar with

- Information about new technologies and communications.
- Importance and necessity of Cyber law.
- Knowledge about cyber-crimes and frauds.

2. Course Objectives

- To expose the need of cyber laws to prosecute cybercrimes in the society
- To familiarize various Licensing Issues Authorities for Digital Signatures.

3. Course Outcomes

Upon successful completion of the course, the Students will be able to:

- outline the pros and cons of Internet.
- operate on confidential data in a precautionous manner.
- discuss Criminal Justice in India and its Implications.
- interpret the Cyber Consumers under the consumer Protection Act
- devise the legal framework for Confidential Information
- determine the e-commerce issues for copyright protection and defend personal data from being hacked

4. Program Outcomes

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

5. Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

| Course outcomes | Program Outcomes and Program Specific Outcome | | | | | | | | | | | | | |
|---|---|-------|-------|-------|-------|-------|-------|-------|-------|--------|--------|--------|---------|---------|
| | P O 1 | P O 2 | P O 3 | P O 4 | P O 5 | P O 6 | P O 7 | P O 8 | P O 9 | P O 10 | P O 11 | P O 12 | P S O 1 | P S O 2 |
| CO1. outline the pros and cons of Internet | | 1 | 2 | | | 3 | | | | | | | | 2 |
| CO2.operate on confidential data in a precautions manner. | | | | | | 2 | | | | | | | | 3 |
| CO3.discuss Criminal Justice in India and its Implications. | | | | 1 | | | 2 | 3 | | | | | | |
| CO4. interpret the Cyber Consumers under the consumer Protection Act | | 2 | 1 | | | | 3 | | | | | | | |
| CO5.devise the legal framework for Confidential Information | | | | | | 2 | | 3 | | | 1 | | 1 | |
| CO6.determine the e-commerce issues for copyright protection and defend personal data from being hacked | 2 | | 3 | | | 1 | | | | | | 2 | 1 | |

6. Prescribed TextBooks

1. Vivek Sood, “ Cyber Law Simplefied”, Tata McGraw Hill.
2. Marjie T. Britz, “Computer Forensics and Cyber Crime”, Pearso

7. Reference TextBooks

- Cyber Laws Texts and Cases, Ferrera, CENGAGE.

8. URLs and Other E-LearningResources

- Cyber Crimes: <http://www.legalindia.com/cyber-crimes-and-the-law/>
- Cyber Laws: <http://www.cyberlawsindia.net/>
- Legal Services: <http://www.legalserviceindia.com/cyber/cyber.htm>
- Digital Signatures: <http://searchsecurity.techtarget.com/definition/digital-signature>

9. Digital LearningMaterials

- <http://cyber.law.harvard.edu/media/files/copyrightandeducation.html>
- http://www.tutorialspoint.com/information_security_cyber_law/quick_guide.htm

➤ https://books.google.co.in/books/about/Cyber_Law_Simplified.html?id=Wxk89dMjxIQC

10.Lecture Schedule / Lesson Plan

| Topic | No. of Periods |
|---|----------------|
| UNIT –1: The IT Act, 2000- A Critique | |
| Crimes in this Millennium | 1 |
| Section 80 of the ITAct, 2000 – A Weapon or a Farce? | 2 |
| Forgetting the Line between Cognizable and Non - Cognizable Offences | 2 |
| Arrest for “About to Commit” an Offence Under the ITAct: A Tribute to Draco | 1 |
| Arrest But No Punishment. | 1 |
| Total | 7 |
| UNIT – 2: Cyber Crime and Criminal Justice | |
| Penalties, Adjudication and Appeals Under the IT Act, 2000: Concept of Cyber Crime and the IT Act, 2000 | 1 |
| Hacking, Teenage Web Vandals | 2 |
| Cyber fraud and Cyber Cheating | 2 |
| Virus on Internet | 1 |
| Defamation ,Harassment and E- mail Abuse | 1 |
| Total | 7 |
| UNIT – 3: Cyber Crime and Criminal Justice | |
| Network Service Providers, Jurisdiction and Cyber Crimes | 2 |
| Nature of Cyber Criminality Strategies to Tackle Cyber Crime and Trends | 2 |

| | |
|---|---|
| Criminal Justice in India and Implications | 2 |
| Total | 6 |
| UNIT – 4: Digital Signatures, Certifying Authorities and e-Governance | |
| Introduction to Digital Signatures | 2 |
| Certifying Authorities and Liability in the Event of Digital Signature compromise | 2 |
| E - Governance in the India: A Warning to Babudom | 1 |
| Are Cyber Consumers Covered under the Consumer Protection | 1 |
| Goods and Services | 1 |
| Consumer Complaint, Defect in Goods and Services, | 1 |
| Restrictive and Unfair Trade Practices | 1 |
| Total | 9 |
| UNIT – 5 : Traditional Computer Crime | |
| Early Hacker and Theft of Components Traditional problems | 2 |
| Recognizing and Defining Computer Crime | 2 |
| Phreakers: Yesterday's Hackers, | 1 |
| Hacking | 2 |
| Computers as Commodities, Theft of intellectual Property | 1 |
| Total | 8 |
| UNIT – 6: Web Based Criminal Activity | |
| Interference with Lawful Use of Computers, Malware | 2 |
| DoS (Denial of Service) and DDoS (Distributed Denial of Service) Attacks | 2 |

| | |
|---|-----------|
| Spam, Ransom ware and Kidnapping of Information, Theft of Information | 2 |
| Data Manipulation, and Web Encroachment Online Gambling Online Fraud | 2 |
| Securities Fraud and stock Manipulation, Ancillary crimes | 2 |
| Total | 10 |
| Total No.of Periods: | 47 |

Assignment-Cum-Tutorial Questions

UNIT-I

SECTION-A

Objective Questions

1. The weapon with which cybercrime are committed is _____.
2. CERT stands for _____.
3. Cybercrimes such as _____ have the potential of shaking economies.
A) Hacking B) planting computer viruses C) online financial frauds
D) All the above.
4. Internet Security software which includes:
A) Firewalls
B) Intrusion-detection programs
C) Authentication and authorization software D) All the Above
5. _____ is the deadliest virus that attacked the Internet world.
6. Under section 80 of IT Act 2000, a person can be arrested from_____.

A) Private place B) public place C) Any place D) none
7. FIR stands for _____.
8. FIR is registered in _____ case.
A) Cognizable B)non-Cognizable C) Both A&B D) None
9. _____ of Cr.P.Ccontains the procedure for registration of FIR.
A) Section 154 B) section 156 C) section 157 D) None

10. Cr.P.C stands for _____.
11. As per the _____ of Cr.P.C, any officer-in-charge of Police station, without the order of a Magistrate, may investigate any cognizable case falling within the jurisdiction of police station.
- A) Section 154 B) section 156 C) section 157 D) None
12. _____ of Cr.P.C states the procedure of investigation in cognizable offences.
- A) Section 154 B) section 156 C) section 157 D) None
13. Preliminary complainant's evidence is taken in _____ case.
- A) Cognizable B) non-Cognizable C) Both A & B D) None

II. Descriptive Questions

1. List various cyber-crimes that affected Internet world and what are the measures taken by the government.
2. Explain section 80 of IT Act, 2000.
3. Explain the differences between cognizable and non-cognizable cases.
4. List the classification of IT Act Offences.
5. Explain various issues of cognizable cases.

B. Questions testing the ability of students in applying the concepts

I. Multiple Choice Questions

1. A type of cyber crime that occurs in pay per click online advertising when a person, automated script or computer program imitates a legitimate user of a web browser clicking on an ad, for the purpose of generating a charge per click without having actual interest in the target of the ad's link.
(a) Phishing (b) Zombie (c) Click fraud (d) none of these
2. Which one of the following is not an example of using computer as a weapon?
(a) Cyber Terrorism (b) I PR violations (c) Credit card frauds (d) All of these
3. The use of the Internet or other electronic means to stalk or harass an individual, a group of individuals, or an organization is termed:
(a) Cyberspace (b) Cyber stalking (c) Pornography (d) none of these
4. The attempt acquire information (and sometimes, indirectly, money) such as usernames, passwords, and credit card details by masquerading as a trustworthy

entity in an electronic communication is termed:

- (a)Spamming (b) Phishing (c) Spoofing (d) None of these
5. _____ is a computer connected to the Internet that has been compromised by a hacker, Computer virus or trojan horse and can be used to perform malicious tasks of one sort or another under remote direction.
- (a)Server (b)Zombie (c) Symbian (d) None of these
6. Which one of the following is an example of denial of service attack'?
- (a)Attempts to flood" a network, there by preventing legitimate network traffic
- (b) Attempts to disrupt connections between two machines, thereby preventing access to a service
- (c)Attempts to prevent a particular individual from accessing a service
- (d) All of these
7. In cyber law terminology 'DoS' means:
- (a)Denial of Service (b) Disc operating System (c) Distant Operator service (d) None
8. The Indian Parliament passed the Information Technology Bill ,which is regarded as the mother legislation regulating the use of computers, computer systems and computer networks as also data and information in the electronic format , in the year:
- (a)2000 (b) 2001 (c) 2002 (d) 2003
9. The seat of the Asian School of Cyber Laws:
- (a)New Delhi (b) Pune (c) Chennai (d) Hyderabad
10. Which one of the following is not an example of using computer as a weapon'?
- (a) Cyber Terrorism (b) I PR violations (c) Credit card frauds (d)All of these

II. Descriptive Questions

1. In law, how a “preparation for the commission of an offence” is different from “an attempt to commit crime”. Justify with a case study?
2. Discuss various cases where innocents are misinterpreted as “being about to commit” an IT Act offence.
3. Discuss the reasons for delay in non-cognizable cases.
4. How section 80 is becoming a FARCE by restricting it to arrest the accused only from a public place?

5. List the characteristics of cyber crimes that do not permit to immediate arrest of the accused.

C. Questions testing the analyzing / evaluating ability of students

1. Discuss some situations where section 80 is vulnerable.
2. List the confusions raised by cognizable offences in case of section 80 of IT Act.
3. Is there a necessity that IT Act should be amended which treats “of committing” and “of being about to commit” as substantive offences.

UNIT-II

A. Questions testing Remembering/ Understanding level of students

I. Objective Questions

1. Hacking requires _____[CO2]
a) Computer b) Network c) both d) none.
2. _____ denotes “any matter expressed or described upon any substance by means of letters, figures or marks, which may be used as evidence of that matter”. [CO3]
a) Document b) Electronic record c) FIR d) none
3. _____ means data, record or data generated, image or sound stored, received or sent in an electronic form or micro film [CO2].
a) Document b) Electronic record c) FIR d) none
4. Breaking into computer systems is called _____ [CO2]
a) Cheating b) fraud c) Hacking d) all the above
5. _____ have deep knowledge of the Internet and telecommunication systems. [CO1]
6. _____ who have knowledge of the intricacies (complex and detailed information) of computer systems and their operations. [CO2]
a) code hackers b) Phreakers c) Cyber prunks d) crackers.
7. _____ specialize in cryptography. [CO2]
a) Code hackers b) Phreakers c) Cyber prunks d) crackers.
8. Hacking with computer system is defined in _____ [CO2]
a) Section 67 b) section 66 c) section 68 d) section 69
9. The main target of cyber fraud is _____. [CO2]
10. Section _____ of IPC defines cheating. [CO1]

11. _____ is defined as any set of computer instructions that are designed to modify, destroy, record, and transmit data or program residing within a computer.[CO2]
12. Making or publishing an imputation concerning any person is called _____[CO2]
- a) Defamation b) Harassment c) e-mail abuse d) all the above
13. Internet protection makes sure that children don't do anything illegal online[CO2].
- A. True B. False
14. A situation in which an individual makes another person feel uncomfortable online is hacking.[CO2]
- A. True B. False
15. When is world computer security day celebrated?[CO1]
- a) December 2 b) November 30 c) May 17 d) February 10
16. Which one is not a malicious software[CO2]
- a) Time bomb b) Mac c) Rabbit d) Trojan Horse
17. Which of the following is known as harassing and individual or a group of individuals by using internet or mobile phone?[CO2]
- a) Cyber Defamation b) Cyber Squatting c) Cyber Stalking d) Cracking
18. What is the common name of an internationally descriptive program that spreads from program to program or disc to disc ?[CO2]
- a) Trojan Horse b) Virus c) Time bomb d) Strap
19. The most common Internet investment fraud is known as what?[CO1]
- A) The Nigerian fraud b) The Manhattan fraud
- c) The pump and dump d) The bait and switch
20. What is the most likely problem with unsolicited investment advice?[CO2]
- A) You might not earn as much as claimed. b)The advice might not be truly unbiased.
- c) The advice might not be from a legitimate firm. d)You might lose money.

II. Descriptive Questions

1. List the classification of cyber crimes.[CO2][L1]
2. Define hacking and explain the characteristics and classification of hacking.[CO2][L1]

3. Explain Section 66 of IT Act, 2000.[CO2][L2]
4. Explain teenage web criminality and what measures can be taken to reduce teenage web vandals.[CO2][L2]
5. Explain the effects of virus on Internet.[CO1][L2]
6. Explain Defamation and its characteristics[CO2][L2]
7. If A writes a letter to B which is derogatory (insulting) of B, If A writes a letter to C containing derogatory remarks about B which damage's B's reputation.[CO2][L6]
Which of the above cases amount defamation and which one do not. Justify your answer.
8. an aircraft to hijack it? Quote some cases to support your answer.[CO2][L6]
9. List some international cyber frauds and technological battles around the world.[CO1][L2]
10. Quote some preventive measures to protect your personal computer from computer viruses.[CO2][L4]

UNIT-III

A. Questions testing Remembering/ Understanding level of students

I. Objective Questions

1. _____ are those who specialize in offering access to the Internet.[CO4]
 - (a) Internet Access Providers (b) Internet Service Providers
 - c) Online Service Providers (d) All the above
2. _____ are those who offer additional services such as hosting content produced by themselves or by users or by third parties.[CO4]
 - (a) Internet Access Providers (b) Internet Service Providers
 - (b) Online Service Providers (d) All the above
3. _____ who provides proprietary content for subscribers on their closed systems [] [CO4]
 - (a) Internet Access Providers (b) Internet Service Providers c) Online Service
 - (b) Providers (d) All the above

4. Section _____ deals with network service providers.[CO3]
5. The cyber criminal has the tendency of jumping geographical borders, called _____ .[CO3]
6. Section 79 makes no distinction between various kinds of _____
7. Cyber crime is extremely _____ [CO3]
8. Delayed justice means _____ [CO3]

II. Descriptive Questions

1. Explain about Controller of Certifying Authority.[CO3][L2]
2. Discuss about monetary penalties and adjudication authority?[CO3][L2]
3. Explain how section 79 imposes an extra burden on network service providers?[CO4][L2]
4. Explain jurisdiction and cyber crimes.[CO3][L2]
5. Explain the nature of cyber criminality and the strategies to tackle the cyber crimes.
6. Discuss about criminal justice in India?

B. Question testing the ability of students in applying the concepts. Multiple Choice Questions

1. The best way to control cyber crimes is provided by _____ []
 (a) **Cross-Domain Solutions** (b) Laws of Extradiction
 (c) Educating people (d) None
2. The State must take pro-active measures to ensure speedy criminal justice, which should not take ___ to conclude.
 (a) 150 days (b) **120 days** (c) 200 days (d) None
3. The majority of computer crimes are committed by _____
 (a) outsiders (b) **insiders** (c) Hackers (d) Overseas criminals
4. The typical computer criminal is _____
 (a) young hacker (b) trusted employee with no criminal record
 (c) trusted employee with long but unknown criminal record
 (d) Overseas young hacker.

5. There are about _____ cases pending in India.
6. If a person plants a virus into a computer system located in India, he will be liable under _____ of IT Act to pay damages, not exceeding 1 crore to the victim. (a) **Section 43 C** (b) Section 46 (c) Section 47 (d) none
7. _____ of the Information Technology Act, 2000 specifically prohibits, transmission or publication of obscene material in electronic form.
(a) section 66A (b) Section 66E (c) **Section 67** (d) Section 67B

III) Problems

1. How the jurisdiction limits effect cyber crimes? Quote a real time example.
2. Analyze the reasons for delayed justice in case of cyber crimes in India.
3. Discuss the necessary amendments to Information Technology Act, 2000 for better.
4. Discuss top 4 cases of delayed justice in India.
5. “Justice delayed is justice denied”- Explain with case studies.

UNIT-IV

Objective Questions

1. _____ under the IT Act, 2000 means authentication of any electronic record by a subscriber by means of electronic method. [CO4]
2. Which one of the following is the responsibility of a Digital Signature? [CO4]
(a) Identification (b) Authentication (c) Security (d) All the above
3. _____ is a system of a secure key pair consisting of a private key for creating a digital signature and a public key to verify the digital signature. [CO4]
4. _____ is used to create a digital signature. [CO4]
(a) Public key (b) private key (c) Both (d) None
5. _____ is used to verify a digital signature and is listed in the Digital Signature Certificate. [CO4]
(a) Public key (b) private key (c) Both (d) None
6. _____ as a person who has been granted a license to issue a “Digital Signature Certificate”. [CO4]

7. A non-refundable fee of _____ rupees has to be paid along with the application for grant of license as a certifying Authority and rupees of _____ for renewal of license. [CO4]
(a) 20000, 10000 (b) 25000, 5000 (c) 20000, 5000 (d) 30000, 10000
8. _____ provides for revocation of digital signature certificates. [CO4]
(a) Rule 29 (b) Rule 30 (c) Rule 11 (d) Rule 12
9. Section _____ deals with the use of e-governance by government agencies. [CO4]
(a) 7 (b) 6 (c) 5 (d) 3
10. _____ - is not covered under CPA. [CO4]
(a) Contract of service (b) Contract for service (c) Both (d) None.
11. _____ refers more to asymmetric key cryptography. [CO4]
a. Timing attack b. Meet in middle attack c. Virus attack d. Worms attack
12. Customer uses _____ key for decryption. [CO4]
a. public key b. private key c. secret key d. hash key
13. The E-commerce domain that involves business activity initiated by the consumer and targeted to businesses is known as ____ [CO4]
a. Business to Business (B2B). b. Consumer to Business (C2B).
c. Business to Consumer (B2C). d. Consumer to Consumer (C2C).
14. Which segment do eBay, Amazon.com belong? [CO4]
a. B2Bs b. B2Cs c. C2Bs d. C2Cs
15. The best products to sell in B2C e-commerce are _____
a. Small products b. Digital products c. Specialty products d. Fresh products
16. Public key encryption uses multiple keys. One key is used to encrypt data, while another is used to decrypt data. The key used to encrypt data is called the _____ key, while the key used to decrypt data is called the _____ key. [CO5]
a. encryption, decryption b. private, public c. encryption, public d. public, private
17. _____ provides that the auditor has to be independent of the Certifying Authority being audited and cannot be a software or hardware vendor. [CO5]
a. Rule 30 b. Rule 31 c. Rule 32 d. Rule 33

18. The purchase of goods or services for use by an organization in producing other goods and services to support the daily operations of the organization or for resale is called: [CO4]
- a. wholesale marketing
 - b. business-to-business marketing
 - c. corporate marketing
 - d. distribution marketing.
19. Consumer Protection Act was introduced in _____ [CO4]
- a. 1987
 - b. 1986
 - c. 1988
 - d. 1989

II) Descriptive Questions

1. Explain about Digital Signature and Asymmetric crypto system for generating keys.[CO4][L2]
2. Explain the process of creating and verifying a digital signature.[CO5][L2]
3. What is Digital Signature Certificate? Explain the process of issue, suspension and revocation of a digital Signature Certificate.[CO4][L1]
4. What is the role of Certifying Authority and powers of Controller of Certifying Authority?[CO4][L1]
5. Explain the process of granting and refusing license/ renewal for Certifying Authority.[CO4][L2]
6. List any ten rules of Certifying Authorities.[CO4][L1]
7. Explain the definition of a consumer with one or two case studies. [CO4][L2]
8. Define “Good” and “service”. What is meant by restrictive and unfair trade practice? [CO4][L1]
9. List some e-governance research centers and illustrate their activities. [CO4][L1]
(Centre for Electronic Governance, Ministry of Information and Technology, Govt. of India, Centre for Electronic Communities, Commonwealth Secretariat's Centre for Electronic Governance)
10. Write any case studies that illustrates defect in services offered and how they are reimbursed. [CO4][L2]
11. List the precautionary measures for safekeeping the Digital Signature. [CO4][L1]

UNIT-V

A. Questions testing the remembering / understanding level of students

I) Objective Questions

1. _____ transforms structured data into cipher code was used to protect the online confidentiality.[CO5]
2. The three general categories of computer crime: __, ____. [CO5]
3. _____ are the precursors for hackers. [CO5]
(a) Cyber punks b) Phreakers c) pre-hackers d) none
4. _____ involves the manipulation of telecommunications carriers to gain knowledge of telecommunication and theft of applicable services. [CO5]
5. _____ is a process to steal access code from unsuspecting individuals while they are dialing. [CO4]
6. _____ is a process of using random number generators which test numerous codes until one is successful. [CO4]
7. What activity is referred to as Hacking in early 1990's at MIT? [CO4]
8. List the six primary motivations to hacking? [CO4]
9. The most dangerous category of hacking is:
(a) Boredom users b) Insiders c) Criminals d) all the above
10. _____ refers to the reproduction, distribution and use of software without the permission or authorization of the owner of the copyright. [CO5]
11. **Commercial programs** that are made available to the public illegally are called as _____. [CO4]

II) Descriptive Questions

1. Explain the traditional problems of Hacking? [CO4][L2]
2. Explain the three incidents of Computer Crime. [CO3][L2]
3. Explain about Phreaking? [CO3][L2]
4. Explain the hierarchy of cyber criminals? [CO4][L2]
5. Evaluate the computers are treated as commodities? [CO5][L5]
6. Explain about theft of intellectual property? [CO5][L2]
7. Explain how phreaking laid steps to hacking? [CO5][L2]

B. Questions testing the ability of students in applying concepts

7. One of the earliest examples of computer crime is _____, which consists of an activity in which telecommunications systems are manipulated and ultimately compromised. [CO4]
- a) Phreaking b) Spamming c) Hacking d) Cracking

II) Problems:

1. Is it possible for hackers to access my computer's webcam?[CO5]
2. Which are the most concerning cyber threats for private businesses and government organizations?[CO5]
3. Which are the industry's most exposed to cyber attacks and why?[CO5]
4. Is hacking a cyber crime justify your answer?[CO5]
5. What Resources Are Available to Combat Cyber or Computer Crimes?[CO6]
6. Why is preventing piracy important?[CO6]

UNIT-VI

A. Questions testing the remembering / understanding level of students

I) Objective Questions

1. The most important characteristic of web that leads to criminal activity is _____[CO6]
a) Information hub b) Anonymity c) ease of committing d) none.
2. Code that causes damage to computer systems is called _____[CO6]
3. _____ virus erases a portion of hard disk and damages the system.
4. The first recognized computer virus is _____.[CO6]
5. The era of computer virus in which viruses are limited is _____ [CO6]
a) Classical b) floppy c) macro d) Internet.
6. _____ virus belongs to Macro era of computer virus. [CO6]
a) Melissa b) Rabbit c) codeRed d) all the above
7. _____ is a DoS attack that jams system's server with voluminous e-mail. [CO6]
8. _____ and _____ are compromised computers attached to the Internet which are used to remotely perform malicious or criminal tasks. [CO6]

9. The first known DDoS attack is named as _____.[CO6]
10. _____ is defined as” a deliberate, politically or religiously motivated attack against data compilations, computer programs and information systems which is intended to disrupt or deny service or acquire the information which disrupts the social, physical, or political infra-structure of the target”. .[CO6]
11. _____ is a type of software intended to deliver advertising, but quite often it tracks user behavior as well. .[CO6]
 - a) ransomware b) adware c)shareware d)none
12. This is an attack in which multiple compromised systems attack a single target, causing users to be denied normal services. .[CO6]
 - a) DDoS attack b) DoS attack c) destruction d) none
13. This is a type of malware that is activated by some trigger, such as a specific date.[CO6].
 - a) logic bomb b) virus bomb c) ransomeware d) none
14. This is a type of malware that is activated by some trigger, such as a specific date.
 - a) logical bomb b) ethical bomb c) virus bomb d) none
15. This is self-replicating malware that spreads through instant messaging networks. .[CO6]
 - a) IM worm b) Virus c) Trojan d) none
16. This is malicious coding that combines virus' ability to alter program code with the worm's ability to reside in live memory and to propagate without any action on the part of the user. .[CO6]
 - a) hybrid virus/worm b) Trojan c) malware d) none
17. This is a means of access to a computer system put in place by either an authorized person or a cracker. .[CO6]
 - a) front door b) modware c) Back door d) none

II) Descriptive Questions

1. Explain the six categories of cyber crime.[CO6][L2]
2. Explain about Malware. .[CO6][L2]
3. Explain the four era’s of computer virus. .[CO6][L2]
4. Explain about DoS and DDoS attacks. .[CO6][L2]B

5. Explain about SPAM and CAN-SPAM act. .[CO6][L2]
6. Explain about theft of information? .[CO6][L2]
7. What is Data manipulation and explain about web encroachment. .[CO6][L2]
8. Explain about Online gambling. .[CO6][L2]
9. Explain about online fraud? .[CO6][L2]
10. Explain about Ancillary crimes? .[CO6][L2]
11. Explain about securities fraud and stock manipulation? .[CO6][L2]
12. List the steps to detect a malware detected? .[CO6][L1]

Signature of the Faculty

HANDOUT ON VIRTUAL AND AUGMENTED REALITY

Class & Sem. : III B.Tech – I Semester

Year: 2020-21

Branch : CSE

Credits : 3

1. Brief History and Scope of the Subject

“Virtual Reality (VR)”¹ is a field of study that aims to create a system that provides a synthetic experience for its user(s). The experience is dubbed “synthetic,” “illusory,” or “virtual” because the sensory stimulation to the user is simulated and generated by the “system.” For all practical purposes, the system usually consists of various types of displays² for delivering the stimulation, sensors to detect user actions, and a computer that processes the user action and generates the display output. To simulate and generate virtual experiences, developers often build a computer model, also known as “virtual worlds” or “virtual environments (VE)” which are, for instance, spatially organized computational objects (aptly called the virtual objects), presented to the user through various sensory display systems such as the monitor, sound speakers, and force feedback devices. One important component of a successful VR system is the provision of interaction, to allow the user not just to feel a certain sensation, but also to change and affect the virtual world in some way.

A New **scope** in today's world. **Virtual Reality** is something that allows everyone to experience the impossible. **Virtual Reality** is the term used to describe a three-dimensional, computer generated environment which can be explored and interacted by a person.

2. Pre-Requisites

Basic knowledge on computer hardware and software components.

3. Course Objectives:

- Learn a ton about virtual and augmented reality; get familiar with the latest technology and software,
- Virtual reality in different object & applications
- To understand key elements of virtual Reality with the components in VR systems.
- To gain knowledge of various input and output devices required for interacting in virtual world along with rendering and modeling.

4. Course Outcomes:

CO1) Understand the components of the virtual reality system

CO2) Describe various input and output devices used for virtual reality

CO3) Apply the different modelling concepts to visual virtualization

CO4) Analyze the performance of given simple applications related to virtual reality

CO5) Understand the concepts of the augmented reality system

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

| CT2524 : VIRTUAL AND AUGMENTED REALITY (OPEN ELECTIVE - II) | | | | | | | | | | | | | | |
|---|---|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| Course outcomes | Program Outcomes and Program Specific Outcome | | | | | | | | | | | | | |
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1. identify basic elements of virtual Reality | 2 | | | | | | | | | | | | | |
| CO 2.describe various input and output devices required for VR experience | 2 | | | | | | | | | | | | | |
| CO3. classify human factors that affect VR experience. | 2 | | 1 | | | 1 | | | | | | 2 | | |
| CO 4. distinguish augmented reality from virtual reality | 2 | 2 | | | | | | | | | | | | |
| CO5. determine the object position and orientation in virtual space. | 2 | 2 | 1 | | | | | | | | | 2 | | |

7. Prescribed Text Books

1. Virtual Reality Systems, John Vince, Pearson Education.
2. Virtual Reality Technology, Second Edition, Gregory C. Burdea & Philippe

Coiffet, John Wiley & Sons, Inc.,

3. Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications and Human Factors for AR and VR", Addison Wesley.

8. Reference Text Books

1. Understanding Virtual Reality, interface, Application and Design, William R. Sherman, Alan Craig, Elsevier (Morgan Kaufmann).

9. URLs and Other E-Learning Resources

- c. Virtual Reality introduction : <http://stanford.edu/class/ee267/>
- d. Standards: <http://technav.ieee.org/tag/2188/virtual-reality>

10. Lecture Schedule / Lesson Plan

| Topic | No. of Periods | |
|---|----------------|----------|
| | Theory | Tutorial |
| UNIT –1: Introduction | | |
| Virtual Reality Introduction | 1 | 1 |
| The three I's of virtual reality | 1 | |
| commercial VR technology | 1 | |
| five classic components of a VR system | 1 | |
| UNIT – 2: Input Devices | | |
| Trackers | 1 | 1 |
| Navigation | 1 | |
| Gesture Interfaces | 1 | |
| Three-dimensional position trackers | 1 | |
| Navigation and manipulation interfaces and gesture interfaces | 1 | 1 |
| UNIT – 3: Output Devices | | |
| Graphics displays | 1 | 1 |
| sound displays | 1 | |
| Haptic feedback | 1 | |
| UNIT – 4: Human Factors | | |
| Methodology and terminology | 2 | 1 |
| user performance studies | 2 | |
| VR health and safety issues | 2 | |
| Medical applications | 2 | 1 |
| military applications | 2 | |
| robotics applications | 2 | |
| UNIT – 5: Augmented Reality | | |
| Introduction – Head-up Displays | 2 | 1 |
| Helmet-mounted sights and displays | 2 | |

| | | |
|--|-----------|----------|
| Smart Glasses and augmenting displays | 2 | 1 |
| UNIT – 6: Understanding Virtual Space | | |
| Visual and Object space | 2 | 1 |
| Defining position and orientation in 3 dimensions | 2 | |
| Total No.of Periods: | 35 | 9 |

11. Seminar Topics

- OpenGL
- Types of Haptics
- Various Applications on virtual reality and augmented reality

Assignment-Cum-Tutorial Questions

UNIT-I

SECTION-A

Objective Questions

1. Which device contains thumbwheel, trackball and a standard mouse ball?

- []
- a) Z mouse b) Joystick c) Mouse d) Trackball

2. Virtual reality, CAD, and animations are the application of[]

- a) Z mouse b) Digitizers c) Data tablets d) Image scanners

3. Which of the following device is not the input device? []

- a) Trackball and space ball b) Data glove
c) Only d d) Impact printers

4. Acronym for VRML: []

- (a) Virtual Reality Modeling Level
(b) Virtual Reality Modulation Language
(c) Virtual Rate Modeling Language
(d) Virtual Reality Modeling Language
(e) Virtual Reality Marketing Language.

5. A multimedia file []

- a) is same as any other regular file
b) Must be accessed at specific rate
c) stored on remote server cannot be delivered to its client
d) None of the mentioned

6. A Multimedia Presentation can be: []

- I. Linear.
II. Nonlinear.
III. Structured link.

A : 1 and 2 only B : 2 only C : 2 and 3 only D : All

Q4. The delay that occur during the playback of a stream is called

- a) stream delay b) playback delay []
c) jitter d) event delay

Q5. Which of the following is the best definition for Virtual Reality?

- A) Any computer game involving graphics. []
B) A 3D simulation of a real or imagined environment using computers.
C) A simulator which requires special eye glasses.
D) The process of coding in another dimension.

Q6. Which of the following extensions would you not expect to see on a VRML file?

- A) wrl B) wrl.gz C) wrz D) vr []

Q7. A multimedia file []

- a) is same as any other regular file
b) Must be accessed at specific rate
c) stored on remote server cannot be delivered to its client
d) None of the mentioned

Q8. Which one of the following is the characteristic of a multimedia system?

- a) high storage b) high data rates
c) both (a) and (b) d) none of the mentioned

Q9. Which of the following is the MIME type for a VRML file?

- A) model/vrml B) audio/vrml
C) midi/vrml D) 3d/vrml

Q10. Which of these is not likely to be the responsibility of a multimedia project?

- (a) Create interfaces
(b) Ensure the visual consistency of the project
(c) Structure content
(d) Create budgets and timelines for the project
(e) Select media types for content.

II) Problems:

1. What are the applications of cinematic VR?
 2. How do you shoot video in all directions at once?
 3. How can I experience VR?
 4. What if I don't have a headset or Google Cardboard?
 5. Can you live-stream VR?
 6. Do i need additional hardware to create VR content?
 7. What Are the Best Images and Subjects to Use for Virtual Reality?
 8. How Is Filming Virtual Reality Different Than Traditional Video?

UNIT-II
SECTION-A

1. Which of the following(s) is / are *essential* for a *Head Mounted Display (HMD)*?

1. brightness control. 2. focusing rings.
3. frequency control. 4. magnification button

A : 1 only B : 2 only C : 1 and 2 only []
D : 2, 3 and 4 only E : All of the above.

2. Which of the following(s) has / have been *ignored* but is / are needed for effective VR applications? []

1. fast interactive time.
2. good graphic display.
3. the sense of smell and taste.
4. force feedback.

A : 1 only B : 3 only C : 1 and 3 only
D : 1, 2 and 3 only E : All of the above.

3. Which of the following device is not the input device? []

- a) Trackball and space ball b) Data glove
c) Only d d) Impact printers

4. What is / are the disadvantage(s) of using *most* VR systems? []

1. the simulators are of higher cost than their *real* counterparts.
2. addiction
3. temporary nausea, dizziness
4. difficult to use

A : 1 only B : 3 only C : 1 and 3 only
D : 2 and 3 only E : All of the above

5. Which of the following(s) is / are a type of VR ? []

1. A child playing a flight simulator game on a PC.
2. A drug designer viewing a drug molecule via a Head Mounted Display coupled to the computer.
3. A NASA operator controlling a space module on the moon to pick up rock samples.

A : 1 and 2 only B : 2 only C : 2 and 3 only D : All of the above.

6. Which of the following relates *most* closely to Virtual Reality with respect to the audiences ?

A : Science Fiction Books B : Comedy Drama Play C : Action films

7. 3-Dimensional tracker is _____

8. Describe Navigation?

9. List out types of trackers?

10. What are commonalities and differences between 3D trackers and Gesture interfaces ?

II) Descriptive Questions

1. What are trackers? Enumerate some important tracker characteristics (make drawings to illustrate your concepts).
2. How does a wireless tracking suit work? Give examples?
3. What is the difference between an absolute and a relative position input device?
4. What are hybrid trackers?
5. What are gesture input devices and explain?
6. How do Inter Sense trackers differ from magnetic ones?
7. How does the Cyber Glove work?

B. Question testing the ability of students in applying the concepts.

I) Multiple Choice Questions

Q1. A Simulated experience generated by computer, like visiting the surface of the sun is called []

- A. Artificial Solar visitation B. Extended experience
C. Virtual reality D. Vicarious actuality

Q2. A device used for 3-D positional information in virtual reality systems is the:

- (a) optical mouse (b) split keyboard (c) track ball []
(d) data glove (e) touch screen

Q3. The device which is used to position the screen cursor is []

- a) Mouse b) Joystick c) Data glove d) Both a and c

Q4. Trackball is []

- a) Two-dimensional positioning device
b) Three- dimensional positioning device
c) Pointing device d) None of these

Q5. Pressure-sensitive joysticks are also called []

- a) Non movable stick b) Joystick
c) Isometric joystick d) None of these

Q6. Which is the device that is constructed with the series of sensors that detects hand and finger motion? []

- a) Digitizers b) Data glove c) Joystick d) Track ball

Q7. A common device for drawing, painting, or interactively selecting coordinate positions on an object is a []

- a) Image scanner b) Digitizers c) Data glove d) Touch panels

Q8. Which device is used to input two-dimensional coordinates by activating a hand cursor on a flat surface []

- a) Graphic tablet b) Data tablet c) Only b d) Both a and b

Q9. _____ can be used to determine the position on the data tablet.[]

- a) Strip microphones b) Signal strength
c) Coded pulse d) Either Signal strength or coded pulse

Q10. Space ball provide _____ degree of freedom. []

- a) 10 degree b) 6 degree c) 8 degree d) 12 degree

II) Problems:

1. Describe an alternative input system to using keyboards for entering and outputting data.
2. What input devices can I use with the Virtual Reality?
3. Is virtual reality devices can be used in pilot training simulations?
4. can we use touch screen is both an input and output device?
5. Explain the advantages of using virtual reality headsets and data gloves.
6. Do i need additional hardware to interact VR system?
7. Explain how disabled users might find voice synthesisers useful??
8. Explain how users interact with a virtual scene displayed with different output devices?

Signature of the Faculty

ENVIRONMENTAL SANITATION

Class& Sem. : III B.Tech–I Semester Academic Year:2019-2020
Branch : CSE Credits : 3

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1.Pre-Requisites

- Engineer and Society
- Environmental Studies

1. Course Objectives:

- To communicate the importance of institutional sanitation in maintaining public health.
- To introduce the strategies for maintaining healthy living and working environment.
- To delineate the role of environmental engineer in industrial environments.

2. Course Outcomes:

After completion of the course, the student will be able to:

- identify the common communicable diseases and the solutions for controlling them.
- suggest appropriate sanitation measures for water supply and sanitation in un-sewered areas.
- describe the process of refuse disposal in rural areas.
- draw out the procedures adopted for maintaining hygiene in institutional buildings.
- list out the occupational comfort parameters to be considered for designing built environment.
- introduce the notion of occupational health, safety and the related management approaches.

3. Program Outcomes:

Engineering Graduates will be able to:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

4. Mapping of Course Outcomes with Program Outcomes:

| | PO 1 | PO 2 | PO 3 | PO4 | PO5 | PO 6 | PO7 | PO 8 | PO9 | PO1 0 | PO 11 | PO1 2 | PS 01 | PS 02 |
|---|------|------|------|-----|-----|------|-----|------|-----|-------|-------|-------|-------|-------|
| C | 2 | | 1 | 3 | 1 | 2 | 3 | | 1 | | | 1 | | |
| C | | | 2 | 3 | 1 | 1 | 3 | | | | | 1 | | |
| C | 2 | 2 | 2 | 3 | 2 | 2 | 3 | | | 2 | | | | |
| C | 2 | | | 2 | | 2 | 2 | | | | | | | |
| C | 2 | | 3 | | | 2 | 3 | | | | | 2 | | |
| C | | | | | | | 3 | | | 1 | 2 | 1 | | |

5. Prescribed Text Books

- 1.Municipal and Rural Sanitation, Victor2.Ehlers, Ernest W. Steel, 6th Edition,2cGraw Hill
- 2.Environmental Sanitation, Joseph A. Salvato, Nelson L. Nemerow, Franklin J. Agardy , 5th Edition, John Wiley and Sons
- 3.OHSAS 180012annual
- 4.WELL Rating System2annual

6. References:

- 1.Integrated Solid Waste2anagement, George Tchobanoglous, Hilary Theisen, Samuel A Vigil,McGraw Hill.
- 2.Not in2y backyard – Solid Waste2anagement in Indian Cities, Sunita Narain, Jain Book Agency.
- 3.National Building Code of India, Bureau of Indian Standards.

BOOKS AVAILABLE IN LIBRARY:

1. Essentials of Environmental Studies, Joseph,Kurian
2. Environmental Engineering, Peavy,Howards
3. Environmental Engineering, Basak,Nn
4. Introduction to Environmental Engineering & Science,2asters,Gilbert
5. Environmental Pollution and Control, Bhatia,Hs
6. Renewable Energy Sources & their Environmental Imp, Abbasi,Sa

7. URLs and Other E-Learning Resources

- <https://www.britannica.com/science/epizootic-disease>
https://www.who.int/foodsafety/areas_work/food-hygiene/en/
<https://www.slideshare.net/anasomoray/principles-of-food-sanitation-safety-hygiene>
https://www.who.int/occupational_health/publications/en/oehwomenanthology.pdf
http://planningcommission.gov.in/plans/planrel/fiveyr/10th/volume2/v2_ch5_5.pdf

8. Digital Learning2aterials:

<https://nptel.ac.in/courses/126104004/>
<https://nptel.ac.in/courses/112105129/40>
<https://nptel.ac.in/courses/123106002/MODULE%20-%20VI/Lecture%20%201.pdf>
<https://nptel.ac.in/courses/109101007/>

9. Lecture Schedule / Lesson Plan

| Topic | No Of Periods |
|---|---------------|
| Introduction | 1 |
| Origin and spread of Communicable diseases like Cholera | 1 |
| Origin and spread of Smallpox, Tuberculosis | 1 |
| Origin and spread of Malaria, Filariasis and Plague | 1 |
| common methods (nose, throat, intestinal discharges) | 1 |
| Role of Public Health Engineering in the preventive aspects of the above diseases | 2 |
| Role of vectors in transmitting diseases | 2 |
| Rodent control methods. | 1 |
| Sanitary protection of wells, | 1 |
| Sanitary protection of springs | 1 |
| economic methods of treatment | 2 |
| Excreta disposal systems | 2 |
| Types of sanitary privies | 2 |
| Quality and quantity of garbage | 2 |
| Quality and quantity of rubbish, ashes | 1 |
| Quality and quantity of street sweepings, night soil | 1 |
| methods of conveyance | 2 |
| sanitary disposal methods | 2 |
| latest technologies adopted to dispose off the solid wastes. | 2 |
| UNIT-IV: FOOD HYGIENE AND SANITATION | |
| Milk and milk products | 1 |
| sanitary maintenance of catering, | 1 |
| sanitary maintenance of establishment, measures | 2 |
| Sanitary requirements | 2 |
| maintenance of the public utility services like schools | 1 |
| maintenance of the public utility services hospitals, offices | 1 |
| public utility services in other public buildings | 2 |
| UNIT -V: VENTILATION, AIR CONDITIONING AND LIGHT | |
| Composition of ambient air, air pollutants | 1 |
| bacteria, odours – Effective Temperature | 1 |

| | |
|---|----|
| Comfort standards of ventilation, air interchange | 2 |
| natural ventilation, artificial ventilation, air conditioning | 2 |
| Measurement of light, illumination standards | 1 |
| natural lighting, artificial lighting | 1 |
| | |
| Occupational hazards in public buildings schools, | 2 |
| Occupational hazards in hospitals, eating establishments, swimming pools | 2 |
| Cleanliness and maintenance of comfort | 2 |
| Industrial plant sanitation | 2 |
| OHSAS 18001 and the WELL Building Standard and rating for built environment | 2 |
| TOTAL NO OF PERIODS | 56 |

Assignment-Cum-Tutorial Questions

UNIT-I

PART-A

1. Epidemiologists are interested in learning about _____
2. Diseases that are always present in a community, usually at a low, more or less constant, frequency are classified as having an _____ pattern.
3. An epidemic that becomes unusually widespread and even global in its reach is referred to as a _____
4. A disease vector is a(n) _____
5. Cause of malaria is _____
6. _____ fraction of the people in the world have chronic diseases that are vector-borne?
7. The prime cause of illness resulting in death in the poor countries of the tropical and subtropical regions today is _____ .
8. Smallpox is caused by _____
9. Which organism is responsible for causing TB _____?
10. Tuberculosis can be separated into how many categories of progression _____

PART -B

1. Define epidemics and epizootics?
2. Explain the communicable diseases cholera and smallpox.
3. What is the origin and spread of plague?
4. How do you control the tuberculosis?
5. Explain any 5 differences in malaria and filaria.

6. What are the common methods can be used for prevent the communicable diseases?
7. Explain the role of public health engineering in the epidemics.
8. What are the preventive aspects of the cholera and malaria?
9. Explain the role of vectors in transmitting diseases
10. Describe in detail rodent control methods.
11. What are the common methods can be used for prevent the plague?

UNIT –II

PART-A

1. Minimum depth for the lining of a sanitary well is?
 - a. 10 feet
 - b. 20 feet
 - c. 35 feet
 - d. 50 feet
2. What is the most common kind of litter, by number, found in waterways?
 - a. plastic bags
 - b. plastic bottles
 - c. aluminum cans
 - d. All of these
3. WELL should be located at _____ distance from septic tank.
4. What is night soil
 - a. Soil containing urea
 - b. Human excreta
 - c. Animal excreta
 - d. Human excreta, animal excreta and urea
5. Which of the following conditions is not suitable for the disposal of excreta or sewage?
 - a. The waste does not pollute the ground surface
 - b. It is not exposed to the atmosphere
 - c. It should be accessible for children
 - d. It does not give odour nuisance
6. The benefits of the society of managing human excreta are considerable, for public health as well as for the environment.
 - a. true
 - b. false
7. The overall purpose of sanitation is to maintain the green environment alone.
 - a. true
 - b. false
8. In urban cities like Bangalore, which of the water carriage system is used?
 - a. Separate system

- b. Combined system
 - c. Partially combined system
 - d. Partially separate system
9. The relatively clean wastewater from baths, sinks, washing machines and other kitchen appliances is called _____
- a. Grey water
 - b. Black water
 - c. Yellow water
 - d. Wastewater
10. The term Municipal Solid Waste (MSW) is generally used to describe:
- a. Wastes from industrial processes, construction and demolition debris.
 - b. Wastes from Private homes, commercial establishments and institutions.
 - c. Mining wastes
 - d. Agricultural wastes

PART- B

1. What is field sanitation?
2. What are the privies used in conservancy system in human excreta?
3. Explain pit privy and cesspool
4. Describe aqua privy?
5. what is the differences between Dug-Well Privy and Chemical Toilet?
6. Describe briefly sanitary protection of wells .
7. What are the economic methods used for disposal of human excreta.
8. Describe briefly sanitary protection of springs.
9. Explain borehole privy and concrete vault privy.
10. Describe in detail rodent control methods

UNIT – III

PART-A

I) Objective Questions

1. Refuse cans
 - a. only solid waste
 - b. only liquid waste
 - c. both solid and liquid waste
 - d. none of the above
2. In conservancy system _____ garbage's are collected from _____ and _____
 - a. dry, streets and roads
 - b. wet, highways and pools.
 - c. wet and dry from streets and roads

- d. none of the above
3. In water carriage system _____ is used to carry the sewage to the point of _____ or _____
 - a. nearby sewer line, dispose or flush out
 - b. reagent, dispose or incinerate
 - c. water, treatment or disposal
 - d. none of the above
 4. If pool is in the open space , care should be taken to have enough _____.
 - a. bacteria decompose
 - b. sun light
 - c. decompose
 - d. to remain no change
 5. In Indian climate the amount of average water for bath for a single person in a day is _____
 - a. 20 to 30 liters
 - b. 20 to 25 liters
 - c. 30 to 40 liters
 - d. above 40 liters
 6. what are the important factors for water supply planning
 - a. financial side
 - b. water supply sources
 - c. area topography
 - d. all the above
 7. Disposal of night soil needs considerable land _____ from habitation
 - a. away
 - b. near
 - c. not mandatory
 8. _____ water can also be allowed to flow with the sewage.
 - a. flush water
 - b. storm water
 - c. overhead tank
 9. An average recommended water in liters for a person is ____
 - a. 50 to 90 liters per day
 - b. 40 to 80 liters per day
 - c. 10 to 50 liters per day
 10. The treatment of water should be _____ for the locality
 - a. sophisticated
 - b. economical
 - c. high price

PART-B

1. What is meant by institutional waste?

2. Describe briefly about the method of sanitation of a public bathing place
3. What are the important points to be considered for a proposed water supply planning.
4. Write notes on
 - a. refuse
 - b. institutional waste
 - c. area topography
 - d. possibility of town development
5. What are the important points to be included in proposed sanitation planning.
6. Define industrial waste? What is the difference between the industrial waste and domestic waste?
7. What is the condition that the industrial wastes are not mixed up with the domestic wastes?
8. How industrial waste should be properly disposed.
9. What type of treatment method is economical? Why is it economical?

UNIT-IV
PART-A

1. Which is a product of milk
 - a. Ghee
 - b. Buttermilk
 - c. Yogurt
 - d. All of the above
2. The amount of fat in milk is
 - a. 3.0-3.5
 - b. 3.0-3.7
 - c. 3.1-3.7
 - d. 3.5-4.0
3. The health of being clean and conducive to health is a -----
4. Hair, Staple Wire, Dust comes under
 - a. Chemical Contaminants
 - b. Physical Contaminants
 - c. Biological Contaminants
 - d. none of the above
5. If PH is below ---- Bacteria will not grow
 - a. 5.6
 - b. 4.6

- c. 4.5
 - d. 5.5
6. Provision of appropriate sharps disposal facilities in public toilets, including:
 - a. sharps collection containers
 - b. outer housings
 - c. installation heights
 - d. All the above
 7. WHO means -----
 8. To maintain food hygiene precautions of safety are
 - a. place should be clean
 - b. should keep away from contaminated food
 - c. person handling the food should follow hygiene precautions
 - d. All the above
 9. Sanitary requirements include
 - a. good plumbing and drainage facilities
 - b. disposal of sewage
 - c. effluent and grey water
 - d. All the above
 10. Failure of public utility maintenance leads to -----

PART-B

1. Explain about production practices and processing of milk and its products?
2. Explain about sanitary maintenance of catering?
3. Explain about sanitary maintenance of establishments?
4. Explain about sanitary maintenance of catering and establishments?
5. Explain about sanitary requirements and maintenance of schools?
6. Explain about sanitary requirements and maintenance of hospitals?
7. Explain about sanitary requirements and maintenance of offices?
8. Write a short note on sanitary requirements and maintenance of schools, hospitals, offices and other public buildings?
9. Describe about FSSAI?
10. Explain about Impact of bad hygiene and sanitation on public health?

UNIT-V

PART- A

1. Secondary air pollutant is:
 - a. Ozone
 - b. Carbon monoxide
 - c. Nitrogen Dioxide
 - d. Sulphur dioxide
2. Which of the following diseases are caused by the smog?
 - (i) Rickets
 - (ii) Throat Cancer

(iii) Skin Cancer

(iv) Breathing Problem

Options are:

- a. Both (i) and (ii)
 - b. Both (iii) and (iv)
 - c. (i), (ii) and (iii)
 - d. (i), (ii) and (iv)
3. What effect of air pollution causes 2 billions of people to die each year?
- a. Global warming
 - b. Damage to the ozone layer
 - c. Acid rain
 - d. Respiratory infections, lung cancer, and heart disease
4. The term _____ is used to mean the free passage of clean air in a structure.
- a. Circulation
 - b. Ventilation
 - c. Dissipation
 - d. Condensation
5. The _____ plays an important role in the comfort of persons affected by ventilation system.
- a. Carbon dioxide
 - b. Purity of air
 - c. Volume of room
 - d. Health of occupant
6. Exhaust system, supply system, air conditioning, etc. comes under _____ type of ventilation system.
- a. Natural
 - b. Mechanical
 - c. Mechanical
 - d. Doors
7. In _____ system, the partial vacuum is created inside of the room by exhausting the vitiated inside air by fans or blowers.
- a. Supply
 - b. Plenum
 - c. Air conditioning
 - d. Exhaust
8. Light is a form of energy produced by a -----
9. Units of light -----
10. Recommended value of illumination for class/lecture room ?
- a. 200
 - b. 250
 - c. 300

PART-B

1. what is ambient air and its composition? Why do we have to monitor ambient air? What are ambient air quality standards ?
2. What is air pollution? Explain the types of air pollution?
3. what are the pollutants emitted from the various industries and also explain about the different effects of air pollution?
4. Explain about bacteria and odours?
5. Explain about ventilation and its functional requirements?
6. Write a short note on types of ventilation and describe about allowable standard temperature rise of ventilation?
7. Describe about (i) Extraction System (ii) Plenum System (iii) Extraction-plenum system
8. What is air conditioning? Explain classification of air conditioning with neat sketch?
9. Explain Selection and Systems of air conditioning?
10. what are units of light, illumination standards of different buildings and also explain about natural and artificial lighting?

UNIT -VI
PART-A

Objective Questions

1. OSHA is not applicable in the following
 - a. theme park
 - b. forest
 - c. residential building
 - d. office
2. select the below option which suits with OHSAS
 - a. Reduces accident and incident rates by reducing or eliminating workplace hazards
 - b. Minimisation of liability of employers through adoption of proactive rather than reactive controls
 - c. Increases employee motivation through the provision of a safer workplace and participation process
 - d. all of the above
3. _____ key elements as being contributors to successful health and safety management
 - a. Auditing and Reviewing
 - b. performance of the project
 - c. trace analysis

- d. defect escalation
- 4. An assessment will have to be made to identify any actual or potential hazards that may prevent you from
- 5. BS OHSAS 18001 is aligned with ISO 14001, which is based upon
- 6. An effective structure that ensure that the hazards and risks associated with organizations activities, products and services are controlled under
 - a. identified > assessed> controlled>monitored >continuously improved
 - b.monitored >continuously improved > identified > assessed> controlled
 - c. assessed> controlled>monitored >continuously improved > identified
- 7. OHSAS 18001 should be reviewed _____ to ensure that it remains relevant and appropriate to the organization.
 - a. not required
 - b. periodically
 - c. no time bound
 - c. depends on authority
- 8. Abbreviation of “SMART”
- 9. A variety of inputs can be used to assess compliance, including: systematically identified and assessed, controlled,monitored and continuously improved
 - a. audits
 - b. facility inspections.
 - c. facility tours and direct observations
 - d. none of the above
- 10. OSHAS applicable for _____ Industries?
 - a. construction
 - b. industrial
 - c. manufacture
 - d. all the above.

PART-B

1. Illustrate different types of hazards in Occupational health and safety.
2. Compare Chemical and biological hazards.
3. Explain about OHSAS policy, organisation and management system elements.
4. What are various occupational health diseases caused by a person and its potential risks to health and safety?
5. Explain how psychological hazards can influence health and social life.
6. Explain the role of OSHAS in food service industry.

7. Describe about preventive measures for work place hazards.
8. Discuss about types of physical hazards can harm to different body parts.
9. Explain briefly about OHSAS 18001
10. Discuss the need of occupational health and safety to the built environment.

Signature of the Faculty

HANDOUT ON GEOINFORMATICS

Class& Sem. :III B.Tech – I Semester

Year 2020-21

Branch : CSE

Credits : 3

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1. **Brief History and Scope of the Subject**

Remote sensing is the measurement of object properties on Earth's surface using data acquired from aircraft and satellites. It attempts to measure something at a distance, rather than in situ, and displays those measurements over a two-dimensional spatial grid, i.e. images. Remote-sensing systems, particularly those deployed on satellites, provide a repetitive and consistent view of Earth, facilitating the ability to monitor the earth system and the effects of human activities on Earth. There are many bands of electromagnetic radiation (EMR) that the Earth's atmosphere absorbs. The interaction of these bands with various surface features such as water, vegetation, soil and man-made features forms the basis for the applications of remote sensing in various fields.

The primary benefit of Geographic Information Systems (GIS) is the ability to interrelate spatially multiple types of information assembled from a range of sources. These data do not necessarily have to be visual. Shape files are helpful for interpolating and visualizing many other types of data, e.g. demographic data. Many study and research models rely on the ability to analyse and extract information from images by using a variety of computer based research tools and then express these findings as part of a project with images in a variety of layers and scenes.

2. **Course Objectives:**

- To introduce the students to the basic concepts and principles of various Components of remote sensing.
- To familiarize with structure and function of Geographic Information System
- To illustrate the multidisciplinary nature of Geospatial applications.

3. Course Outcomes:

CO1: relate the scientific theories to the behaviour of electromagnetic spectrum

CO2: distinguish between different types of satellites and identify appropriate remote sensing data products for mapping, monitoring and management applications.

CO3: interpret satellite images and processes outputs for extracting relevant information.

CO4: structure the concept of a spatial decision support system in its analog and digital forms.

CO5: perform tasks related to building a GIS database with location, attribute and meta data.

CO6: list and elaborate applications of Geoinformatics in various fields.

4. Mapping of Course Outcomes with Program Outcomes:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | | | 1 | 1 | | | | 3 | 1 | | 2 | | | |
| CO2 | 2 | 2 | 2 | 1 | 1 | | | | | | 3 | | | |
| CO3 | 2 | 3 | 2 | 1 | 2 | | | 3 | 2 | | 3 | | | |
| CO4 | 2 | | 2 | 1 | 1 | | | 3 | 1 | | 2 | | | |
| CO5 | 2 | 3 | 2 | | | | | | | | | | | |
| CO6 | | | 2 | | | 1 | | | | | | 2 | | |

5. Program outcomes

Computer Science and Engineering Graduates will be able to:

- Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Prescribed Text Books

- a. Remote Sensing and Geographical Information System, Anji Reddy, M. 4th edition. BS Publications, Hyderabad.
- b. Remote Sensing by Basudeb Bhatta, 2nd edition, Oxford University Press.

7. Reference Text Books

- a. Remote sensing and image interpretation, Lillesand, T.M, R.W. Kiefer and J.W. Chipman, 7th edition (2015), Wiley India Pvt. Ltd., New Delhi
- b. Remote sensing Digital Image Analysis, Richard, John A, 5th edition (2014), Springer.

8. Digital Learning Materials:

- <https://onlinecourses.nptel.ac.in>
- <http://www.gisresources.com>

9. Lecture Schedule / Lesson Plan

| Topic | No. of Periods | |
|---|----------------|-------------------------|
| | | Theory |
| UNIT –1: EMR and Its Interaction with Atmosphere & Earth Material | | |
| Definition of remote sensing and its components | 1 | 8 periods for Unit I |
| Electromagnetic spectrum | 1 | |
| wavelength regions important to remote sensing | | |
| Wave theory, Particle theory | 1 | |
| Stefan-Boltzmann and Wien's Displacement Law | 1 | |
| Atmospheric scattering, Absorption | 1 | |
| Atmospheric windows, spectral signature concepts | 1 | |
| typical spectral reflective characteristics of water, vegetation and soil | 2 | |
| UNIT – 2: Platforms and Sensors | | |
| Types of platforms – orbit types | 1 | 8 periods for Unit II |
| Sun-synchronous and Geosynchronous, Passive and Active sensors | 1 | |
| Resolution concept | 1 | |
| Pay load description of important Earth Resources and Meteorological satellites | 2 | |
| Airborne and spaceborne TIR and microwave sensors | 3 | |
| UNIT – 3: Image Interpretation and Analysis | | |
| Types of Data Products | 1 | 10 periods for Unit III |
| Types of image interpretation, basic elements of image Interpretation | 1 | |
| Visual interpretation keys , Digital Image Processing | 2 | |
| Preprocessing, image enhancement techniques | 2 | |
| Multispectral image classification, Supervised and unsupervised. | 4 | |
| UNIT – 4: Geographic Information System | | |
| Introduction – Maps – Definitions | 1 | 8 periods for Unit IV |
| Map projections – types of map projections, map analysis | 2 | |
| GIS definition – basic components of GIS | 1 | |
| Standard GIS software's, Data type, Spatial and non-spatial (attribute) data | 2 | |
| Measurement scales, ata Base Management Systems(DBMS). | 1 | |
| Attribute data analysis – integrated data analysis | 1 | |

| | | |
|--|---|------------------------|
| UNIT – 5: Data Entry, Storage and Analysis | | |
| Data models, vector and raster data | 4 | 10 periods for Unit V |
| Data compression, data input by digitization and scanning | 2 | |
| Modeling in GIS, Highway alignment studies, Land Information System. | 4 | |
| UNIT – 6: RS and GIS Applications | | |
| Land cover and land use, agriculture | 3 | 12 periods for Unit VI |
| Forestry, geology, geomorphology | 3 | |
| Urban applications, hydrology- flood zone delineation and mapping | 3 | |
| Groundwater prospects and recharge, reservoir storage estimation. | 3 | |
| Total No.of Periods: | | 56 |

Assignment-Cum-Tutorial Questions

UNIT – I

Section - A

Objective Questions

1. Define Remote Sensing
2. Explain the energy balance equation.
3. List the primary colours.
4. What is the wavelength of Near IR?
5. Which portion of EMR is better suited for studying vegetation?
6. Which portion of EMR is better suited for studying water?
7. Which portion of EMR is better suited for studying soil?
8. The distance between two successive crests in a wave is termed as the _____ of the wave.
9. Quantum/Particle theory proposes that energy is propagated in the form of _____.
10. The wavelength of Ultraviolet Rays is _____ < / > / = Visible Spectrum.
11. The frequency of Infrared Rays is _____ < / > / = Visible Spectrum.
12. A passive sensor uses _____ as source of energy.
13. The arrangement of terrain features which provides attributes: the shape, size and texture of objects, is called _____.

14. The instruments which provide electromagnetic radiation of specified wave length or a band of wave lengths to illuminate the earth surface, are called_____.
15. Coherence of two electromagnetic waves takes place if their phase difference is_____.
16. Which gases block Far Infra Red radiation leading to the well known Green House effect?

Section - B

Subjective Questions

- 1) Explain the concept of remote sensing and various elements involved in remote sensing with a neat sketch.
- 2) Define Atmospheric window. Explain its significance in Remote Sensing of the Earth's surface.
- 3) State Stefan Boltzmann's, Wien's displacement Law of blackbody radiation.
- 4) Explain Wave Theory and Particle Theory of electromagnetic radiation.
- 5) What is the difference between an ideal remote sensing system and practical remote sensing system
- 6) Explain with a neat sketch ideal specular and ideal diffuse reflection of light.
- 7) Sketch a graph between wavelength and transmission to illustrate the idea of atmospheric window in the Infra Red portion of the EMR.
- 8) Explain the following
 - (i) Energy interactions with the atmosphere.
 - (ii) Energy interactions with the earth surface.
- 9) Explain the spectral reflectance characteristics for soils, water & vegetation. Draw the spectral signature curve for soil, water and vegetation.
- 10) Write down the wave length and applications of the following regions of electromagnetic spectrum.
 - a) Microwave
 - b) Infra Red

Section - C.

1. Does the transmission of solar radiation through the atmosphere, reaching towards the surface of the earth change from season to season? If yes, why? Which parts of the radiation are likely to be inhibited and which parts of the radiation are unlikely to be affected in monsoon season?
2. What is the difference between the image taken by an X-ray, Cell phone camera, Analog (Film) camera, a Remote Sensing Sensor (passive) and a Remote Sensing Sensor (active)?

UNIT – II

Section - A

Objective Questions

1. Give an example for a ground based remote sensing platform. _____
2. ResourceSat -1 is placed in a _____ orbit.
3. INSAT-3DR is parked in a _____ orbit.
4. The international space station is placed in an orbit which is at a height of _____ km .
5. _____ is an example of an Indian Passive Remote Sensing Sensor.
6. _____ is an example of an Indian Active Remote Sensing Sensor.
7. The spatial resolution of LISS-4 panchromatic sensor is _____ m.
8. The temporal resolution of CARTOSAT-2E is _____ days.
9. _____ series of Indian satellites are used for weather monitoring.
10. ISRO's satellite launching centre is located at _____, AP, India
11. Earth Observation Satellites are installed on _____ platforms.
 - a) Spaceborne
 - b) Airborne
 - c) Waterborne
 - d) Ground-based
12. An earth observation satellite orbit is placed in a _____ path.
 - a) Elliptical
 - b) Linear
 - c) Circular
 - d) Sinusoidal
- 13 Towers comes under _____ platforms

- a) airborne
 - b) spaceborne
 - c) ground based
 - d) none
- 14 1M x 1M when mentioned as a satellite data specification, denotes
- a) spatial resolution
 - b) spectral resolution
 - c) temporal
 - d) radiometric
- 15 Low level earth observation satellite orbits range from
- a) 700-1500 km
 - b) 300-500km
 - c) 100-200km
 - d) 10000-36000km
- 16 Radiosonde is used to measure
- a) Pressure
 - b) Voltage
 - c) Light speed
 - d) Resolution
- 17 SAR means
- a) Synthetic aperture radar
 - b) Super air radar
 - c) Synthetic air radar
 - d) Synthetic assembler radar
- 18 Digital photography permits _____ transmission
- a) Real-time
 - b) Inconsistent
 - c) Analogue
- 19 Thermal Infrared RS is a method to acquire thermal infrared rays, which are _____ from land surface heated by sunlight.
- a) Radiated
 - b) Transmitted
 - c) Exposed
 - d) Reflected

20 CARTOSAT 1A is

- a) Panchromatic
- b) Multispectral
- c) Hyperspectral
- d) Superspectral

Section - B

Subjective Questions

1. Write brief note on Geo-Stationary orbit, Sun-Synchronous Polar orbit.
2. List out the currently operational Indian platforms and sensors available for acquisition of satellite imagery.
3. Write down the payload description of any two Foreign Earth Resources and Meteorological satellites.
4. State the difference between panchromatic and multispectral image.
5. Write down the difference between Earth Resources and Meteorological satellites.
6. What are the two Indian satellites that are depicted on Rs.2 bank note and Rs.2000 bank note? Recount India's space journey from Aryabhata to GSAT-17
7. Tabulate 10 different remote sensing satellite sensors, the spatial resolution of the image and repeat interval for acquiring data.
8. Write about the advantages of MicroWave Remote Sensing over Visible range remote sensing.
9. Differentiate between active remote sensing sensor and passive remote sensing sensor. Explain the applications of data collected by these sensors.
10. Explain the concepts of spatial, spectral and temporal resolution of satellite images.
11. What bands of the electromagnetic radiation do active sensors use? Illustrate this with an actual Active Sensor deployed on Indian Earth Observation Satellites.
12. Write a note on Infra Red Radiation and its application in remote sensing. What is the relation of Infra Red radiation to Global Warming?
13. Write a note on spatial resolution of cameras/sensors with examples and explain applications for images of various spatial resolutions.

14. Explain the principles of thermal remote sensing and microwave remote sensing.
15. List out the payload description on CARTOSAT 2E.
16. How do GPS satellites differ from Earth Observation Satellites?

Section - C.

1. Does an active remote sensing sensor need a sun synchronous orbit for its function? Explain why?
2. Why is there a big difference in orbit height of polar and geostationary satellites? Can a satellite be geostationary in low earth orbit? Why (not) ?
3. Once a remote sensing satellite is placed in a polar orbit, can the revisit period of the sensor be changed? How?
4. Indian Space Research Organisation names its satellites EDUSAT, GRAMSAT, OCEANSAT, RESOURCESAT, CARTOSAT etc.,. Describe the applications of these satellites based on their names and the types of sensor deployed onboard.

UNIT – III

Section - A.

Objective Questions

1. What is the tool used in tasks such as zooming, shrinking, rotating, etc.?
 a) Sampling
 b) Interpolation
 c) Filters
 d) None of the Mentioned
2. The smallest discernible change in intensity level is called _____
 a) Intensity Resolution
 b) Contour
 c) Saturation
 d) Contrast
3. A continuous image is digitised at _____ points.
 a) random
 b) vertex
 c) contour
 d) sampling
4. The transition between continuous values of the image function and its digital equivalent is called _____

- a) Quantisation
 - b) Sampling
 - c) Rasterisation
 - d) None of the Mentioned
5. What is image enhancement?
 6. What is visual interpretation?
 7. Define classification of raster image.
 8. Differentiate supervised and unsupervised classification of raster image.
 9. Define Preprocessing.
 10. Define Feature Extraction

Section - B.

Subjective Questions

1. Explain various image enhancement techniques and in detail.
2. Illustrate different Multi- spectral enhancement techniques.
3. Classify different types of Image classification techniques
4. Classify different data products.
5. Explain about Satellite image preprocessing technique.
6. Identify different Geometric Correction Methods
7. Determine different Radiometric Correction Methods.
8. Illustrate different data models.
9. Define Training Stage and Contrast Stretching.
10. Compare the differences between Multispectral and panchromatic image

UNIT-IV

Section - A

Objective Questions

1. Which of the following are essential components of a GIS?
 - a. A computer with sufficient memory and processing power to run the software.
 - b. Data input and output devices such as digitizers/scanners and printer/plotters.
 - c. A fast Internet connection.
 - d. Appropriate GIS software.
 - e. A visual display unit capable of high resolution colour graphical display as well as text.
 - f. Spatial data
2. Human factors influence the success of GIS as a decision support tool.
 - a.) True
 - b) False
3. Attribute data are one type of spatial data.
 - a) True

- b) False
4. In the world of GIS, another term for the property of connectivity is:
- a) proximity
 - b) neighborhood
 - c) topology
 - d) boolean identity
 - e) location
5. By definition a GIS must include:
- a) A subsystem for data reporting and product generation
 - b) A method for data storage, retrieval, and representation
 - c) A method for storing demographic information
 - d) A method for scanning maps to produce raster files
 - e) Data analysis functions
 - f) A means for the input of spatial and non-spatial data
6. Which of the following are areas of GIS application in commercial industry?
- a) Oil and gas exploration
 - b) Dispatch of emergency medical services
 - c) Timber and lumber production
 - d) Direct marketing and retailing
 - e) Managing telecommunication networks
 - f) Monitoring wetland habitats
7. Which of the following are true?
- a) Digitizing is defined as converting aerial photographs into maps
 - b) Digitizing involves tracing map features into a computer
 - c) A keyboard cannot be used to digitize maps, only to enter attribute information
 - d) Digitizing from a tablet involves using a template
 - e) A digitizing tablet and mouse are examples of input devices used in digitizing
8. Define GIS.
9. Define Scale.
10. Define Map.
11. Define Projection.
12. List out the types of projections.
13. Define user in GIS

Section - B

Subjective Questions

1. Explain various components of GIS in detail.

2. Illustrate the concept of projections.
3. List out and explain the types of scales.
4. Explain different types of co-ordinate systems in map projections.
5. Explain the types of maps in detail.
6. List out and explain the elements of GIS.
7. Elaborate the framework of GIS.
8. Explain the concepts of DBMS
9. Explain raster and vector data.
10. List out the uses of DBMS.
11. Compare the differences between spatial data and attribute data.

Section - C

1. List out the functions of DBMS?
2. Enumerate the uses of GIS.
3. Explain GIS architecture.
4. Differentiate GCS and PCS.

UNIT-V

Section - A.

Objective Questions

1. MAP model comes under.....
2. Polyvrt is.....
3. Locus of points is called.....
4. A point represents.....
5. An automated system for the capture, storage, retrieval, analysis, and display of spatial data is known as
 - a) GPS
 - b) GIS
 - c) LIDAR
 - d) TS
6. Which is NOT a commonly used coding scheme for images?
 - a) JPEG
 - b) GIF
 - c) MP3
 - d) TIFF
7. Which form of representation does a paper map use?
 - a) analog
 - b) digital
 - c) binary
 - d) decimal
8. In the world of GIS, another term for the property of connectivity is:

- a) proximity
 - b) neighbourhood
 - c) topology
 - d) boolean identity
 - e) location.
9. Which of the following are true?
- a) Digitizing is defined as converting aerial photographs into maps
 - b) Digitizing involves tracing map features into a computer
 - c) A keyboard cannot be used to digitize maps, only to enter attribute information
- 10 IMGRID is a
- a) Raster model
 - b) Vector model
11. Point comes under?
- a) Raster data
 - b) Vector data.

Section - B.

Subjective Questions

1. Summarize the advantages and disadvantages of raster data.
2. Compare the advantages and disadvantages of vector data.
3. Define different models of spatial data.
4. Summarize the differences between Raster and Vector data.
5. Explain topological vector model.
6. Explain briefly about Digitizers.
7. Explain the use of Raster and Vector data products in LULC.
8. Define spatial models and their types.
9. Explain GRID, IMGRID.
10. Explain the raster representation.
11. Determine the scope of Raster data model in planning a Highway alignment.

Section - C.

1. Explain the scope of Vector data model in Land information system.
2. Explain different input devices used in GIS and explain the dependency on one another.

UNIT-VI

Section - A.

Objective Questions

1. Define Land use
2. Define Land Cover.
3. Outline forest fires.
4. Describe DEM.
5. Describe DTM.
6. Define Contour.
7. Define Geology.
8. What is Geomorphology?
9. What is landslide?
10. What is TIN?

Section – B

Descriptive Questions

1. What do you understand by the application of remote sensing?
2. Explain the role of RS&GIS in Land use land cover.
3. Explain the application of remote sensing in coastal monitoring.
4. Explain the use of remote sensing in Soil mapping.
5. Explain the use of GIS in Inter linking of Rivers.
6. Explain the use of GIS in population density mapping.
7. Determine role of GIS in Disaster response.
8. How GIS is used in finding the elevation of the earth surface.
9. Explain the use of RS&GIS in Urban planning.
10. Explain the concept of Remote sensing in Land Cover and Land use.
11. Explain the crop inventory process applied in RS&GIS.
12. Explain the use of GIS in finding the storage capacity of a reservoir.
13. Explain the concept of GIS in Geology and Geomorphology.
14. Explain Flood zone mapping.
15. Explain how GIS is being used in Flood zone mapping

Section - C.

1. Explain the concept of RS&GIS in crop disease identification.
2. Illustrate the use of RS&GIS in ground water mapping.
3. Explain the process of crop yield identification by using RS&GIS.
4. Explain the application of RS&GIS in forest mapping.
5. Illustrate how Remote sensing is used in crop management.
6. Explain with a case study on usage of RS&GIS in forest fire mapping.

Signature of the Faculty

GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, Gudlavalleru – 521 356.

Department of Computer Science and Engineering



2020-21 SEM -I

IV-B.Tech Handout

GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, Gudlavalleru – 521 356.

Department of Computer Science and Engineering



Academic Year: 2020-21

IV-B.Tech SEM –I

HANDOUT ON CRYPTOGRAPHY AND NETWORK SECURITY

Vision of the Institute

To be a leading Institution of Engineering education and research, preparing students for leadership in their fields in a caring and challenging learning environment.

Mission of the Institute

- To produce quality engineers by providing state-of-the-art engineering education.
- To attract and retain knowledgeable, creative, motivated, and highly skilled individuals whose leadership and contributions uphold the college tenets of education, creativity, research and responsible public service.
- To develop faculty and resources to impart and disseminate knowledge and information to students that will enhance educational level, which in turn will contribute to social and economic betterment of society.
- To provide an environment that values and encourages knowledge acquisition and academic freedom, making this a preferred institution for knowledge seekers.
- To provide quality assurance.
- To partner and collaborate with industry, government, and R & D institutes to develop new knowledge and sustainable technologies and serve as an engine for facilitating the nation's economic development.
- To impart personality development skills to students that will help them to succeed and lead.
- To instill in students the attitude, values and vision that will prepare them to lead lives of personal integrity and civic responsibility.
- To promote a campus environment that welcomes and makes students of all races, cultures and civilizations feel at home.
- Putting students face to face with industrial, governmental, and societal challenges.

Vision of the Department

To be a centre of excellence in Computer Science and Engineering education and training to meet the challenging needs of the industry and society.

Mission of the Department

- To impart quality education through well-designed curriculum in tune with the growing software needs of the industry.
- To serve our students by inculcating in them problem solving, leadership, teamwork skills and the value of commitment to quality, ethical behavior & respect for others.
- To foster industry-academia relationship for mutual benefit and growth.

Program Educational Objectives :

PEO1: Identify, analyze, formulate and solve Computer Science and Engineering problems both independently and in a team environment by using the appropriate modern tools.

PEO2: Manage software projects with significant technical, legal, ethical, social, environmental and economic considerations.

PEO3: Demonstrate commitment and progress in lifelong learning, professional development, Leadership and Communicate effectively with professional clients and the public.

SUBJECT:- CRYPTOGRAPHY AND NETWORK SECURITY

Class & Sem. : IV B.Tech – I Semester

Year : 2020-21

Branch : CSE

Credits : 3

1. Brief History and Scope of the Subject

History:

- Since the early days of writing, heads of state and military commanders understood that it was necessary to provide some mechanism to protect the confidentiality of written correspondence and to have some means of detecting tampering.
- Julius Caesar is credited with the invention of the Caesar cipher ca. 50 B.C., which was created in order to prevent his secret messages from being read should a message fall into the wrong hands.
- World War II brought about many advancements in information security and marked the beginning of the professional field of information security.
- The end of the 20th century and early years of the 21st century saw rapid advancements in telecommunications, computing hardware and software, and data encryption. The availability of smaller, more powerful and less expensive computing equipment made electronic data processing within the reach of small business and the home user. These computers quickly became interconnected through a network generically called the Internet or World Wide Web.
- The rapid growth and widespread use of electronic data processing and electronic business conducted through the Internet, along with numerous occurrences of international terrorism, fueled the need for better methods of protecting the computers and the information they store, process and transmit. The academic disciplines of computer security, information security and information assurance emerged along with numerous professional organizations – all sharing the common goals of ensuring the security and reliability of information systems

Developments:

In recent years, a body of law has emerged that explicitly establishes certain minimum duties with regard to the security of business information systems. Outside of certain regulated industries such as telecommunications or banking, there were not formerly any laws that directly and explicitly established duties with regard

to information security. Of course, many laws can be construed as implicitly imposing a duty to maintain an appropriate level of information system security. For example, statutes that authorize commercial transactions in electronic form contain implicit information security requirements if they

provide that electronic records will only be recognized as equivalent the electronic records are accurate and accessible.

In addition, it is possible to infer duties to maintain minimum levels of information

security from laws such as anti-money laundering laws, wiretap laws or securities laws. Recent information security legislation clearly departs from these earlier laws, for example by defining the subject of information security clearly or by spelling out concrete and specific duties that apply to business information systems.

2. Pre-Requisites

You need to have a decent understanding of the basics of TCP/IP. You should know the difference between IP, ICMP, TCP, and UDP. You should know what port numbers and sequence numbers are, and have (some) understanding of the TCP flags.

You should also be comfortable with sockets programming — some of the homework assignments will require you to implement network clients or servers.

3. Course Objectives:

- To familiarize different types of security attacks and services.
- To expose different cryptographic techniques and algorithms.

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

- describe security attacks and services over networks.
- differentiate symmetric and asymmetric encryption techniques.
- apply integrity checking and authentication techniques.
- compare E-mail security and IP level security.
- use firewalls and intrusion detection techniques for system security.
- outline web security threats and counter measures.

5. Program Outcomes:

Graduates of the Computer Science and Engineering Program will have

PO1. Apply knowledge of computing, mathematics, science and engineering fundamentals to solve complex engineering problems.

PO2. Formulate and analyze a problem, and define the computing requirements appropriate to its solution using basic principles of mathematics, science and computer engineering.

PO3. Design, implement, and evaluate a computer based system, process, component, or software to meet the desired needs.

PO4. Design and conduct experiments, perform analysis and interpretation of data and provide valid conclusions.

PO5. Use current techniques, skills, and tools necessary for computing practice.

PO6. Understand legal, health, security and social issues in Professional Engineering practice.

PO7. Understand the impact of professional engineering solutions on environmental context and the need for sustainable development.

PO8. Understand the professional and ethical responsibilities of an engineer.

PO9. Function effectively as an individual, and as a team member/ leader in accomplishing a common goal.

PO10. Communicate effectively, make effective presentations and write and comprehend technical reports and publications.

PO11. Learn and adopt new technologies, and use them effectively towards continued professional development throughout the life.

PO12. Understand engineering and management principles and their application to manage projects in the software industry.

6. Mapping of Course Outcomes with Program Outcomes:

| CT2533 : CYPTOGRAPHY AND NETWORK SECURITY | | | | | | | | | | | | | | |
|--|---|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|------------------|------------------|
| Course outcomes | Program Outcomes and Program Specific Outcome | | | | | | | | | | | | | |
| | P
O
1 | P
O
2 | P
O
3 | P
O
4 | P
O
5 | P
O
6 | P
O
7 | P
O
8 | P
O
9 | P
O
10 | P
O
11 | P
O
12 | P
S
O
1 | P
S
O
2 |
| CO1: describe security attacks and services over networks.. | 3 | | | | | | | | | | | 1 | | |
| CO2: differentiate symmetric and asymmetric encryption techniques. | 2 | 1 | | | | | | 2 | | | | 2 | 2 | 2 |
| CO3: apply integrity checking and authentication techniques. | | 2 | 2 | | | | | 2 | | | | 2 | 2 | 2 |

| | | | | | | | | | | | | | | | |
|--|---|---|--|--|--|--|--|--|---|--|--|--|---|---|---|
| CO4: compare E-mail security and IP level security. | 2 | 2 | | | | | | | 2 | | | | 2 | 2 | 2 |
| CO5: use firewalls and intrusion detection techniques for system security. | 2 | 2 | | | | | | | 2 | | | | 2 | 2 | 2 |
| CO6: outline web security threats and counter measures. | 3 | | | | | | | | 2 | | | | 2 | 1 | 1 |

7. Prescribed Text Books

1. William Stallings, “Cryptography and Network Security Principles and Practice”, 5th edition, Pearson Education.
2. Bernard Menezes, “Network security and cryptography”, Cengage Learning.

Reference Text Books

1. William Stallings, “Network Security Essentials”, 4th edition, Pearson education.
2. Eric Maiwald, “Fundamentals of Network Security”, 1st edition, Dream Tech press.
3. Buchmann, “Introduction to Cryptography”, Springer.

URLs and Other E-Learning Resources

➤ URL’s:

<http://www.williamstallings.com/StudentSupport.html>

<http://eprint.iacr.org>

<http://www.cryptography.com>

➤ Journal: IEEE/ACM Transactions on Networking

➤ On-Line Journal:

- ACM Transactions on Information and Systems Security
<http://portal.acm.org/TISSEC>
- ACM Transactions on Information Systems
<http://portal.acm.org/TOIS>

- IEEE Transactions on Information Theory
<http://ieeexplore.ieee.org/servlet/opac?punumber=18>

8. Digital Learning Materials:

JKC CD's -2 on CRYPTOGRAPHY and NETWORK SECURITY

9. Lecture Schedule / Lesson Plan

| Topic | No. of Periods | |
|--|----------------|----------|
| | Theory | Tutorial |
| UNIT –1: Introduction | | |
| Security Attacks | 2 | 1 |
| Security Services | 1 | |
| Security Mechanisms. | 1 | |
| A model for Internetwork security. | 1 | |
| Non Cryptographic protocol vulnerabilities | 2 | 1 |
| Software vulnerabilities | 2 | |
| UNIT – 2: Secret key cryptography | | |
| Symmetric Cipher model | 1 | 1 |
| Block and Stream Ciphers | 2 | |
| Data Encryption Standard(DES) | 2 | 2 |
| Block cipher design principles and modes of operation | 2 | |
| Triple DES | 1 | |
| AES Structure | 1 | |
| UNIT – 3: Public key cryptography | | |
| Introduction | 2 | 1 |
| Principles of public-key crypto systems | 2 | |
| RSA algorithm | 2 | |
| Diffie-Hellman key exchange | 2 | 1 |
| Introduction to elliptic curve cryptography | 2 | |
| UNIT – 4: Hash Functions and Digital Signatures | | |
| Cryptographic hash functions | 1 | 1 |
| Applications of cryptographic hash functions | 1 | |
| Secure hash algorithm | 2 | 1 |
| HMAC | 2 | |
| Digital signatures | 2 | |
| Digital Signature algorithm | 2 | |
| UNIT – 5: E-mail Security and IP Security | | |
| PGP | 2 | 2 |
| S/MIME | 2 | |
| Overview of IP Security | 1 | |
| IP Security Architecture | 1 | 1 |
| Authentication Header | 1 | |
| Encapsulating Security Payload | 2 | |

| UNIT – 6: Web Security and System Security | | |
|---|-----------|-----------|
| Web Security-Requirements | 1 | 1 |
| Secure Socket Layer (SSL) | 2 | |
| Transport Layer Security (TLS) | 2 | |
| Firewall Design principles | 2 | 1 |
| Intrusion Detection Systems. | 2 | |
| Total No.of Periods: | 56 | 14 |

10. Seminar Topics

- Conventional encryption algorithms
- public key cryptography algorithms
- secure hash functions and HMAC.
- Email privacy- Pretty Good Privacy (PGP)
- Overview of IP Security
- SET
- Viruses and related threats

Signature of the Faculty

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Department of Computer Science and Engineering



Academic Year: 2020-21

IV-B.Tech SEM –I

HANDOUT ON IMAGE PROCESSING

Vision of the Institute

To be a leading Institution of Engineering education and research, preparing students for leadership in their fields in a caring and challenging learning environment.

Mission of the Institute

- To produce quality engineers by providing state-of-the-art engineering education.
- To attract and retain knowledgeable, creative, motivated, and highly skilled individuals whose leadership and contributions uphold the college tenets of education, creativity, research and responsible public service.
- To develop faculty and resources to impart and disseminate knowledge and information to students that will enhance educational level, which in turn will contribute to social and economic betterment of society.
- To provide an environment that values and encourages knowledge acquisition and academic freedom, making this a preferred institution for knowledge seekers.
- To provide quality assurance.
- To partner and collaborate with industry, government, and R & D institutes to develop new knowledge and sustainable technologies and serve as an engine for facilitating the nation's economic development.
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- To instill in students the attitude, values and vision that will prepare them to lead lives of personal integrity and civic responsibility.
- To promote a campus environment that welcomes and makes students of all races, cultures and civilizations feel at home.
- Putting students face to face with industrial, governmental, and societal challenges.

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- To impart quality education through well-designed curriculum in tune with the growing software needs of the industry.
- To serve our students by inculcating in them problem solving, leadership, teamwork skills and the value of commitment to quality, ethical behavior & respect for others.
- To foster industry-academia relationship for mutual benefit and growth.

Program Educational Objectives :

PEO1: Identify, analyze, formulate and solve Computer Science and Engineering problems both independently and in a team environment by using the appropriate modern tools.

PEO2: Manage software projects with significant technical, legal, ethical, social, environmental and economic considerations.

PEO3: Demonstrate commitment and progress in lifelong learning, professional development, Leadership and Communicate effectively with professional clients and the public.

SUBJECT:- IMAGE PROCESSING

Class & Sem. : IV B.Tech – I Semester

Year :2021-22

Branch : CSE

Credits : 3

1. Brief History and Scope of the Subject

Many of the techniques of digital image processing, or digital picture processing as it often was called, were developed in the 1960s at the Jet Propulsion Laboratory, Massachusetts Institute of Technology, Bell Laboratories, University of Maryland, and a few other research facilities, with application to satellite imagery, wire-photostandards conversion, medical imaging, videophone, character recognition, and photograph enhancement. The cost of processing was fairly high, however, with the computing equipment of that era. That changed in the 1970s, when digital image processing proliferated as cheaper computers and dedicated hardware became available. Images then could be processed in real time, for some dedicated problems such as television standards conversion. As general-purpose computers became faster, they started to take over the role of dedicated hardware for all but the most specialized and computer-intensive operations. With the fast computers and signal processors available in the 2000s, digital image processing has become the most common form of image processing and generally, is used because it is not only the most versatile method, but also the cheapest.

Digital image processing technology for medical applications was inducted into the Space Foundation Space Technology Hall of Fame in 1994.

In 2002 Raanan Fattal, introduced Gradient domain image processing, a new way to process images in which the differences between pixels are manipulated rather than the pixel values themselves

2. Pre-Requisites

- Integrations and differentiations
- Computer graphics

3. Course Objectives:

- To gain the knowledge in various image processing techniques.

4. Course Outcomes: Students will be able to

Upon successful completion of the course, the students will be able to:

CO1: use appropriate image enhancement technique to improve the quality of an image.

CO2: apply suitable image segmentation technique for an application.

CO3: analyze various image compression techniques.

CO4: apply morphological operations to modify the structure of an image.

5. Program Outcomes:

Engineering Graduates will be able to:

PO1. Apply knowledge of computing, mathematics, science and engineering fundamentals to solve complex engineering problems.

PO2. Formulate and analyze a problem, and define the computing requirements appropriate to its solution using basic principles of mathematics, science and computer engineering.

PO3. Design, implement, and evaluate a computer based system, process, component, or software to meet the desired needs.

PO4. Design and conduct experiments, perform analysis and interpretation of data and provide valid conclusions.

PO5. Use current techniques, skills, and tools necessary for computing practice.

PO6. Understand legal, health, security and social issues in Professional Engineering practice.

PO7. Understand the impact of professional engineering solutions on environmental context and the need for sustainable development.

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PO10. Communicate effectively, make effective presentations and write and comprehend technical reports and publications.

PO11. Learn and adopt new technologies, and use them effectively towards continued professional development throughout the life.

PO12. Understand engineering and management principles and their application to manage projects in the software industry.

6. Mapping of Course Outcomes with Program Outcomes:

| CT2530 : IMAGE PROCESSING (PROFESSIONAL ELECTIVE – IV) | |
|--|---|
| Course outcomes | Program Outcomes and Program Specific Outcome |

| | P
O
1 | P
O
2 | P
O
3 | P
O
4 | P
O
5 | P
O
6 | P
O
7 | P
O
8 | P
O
9 | P
O
10 | P
O
11 | P
O
12 | | PS
O1 | PS
O2 |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|--|----------|----------|
| CO1. use appropriate image enhancement technique to improve the quality of an image. | 3 | 2 | 1 | | | | | | | | | 1 | | 1 | |
| CO 2.apply suitable image segmentation technique for an application. | 2 | 2 | 3 | 1 | | | | | | | | 2 | | 2 | |
| CO3. analyze various image compression techniques. | 2 | 3 | | | | | | | | | | 1 | | 1 | |
| CO 4. apply morphological operations to modify the structure of an image. | 3 | | 2 | 1 | | | | | | | | 2 | | 1 | |

7. Prescribed Text Books

- Rafael C.Gonzalez, Richard E.Woods, Digital Image Processing, Second Edition, Pearson Education/PHI.

Reference Text Books

- Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing, Analysis, and Machine Vision, Thomson Learning, Second Edition.
- Adrian Low, Computer Vision and Image Processing, B.S.Publications, Second Edition.
- William K. Prat, Digital Image Processing, Wily Third Edition.
- B. Chanda, D. Datta Majumder, Digital Image Processing and Analysis, Prentice Hall of India, 2003

8. URLs and Other E-Learning Resources

Journals: International Journal of Image Processing (IJIP)
<http://www.cscjournals.org/journals/IJIP/description.php>

9. Digital Learning Materials:

<http://nptel.ac.in/courses/117105079/>

<https://www.tutorialspoint.com/dip/>

<https://www.slideshare.net/sahilbiswas/image-processing-27960248>

10. Lecture Schedule / Lesson Plan

| Topic | No. of Periods |
|-------|----------------|
|-------|----------------|

| | Theory | Tutorial |
|---|---------------|-----------------|
| UNIT –1: Digital Image Processing | | |
| Introduction Digital image processing | 1 | 1 |
| Examples of fields that use digital image processing
Fundamental steps in digital image processing | 2 | |
| Components of image processing system | 1 | |
| Image sensing and Acquisition | 2 | 1 |
| Sampling and quantization | 2 | |
| Basic relationships between pixels | 1 | |
| UNIT – 2: Image enhancement in the spatial domain | | |
| Introduction Spatial Domain and Point Processing | 1 | 1 |
| Basic gray-level transformations | 2 | |
| Histogram processing | 2 | |
| Enhancement using arithmetic and logic operators | 1 | 1 |
| Basics of spatial filtering ,Smoothing | 1 | |
| Sharpening spatial filters | 1 | |
| Combining the spatial enhancement methods | 1 | |
| UNIT – 3: Color Image Processing | | |
| Color Image Processing Introduction ,Color fundamentals | 1 | 1 |
| Color models | 2 | |
| Pseudo color image processing | 1 | |
| Basics of full color image processing | 1 | 1 |
| Color transformations | 2 | |
| Color image smoothing and sharpening | 1 | |
| Color segmentation | 1 | |
| UNIT – 4: Image Compression | | |
| Image Compression Fundamentals | 2 | 1 |
| Image compression models | 2 | |
| Error-free compression | 2 | 1 |
| Lossy predictive coding | 2 | |
| UNIT – 5: Morphological Image Processing | | |
| Morphological Image Processing Preliminaries | 1 | 1 |
| Dilation and erosion | 2 | |
| Open and closing | 1 | |
| Hit or miss transformation | 2 | 1 |
| Basic morphologic algorithms | 2 | |
| UNIT – 6: Image Segmentation Detection | | |
| Image Segmentation Detection of discontinuous | 2 | 1 |
| Edge linking and boundary detection | 2 | |
| Thresholding | 2 | 1 |
| Region-based segmentation | 2 | |
| Total No. Of Periods: | 51 | 12 |

11. Seminar Topics

- Basic relationships between pixels
- Color transformations
- Enhancement using arithmetic and logic operators
- Lossy predictive coding

Assignment-Cum-Tutorial Questions

UNIT-I

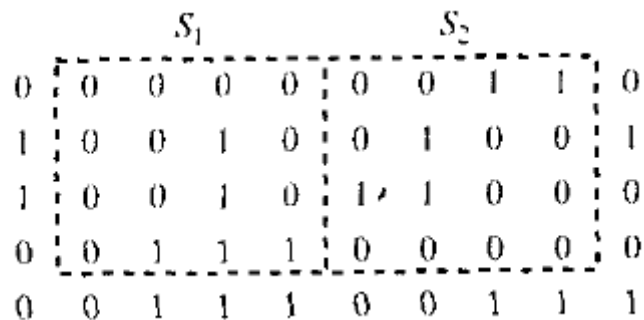
I. Objective Questions

1. A pixel p at coordinates (x, y) has four horizontal and vertical neighbors whose coordinates are given by _____ called the 4-neighbors of p .
 - a. $(x+1, y)$
 - b. $(x-1, y)$
 - c. $(x, y+1)$
 - d. $(x, y-1)$
 - e. ALL
2. A pixel p at coordinates (x, y) has called the 8-neighbors of p if it has _____.
 - a. Horizontal and vertical neighbors $(x+1, y)$, $(x-1, y)$, $(x, y+1)$, $(x, y-1)$
 - b. Diagonal neighbors $(x+1, y+1)$, $(x+1, y-1)$, $(x-1, y+1)$, $(x-1, y-1)$
 - c. Both A and B
 - d. None of the above
3. Intensity levels in 8-bit image are _____.
 - a. 128
 - b. 255
 - c. 256
 - d. 512
4. In bit plane slicing 8 bit image will have _____ number of planes.
 - a. 6
 - b. 7
 - c. 8
 - d. 9
5. A continuous image is digitized at _____ points.
 - a. random
 - b. vertex
 - c. contour
 - d. sampling
6. The smallest discernible change in intensity level is called _____.
 - a. Intensity Resolution
 - b. Contour

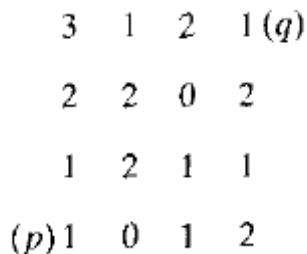
- c. Saturation
 - d. Contrast
7. The difference in intensity between the highest and the lowest intensity levels in an image is _____ .
- a. Noise
 - b. Saturation
 - c. Contrast
 - d. Brightness
8. Which of the following is used for chest and dental scans?
- a. Hard X-Rays
 - b. Soft X-Rays
 - c. Radio waves
 - d. Infrared Rays
9. In a binary image with values 0 and 1, two pixels may be 4-neighbors, but they are said to be connected only if they have the ____ value.
- a. Same
 - b. Different
 - c. Both A and B
 - d. none
10. Image enhancement and restoration are used to process _____.
- a. high resolution images
 - b. degraded images
 - c. high quality images
 - d. brighter images
11. Which one is not the area of digital image processing?
- a. law enforcement
 - b. lithography
 - c. medicine
 - d. voice calling
12. An image is a two dimensional function where x and y are_____.
- a. spatial coordinates
 - b. frequency coordinates
 - c. time coordinates
 - d. real coordinates
13. Which is the image processing related fields?
- a. medicines
 - b. chemistry
 - c. neurobiology
 - d. chemicals
14. Method in which images are input and attributes are output is called_____.
- a. low level processes
 - b. high level processes
 - c. mid level processes
 - d. edge level processes

II. Descriptive Questions

1. What is meant by Digital Image Processing? Explain how digital images can be represented?
2. Explain of Fields that Use Digital Image Processing.
3. What are the fundamental steps in Digital Image Processing?
4. What are the components of an Image Processing System?
5. Explain the process of image acquisition.
6. Explain about image sampling and quantization process.
7. Define spatial and gray level resolution. Explain about isopreference curves.
8. Explain about Aliasing and Moire patterns.
9. Explain about the basic relationships and distance measures between pixels in a digital image.
10. Calculate the 4 neighbors of a pixel at coordinates $p(2,3)$.
11. Calculate the resolution of an 1024×1024 image.
12. Find out 8 neighbors of a pixel at coordinates $p(8,8)$.
13. Calculate the number of bits required to store an 128×128 image with 64 gray levels.
14. Consider the two image subsets, S_1 and S_2 , shown in the following figure. For $V=\{1\}$, determine whether these two subsets are (a) 4-connect (b)8-connect or (c) m-adjacent.



15. Consider the image segment shown below, Let $V=\{0,1\}$ and compute the lengths of the shortest 4, 8, and m-path between p and q . if a particular path does not exist between these two points, explain why?

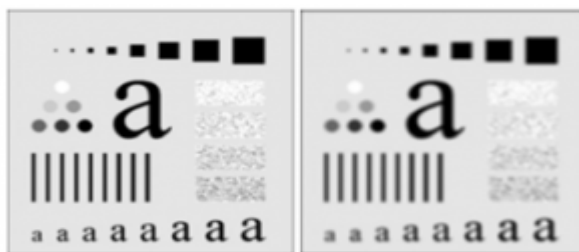


16. Compute for $V = \{1,2\}$ with the same data in problem 6.
17. Calculate the (Euclidean) distance between points $(2, -1)$ and $(-2, 2)$.

UNIT-II

I. Objective Questions

- In spatial domain, which of the following operation is done on the pixels in sharpening the image?
a. Integration b. Average c. Median d. Differentiation
- Sum of all components in normalized histogram is equal to____.
a. 100 b.2 c. 0 d. 1
- If r be the gray-level of image before processing and s after processing then which expression defines the negative transformation, for the gray-level in the range $[0, L-1]$?
a. $s = L - 1 - r$
b. $s = cr^\gamma$, c and γ are positive constants
c. $s = c \log(1 + r)$, c is a constant and $r \geq 0$
d. none of the mentioned
- The power-law transformation is given as: $s = cr^\gamma$, c and γ are positive constants, and r is the gray-level of image before processing and s after processing. Then, for what value of c and γ does power-law transformation becomes identity transformation?
a. $c = 1$ and $\gamma < 1$ b. $c = 1$ and $\gamma > 1$
c. $c = -1$ and $\gamma = 0$ d. $c = \gamma = 1$
- The power-law transformation is given as: $s = cr^\gamma$, c and γ are positive constants, and r is the gray-level of image before processing and s after processing. What happens if we increase the gamma value from 0.3 to 0.7?
a. The contrast increases and the detail increases
b. The contrast decreases and the detail decreases
c. The contrast increases and the detail decreases
d. The contrast decreases and the detail increases
- If the size of the averaging filter used to smooth the original image to first image is 9, then what would be the size of the averaging filter used in smoothing the same original picture to second in second image?



a.3

b.5

c.9

d.15

- In power-law transformation what happens if we change the gamma value from 0.9 to 0.2?
a. The contrast increases and the detail increases
b. The contrast decreases and the detail decreases

8. If normalized RGB image intensities are $R=G=B=0$, after converting the RGB image to HSI format what is S value.
 a. 1 b. 0 c. 0.5 d. 2
9. If H Component of RGB Pixel is obtained as θ by _____
 a. $H=\theta$ if $B \leq G$ b. $H=360-\theta$ if $B > G$
 c. $H=\theta$ if $B >= G$ d. Both A and B
10. If normalized RGB image intensities are $R=G=B=1$, after converting the RGB image to HSI format what is I value.
 a. 1 b. 0 c. 0.5 d. not determined
11. For any value of $x(\text{red})=.3$ and $y(\text{green})=.6$ the corresponding value of $z(\text{blue})$ is _____
 a. 0.9 b. 0 c. 1 d. 0.1
12. Represent Bright green in Hex number system .
 a. (00FF00) b. (11FF11) c. (11FF00) d. (00FF11)
13. $(FFFFFF)_{16}$ is represent _____ color in RGB format .
 a. White b. Black c. red d. both A and B

II. Descriptive Questions

1. Explain about color fundamentals.
2. Illustrate RGB color model.
3. Explain CMY color model.
4. Explain HSI color model.
5. Explain about pseudocolor image processing.
6. Summarize color segmentation process.
7. Outline the basics of full color image processing.
8. Demonstrate image smoothing and image sharpening
9. Summarize color transformations

UNIT-IV

I. Objective Questions

1. If n_1 and n_2 denote the number of information-carrying units in two data sets that represent the same information then compression ratio C_R of the first data set (the one characterized by n_1) is calculated as _____
 A) n_1/n_2 B) n_1*n_2 C) n_2/n_1 D) none of the above
2. If n_1 and n_2 denote the number of information-carrying units in two data sets that represent the same information, the relative data redundancy R_D of the first data set (the one characterized by n_1) can be defined as _____
3. In coding redundancy, If the number of bits used to represent each value of r_k is l (r_k), then the average number of bits required to represent each pixel is _____. In coding redundancy, the total number of bits required to code an $M \times N$ image is MNl_{avg} . [True/False]

4. _____ is responsible for reducing or eliminating any coding, interpixel, or psychovisual redundancies in the input image.
 A)source encoder B)source decoder
 C)channel encoder D)channel decoder
5. If n_1 and n_2 denote the number of information-carrying units in two data sets that represent the same information then compression ratio C_R of the first data set (the one characterized by n_1) is _____ for the case $n_1 \gg n_2$
 A) 0 B) 1 C) ∞ D) none.
6. If n_1 and n_2 denote the number of information-carrying units in two data sets that represent the same information, the relative data redundancy R_D of the first data set (the one characterized by n_1) can _____ for the case $n_1 = n_2$
 A) 0 B) 1 C) Both D) none
7. An alphabet consists of the letters A, B, C and D. The probability of occurrence is $P(A) = 0.4$, $P(B) = 0.1$, $P(C) = 0.2$ and $P(D) = 0.3$. The Huffman code is ____.
 A) A = 0 B = 11 C = 10 D = 111
 B) A = 0 B = 111 C = 11 D = 101
 C) A = 0 B = 111 C = 110 D = 10
 D) A = 01 B = 111 C = 110 D = 10
8. A Huffman code: A = 1, B = 000, C = 001, D = 01 $P(A) = 0.4$, $P(B) = 0.1$, $P(C) = 0.2$, $P(D) = 0.3$ The average number of bits per letter is _____.
 A) 2.1 bit B) 1.9 bit C) 8.0 bit D) 2.0 bit
9. Given a Gray Code: $g_3 \ g_2 \ g_1 \ g_0 = 1 \ 0 \ 0 \ 1$ then Binary Code: $b_3 \ b_2 \ b_1 \ b_0$ is:
 A) 1 1 1 0 B) 1 1 1 1 C) 1 0 1 1 D) 0 1 0 1
10. Digitizing image intensity amplitude is called _____.
 a. sampling
 b. quantization
 c. framing
 d. Both A and B
11. Information is the _____.
 a. data
 b. meaningful data
 c. raw data
 d. Both A and B
12. Image compression comprised of _____.
 a. encoder
 b. decoder
 c. frames
 d. Both A and B
13. Coding redundancy works on _____.
 a. pixels
 b. matrix
 c. intensity
 d. coordinates

14. Every run length pair introduce new _____.
- pixels
 - matrix
 - frames
 - intensity
15. If pixels are reconstructed without error mapping is said to be _____.
- reversible
 - irreversible
 - temporal
 - facsimile

II. Descriptive Questions

- Define image compression. Explain about the redundancies in a digital image.
- Explain about fidelity criterion.
- Explain about image compression models.
- Explain a method of generating variable length codes with an example.
- Explain arithmetic encoding process with an example.
- Explain LZW coding with an example
- Explain the concept of bit plane coding method.
- Explain with a block diagram about transform coding system.
- Explain about wavelet coding

UNIT-V

III. Objective Questions

- Smooths the contour of an object, breaks narrow isthmuses, and eliminate thin protrusions.
 - Opening
 - Closing
 - Dilation
 - Erosion
- _____ eliminates small holes and gaps in the contour.
 - Opening
 - Closing
 - Dilation
 - Erosion
- We use morphological algorithms for _____.
 - Extracting boundaries
 - Connected components
 - Convex hull, skeleton of the region
 - All the above
- Region filling is based on _____.

- a. Only the Set dilation
 - b. Only the Set complementation
 - c. Only the Set intersection
 - d. All the three
5. Erosion of A by B, followed by a dilation of the result by B is_____.
- a. Opening A by B
 - b. Closing A by B
 - c. Opening B by A
 - d. Closing B by A
6. Dilation of A by B, followed by the erosion of the result by B is _____.
- a. Opening A by B
 - b. Closing A by B
 - c. Opening B by A
 - d. Closing B by A
7. First eroding A by suitable structuring element B and then performing the set difference between A and its erosion is_____ operation.
- a. Boundary Extraction
 - b. Region Filling
 - c. Both
 - d. None
8. If z is point of skeleton S(A) and (D)z is the largest disk centred at z and contained in A, one cannot find largest disk containing (D)z and include in A. The disk (D)z is called_____.
- a. mask disk
 - b. large disk
 - c. maximum disk
 - d. grater disk
9. The maximum disk (D)z can touches the boundaries of at how many places?
- a. 1
 - b. 0
 - c. 2
 - d. More than 2
10. Set A is said to be _____ if the straight line segment joining any two points in A lies entirely within A.
- a. Convex
 - b. Concave
 - c. Both
 - d. None
11. If $P(E) = 1$, it means event _____.
- a. does not occur
 - b. always occurs
 - c. no probability

- d. normalization
12. In coding redundancy technique we use _____.
a. fixed length code
b. variable length code
c. byte
d. Both A and B
13. Source of information depending on finite no of outputs is called _____.
a. Markov
b. finite memory source
c. zero source
d. Both A and B
14. Compression is done for saving _____.
a. storage
b. bandwidth
c. money
d. Both A and B
15. Source of event itself called _____.
a. zero-memory source
b. nonzero-memory source
c. zero source
d. memory source
16. Histogram equalization refers to image _____.
a. sampling
b. quantization
c. framing
d. normalization

IV. Descriptive Questions

- a. Explain Basic concepts from set theory on binary images in morphological image processing.
- b. Explain Basic concepts from logical operations involving binary images in morphological image processing.
- c. Describe Dilation and Erosion morphological transformations on a binary image.
- d. Explain the opening operation in image morphology with examples?
- e. Explain the closing operation in image morphology with examples?
- f. Write about the importance of Hit-or-Miss morphological transformation operation on a digital binary image.
- g. Explain boundary extraction and region filling process
- h. Write the procedure for extraction of connected components
- i. Explain convex hull

UNIT-VI

1. Objective Questions

1. For line detection we use _____ mask.
 - a. Gaussian
 - b. Laplacian
 - c. ideal
 - d. Butterworth
2. If inner region of object is textured then approach we use is _____.
 - a. discontinuity
 - b. similarity
 - c. extraction
 - d. recognition
3. To avoid negative values taking absolute values in Laplacian image doubles _____.
 - a. thickness of lines
 - b. thinness of lines
 - c. thickness of edges
 - d. thinness of edges
4. Second derivative approximation says that values along ramp must be _____.
 - a. nonzero
 - b. zero
 - c. positive
 - d. negative
5. Gradient magnitude images are more useful in _____.
 - a. point detection
 - b. line detection
 - c. area detection
 - d. edge detection
6. In Laplacian images light shades of gray level is represented by _____.
 - a. 0
 - b. 1
 - c. positive
 - d. negative
7. For edge detection we use _____.
 - a. first derivative
 - b. second derivative
 - c. third derivative
 - d. Both A and B
8. Sobel gradient is not that good for detection of _____.
 - a. horizontal lines
 - b. vertical lines
 - c. Diagonal lines
 - d. edges
9. Response of derivative mask is zero at _____.

- a. sharp intensities
 - b. constant intensities
 - c. low intensities
 - d. high intensities
10. Point detection is done using _____ filter.
- a. Gaussian
 - b. Laplacian
 - c. ideal
 - d. Butterworth
11. _____ is a procedure that groups pixels or sub regions. What is the choose criteria for region growing for a pixel to be annexed to a region.
- a. The absolute gray-level difference between any pixel and the seed had to be less than some threshold
 - b. To be included in one of the regions, the pixel had to be 8-connected to at least one pixel in that region.
 - c. Both
 - d. none
12. Sobel is better than prewitt in image _____.
- a. sharpening
 - b. blurring
 - c. smoothing
 - d. contrast
13. Intensity's local changes can be detected through _____.
- a. differentiation
 - b. derivation
 - c. addition
 - d. integration

II. Descriptive Questions

1. Explain the method for point detection.
2. Explain the method for line detection.
3. Explain the method for edge detection.
4. What are the derivative operators useful in image segmentation? Explain their role in segmentation.
5. Explain about the edge linking procedures.
6. What is thresholding? Explain about global thresholding.
7. Explain about basic adaptive thresholding process used in image segmentation.
8. Explain in detail the threshold selection based on boundary characteristics.
9. Explain Region Growing in region based segmentation.
10. Explain about Region splitting and merging in region based segmentation.

Signature of the Faculty

GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, Gudlavalleru – 521 356.

Department of Computer Science and Engineering



Academic Year: 2020-21

IV-B.Tech SEM –I

HANDOUT ON MACHINE LEARNING

Vision of the Institute

To be a leading Institution of Engineering education and research, preparing students for leadership in their fields in a caring and challenging learning environment.

Mission of the Institute

- To produce quality engineers by providing state-of-the-art engineering education.
- To attract and retain knowledgeable, creative, motivated, and highly skilled individuals whose leadership and contributions uphold the college tenets of education, creativity, research and responsible public service.
- To develop faculty and resources to impart and disseminate knowledge and information to students that will enhance educational level, which in turn will contribute to social and economic betterment of society.
- To provide an environment that values and encourages knowledge acquisition and academic freedom, making this a preferred institution for knowledge seekers.
- To provide quality assurance.
- To partner and collaborate with industry, government, and R & D institutes to develop new knowledge and sustainable technologies and serve as an engine for facilitating the nation's economic development.
- To impart personality development skills to students that will help them to succeed and lead.
- To instill in students the attitude, values and vision that will prepare them to lead lives of personal integrity and civic responsibility.
- To promote a campus environment that welcomes and makes students of all races, cultures and civilizations feel at home.
- Putting students face to face with industrial, governmental, and societal challenges.

Vision of the Department

To be a centre of excellence in Computer Science and Engineering education and training to meet the challenging needs of the industry and society.

Mission of the Department

- To impart quality education through well-designed curriculum in tune with the growing software needs of the industry.
- To serve our students by inculcating in them problem solving, leadership, teamwork skills and the value of commitment to quality, ethical behavior & respect for others.
- To foster industry-academia relationship for mutual benefit and growth.

Program Educational Objectives :

PEO1: Identify, analyze, formulate and solve Computer Science and Engineering problems both independently and in a team environment by using the appropriate modern tools.

PEO2: Manage software projects with significant technical, legal, ethical, social, environmental and economic considerations.

PEO3: Demonstrate commitment and progress in lifelong learning, professional development, Leadership and Communicate effectively with professional clients and the public.

SUBJECT :- MACHINE LEARNING

Class & Sem : IV B.Tech – I Semester

Year : 2020-21

Branch : CSE

Credits : 3

1. Brief History & Scope of the Subject

A machine that is intellectually capable as much as humans has always fired the imagination of writers and also the early computer scientist who were excited about artificial intelligence and machine learning, but the first machine learning system was developed in the 1950s. In 1952, Arthur Samuel was at IBM. He developed a program for playing Checkers. In 1957, Rosenblatt proposed the Perceptron. However, the work along these lines suffered a setback when Minsky in 1969 came up with the limitations of perceptron. In 1986, J.R.Quinlan came up with decision tree learning, specifically the ID3 algorithm.

In the 90s, machine learning embraced statistics to a large extent. It was during this time, that support vector machines were proposed. It was a machine learning breakthrough and the support vector machines was proposed by Vapnik and Cortes in 1995 and S.V. Hemhad very strong theoretical standing and empirical results. Another strong machine learning model was proposed by Freund and Schapire in 1997, which was part of what we called ensembles or boosting and they came up with an algorithm called Adaboost by which they could create a strong classifier from an ensemble of weak classifiers. During 2001, Bayes net learning was also proposed. The rise of neural network began roughly in 2005 with the conjunction of many different discoveries for people by Hinton, LeCun, Bengio, Andrew and other researchers.

Some of the applications of machine learning are : In 1994, the first self driving car made a road test; in 1997, Deep Blue beat the world champion Gary Kasparov in the game of chess; in 2009 we have Google building self driving cars; in 2011, Watson, again from IBM, won the popular game of Jeopardy; 2014, human vision surpassed by ML systems. In 2014-15, machine translation systems driven by neural networks are very good and they are better than the other statistical machine translation systems where certain concepts and certain technology.

Now, in machine learning we have GPU's, which are enabling the use of machine learning and deep neural networks. There is the cloud, there is availability of big data and the field of machine learning is very exciting now.

2. Prerequisites

- Mathematics & statistics – calculus, differential equations, probability theory, graph theory
- Programming Experience – Python, R

3. Course Objectives

- To familiarize with supervised and unsupervised learning.
- To get acquainted with various machine learning algorithms.

4. Course Outcomes:

Students will be able to:

CO1: Describe the features of a learning system

CO2: Apply Find-S and Candidate-elimination algorithms to solve problems of moderate complexity

CO3: Demonstrate different types of neural networks and their representation

CO4: Calculate posterior probabilities using Bayes theorem..

CO5: Differentiate lazy and eager learning algorithms along with their strengths and weaknesses.

CO6: Illustrate the use of genetic algorithms in machine learning

5. Program Outcomes:

Graduates of the Computer Science and Engineering Program will have an ability to

PO1: apply knowledge of computing, mathematics, science and engineering fundamentals to solve complex engineering problems.

PO2: formulate and analyze a problem, and define the computing requirements appropriate to its solution using basic principles of mathematics, science and computer engineering.

PO3: design, implement, and evaluate a computer based system, process, component, or software to meet the desired needs.

PO4: design and conduct experiments, perform analysis and interpretation of data and provide valid conclusions.

PO5: use current techniques, skills, and tools necessary for computing practice.

PO6: understand legal, health, security and social issues in Professional Engineering practice.

PO7: understand the impact of professional engineering solutions on environmental context and the need for sustainable development.

PO8: understand the professional and ethical responsibilities of an engineer.

PO9: function effectively as an individual, and as a team member/ leader in accomplishing common goal.

PO10: communicate effectively, make effective presentations and write and comprehend technical reports and publications.

PO11: learn and adopt new technologies, and use them effectively towards continued professional development throughout the life.

PO12: understand engineering and management principles and their application to manage projects in the software industry.

6. **Mapping of Course Outcomes with Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | 1 | | | | | | | | | | | |
| CO2 | 2 | | 1 | | | | | | | | | |
| CO3 | 2 | | | | | | | | | | | 1 |
| CO4 | 3 | | | | | | | | | | | 2 |
| CO5 | 2 | 1 | | | | | | | | | | 2 |
| CO6 | 2 | | | | | | | | | | | 1 |

*3-> High 2->Medium 1-> Low

7. **Prescribed Text Books:**

1. Tom M. Mitchell, “Machine Learning”, MGH.
2. Peter Harrington, “Machine Learning in Action”, Manning Publications

8. **Reference Books:**

1. Ethem Alpaydin, “Introduction to Machine Learning”, 3rd edition, PHI.
2. Jason Bell, “Machine Learning: Hands-On for Developers and Technical Professionals”, Wiley.

9. **URLs and Other E-Learning Resources**

1. <https://www.coursera.org/learn/machine-learning>

10. **Digital Learning Materials:**

1. <http://nptel.ac.in/courses/106106139/>
2. <http://nptel.ac.in/courses/106105152/>

11. **Lecture Schedule / Lesson Plan:**

| Topic | No. of Periods | |
|-------------------------------|----------------|----------|
| | Theory | Tutorial |
| UNIT I : Introduction | | |
| Well- posed learning problems | 3 | 1 |
| Designing a learning system | 3 | |

| | | |
|--|-----------|-----------|
| Perspectives and issues in machine learning | 1 | |
| UNIT - II: Concept Learning | | |
| Introduction | 1 | 1 |
| A concept learning task | 2 | |
| Concept learning as search | 2 | |
| Find-s: finding a maximally specific hypothesis | 2 | 2 |
| Version spaces and the candidate elimination algorithm | 2 | |
| Remarks on version spaces and candidate elimination | 1 | |
| UNIT - III: Bayesian learning | | |
| Bayes theorem | 1 | 1 |
| Maximum likelihood and least squared error hypotheses | 2 | |
| Minimum description length principle | 2 | |
| Bayes optimal classifier | 2 | 2 |
| Naive Bayes Classifier | 2 | |
| Bayesian belief networks | 2 | |
| UNIT – IV: Artificial Neural Networks | | |
| Introduction | 1 | 1 |
| Neural network representation | 1 | |
| Appropriate problems for neural network learning | 3 | |
| Perceptrons | 3 | 2 |
| Multilayer networks and the back propagation algorithm | 3 | |
| UNIT -V: Instance-Based Learning | | |
| Introduction | 1 | 1 |
| k-nearest neighbour learning | 2 | |
| Locally weighted regression | 2 | |
| Radial basis functions | 2 | 2 |
| Case-based reasoning | 2 | |
| Remarks on lazy and eager learning | 1 | |
| UNIT - VI: Genetic Algorithms | | |
| Motivation | 2 | 1 |
| Genetic algorithms | 3 | |
| Genetic programming | 2 | |
| Total No. of Periods | 56 | 14 |

Assignment-Cum-Tutorial Questions

UNIT-I

A. Objective Questions

1. Machine learning is
 - A. The autonomous acquisition of knowledge through the use of computer programs
 - B. The autonomous acquisition of knowledge through the use of manual programs
 - C. The selective acquisition of knowledge through the use of computer programs
 - D. The selective acquisition of knowledge through the use of manual programs
2. Factors which affect the performance of learner system does not include
 - A. Representation scheme used
 - B. Training scenario
 - C. Type of feedback
 - D. Good data structures
3. What types of Machine Learning, if any, best describe the following three scenarios:
 - (i) A coin classification system is created for a vending machine. The developers obtain exact coin specifications from the U.S. Mint and derive a statistical model of the size, weight, and denomination, which the vending machine then uses to classify coins.
 - (ii) Instead of calling the U.S. Mint to obtain coin information, an algorithm is presented with a large set of labeled coins. The algorithm uses this data to infer decision boundaries which the vending machine then uses to classify its coins.
 - (iii) A computer develops a strategy for playing Tic-Tac-Toe by playing repeatedly and adjusting its strategy by penalizing moves that eventually lead to losing.
 - A. (i) Supervised Learning, (ii) Unsupervised Learning, (iii) Reinforcement Learning
 - B. (i) Supervised Learning, (ii) Not learning, (iii) Unsupervised Learning
 - C. (i) Not learning, (ii) Reinforcement Learning, (iii) Supervised Learning
 - D. (i) Not learning, (ii) Supervised Learning, (iii) Reinforcement Learning
 - E. (i) Supervised Learning, (ii) Reinforcement Learning, (iii) Unsupervised Learning
4. Which of the following problems are best suited for Machine Learning?
 - (i) Classifying numbers into primes and non-primes.
 - (ii) Detecting potential fraud in credit card charges.
 - (iii) Determining the time it would take a falling object to hit the ground.
 - (iv) Determining the optimal cycle for traffic lights in a busy intersection.
 - A. (ii) and (iv)
 - B. (i) and (ii)

C. (i), (ii), and (iii)

D. (iii)

E. (i) and (iii)

5. I am the marketing consultant of a leading e-commerce website. I have been given a task of making a system that recommends products to users based on their activity on Facebook. I realize that user-interests could be highly variable. Hence I decide to

i. First, cluster the users into communities of like-minded people and

ii. Second, train separate models for each community to predict which product category (e.g. electronic gadgets, cosmetics, etc) would be the most relevant to that community.

The first task is a/an _____ learning problem while the second is a/an _____ problem.

Choose from the options:

A. Supervised and unsupervised

B. Unsupervised and supervised

C. Supervised and supervised

D. Unsupervised and unsupervised

5. Which ONE of the following are regression tasks?

A. Predict the age of a person

B. Predict the country from where the person comes from

C. Predict whether the price of petroleum will increase tomorrow

D. Predict whether a document is related to science

6. Which of the following are classification tasks? (Mark all that apply)

A. Find the gender of a person by analyzing his writing style

B. Predict the price of a house based on floor area, number of rooms etc.

C. Predict whether there will be abnormally heavy rainfall next year

D. Predict the number of copies of a book that will be sold this month

7. Which of the following are examples of unsupervised learning?

A. Group news articles based on text similarity

B. Make clusters of books on similar topics in a library

C. Filter out spam emails

D. Segment online customers into two classes based on their age group – below 25 or above 25

B. Descriptive Questions

1. Define machine learning.

2. What do you mean by a well –posed learning problem? Explain the important features that are required to well –define a learning problem.

3. Explain well posed learning problem for the following:

- i) A checkers learning problem.
 - ii) A handwritten recognition learning problem.
 - iii) A robot driving learning problem.
4. Discuss different applications of machine Learning.
 5. Explain the phases in designing a learning system.
 6. State LMS weight update rule.
 7. Discuss perspectives and issues in machine learning.
 8. Define target function in machine learning with an example.
 9. List the objectives of machine learning.
 10. Devise a simple machine learning solution to solve Checkers game problem.
 11. Explain various design choices of machine learning strategies.

UNIT-II

A. Objective Questions

1. Consider the following instances and hypothesis, identify the correct statement

x1= <Sunny, Warm, High, Strong, Cool, Same>
 x2= <Sunny, Warm, High, Light, Warm, Same>

h1= <Sunny, ?, ?, Strong, ?, ?>
 h2= <Sunny, ?, ?, ?, ?, ?>
 h3 = <Sunny, ?, ?, ?, Cool, ?>

- A. h3 is more general than h1
 - B. h1 is more general than h2
 - C. h2 is more general than h1
 - D.. All of the above
2. Which of the following is a negative example of EnjoySport learning task?
 - A. h=<Sunny, Warm, Normal, Strong, Warm, Same>
 - B. h=<Sunny, Warm, ?, Strong, Warm, Same>
 - C. h=<Sunny, Warm,?, Strong, Warm, Same>
 - D. h=<Sunny, Warm, ?,Strong,?,?>
 3. Which of the following is a generalization of h with respect to FIND-S algorithm?
 - A. h=<Sunny, Warm, Normal, Strong, Warm, Same>
 - B. h=<Sunny, Warm, ?, Strong, Warm, Same>
 - C. h=<Sunny, Warm,?, Strong, Warm, Same>
 - D.. h=<Sunny, Warm, ?,Strong,?,?>
 4. Identify the incorrect statement for FIND-S algorithm.
 - A. Can't tell whether it has learned concept.
 - B. Can't tell when training data consistent.

- C. Picks a maximally specific h
- D. depending on H, there are several h.

5. Pick the correct hypothesis representation for the task:

Consider the set of all pairs of people where the first is a tall male(of any nationality and hair color) and the second is a Japanese female(of any hair color and height)

- A.<<male ? tall ?><female ? ? Japanese>>
- B. <<? ? tall ?><female ? ? Japanese>>
- C.<< ? ? tall ?><female ? ? ?>>
- D.<<male ? tall ? >< female ? ? ?>>

6. The size of hypothesis space in the given learning task is:
Sex(male,female),Clor(black,brown,blonde),Height(tall,medium,short),Nationality(US,French,German,Trish,Indian,Japanese,Portuguese)

- A. 384 B.385 C. 383 D. 386

7. Which of the following learning algorithm has no inductive bias
A. Rote Learner B. Candidate-Elimination C. FIND-S D. None of the above.

8. Which of the following statement is true about Candidate-elimination algorithm?

- A. Candidate-elimination algorithm uses general-to-specific ordering to find version space.
- B. Candidate-elimination algorithm works well on noisy data.
- C. Candidate-elimination algorithm searches the hypothesis space completely.
- D. Both A and C

B. Descriptive Questions

1. What is Concept Learning?
2. Elaborate on Find-S algorithm.
3. Write the steps for LIST-THEN-ELIMINATE algorithm.
4. Write the steps for CANDIDATE_ELIMINATION algorithm using version spaces.
5. Write the expression for defining version spaces.
6. Depict the version space for EnjoySport task with its general and specific boundary sets.
7. Explain why the size of the hypothesis space in the EnjoySport learning task is 973.
8. How would the number of possible instances and possible hypotheses increase with the addition of the attribute WaterCurrent, which can take on the values Light, Moderate or Strong ?
9. How the most specific hypothesis is represented? Explain with an example.

UNIT-III

A. Objective Questions

1. Bayes error is the _____ bound of probability of classification error.
A. Lower B. Upper

3. Bayes decision rule is the theoretically classifier that minimize probability of classification error.
A. Best B. Worst C. Average

4. In Bayes Theorem, unconditional probability is called as
A. Evidence b. Likelihood c. Prior d. Posterior

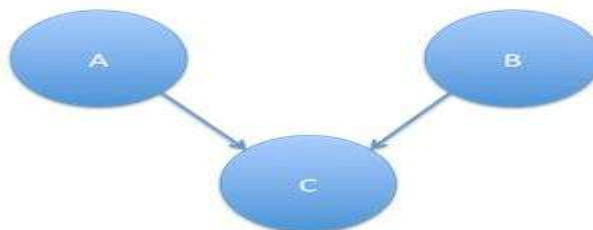
5. In Bayes Theorem, Class conditional probability is called as
A. Evidence B. Likelihood c. Prior d. Posterior
5. Bayesian reasoning provides a _____ approach to inference.
A. deterministic B. Probabilistic C. both A and B D. none of the above

6. Previous probabilities in Bayes Theorem that are changed with help of new available information are classified as
A. independent probabilities
B. posterior probabilities
C. independent probabilities
D. dependent probabilities

7. Three components of Bayes decision rule are class prior, likelihood and
A. Evidence B. Instance C. Confidence D. Saliency

9. A and B are Boolean random variables. Given: $P(A=True) = 0.3$, $P(A=False) = 0.7$, $P(B=True|A=True) = 0.4$, $P(B=False|A=True) = 0.6$, $P(B=True|A=False) = 0.6$, $P(B=False|A=False) = 0.4$. Calculate $P(A=True|B=False)$ by Bayes rule.
A.0.49 B. 0.39 C. 0.37 D.0.28

10. In the following Bayesian network A, B and C are Boolean random variables taking values in {True, False}.



Which of the following statements is true?

- A. The value of C is not given. If the value of B changes from True to False, the conditional probability of A, $P(A|B)$ changes.
- B. The value of C is given to be True. If the value of B changes from True to False, the conditional probability of A, $P(A|B)$ changes.
- C. Neither A nor B
- D. Both A and B

11. Diabetic Retinopathy is a disease that affects 80% people who have diabetes for more than 10 years. 5% of the Indian population has been suffering from diabetes for more than 10 years. Answer the following questions. What is the joint probability of finding an Indian suffering from Diabetes for more than 10 years and also has Diabetic Retinopathy?

- A. 0.024
- B. 0.040
- C. 0.076
- D. 0.005

12. Which of the following properties is false in the case of a Bayesian Network:

- A. The edges are directed
- B. Contains cycles
- C. Represents conditional independence relations among random variables
- D. All of the above

B. Descriptive Questions

1. Define the concept of Conditional Independence.
2. What is Bayes theorem? Explain how this is used in computing MAP and Maximum likelihood hypothesis?
3. Write the features of Bayesian learning methods.
3. Explain Naive Bayes Classifier with example.
4. Write a short note on Bayesian Belief Networks.
5. How is Naive Bayes algorithm useful for learning and classifying text?
6. Describe maximum likelihood and least-squared error hypotheses
7. Explain minimum description length principle.
8. Explain about posteriori probability in Bayes theorem.

UNIT-IV

A. Objective Questions

1. The classification boundary realised by the perceptron is a:

- A. Circle
- B. Parabola
- C. Straight line
- D. Ellipse

2. A perceptron has two inputs x_1 and x_2 with weights w_1 and w_2 and a bias weight of w_0 . The activation function of the perceptron is $h(x)$. The output of the perceptron is given by:

- A. $y = h(w_1 x_1 + w_2 x_2 + w_0)$
- B. $y = h(w_1 + w_2 + w_0)$
- C. $y = w_1 x_1 + w_2 x_2 + w_0$
- D. $y = h(w_1 x_1 + w_2 x_2 - w_0)$

3. We provide a training input x to a perceptron learning rule. The desired output is t and the actual output is o . If learning rate is η , the weight update performed by the learning rule is given by the equation?

- A. $w_i \leftarrow w_i + \eta(t - o)$
- B. $w_i \leftarrow w_i + \eta(t - o)x$
- C. $w_i \leftarrow \eta(t - o)x$
- D. $w_i \leftarrow w_i + (t - o)$

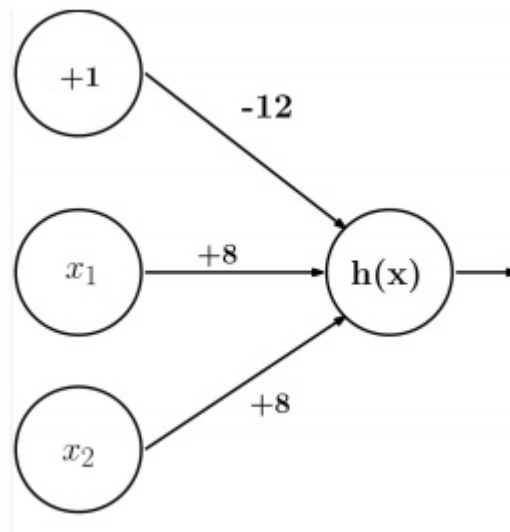
4. Suppose we have n training examples $x_i, i=1, 2, \dots, n$, whose desired outputs are $t_i, i=1, 2, \dots, n$. The output of a perceptron for these training examples x_i 's are $o_i, i=1, 2, \dots, n$. The error function minimised by the gradient descend perceptron learning algorithm is:

- A. $E \equiv 1/2 \sum_{i=1, 2, \dots, n} (t_i - o_i)$
- B. $E \equiv 1/2 \sum_{i=1, 2, \dots, n} (t_i - o_i)^2$
- C. $E \equiv 1/2 \sum_{i=1, 2, \dots, n} (t_i + o_i)^2$
- D. $E \equiv 1/2 \sum_{i=1, 2, \dots, n} (t_i + o_i)$

5. The sigmoid activation function is

- A. Discontinuous and not differentiable
- B. Discontinuous but differentiable
- C. Continuous but not differentiable
- D. Continuous and differentiable

6. The neural network given below takes two binary valued inputs $x_1, x_2 \in \{0, 1\}$ and the activation function is the binary threshold function ($h(x)=1$ if $x>0$; 0 otherwise). Which of the following logical functions does it compute?



- A. OR
- B. AND
- C. NAND
- D. NOR

6. Which of the following statement is true for a multilayered perceptron?
- A. Output of all the nodes of a layer is input to all the nodes of the next layer
 - B. Output of all the nodes of a layer is input to all the nodes of the same layer
 - C. Output of all the nodes of a layer is input to all the nodes of the previous layer
 - D. Output of all the nodes of a layer is input to all the nodes of the output layer

7. Which of the statement is true for the backpropagation learning algorithm?
- A. It always converges to global minima
 - B. Convergence is independent of the initial weight values
 - C. It may converge to local minima
 - D. Learning time decreases with increase in number of hidden layers

8. Under which of the following situation would you expect overfitting to happen?
- A. With training iterations error on training set as well as test set decreases
 - B. With training iterations error on training set decreases but test set increases
 - C. With training iterations error on training set as well as test set increases
 - D. With training iterations training set as well as test set error remains constant

9. Out of the networks A, B, C, D, identify which are deep neural networks.
 A-Convolutional Neural Network, B-Support Vector Machine, C Autoencoder, D-Deep Belief Network
- A. A and D
 - B. A, C and D
 - C. A, D and B
 - D. A, B, C and D

11. . From the given list of neural networks, identify which are Convolutional Neural Networks A - U-Nets, B - Convolutional Autoencoder, C - Res-Net, D – GoogLeNet

A. B, C, D

B. A, C, D

C. Only D

D. A, B, C, D

12. For the same size of training data as input, the fastest learning technique is

A. Supervised training with gradient descent error correction

B. Supervised training with stochastic method.

C. Unsupervised training without error calculation.

D. Unsupervised training with Hebbian method.

13. Training Perceptron is based on

A. Supervised learning technique.

B. Unsupervised learning

C. Reinforced learning

D. Stochastic learning

14. A batch mode of training is generally implemented through the _____ in error calculation

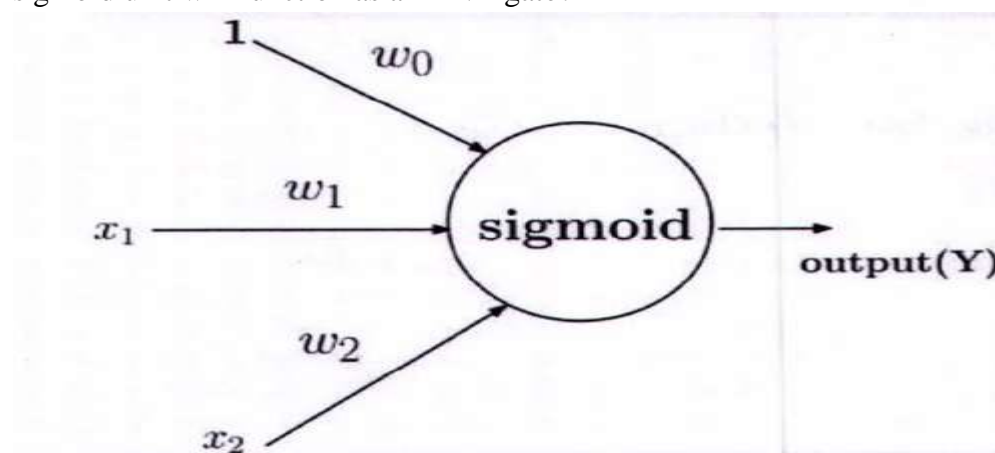
A. Minimization of median square error

B. Maximization of median square error

C. Maximization of mean square error

D. Minimization of mean square error

15. What would be a correct option for weight $W[W_0, W_1, W_2]$ so that the following sigmoid unit will function as an AND gate?



A. [-5,10,10]

- B. [-10,15,15]
C. [-10,15,5]
D. [-10,9,9]
15. In a neural network, which one of the following techniques is NOT useful to reduce overfitting?
- A. Dropout
 - B. Regularization
 - C. Batch normalization
 - D. Adding more layers
16. What are the steps for using a gradient descent algorithm?
- 1. Calculate error between the actual value and the predicted value
 - 2. Repeat until you find the best weights of network
 - 3. Pass an input through the network and get values from output layer
 - 4. Initialize random values for weight and bias
 - 5. Go to each neurons which contributes to the error and change its respective values to reduce the error
- A. 4,3,1,5,2
 - B. 1,2,3,4,5
 - C. 3,4,5,2,1
 - D. 2,3,4,5,1

B. Descriptive Questions

- 1. Depict the basics and representation of Artificial Neural Networks.
- 2. What is ANN? Briefly explain the problem characteristics for which ANN is most commonly used.
- 3. Design a neural network that implements Boolean NOT gate.
- 4. Explain representational power of perceptrons.
- 5. What is perceptron training rule? Explain in detail.
- 6. Represent and describe the Back Propagation Algorithm
- 7. Derive equations for updating the output unit and the hidden unit weights in back propagation algorithm.
- 8. Describe how the neural network will steer an autonomous vehicle.

UNIT-V

A. Objective Questions

1. k-NN algorithm does more computation on test time rather than train time.
A. TRUE
B. FALSE

2. Which of the following option is true about k-NN algorithm?
A. It can be used for classification
B. It can be used for regression
C. It can be used in both classification and regression
D. It can be used for clustering.

3. Which of the following statement is true about k-NN algorithm?
 1. k-NN performs much better if all of the data have the same scale
 2. k-NN works well with a small number of input variables (p), but struggles when the number of inputs is very large
 3. k-NN makes no assumptions about the functional form of the problem being solvedA. 1 and 2
B. 1 and 3
C. Only 1
D. All of the above

4. Which of the following will be Euclidean Distance between the two data point A(1,3) and B(2,3)?
A. 1
B. 2
C. 4
D. 8

5. When you find noise in data which of the following option would you consider in k-NN?
A. I will increase the value of k
B. I will decrease the value of k
C. Noise cannot be dependent on value of k
D. None of these.

6. In k-NN it is very likely to overfit due to the curse of dimensionality. Which of the following option would you consider to handle such problem?
 1. Dimensionality Reduction
 2. Feature selectionA. 1
B. 2
C. 1 and 2
D. None of these

7. Below are two statements given. Which of the following will be true both statements?
1. k-NN is a memory-based approach is that the classifier immediately adapts as we collect new training data.
 2. The computational complexity for classifying new samples grows linearly with the number of samples in the training dataset in the worst-case scenario.
- A. 1
B. 2
C. 1 and 2
D. None of these
8. You have given the following 2 statements, find which of these option is/are true in case of k-NN?
1. In case of very large value of k, we may include points from other classes into the neighborhood.
 2. In case of too small value of k the algorithm is very sensitive to noise
- A. 1
B. 2
C. 1 and 2
D. None of these
10. In k-NN what will happen when you increase/decrease the value of k?
- A. The boundary becomes smoother with increasing value of K
B. The boundary becomes smoother with decreasing value of K
C. Smoothness of boundary doesn't dependent on value of K
D. None of these

B. Descriptive Questions

1. Write the disadvantages of instance-based learning.
2. Why instance based learning algorithm sometimes referred as Lazy learning algorithm?
3. Explain distance-weighted nearest neighbour algorithm.
4. Illustrate with suitable example k-nearest neighbor classifier.
5. Write a short note on Lazy and Eager Learning.
6. Describe the method of learning using locally weighted linear regression
7. Explain Case-based Reasoning Learning paradigm.
8. Discuss remarks on lazy and eager learning.
9. List out eager and lazy learning algorithms.
10. Write the differences between Lazy and Eager Learning methods.
11. What is Curse of Dimensionality?

UNIT-VI

A. Objective Questions

1. Fuzzy – Genetic Hybrid system is a
 - A. Fuzzy logic in parallel with the Genetic algorithm
 - B. Fuzzy logic controlled Genetic algorithm
 - C. Genetic algorithm controlled Fuzzy logic
 - D. None of the above

3. Both fuzzy logic and artificial neural network are soft computing techniques because,
 - A. Both gives precise and accurate results.
 - B. Artificial neural network gives accurate result but fuzzy logic does not.
 - C. In each, no precise mathematical model of the problem is required.
 - D. Fuzzy gives exact result but artificial neural network does not.

4. Which of the following(s) is/are the pre-requisite(s) when Genetic Algorithms are applied to solve problems? (i) Encoding of solutions. (ii) Well-understood search space. (iii) Method of evaluating the suitability of the solutions. (iv) Contain only one optimal solution.
 - A. i and ii only.
 - B. ii and iii only.
 - C. i and iii only.
 - D. iii and iv only.

4. Which GA operation is computationally most expensive?
 - A. Initial population creation
 - B. Selection of sub-population for mating
 - C. Reproduction to produce next generation
 - D. Convergence testing

5. Which of the following is not true for Genetic algorithms?
 - A. It is a probabilistic search algorithm
 - B. It is guaranteed to give global optimum solutions
 - C. If an optimization problem has more than one solution, then it will return all the solutions

- D. It is an iterative process suitable for parallel programming
6. Which one of the following is not necessarily be considered as GA parameters?
- A. N, Population Size
 - B. σ , the obtainable accuracy
 - C. μ_p , the mutation probability
 - D. f , the average fitness score
6. Which of the following optimization problem(s) can be better solved with Order
- A. 0-1 Knapsack problem
 - B. Travelling salesman problem
 - C. Job shop scheduling problem
 - D. Optimal binary search tree construction problem
7. Which of the following statements is/are true about 'Traveling Salesman problem' (TSP)?
- A. It is an NP-hard problem in combinatorial optimisation
 - B. There aren't any exact algorithms known to solve TSP therefore we use heuristic techniques
 - C. Ant colony optimisation can generate "good solutions" to TSP using a simulation of an ant colony
 - D. All of the above
8. The basic idea behind Genetic Algorithms is to work with a population
- A. of problem solvers that interact with each other through signs.
 - B. of candidate solutions to try and create better candidates by mixing genes
 - C. of candidate solutions in which each candidate is heuristically refined.
 - D. of problem solvers each of which does an independent heuristic search.
10. A genetic algorithm (GA) for optimization is most likely to succeed given
- A. a small population of fit and similar individuals.
 - B. a large population of fit and similar individuals.
 - C. a small diverse population of fit individuals.
 - D. a large diverse population of fit individuals.

Signature of the Faculty

GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, Gudlavalleru – 521 356.

Department of Computer Science and Engineering



Academic Year: 2020-21

IV-B.Tech SEM –I

HANDOUT ON MOBILE COMPUTING

Vision of the Institute

To be a leading Institution of Engineering education and research, preparing students for leadership in their fields in a caring and challenging learning environment.

Mission of the Institute

- To produce quality engineers by providing state-of-the-art engineering education.
- To attract and retain knowledgeable, creative, motivated, and highly skilled individuals whose leadership and contributions uphold the college tenets of education, creativity, research and responsible public service.
- To develop faculty and resources to impart and disseminate knowledge and information to students that will enhance educational level, which in turn will contribute to social and economic betterment of society.
- To provide an environment that values and encourages knowledge acquisition and academic freedom, making this a preferred institution for knowledge seekers.
- To provide quality assurance.
- To partner and collaborate with industry, government, and R & D institutes to develop new knowledge and sustainable technologies and serve as an engine for facilitating the nation's economic development.
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- To foster industry-academia relationship for mutual benefit and growth.

Program Educational Objectives :

PEO1: Identify, analyze, formulate and solve Computer Science and Engineering problems both independently and in a team environment by using the appropriate modern tools.

PEO2: Manage software projects with significant technical, legal, ethical, social, environmental and economic considerations.

PEO3: Demonstrate commitment and progress in lifelong learning, professional development, Leadership and Communicate effectively with professional clients and the public.

2. Pre-Requisites

- Good knowledge in computer networks.

3. Course Objectives:

- To acquire solid knowledge on mobile networks
- To understand mobile networks Technology
- To Asses Different protocols in mobile networks
- To distinguish different mobile computing techniques

4. Course Outcomes:

Students will be able to

- Understand the basics of wireless communication
- Describe about various mobile device features
- Differentiate various mobile system networks
- Apply advanced data communicating methods and networking protocols for wireless.
- Describe the features of wireles and mobile networks.

5. Program Outcomes:

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

Students will be able to

1. Organize, monitor and protect IT Infrastructural resources.
2. Design and Develop web, mobile, and smart apps based software solutions to the real world problems.

6. Mapping of Course Outcomes with Program Outcomes:

| MOBILE COMPUTING (Elective-3) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PS O1 | PS O2 |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|--------------|--------------|
| CO1: Understand the basics of Wireless Communication. | 3 | | | | | | | | | | | | 2 | 1 |
| CO2: describe about various mobile device features. | 3 | | | | | | | | | | | | | 1 |
| CO4: differentiate various mobile system networks. | 3 | 2 | | | | | | | | | | | 2 | 1 |
| CO4: apply advanced data communicating methods and networking protocols for wireless. | 3 | 2 | | | 1 | | | | | | | | 2 | 1 |
| CO5: describe the features of wireless and mobile networks. | 3 | 2 | | | 1 | | | | | | | | | 1 |

7. Prescribed Text Books

- Raj Kamal, “Mobile Computing”, 2nd Edition, Oxford University Press.

8. Reference Books

- UWE Hansmann, Lothar Merk, Martin S. Nocklous, Thomas Stober, “Principles of Mobile Computing,” Second Edition, Springer.
- Jochen Schiller, “Mobile Communications”, Second Edition, Pearson publications.
- ASOKE K TALUKDER, HASAN AHMED, ROOPA R YAVAGAL, “Mobile Computing, Technology Applications and Service Creation” Second Edition, Mc Graw Hill.

9. URLs and Other E-Learning Resources

- <https://www.coursera.org/learn/wireless-communications>
- <https://www.udemy.com/introduction-to-wireless-communications/>
- <https://www.netacad.com/>
- <https://nptel.ac.in/courses/117102062/>

10. Lecture Schedule / Lesson Plan

| S.NO | Topic | No.of periods |
|-----------------|---|--------------------|
| Unit-I | | |
| 1 | Introduction: Mobile Communications | 1 |
| 2 | Guided transmission | 1 |
| 3 | Unguided transmission | 2 |
| 4 | Modulation methods and standards for data and voice communication | 1 |
| 5 | Mobile computing and Novel applications and limitations | 1 |
| 6 | Mobile computing architecture, Mobile system networks | 2 |
| | | Th -8, Tu-2 |
| Unit-II | | |
| 7 | Mobile devices and systems- Cellular networks and frequency reuse | 2 |
| 8 | mobile smart phone, smart mobiles and systems | 1 |
| 9 | handheld pocket computers, handheld devices | 1 |
| 10 | smart systems, limitations of mobile devices | 1 |
| 11 | GSM and other 2G architectures: GSM-Services and system architecture | 2 |
| 12 | Radio interfaces of GSM | 1 |
| 13 | Protocols of GSM | 1 |
| 14 | Localization and call handling | 2 |
| 15 | GPRS system architecture | 1 |
| | | Th-12, Tu-2 |
| Unit-III | | |
| 16 | Wireless medium access control, CDMA, 3G and 4G Communication- Multiplexing | 1 |
| 17 | Controlling the medium access | 2 |

| | | |
|----------------|--|-------------------|
| 18 | Spread spectrum | 2 |
| 19 | IMT_2000 3G wireless,WCDMA, CDMA3G communication standards | 1 |
| 20 | Broadband wireless access, 4G networks | 1 |
| | | Th-7, Tu-2 |
| Unit-IV | | |
| 21 | Mobile IP Network layer- OSI layer functions | 1 |
| 22 | TCP/IP and Internet Protocol | 1 |
| 23 | Mobile IP | 1 |
| 24 | Packet delivery and handover management | 2 |
| 25 | Location management | 2 |
| 26 | Mobile TCP | 1 |
| | | Th-8, Tu-2 |
| Unit-V | | |
| 27 | Mobile Ad hoc and Wireless Sensor Networks-
Introduction to the Mobile Ad hoc networks | 1 |
| 28 | Fixed infrastructure architecture | 1 |
| 29 | MANET infrastructure architecture | 1 |
| 30 | MANET-properties, spectrum, applications | 2 |
| 31 | Security in Ad-hoc networks. | 1 |
| 32 | Wireless sensor networks | 1 |
| 33 | Sensor networks applications | 1 |
| | | Th-8, Tu-2 |
| Unit-VI | | |
| 34 | Mobile Wireless short Range Networks and Mobile Internet- Wireless networking and wireless LAN | 1 |
| 35 | Wireless LAN architecture (WLAN) | 1 |
| 36 | IEEE 802.11 protocol layers | 1 |

| | | |
|----|---|---------------------|
| 37 | WAP1.1 architecture, WDP, WTLS | 2 |
| 38 | Wireless transaction and session layers | 1 |
| 39 | Wireless application environment | 1 |
| | | Th-7, Tu-2 |
| | Grand Total: | Th-50, Tu-12 |

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Academic Year: 2020-21

IV-B.Tech SEM –I

HANDOUT ON SOCIAL NETWORKS

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SUBJECT:-SOCIAL NETWORKS

Class & Sem. :IV B.Tech – I Semester

Year : 2020-21

Branch: CSE

Credits:3

=====

1. Brief History and Scope of the Subject

Social networks have been at the core of human society since we were hunters and gatherers. People were tied together through their relations with one another and their dependence on one another. Kinship and family relations are social networks. Neighbourhoods, villages, and cities are crisscrossed with networks of obligations and relationships. Beyond kinship relations, people in modern societies are dependent upon one another for many things. It is well known that World Wide Web is the main driving force behind making new connections. Internet itself is an example of a huge network and changed the rules of social networks.

Social networks and their analysis is an inherently interdisciplinary academic field which emerged from social psychology, sociology, statistics and graph theory. Social network analysis can be applied to many substantive areas. Social network analysis is now one of the major paradigms in contemporary sociology, and is also employed in a no. of other social and formal sciences. Together with other complex networks, it forms part of the nascent field of network science. This course covers introduction to social concepts and social network analysis.

2. Pre-Requisites

- Familiar with the fundamental concepts of Graph Theory.

3. Course Objectives:

- To familiarize with the technological concepts of Social networks.
- To provide a comprehensive overview of Social Network Systems.

4. Course Outcomes:

Upon successful completion of this course, students should be able to:

- CO1:** outline social concepts.
- CO2:** categorize network segments and their Characteristics.
- CO3:** analyze psychological foundations of Social networks.
- CO4:** evaluate network structure of organizations.

CO5: examine Network Influence and diffusion of ideas.

CO6: evaluate network as social capital

5. Program Outcomes:

Graduates of the Computer Science and Engineering Program will have

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

| CT2539 : SOCIAL NETWORKS (VERTICAL MOBILITY) | | | | | | | | | | | | | | | |
|--|---|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|--|
| Course outcomes | Program Outcomes and Program Specific Outcome | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | |
| CO1:outline social network concepts | 2 | | | | | | | | | | | | | | |
| CO2:categorize network segments and their characteristics. | 2 | 2 | | | | | | | | | | 1 | | | |
| CO3:analyze psychological foundations of social networks. | 2 | 2 | | | 2 | | | | | | | 1 | | | |
| CO4:evaluate network structure of organizations. | 2 | 1 | 2 | 1 | | | | | | | | 1 | | | |
| CO5:examine network influence and diffusion of ideas. | | 3 | | | | | | | | | | 1 | | | |

| | | | | | | | | | | | | | |
|---|---|---|--|--|--|---|--|--|--|--|---|--|--|
| CO6:evaluate network as social capital. | 2 | 1 | | | | 1 | | | | | 1 | | |
| SOCIAL NETWORKS | 2 | 2 | | | | 1 | | | | | 1 | | |

7. Prescribed Text Books

1. Understanding Social Networks: Theories, Concepts, and Findings By Charles Kadushin.

8. Reference Text Books

1. Social Networks and the Semantic Web By Peter Mika.
2. Social Network Analysis: Methods and Applications By Stanley Wasserman, Katherine Faust.

9. URLs and Other E-Learning Resources

- a. www.ischool.utexas.edu/~i385q/archive/sharma_social_networks.ppt
- b. <http://www.pr.com/press-release/214190cs.nyu.edu/~jchen/socialnetworks.ppt>
- c. http://en.wikipedia.org/wiki/Social_network

10. Lecture Schedule / Lesson Plan

| Topic | No. of Theory Periods |
|---|-----------------------|
| UNIT –1: Basic social network concepts | |
| Basic social network concepts | 4 |
| Distributions | 3 |
| Multiplexity | 2 |
| Roles and positions | 1 |
| Embedded of the informal within instituted or named networks | 2 |
| | 12 |
| UNIT – 2: Network segmentation | |
| Network segmentation | 2 |
| Named and Unnamed Network segments | 2 |
| Segmenting groups on the basis of cohesion | 2 |
| structural similarity and structural equivalence | 2 |
| | 8 |
| UNIT – 3: Psychological foundations of social networks | |
| Psychological foundations of social networks | 2 |

| | |
|---|-----------|
| Safety | 2 |
| Effectiveness | 2 |
| Status | 2 |
| Limits on individual networks | 2 |
| | 10 |
| UNIT – 4: Organizations and networks Information | |
| Organizations and networks Information | 2 |
| Driven organizations | 2 |
| Bridging the gaps: Network size | 2 |
| diversion and social cohesion | 2 |
| | 8 |
| UNIT – 5: Networks, Influence and diffusion | |
| Networks and diffusion | 3 |
| Influence and decision making | 4 |
| Epidemiology and network diffusion | 4 |
| | 11 |
| UNIT – 6: Network as social capital | |
| Network as social capital | 3 |
| Individual level social capital | 3 |
| social capital as an attribute of social systems | 3 |
| | 9 |
| Total No. of Periods: | 58 |

11. Seminar Topics

- Social Networking
- The Small World Phenomenon
- Semantic Web
- Social Network Clusters
- Privacy and Security in Social Networks

UNIT-I

Assignment- Cum- Tutorial Questions

Objective Questions

1. The term Sociogram is invented by _____.
2. _____ is used to represent the network mathematically.
3. _____ The phrase “A Friend of my friend is a friend of mine” is example of _____
4. As per the well-known history of Karate club, in the end, the club got divided into how many communities
a) 1 b) 2 c) 3 d) 4

A Person with higher degree than others has

- a) high centrality b) low Centrality

- c) small distance
- d) None of these

Networks in which boundaries are not clear

- a) Ego-Centric Network
- b) Socio-Centric Network
- c) Open System Network
- d) None of these.

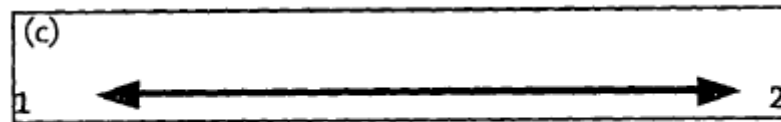
5. When nodes are more likely to be connected based on geographical proximity, it is called as

- a) Propinquity
- b) Homophily
- c) Mutuality
- d) Balanced

Homophily refers to the friendship between people

- a) Who are similar to each other
- b) Who are dissimilar to each other
- c) Who are introduced to each other because of a common friend
- d) Who have different ethnicity but live at the same place

Identify the type of dyad in the figure below



- a) Null
- b) Asymmetric
- c) Mutual
- d) None

6. In social networks, friends and acquaintances respectively lead to:

- a) Strong Ties, Weak Ties
- b) Weak Ties, Strong Ties
- c) Both lead to Strong Ties
- d) Both lead to Weak Ties

7. Identify the network group in which a person receives support for job search

- a) Ego-Centric Network
- b) Socio-Centric Network
- c) Open System Network
- d) None of these.

8. Diameter of a network is defined as?

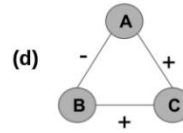
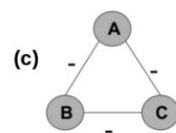
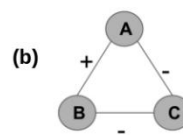
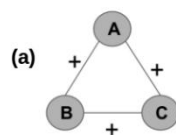
- a) The number of nodes on the longest path between the two most distant nodes in the network.
- b) The number of nodes on the shortest path between the two most distant nodes in the network.
- c) The number of edges on the longest path between the two most distant nodes in the network.
- d) The number of edges on the shortest path between the two most distant nodes in the network.

9. The Famous allegation “six degrees of separation” demonstrates

- a) The Theoretical no. of steps between any two persons in India.
- b) The original no. of steps between any two persons in India.
- c) The Theoretical no. of steps between any two persons in US.
- d) The original no. of steps between any two persons in US.

10. Citation Network is which type of network?

- a) Directed b) Undirected c) Weighted d) None of the above
11. Co-authorship Network is which type of network?
 a) Role Multiplicity b) Position Multiplicity
 c) Content Multiplicity d) None
12. _____ were first identified as loyalties for accomplishment of tasks
 a) Formal relations b) Informal Relations
 c) Complex Relations d) Multiple Relations
13. Dynamics of friendships formation and behavior of people in a network is
 a) Impacted by neither - selection and social influence.
 b) Impacted by both, selection as well as social influence.
 c) Impacted by selection but not social influence.
 d) Impacted by social influence but not selection.
14. Weak ties are important because:
 a) They might later become strong ties.
 b) They provide connections across communities.
 c) They connect nodes with difficult-to-reach parts of the network.
 d) both b and c
15. Triadic closure implies that:
 a) Two people having a common enemy have more probability of becoming friends with each other.
 b) Three people having a common enemy have more probability of becoming friends with each other.
 c) Two people having a common friend have more probability of becoming friends with each other.
 d) Two people having a common person as a distant acquaintance have more probability of becoming friends with each other.
16. Which of the following triangles follows the social belief that 'Enemy of my enemy is my friend'?



Descriptive Questions

Define Network. What are different relationships between nodes of a network?

Mention different kinds of networks investigated by social scientists?

What is Propinquity Effect?

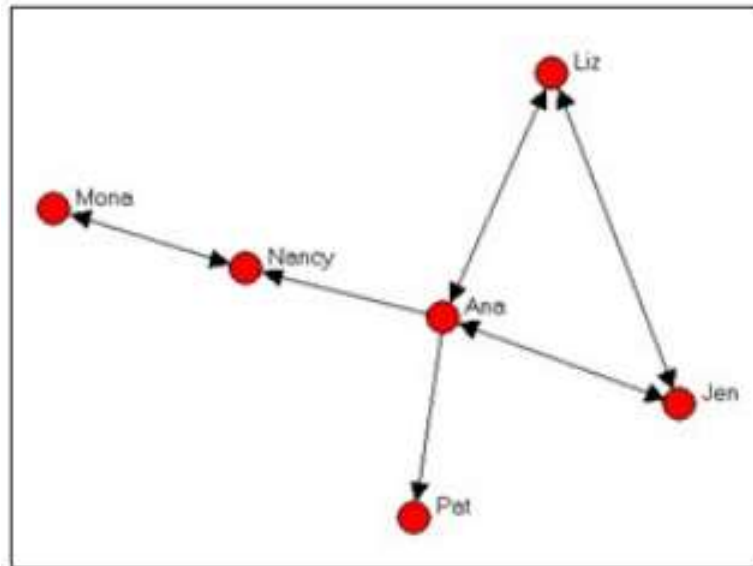
What is Density? What does Density facilitates?

Define Geodesic Distance. How a set of nodes can be grouped into different zones based on distance?

What is Sociogram? Write the concept of mutuality

Briefly discuss about Individual-Level Homophily.

1. Point out the importance of Centrality in a Network
2. Discuss in detail about size of Interpersonal Environment.
3. Explain about Multiplexity in Social Networks.
4. Identify Dyad based Reciprocity in the network below:



5. Compare and Contrast Formal and Informal relations in a network **Unit-II**

Objective Questions

Identify which type of elite core suggest type of cluster can be applied to the community power literature

- | | |
|----------------------|-----------|
| a) Groucho Marx Core | b) Caucus |
| c) Deference | d) Meek |

Separating the whole network into smaller meaningful parts known as

- | | | | |
|-----------|------------|-------------|-------------|
| a) Groups | b) Cliques | c) Clusters | d) Segments |
|-----------|------------|-------------|-------------|

Networks that correspond to names given by the participants in the network

- | | | | |
|------------------|------------------|-------------------|---------|
| a) emic Networks | b) etic Networks | c) Local Networks | d) None |
|------------------|------------------|-------------------|---------|

1. A small social group whose members share close personal enduring relationships

- | | | | |
|-------------|------------|-------------------|-------------|
| a) Clusters | b) Cliques | c) Primary Groups | d) Segments |
|-------------|------------|-------------------|-------------|

A maximal complete sub graph of three or more nodes

- | | | | |
|---------|----------|-----------|----------------------|
| a) dyad | b) triad | c) Clique | d) None of the above |
|---------|----------|-----------|----------------------|

Group of thing or persons close together is known as

- | | | | |
|-------------|------------|-------------------|-------------|
| a) Clusters | b) Cliques | c) Primary Groups | d) Segments |
|-------------|------------|-------------------|-------------|

Higher density of node in a network can be identified by

- a) A Node has more Likes
- b) A Node has less likes
- b) A Node has no likes
- d) None of the above

Nodes that have similar patterns of relationships with other nodes are grouped together

- a) Structural Equivalence
- b) Structural Similarity
- c) clusters
- d) Cliques

8. Identify which of the following block model is suitable for “Block A relates to block A and block B, B relates to A but not to itself”.

- a)

| | A | B |
|---|---|---|
| A | 1 | 1 |
| B | 1 | 0 |
- b)

| | A | B |
|---|---|---|
| A | 1 | 0 |
| B | 0 | 0 |
- c)

| | A | B |
|---|---|---|
| A | 1 | 1 |
| B | 1 | 0 |
- d)

| | A | B |
|---|---|---|
| A | 1 | 0 |
| B | 1 | 0 |

9. Identify which adjacency matrix represents symmetric relation

- a)

| | A | B |
|---|---|---|
| A | 0 | 1 |
| B | 1 | 0 |
- b)

| | A | B |
|---|---|---|
| A | 1 | 0 |
| B | 0 | 1 |
- c)

| | A | B |
|---|---|---|
| A | 0 | 1 |
| B | 0 | 0 |
- d)

| | A | B |
|---|---|---|
| A | 0 | 0 |
| B | 1 | 0 |

10. There can be a situation in which A remains the elite in that relates only to other A's, but B also has some density of relating to other B's, and also to A. Breiger calls this situation.

- a) The Meek
- b) Deference
- c) Polarization
- d) Caucus

11. Which of the following block model comes under polarization

- a)

| | A | B |
|---|---|---|
| A | 1 | 0 |
| B | 0 | 1 |
- b)

| | A | B |
|---|---|---|
| A | 0 | 0 |
| B | 0 | 0 |
- c)

| | A | B |
|---|---|---|
| A | 0 | 1 |
| B | 1 | 0 |
- d)

| | A | B |
|---|---|---|
| A | 0 | 0 |
| B | 1 | 0 |

12. Identify the two master ideas about social relations in network

- a) Cohesiveness, Structural Similarity
- B) Structural Similarity, Structural Equivalence
- C) Cohesiveness, Structural Equivalence
- D) None of these.

13. Nodes can be removed or added to the network the former and latter is called

- a) adhesion, cohesion
- b) cohesion, adhesion
- c) adhesion, disruption
- d) None of these

14. For the following Karate club member networks which pairs of nodes has highest Density

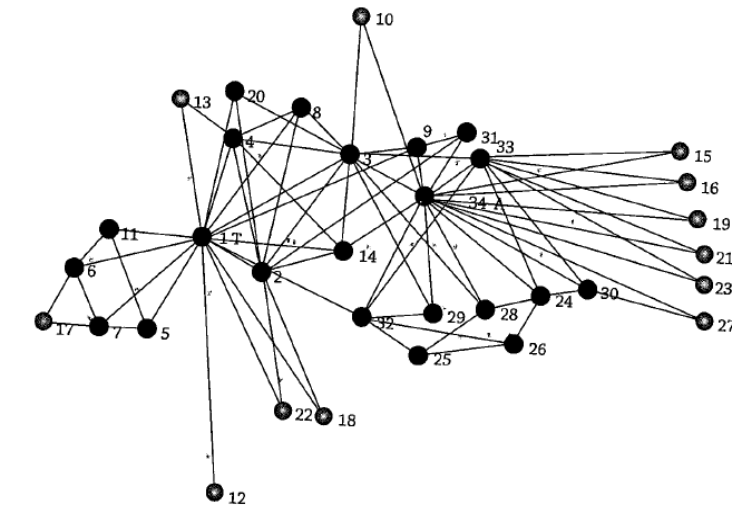
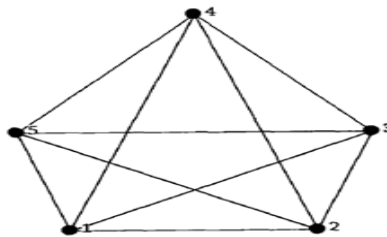


FIGURE 3.1 Friendship Network among Karate Club Members

- a) 1,34
- b) 10,22
- c) 4,33
- d) 25,31

15. Name the following network



- a) Dyad
- b) Triad
- c) Clique
- d) Primary Group

16. In a core-periphery structure

- a) Low status people are linked in densely connected core while the high status people atomize around this core as periphery of the network.
- b) Core and the periphery occupy interchangeable positions in the network.
- c) The notion of a node being in a core or in a periphery does not depend on the social status or the wealth of a node.
- d) High status people are linked in densely connected core while the low status people atomize around this core as periphery of the network.

Descriptive Questions

Define Network Segmentation. What are its advantages.

Discuss in detail about Structural Similarity.

State the Mathematical definition of Cliques.

Differentiate between Structural Similarity and Structural Equivalence.

Explain Named and Unnamed Network Segments.

(February 2019)

Explain the concept of Resistance to Disruption.

Illustrate Core-Periphery Structures.

(February 2019)

(or)

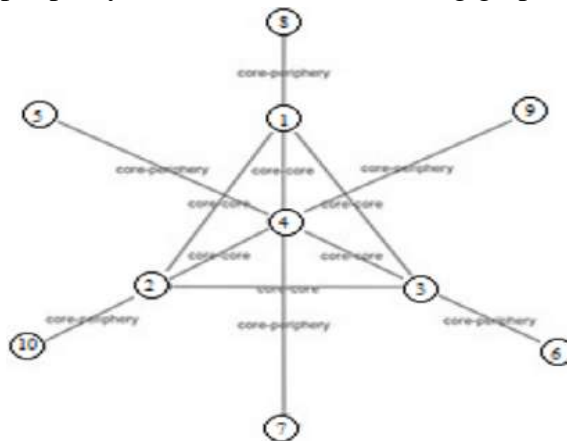
Illustrate various block models involved for the symmetric network.

Write a short note on

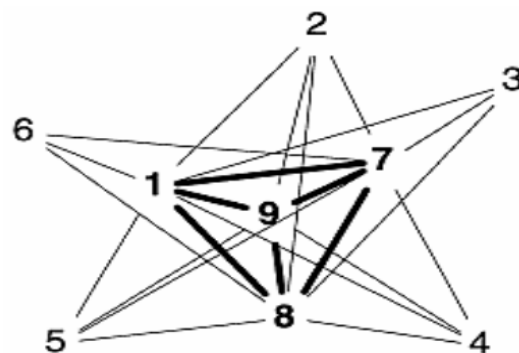
Clusters

Primary Groups.

1. Assume that there are two blocks in a network: block A having nodes 1,2,3,4 and block B having the nodes 5,6,7,8,9,10. Compute the Adjacency Matrix and various core/periphery structures of the following graph.

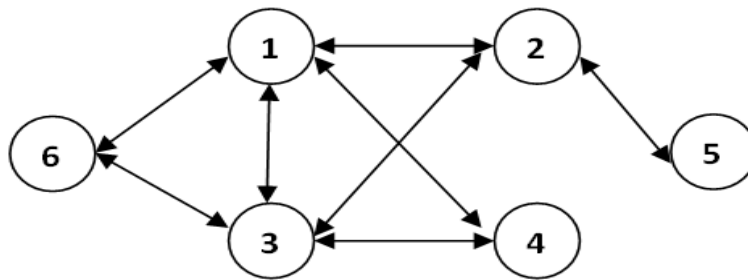


2. Assume that there are two blocks in a network: In block A having nodes 1,7,8,9 and block B having the nodes 2,3,4,5,6. Compute the Adjacency Matrix and various core/periphery structures of the following graph.



3. For the given network, assume there are two blocks – block A having nodes <1,2,3> and block B having nodes <4,5,6>. Write Blocked Adjacency

Matrix and various Core/Periphery Structures.
(November 2018)



Unit III

Assignment- Cum- Tutorial Questions

Objective Questions

Two kinds of basic human motivations respond to primary needs are

- a) feel safe, individual
- b) reach out, integrity
- c) feel safe, reach out
- d) none

A professional manipulator of people and information who brings communication for profit is known as

- a) broker
- b) neighbour
- c) manager
- d) None of the above

When examining community and support, one first checks for the presence of **ties** embedded in the social system.

Cohesion and support became more important in

- a) traditional systems
- b) modern society
- c) social cocoon
- d) none

The main difference between effectiveness networks and safety networks as ideal types is

- a) Location of Fraud
- b) Location of deceit
- c) Location of Trust
- d) None

A sense of self-sufficiency, autonomy and individuation is called as

- a) safety
- b) effectiveness
- c) cohesion
- d) support

Dense social networks are characterized by the sense of

- a) Fraud
- b) Trust
- c) individuality
- d) none

By focusing on which, we concern ourselves more with efficacy than safety

- a) Connections
- b) Holes
- c) mutual relationships
- d) none

Identify the concept to which the following statement belongs to "Stay within one's social cocoon, for the connections between people".

- Safety b) communication c) effectiveness d) None of the above
2. In case of exchange situations of nodes in a network, relate which of the following are altered.
 Safety&effectiveness b)Cohesion& Support c)Cohesion d)Support
3. “Density depends on Structural holes rather than cohesion” correlate the statement to appropriate one.
 A)Effectiveness b)Proximity c) Safety d)None of these
4. Identify the group for which network of infant and her mother, father or household members belongs to
 a) modern society group b) Human Group
 c) social cocoon group d) traditional systems group.
5. Connect the group affiliation-trust-density with the related aspect
 a) Status b)Effectiveness c)Safety d)None
6. “People follow their own goals, and independent of others” associate this statement to related property.
 a) Co-joint b)Dis-joint c)Joint d)None
7. The mean size of one's circle of acquaintances per men and women
 a) 650,590 b) 590,650 c) 600,500 d)
 500,600

Descriptive Questions

Write briefly about psychological foundations of Social networks.

Write a short note on community and support.

Explain briefly about Effectiveness and Structural Holes

Discuss in detail about Safety and Social Networks

Explain about Cultural Differences in Safety, Effectance, and Rank

Explain in detail about Cognitive Limits on Individual Networks

Differentiate the following.

A) Safety

B) Effectiveness

Discuss in detail about Status.

Illustrate that the feelings of safety and reach out aspects are needs for human motivation.

4. Categorise affiliation, competition, location of trust, structural holes, density in to two drives.

UNIT-IV

Objective Questions

Modern organizations are *rational-legal systems*, based on *universalistic principles* and are supposed to be

- Fair b) unfair c) None of the above d) Both a & b

Workers also brought their own cultural values and attitudes into the situation. Among those values, as we will see, was the working-class fear of

- Employment b) Un-Employment c) profession d) hiring

The Network “Bank Wiring Room” is an example of

- a) Helping Network b) Organizational Network
c) Both a & b d) None of the above

Organizations are social structures designed to get things done through the cooperation of

- Individuals b) Groups c) Clusters d) None of these

The organization systems like “The Law offices, health delivery systems, R&D and many nonprofit organizations” comes under

- In-Organic Systems b) Organic Systems
c) Both a & b d) None of the above

The situation in which “Requests are accepted as fitting and legitimate but outside of which they are not” is Characterized by

- a) zone of indifference b) Area of acceptance
c) both a & b d) None of these.

In Multilevel organization there is a situation in which if one individual of one group can collaboratively work with other individual of another group.

- a) Re-legislate b) Both a & c c) Silo Problem d) None of the above

In Multilevel organization there is a situation in which if a position does not like a particular decision made in the unit and bypasses her boss to directly approach the CEO

- Re-legislate b) Silo Problem c) Both a & b d) None of the above

Identify the statement “Lies with persons to whom it [an order] is addressed, and does not reside in persons of authority” is an example of

- a) Informal Organization
- b) Formal Organization
- c) Both a&b
- d) None of the above.

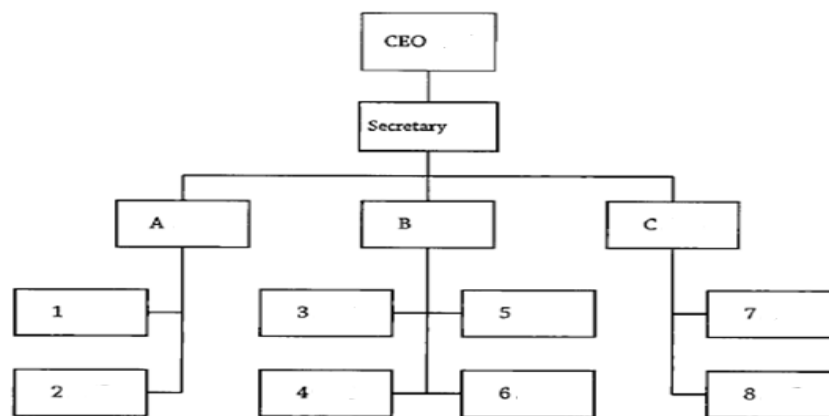
9. The extent that the friendship, homophily, and propinquity play roles, these networks are fundamentally "**unfair**"

- a) Because these networks are based on Universalistic principles.
- b) Because these networks are based on rational legal systems.
- c) Because these networks are based on particularistic principles.
- d) All the above.

10. The Networks like factory floor, assembly line, and repetitive forms of production are designed

- a) To maximize control of the workers and minimize their opportunities for informal interaction.
- b) To minimize control of the workers and minimize their opportunities for informal interaction.
- c) To maximize control of the workers and maximize their opportunities for informal interaction.
- d) To minimize control of the workers and minimize their opportunities for informal interaction.

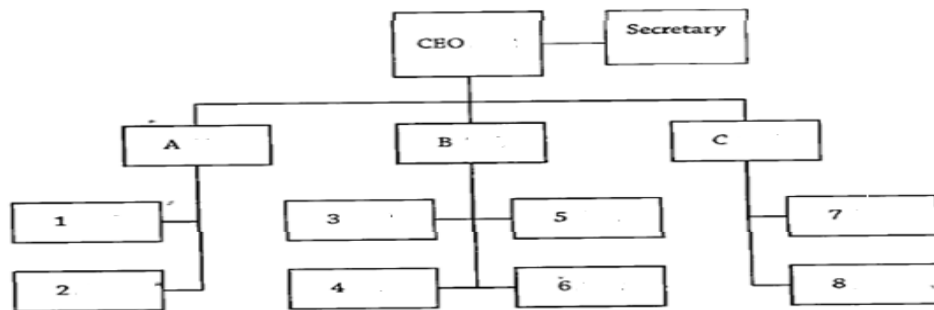
11. Consider the given Multi-level Organization chart, Identify which position has highest Krebs power score



- a) Division Leaders
- b) Secretary
- c) CEO
- d) Units.

13. Choose the best possible answer for the given statement “People have to be motivated to share, and this motivation is increased in socially cohesive situations”. This is because

- a) Social Cohesion increases bandwidth whereas Weak Ties decreases it
 - b) Social Cohesion decreases bandwidth whereas Weak Ties decreases it
 - c) Social Cohesion increases bandwidth whereas Weak Ties increases it
 - d) Social Cohesion decreases bandwidth whereas Weak Ties increases it
14. Consider the network situation in which “Players with relationships free of structural holes at their own end and rich in structural holes at the other end” is
- A) Structurally Equivalent
 - b) Structurally Autonomous
 - c) Both a & b
 - d) None of the above
15. Identify the type of networks used by organizations “To develop ideas that help them decide what to make and/or what services to provide and how to do it”.
- a) Internal Networks
 - b) External Networks
 - c) Both a & b
 - d) Eitic networks
16. All formal or external systems breed informal networks that are grafted onto them. By way of the motivations of
- a) Safety
 - b) Effectance
 - c) Safety and Reflectance
 - d) Safety, effectance, and status achievement.
17. Identify the system in which subordinate believes the system is legitimate, consent is given by the subordinate rather than enforced by the leader.
- A) Traditional systems
 - b) Rational-Legal Systems
 - c) Both a & b
 - d) None of the above
18. Consider the given Multi-level Organization chart, Identify which position has highest Krebs power score



- A) Division Leaders
- b) Secretary
- c) CEO
- d) Units.

Descriptive Questions

Define the term organization in social network and explain about formal organization.

Write briefly about Contradictions of Authority.

List various challenges faced by organizations.

Outline “Bank Wiring Room” helping network and list various constraints involved

(Or)

Discuss briefly about Emergent Networks in organizations

1. Illustrate Barnard’s Zone of Indifference about formal organizations.
2. What organization chart? Explain with suitable example.
3. Compare traditional system with rational-legal systems related to organizations.

Describe briefly about continuous production system in an organization.

4. Explain about Information-Driven Organizations.
5. Discover a silo problem in Multi level organization..
6. Relate chimney problem in Multi-Level organization with Re-legislating.
7. Discuss about Network diversity.
8. Write short notes on trade-offs between Network Size, Diversity and Social Cohesion
9. Determine various bridging gaps between different units of organizations.

UNIT-V

Objective Questions

1. The process through which elements are transferred, borrowed, or adopted into a social system is referred as _____.
2. Diffusion occurs through
 - a) Contact that involves some form of influence, persuasion, or coercion
 - b) Contact that involves some kind of emulation
 - c) Adoption or emulation without direct social contact
 - d) All of the above

3. Diffusion through presumed imitation or adoption of what must have been considered a superior system is termed as
 - a) Cultural Diffusion b) Demic Diffusion c) Biological Diffusion
 - d) None
4. Epidemiology is the study of Biological Diffusion.[True/False]

The Contagion Model of diffusion produces _____ shaped curve

 - a) S-shaped b) U-shaped c) V-shaped d) Z-shaped
5. Decision making process is generally influenced by
 - a) Mass Advertisements b) Researchers c) Friends d) All of them
6. Potential factors for diffusion of diseases are
 - a) close person-to-person proximity b) repetitive exposure
 - c) poor ventilation d) All of the above
7. Vaccinating people who are tightly knit with one another is
 - a) Assortative Mixing b) Concurrency c) Both a & b d) None
8. Probit Regression Model which explains the differences in
 - a) time of adoption b) time of imitation c) time of influence d) None
9. Later adopters who are more sensitive to price or the cost will adopt only if
 - a) Prices are lowered b) Prices are hiked
 - c) Prices are stable d) no price
10. The process of Qualitative Assessment includes
 - a) Evaluating the impact of the different sources of influence
 - b) Evaluating the relative impact of the perceived attributes
 - c) Evaluating the influence of media messages
 - d) All of the above
11. Those whose lower threshold has been exceeded are called _____ and those whose upper threshold has been exceeded are called _____
 - a) Adopters, Snobs b) Influentials, Imitators
 - c) Snobs, Adopters d) Imitators, Influentials
12. "Bandwagon effect produces S-shaped diffusion curve". In this process, people involved are
 - a) Early adopters who evaluate the utility of an innovation
 - b) Later adopters who imitate the successful adoption by the initial users

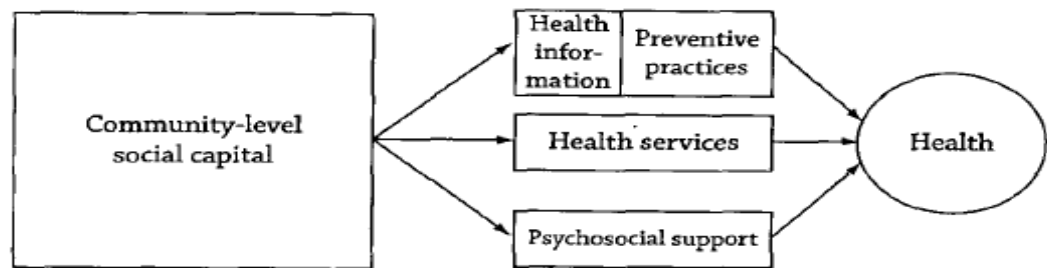
- c) The population ecology model driven by density and competition between firms
 - d) All of the above
13. Which of the following phenomenon results in Diffusion
- a) Diversity b) Balance c) Both a & b d) None
14. Low Network Threshold adopters are early adopters relative to _____ and High Network Threshold adopters are early adopters relative to _____
- a) Social System, Personal Network
 - b) Personal Network, Social System
 - c) Personal Network, Personal Network
 - d) Social System, Social System
15. Potential factors for diffusion of diseases are
- a) close person-to-person proximity b) repetitive exposure
 - c) poor ventilation d) All of the above
16. The concept of “Keep up with the Joneses” is related to
- a) Effectiveness by adoption b) Effectiveness by imitation
 - c) Effectiveness by influence d) not related to any
17. Adoption is maximized when agents' neighbors include
- a) agents with similar thresholds and a core group of similar others
 - b) agents with different thresholds and a core group of dissimilar others
 - c) agents with different thresholds and a core group of similar others
 - d) agents with similar thresholds and a core group of dissimilar others
18. The concept that ties individual decision-making and action []
- a) Peak b) Threshold c) Tipping Point d) None
19. The speed of transmission of a highly contagious disease can be controlled by restricting
- a) Travel b) Class size c) both a&b d) none

B.Descriptive Questions

- 10. Discuss briefly about Network Influence and Network Diffusion.
- 11. Discuss different types of diffusion.
- 12. Explain different models of diffusion.

2. Personal state of isolation and anxiety resulting from a lack of social control and regulation. Relate the above statement to suitable one
 - a) Individual level social capital
 - b) Individual level anomie
 - c) only b
 - d) Both a & b
3. The statement “High voluntary organization participation increases community voter turnout.” is an example of
 - a) Individual level social capital
 - b) Social capital investment
 - c) Both a & b
 - d) None of the above
4. “Financial meltdown of 2008 and quick turnaround”. The crisis related to which of the following social system aspect
 - a) Network resources
 - b) Social attributes
 - c) Social capital as an investment.
 - d) None of the above.
5. Identify which of the following people will try to estimate what they can earn if they suspend current resources and invest them in long term resources
 - a) Team leaders
 - b) Entrepreneurs
 - c) Project leaders
 - d) None of the above
6. “The aggregate of the actual resources which are linked to control of a durable network”. In the above statement durable network consists of
 - a) Social relationships of individual recognition
 - b) Institutionalized relationships of mutual recognition
 - c) Both a & b
 - d) None of the above.
7. In the emerging software industry to engage similar strategies identify which of the following are related.
 - a) Network diffusion and Effectance
 - b) Network centrality and geographic propinquity
 - c) Both a & b
 - d) None of the above
8. Choose the incorrect statement in the following.
 - a) Indirect networks reduce the flow of information
 - b) Cohesive networks having greater trust
 - c) Sparse networks give optimal outcomes than dense networks

- d) Dense networks give optimal outcomes than sparse networks.
9. A firm that gave bonuses to existing workers for referring potential employees: "The firm's \$250 investment yields a return of \$416 in reduced recruiting costs". Correlate the above statement to suitable social aspect
 A) Social system b) Legal system
 c) Social investment d) None of the above
10. Choose the incorrect statement related to community level social capital from the following figure []



- a) decreases the level of available information on treatment and preventive measures
- b) lowers the effort required to organize politically and therefore *bring* more health facilities
- c) makes social support more accessible.
- d) increases the level of available information on treatment and preventive measures

Descriptive Questions

Define the term Social Capital.

Explain in detail about Individual-Level Social Capital.

Discuss about Position and Resources Generators.

Write the ecological fallacy attributes correlations.

What is Social Support? Why social support called fuzzy? Explain it.

Explain different situations in which social capital be as an investment.

State about the theorists of Social System Social Capital.

Discuss about social capital and its consequences

Write the general idea of Name Generators.

What is community - level social support system? Sketch flow diagram pathways.

Signature of the Faculty

GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, Gudlavalleru – 521 356.

Department of Computer Science and Engineering



2020-21 SEM -II

I-B.Tech Handout

Vision of the Department

To be a centre of excellence in Computer Science and Engineering education and training to meet the challenging needs of the industry and society.

Mission of the Department

- To impart quality education through well-designed curriculum in tune with the growing software needs of the industry.
- To serve our students by inculcating in them problem solving, leadership, teamwork skills and the value of commitment to quality, ethical behavior & respect for others.
- To foster industry-academia relationship for mutual benefit and growth.

Program Educational Objectives (PEOs)

PEO1 : Identify, analyze, formulate and solve Computer Science and Engineering problems both independently and in a team environment by using the appropriate modern tools.

PEO2 : Manage software projects with significant technical, legal, ethical, social, environmental and economic considerations.

PEO3 : Demonstrate commitment and progress in lifelong learning, professional development, leadership and communicate effectively with professional clients and public.

HANDOUT ON DATA STRUCTURES

Class & Sem. : I B. Tech – II Semester

Year : 2020-21

Branch : CSE

Credits: 3

=====

1. Brief History and Scope of the Subject

A data structure is a particular way of storing and organizing data in a computer so that it can be used efficiently. Different kinds of data structures are suited to different kinds of applications, and some are highly specialized to specific tasks. For example, B-trees are particularly well-suited for implementation of databases, while compiler implementations usually use hash tables to look up identifiers. Data structures are used in almost every program or software system. Data structures provide a means to manage huge amounts of data efficiently, such as large databases and internet indexing services. Usually, efficient data structures are a key to designing efficient algorithms. Some formal design methods and programming languages emphasize data structures, rather than algorithms, as the key organizing factor in software design.

2. Pre-Requisites

- Knowledge of any programming language that supports pointers for referencing.

3. Course Objectives:

- To gain knowledge of linear and non-linear data structures.
- To familiarize with different sorting and searching techniques

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

- demonstrate the working process of sorting (bubble, insertion, selection and heap) and searching (linear and binary) methods using a programming language.
- design algorithms to create, search, insert, delete and traversal operations on linear and non-linear data structures.
- evaluate the arithmetic expressions using stacks.

- choose appropriate collision resolution techniques to resolve collisions.
- compare array and linked list representation of data structures.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | | 3 | | | | | | | | | | | |
| CO2 | | 3 | | | | | | | | | | | |
| CO3 | | 3 | | | | | | | | | | | |
| CO4 | | | 3 | | 2 | | | | | | | | |
| CO5 | | | | | 2 | | | | | | | | |

7. Prescribed Text Books

- a. Debasis samanta, Classic Data Structures, PHI, 2nd edition,2011.
- b. Richard F, Gilberg , Forouzan, Data Structures, 2nd edition, ,Cengage

8. Reference Text Books

- a. Seymour Lipschutz, Data Structure with C, TMH.
- b. G. A. V. Pai, Data Structures and Algorithms, TMH, 2008.
- c. Horowitz, Sahni, Anderson Freed, Fundamentals of Data Structure in C, University Press, 2nd edition

9. URLs and Other E-Learning Resources

- a. [https://www.courserA\)org/learn/data-structures](https://www.courserA)org/learn/data-structures)
- b. <http://www.studytonight.com/data-structures/>
- c. <http://www.indiabix.com/technical/data-structures/>
- d. [http://nptel.aC\)in/courses/106102064/1](http://nptel.aC)in/courses/106102064/1)
- e. <http://freevideolectures.com/Course/2279/Data-Structures- And- Algorithms/2#>

10. Lecture Schedule / Lesson Plan

| Topic | No. of Periods | |
|--|----------------|----------|
| | Theory | Tutorial |
| UNIT – 1: Searching and Sorting | | |
| Concepts of data structures, Overview of data structures | 1 | 1 |
| Linear search | 1 | |
| Binary search | 1 | |
| Internal sorting: Basic concept | 1 | 1 |
| Bubble sort | 1 | |
| Insertion sort | 1 | |
| Selection sort | 1 | |
| | 7 | 2 |
| UNIT –2: Linked Lists | | |
| Linked Lists- Basic concepts | 1 | 1 |
| Single linked list-operations | 4 | |
| Circular linked list | 2 | |
| Double linked list | 4 | 1 |
| | 11 | 2 |
| UNIT – 3: Stacks and Queues | | |
| Stack introduction, Array and Linked List representations of stack | 2 | 1 |
| Operations on stacks using array and linked list | 4 | |
| Evaluation of arithmetic expression | 3 | |
| Queue introduction, Array and Linked List representations of queue | 2 | 1 |
| Operations on queues using array and linked list | 3 | |
| Circular queue introduction | 1 | |
| | 15 | 2 |
| UNIT – 4: Trees | | |
| Basic tree concepts, Properties | 2 | 1 |
| Representation of Binary Trees using Arrays, linked lists | 1 | |
| Binary Tree Traversals (recursive) | 1 | |
| Binary search trees: Basic concepts, Search, insertion operations | 2 | 1 |
| Deletion Operation (Examples only) | 1 | |
| Creation of binary search tree from in-order and pre (post) order | 1 | |
| Heap Trees: Basic Concept, Operations | 2 | 1 |
| | 10 | 3 |
| UNIT – 5: Graphs and Hashing | | |

| | | |
|---|-----------|-----------|
| Graphs-Basic concepts, Representations of graphs | 2 | |
| Graph traversals Breadth First Search (BFS), Depth First Search (DFS) | 4 | 1 |
| Hashing: Basic concepts, hashing functions (division method, multiplication method) | 3 | 1 |
| Collision resolution techniques- open hashing | 1 | 1 |
| Closed hashing (Linear Probing, Quadratic Probing, Double Hashing) | 3 | 1 |
| | 13 | 3 |
| Total Number of Hours | 56 | 12 |

Assignment-Cum-Tutorial Questions

UNIT-I

SECTION-A

A. Objective Questions

1. Find the location of the element with a given value is _____? []
 A) Traversal B) Searching C) Sorting D) None of above
2. Which of the following is false? []
 A) A linear search begins with the first array element
 B) A linear search continues searching, element by element, either until a match is found or until the end of the array is encountered
 C) A linear search is useful when the amount of data that must be searched is small
 D) For a linear search to work, the data in the array must be arranged in either alphabetical or numerical order
3. Which characteristic will be used by binary search but the linear search ignores is _____ []
 A) Order of the elements of the list B) Length of the list
 C) Maximum value in list D) Type of elements of the list
4. Choose the false statement. []
 A) A binary search begins with the middle element in the array
 B) A binary search continues having the array either until a match is found or until there are no more elements to search
 C) If the search argument is greater than the value located in the middle of the binary, the binary search continues in the lower half of the array

- D) For a binary search to work, the data in the array must be arranged in either alphabetical or numerical order
5. Which of the following is *not* a limitation of binary search algorithm? []
- A) Must use a sorted array
- B) Requirement of sorted array is expensive when a lot of insertion and deletions are needed
- C) There must be a mechanism to access middle element directly
- D) Binary search algorithm is not efficient when the data elements more than 1500
6. What is the complexity of searching an element from a set of n elements using Binary search algorithm is []
- A) $O(n)$ B) $O(\log n)$ C) $O(n^2)$ D) $O(n \log n)$
7. Label the process of arranging values in an ordered manner is called as__.
8. In which sorting technique, consecutive adjacent pairs of elements in the array are compared with each other. []
- A) Bubble sort B) Selection Sort C) Insertion Sort D) None
9. Identify the number of comparisons required to sort a list of 10 numbers in *pass 2* by using *Bubble Sort* is__.
- A) 10 B) 9 C) 8 D) 7
11. Consider an array of elements $arr[5] = \{99, 22, 55, 44, 33\}$, what are the steps done while doing bubble sort in the array. []
- A) 22 55 44 33 99 33 22 44 99 55 22 44 99 33 55
44 22 55 33 99
- B) 22 55 44 33 99 22 44 33 55 99 22 33 44 55 99 22 33
44 55 99
- C) 55 44 33 99 22 44 22 33 99 55 55 33 99 22 44
99 55 44 33 22
- D) None of the above

12. Which sorting technique sorts a list of elements by moving the current data element past the already sorted values with the preceding value until it is in its correct place. []
- A) Insertion sort B) Bubble Sort C) Selection Sort D) None
13. Identify the number of passes required by insertion sort for the list **size 15**.
- A) 15 B) 16 C) 14 D) 13
14. Which of the following sorting algorithms in its implementation gives best performance when applied on an array which is sorted or almost sorted (maximum 1 or two elements are misplaced). []
- A) Insertion sort B) Bubble Sort C) Selection Sort D) None
15. Consider an array of elements $arr[5] = \{5,4,3,2,1\}$, what are the steps of insertions done while doing insertion sort in the array. []
- A) 4 5 3 2 1 3 4 5 2 1 2 3 4 5 1 1 2 3 4 5
- B) 5 4 3 1 2 5 4 1 2 3 5 1 2 3 4 1 2 3 4 5
- C) 4 3 2 1 5 3 2 1 5 4 2 1 5 4 3 1 5 4 3 2
- D) 4 5 3 2 1 2 3 4 5 1 3 4 5 2 1 1 2 3 4 5
16. Consider the array $A[] = \{6,4,8,1,3\}$ apply the *insertion sort* to sort the array . Consider the cost associated with each sort is 25 rupees, what is the total cost of the insertion sort when element 1 reaches the first position of the array? []
- A) 50 B) 25 C) 75 D) 100
17. Consider a situation where swap operation is very costly. Which of the following sorting algorithms should be preferred so that the numbers of swap operations are minimized in general? []
- A) Bubble Sort B) Selection Sort C) Insertion Sort D) None
18. Which one of the following in-place sorting algorithms needs the minimum number of swaps? []

A) Insertion Sort B) Bubble Sort C) Selection Sort D) All of the above

19. Discover the comparisons needed to sort an array of length 5 if a straight selection sort is used and array is already in the opposite order? []

A) 1 B) 10 C) 5 D) 20

20. Determine the advantage of bubble sort over other sorting techniques? []

- a) It is faster
- b) Consumes less memory
- c) Detects whether the input is already sorted
- d) All of the mentioned

B. SECTION-B

SUBJECTIVE QUESTIONS

1. Given a telephone directory and a name of the subscriber, choose search method you would suggest for finding the telephone number of the given subscriber.
2. Apply linear search for an element 18 and 100 in the following list. 36, 72, 19, 45, 18, 22, 12, 55
3. Apply binary search for an element 54 and 100 in the following list. 13, 27, 91, 54, 81, 6, 51, 59, 45, 69
4. Make use of bubble sort for the following elements. 30, 52, 29, 87, 63, 27, 19, 54
5. Make use of insertion sort for the following elements. 59, 19, 54, 96, 81, 801, 45, 72, 64, 92
6. Make use of selection sort for the following elements. 36, 12, 81, 45, 90, 27, 72, 18
7. Explain bubble sort algorithm.

8. Explain insertion sort algorithm.
9. Explain selection sort algorithm.
10. Explain non recursive linear search algorithm.
11. Explain recursive binary search algorithm.
12. Develop a C program using for loop to find all the occurrences of a given key in a given list using linear search. The algorithm should display locations of all the occurrences of the given key. Discuss with an example.

SECTION-C-QUESTIONS AT THE LEVEL

OF GATE

1. Consider the C function given below. Assume that the array listA contains n (> 0) elements, sorted in ascending order. (GATE-CS-2014)

```
int ProcessArray(int *listA, int x, int n)
```

```
    int i, j, k; i= 0;
```

```
    j = n-1;
```

```
    do { k
```

```
        =(i+j)/2
```

```
        ;if (x <=
```

```
            listA[k]
```

```
        )j =
```

```
        k-1;if
```

```
        (listA[k
```

```
        ] <= x)
```

```
        i =
```

```
        k+1;}
    while
```

```
        (i <= j);
```

```
if (listA[k] == x) return(k);  
    else  
        return -1;  
}
```

Which one of the following statements about the function ProcessArray is CORRECT?

- (A) It will run into an infinite loop when x is not in listA.
- (B) It is an implementation of binary search.
- (C) It will always find the maximum element in listA.
- (D) It will return -1 even when x is present in listA.

2. Consider the following C program that attempts to locate an element x in an array Y[] using binary search. The program is erroneous. (GATE CS 2008) []

```

1. f(int Y[10], int x) {
2.     int i, j, k;
3.     i = 0; j = 9;

4.     do {
5.         k = (i + j) / 2;
6.         if( Y[k] < x) i = k; else j = k;
7.     } while(Y[k] != x && i < j);
8.     if(Y[k] == x) printf ("x is in the array ");
9.     else printf (" x is not in the array ");
10. }
```

On which of the following contents of Y and x does the program fail?

- (A) Y is [1 2 3 4 5 6 7 8 9 10] and $x < 10$
- (B) Y is [1 3 5 7 9 11 13 15 17 19] and $x < 1$
- (C) Y is [2 2 2 2 2 2 2 2 2 2] and $x > 2$
- (D) Y is [2 4 6 8 10 12 14 16 18 20] and $2 < x < 20$ and x is even

3. In the above question, the correction needed in the program to make it work properly is (GATE CS 2008) []

- (A) Change line 6 to: if (Y[k] < x) i = k + 1; else j = k-1;
- (B) Change line 6 to: if (Y[k] < x) i = k - 1; else j = k+1;
- (C) Change line 6 to: if (Y[k] <= x) i = k; else j = k;
- (D) Change line 7 to: } while ((Y[k] == x) && (i < j));

4. The average number of key comparisons done in a successful sequential search in a list of length n is (GATE CS 1996) []

- (A) $\log n$ (B) $(n-1)/2$ (C) $n/2$ (D) $(n+1)/2$

UNIT-II

SECTION-A

Objective Questions

1. The logical or mathematical model of a particular organization of data is defined as_____.
2. An ordered collection of finite, homogeneous data elements where the linear order is maintained by means of links or pointers is defined as _____.
3. In single linked list each node contain minimum of two fields. One field is data field to store the data and select for what purpose the second field is used to store _____? []
a) Pointer to character b) Pointer to integer c) Pointer to next node d) None
4. Identify the memory allocation process in Linked list []
a)Dynamic b)Compile Time c)Static d)None of these
5. A variant of linked list, identify in which last node of the list points to the first node of the list is? []
a)Singly linked list b) Doubly linked list c)Circular linked list d) Multiply linked list
6. In doubly linked lists, identify which type of traversal can be performed? []
a)Only in forward direction b) Only in reverse direction c)In both directions d) None
7. A variant of the linked list, identify in which none of the node contains NULL pointer is? []
a)Singly linked list b) Doubly linked list c)Circular linked list d) None
8. Identify non-linear Data Structure from the following []
a. Array b. Stack c. Graph d. Linked list
9. A node in single linked list can reference the previous node. [True/False]
10. Choose, Which type of structure is used to create a linked list? []
a) Nested structure b) Self referential structure c) Array of structure d) pointers to structure
11. Predict, Which type of linked list occupies more memory? []
a)SLL b) DLL c)CLL d)None
12. Compute how many pointers need to modify in inserting a node at the beginning of the single linked list a)
1 b) 2 c) 3 d) 0 []
13. What does the following function do for a given Linked List with first node as head? []
void fun1(struct node* head)
{
 if(head ==
 NULL)return;

```

fun1(head->next);
printf("%d ",
head->data);
}

```

- a) Prints all nodes of linked lists
- b) Prints all nodes of linked list in reverse order
- c) Prints alternate nodes of Linked List
- d) Prints alternate nodes in reverse order

14. Deleting a node at any position (middle) of the single linked list needs to modify_____pointers.

- a) 1
 - b) 2
 - c) 3
 - d) 0
- []

15. A double linked list is declared as follows:

```

struct dllist
{
struct dllist *fwd,
*bwd;int data;
}

```

Where fwd and bwd represents forward and backward links to adjacent elements of the list. Which among the following segments of code deletes the element pointed to by X from the double linked list,if it is assumed that X points to neither the first nor last element of the list?

- a. X -> bwd -> fwd = X -> fwd;
X -> fwd -> bwd = X -> bwd
- b. X -> bwd -> fwd = X -> bwd;
X -> fwd -> bwd = X -> fwd
- c. X -> bwd -> bwd = X -> fwd;
X -> fwd -> fwd = X -> bwd
- d. X -> bwd -> bwd = X -> bwd;
X -> fwd -> fwd = X -> fwd

15. Which among the following segment of code inserts a new node pointed by X to be inserted at the beginning of the double linked list. The start pointer points to beginning of the list? []

- a. X -> bwd = X -> fwd;
X -> fwd = X -> bwd;
- b. X -> fwd = start;
start -> bwd = X;
start = X;

- c. X -> bwd = X -> fwd;
X -> fwd = X -> bwd;
start = X;
- d. X -> bwd -> bwd = X -> bwd;
X -> fwd -> fwd = X -> fwd

16. Does C perform array out of bound checking? What is the output of the following program? []

```
int main()
{
    int i;
    int arr[5] = {0};
    for (i = 0; i <= 5;
        i++) printf("%d ",
            arr[i]);
    return 0;
}
```

- a) Compiler Error: Array index out of bound.
- b) The always prints 0 five times followed by garbage value
- c) The program always crashes.
- d) The program may print 0 five times followed by garbage value, or may crash if address (arr+5) is invalid.

17. Which boolean expression indicates whether the numbers in two nodes (p and q) are the same. Assume that neither p nor q is null. []

- a) p == q
- b) p.data == q.data
- c) p.link == q.link
- d) None of the above.

18. Which of the following statement is true []

- I. Using single linked list it is not possible to traverse the list in backward direction.
- II. To find the predecessor it is required to traverse the list from the first node in case of single linked list.

- a) I only b) II only c) Both I and II d) None of the above

19. Suppose each set is represented as a linked list with elements in arbitrary order. Which of the operations among union, intersection, membership, cardinality will be the slowest? []

- a) union only
- b) intersection, membership
- c) membership, cardinality
- d) union, intersection

20. The following C function takes a singly linked list as input argument. It modifies the list by moving the last element to the front of the list and returns the modified list. Some part of the code is left blank.

```
typedef struct node
{
```

```

    Intvalue;
    Structnode
    *next;
}Node;
Node *move_to_front(Node *head)
{
    Node *p, *q;
    If ((head == NULL: || (head->next ==
        NULL))Return head;
    Q = NULL;
    p = head;
    While (p->next !=NULL)
    {
        Q = p;
        P = p->next;
    }
    1. -----
    Return head;
}

```

Choose the correct alternative to replace the blank line.

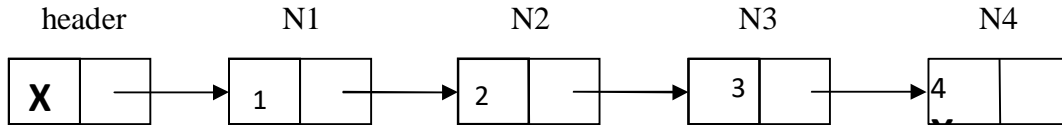
- a) q = NULL; p->next = head; head = p;
- b) q->next = NULL; head = p; p->next = head;
- c) head = p; p->next = q; q->next = NULL;
- d) q->next = NULL; p->next = head; head = p;

C. SECTION-B

SUBJECTIVE QUESTIONS

1. Explain about delete operation in singly linked list.
2. Compare single linked list and circular single linked list.
3. Write an algorithm to perform deletion operation on circular linked list.
4. Write an algorithm to perform insertion operation on a double linked list.
5. Write an algorithm to perform deletion operation on a double linked list.
6. Write short notes on data structures.

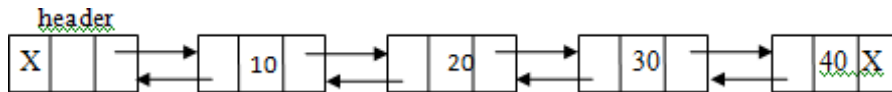
7. Consider the following single linked list.



Demonstrate the following operations on this list and draw the updated single linked list after each operation.

1. Insert 5 at end
2. Insert 6 at begin
3. Insert 9 after 2
4. Delete 6
5. Delete 5
6. Delete 3

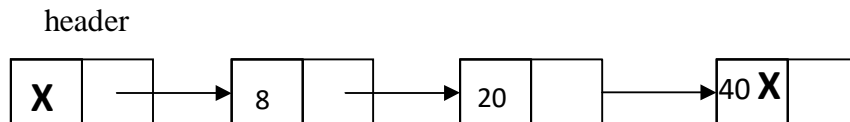
8. Consider the following double linked list.



Illustrate the following operations on this list and draw the updated single linked list after each operation.

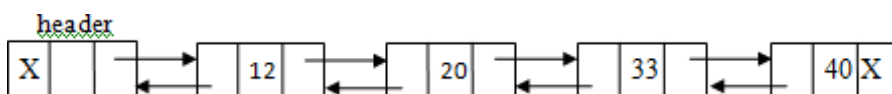
1. Insert 50 at end
2. Insert 60 at begin
3. Insert 90 after 20
4. Delete 60
5. Delete 50
6. Delete 30

9. Consider the following single linked list.



Insert the following elements into the list **2,15,30,50**. Such that the list will be in **ascending** order and draw the updated single linked list after each insertion operation.

10. Consider the following double linked list.



Insert the following elements into the list **2,15,30,50**. Such that the list will be in **ascending** order and draw the updated single linked list after each insertion operation.

11. Write a program to implement insert operation in a doubly linked List.
12. Write a program to perform deletion operation in the middle of a doubly linked list.
13. Develop a program to delete an element of a single linked list.

14. Develop a program to merge two single linked lists into one list so that the resultant list will be in ascending order.

SECTION-C

QUESTIONS AT THE LEVEL OF GATE

1. Consider the function f defined below.

(GATE 2003)

```
struct item
{
    int data;
    struct item * next;
};
int f(struct item *p)
{
    return( (p == NULL) || (p->next == NULL) || (( P->data <= p->next->data) && f(p->next)) );
}
```

For a given linked list p, the function f returns 1 if and only if

- a) the list is empty or has exactly one element
 - b) the elements in the list are sorted in non-decreasing order of data value
 - c) the elements in the list are sorted in non-increasing order of data value
 - d) not all elements in the list have the same data value.
-
2. A circularly linked list is used to represent a Queue. A single variable p is used to access the Queue. To which node should p point such that both the operations enqueue and dequeue can be performed in constant time? (GATE 2004)
- a) rear node b) front node c) not possible with a single pointer d) node next to front
3. In the worst case, the number of comparisons needed to search a singly linked list of length n for a given element is (GATE 2002)
- a) $\log_2 n$ b) $n/2$ c) $\log_2 n - 1$ d) n

UNIT-III

SECTION-A

Objective Questions

1) To add and remove nodes from a queue _____ access is used. []

- a.) LIFO, Last In First Out b). FIFO, First In First Out
c). Both a and b d) . None

2.) Which one of the following is an application of Queue Data Structure?

- a) When a resource is shared among multiple consumers. []
b) When data is transferred asynchronously
c) Load Balancing
d) All of the above

3.) Which of the following is not the type of queue? []

- a) Ordinary queue b) Single ended queue c) Circular queue d) Priority queue

4.) Suppose a circular queue of capacity $(n - 1)$ elements is implemented with an array of n elements. Assume that the insertion and deletion operation are carried out using REAR and FRONT as array index variables, respectively. Initially, $REAR = FRONT = 0$. The conditions to detect queue full and queue empty are

- a) Full: $(REAR+1) \bmod n == FRONT$, empty: $REAR == FRONT$ []
b) Full: $(REAR+1) \bmod n == FRONT$, empty: $(FRONT+1) \bmod n == REAR$
c) Full: $REAR == FRONT$, empty: $(REAR+1) \bmod n == FRONT$
d) Full: $(FRONT+1) \bmod n == REAR$, empty: $REAR == FRONT$

5.) What is the need for a circular queue? []

- a) effective usage of memory b) easier computations
c) all of the mentioned d.) none

6. What is the space complexity of a linear queue having n elements? []

- a) $O(n)$ b) $O(n \log n)$ c) $O(\log n)$ d) $O(1)$

7.) In linked list implementation of a queue, where does a new element get deleted? []

- a) $O(1)$ for insertion and $O(n)$ for deletion []
- b) $O(1)$ for insertion and $O(1)$ for deletion
- c) $O(n)$ for insertion and $O(1)$ for deletion
- d) $O(n)$ for insertion and $O(n)$ for deletion

14.) Which of the following permutation can be obtained in the same order using a stack assuming that input is the sequence 5, 6, 7, 8, 9 in that order? []

- a) 7, 8, 9, 5, 6 b) 5, 9, 6, 7, 8 c) 7, 8, 9, 6, 5 d) 9, 8, 7, 5, 6

15.) If the sequence of operations – push (1), push (2), pop, push (1), push (2), pop, pop, pop, push (2), pop are performed on a stack, the sequence of popped out values []

- a) 2,2,1,1,2 b) 2,2,1,2,2 c) 2,1,2,2,1 d) 2,1,2,2,2

16.) The postfix form of the expression $(A + B) * (C * D - E) * F / G$ is? []

- a) $AB + CD * E - FG /**$ b) $AB + CD * E - F **G /$
- c) $AB + CD * E - *F *G /$ d) $AB + CDE * - * F *G /$

17.) The postfix form of $A * B + C / D$ is? []

- a) $*AB / CD +$ b) $AB * CD / +$ c) $A * BC + / D$ d) $ABCD + / *$

18.) The prefix form of $A - B / (C * D ^ E)$ is? []

- a) $- / * ^ A C B D E$ b) $- A B C D * ^ D E$ c) $- A / B * C ^ D E$ d) $- A / B C * ^ D E$

19.) The result of evaluating the postfix expression 5, 4, 6, +, *, 4, 9, 3, /, +, * is? []

- a) 600 b) 350 c) 650 d) 588

matching []

- a) n-ary b) c) priority queue d) stack

20.) Which of the following data structures can be used for parentheses

1. SECTION-B

SUBJECTIVE QUESTIONS

- 1 . Explain the prefix and post fix notation of $(a + b) * (c + d)$?
- 2 . Define what is stack? Why do we use stack ? And what are the operations performed on stacks?
3. Convert the expression $(a+b)/d-((e-f)\%g)$ into reverse polish notation using stack and show the contents of stack for every operation.
4. Evaluate the expression $12/3*6+6-6+8\%2$ using stack.
5. Convert the expression $a+b*c/d\%e-f$ into postfix expression using stack.
6. Implement queue using arrays?
- 7 .Implement queue using Linked List?
8. What is Queue? discuss the types of Queues ?And explain why we we are going for circular queue?
- 9.Lsit out Applications of Stacks?
- 10.List out applications of queues?

SECTION-C

QUESTIONS AT THE LEVEL OF GATE

- 1.Consider the following pseudocode that uses a stack
declare a stack of characters
while (there are more characters in the word to read)
{ read a character

push the character on the stack

}

while (the stack is not empty)
{

```

pop a character off the stack
write the character to the screen
}

```

2. What is output for input “geeksquiz”? []

- (A) geeksquizgeeksquiz
- (B) ziuqskeeg
- (C) geeksquiz
- (D) ziuqskeegziuskeeg

3. Assume that the operators +, -, × are left associative and ^ is right associative. The order of precedence (from highest to lowest) is ^, x, +, -. The postfix expression corresponding to the infix expression $a + b \times c - d^e^f$ is

$abc \times + def^e^f -$ []

$abc \times + de^e^f -$

$ab + c \times d - e^e^f$

$- + a \times bc^e^e def$

4. The following postfix expression with single digit operands is evaluated using a stack: []

$8 2 3^e / 2 3^e * + 5 1^e * -$

Note that ^ is the exponentiation operator. The top two elements of the stack after the first * is evaluated are:

- (A) 6, 1
- (B) 5, 7
- (C) 3, 2
- (D) 1, 5

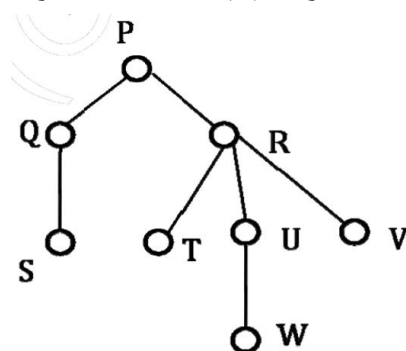
UNIT-IV

SECTION-A

Objective Questions

1. How many nodes in a tree have *no* ancestors?
[] (A) 0 (B) 1 (C) 2 (D) n
2. What is the maximum possible number of nodes in a binary tree at level 6?
[] (A) 6 (B) 12 (C) 64 (D) 32
3. A full binary tree with $2n+1$ nodes contain_____? []
(A) n leaf nodes (B) n non-leaf nodes
(C) n-1 leaf nodes (D) n-1 non-leaf nodes
4. A full binary tree with n leaves contains_____? []
(A) n nodes (B) $\log_2 n$ nodes (C) $2n-1$ nodes (D) 2^n nodes
5. The number of leaf nodes in a complete binary tree of depth d is_____
? [] (A) 2^d (B) $2^{d-1}+1$
(C) $2^{d+1}+1$ (D) 2^d+1
6. The pre-order and post order traversal of a Binary Tree generates the same output. The tree can have maximum_____. []
(A) Three nodes (B) Two nodes
(C) One node (D) Any number of nodes
7. The height of a tree is the length of the longest root-to-leaf path in it. The maximum and minimum number of nodes in a binary tree of height 5 are:___ []
(A) 63 and 6, respectively (B) 64 and 5, respectively
(C) 32 and 6, respectively (D) 31 and 5, respectively
8. If a node in a BST has two children, then its *inorder predecessor* has. []
(A) No left child (B) No right child
(C) Two children (D) No child
9. In order to get the contents of a Binary search tree in ascending order, one has _____to traverse it in fashion? []

- (A) pre-order (B) in-order (C) post order (D) Not possible
10. A BST is traversed in the following order recursively: **right, root, left**. The output sequence will be in []
- (A) Ascending order (B) Descending order
(C) Bitomic sequence (D) No specific order
11. In order to get the information stored in a Binary Search Tree in the descending order, one should traverse it in which of the following order? []
- (A) left, root, right (B) root, left, right
(C) right, root, left (D) right, left, root
12. What is common in three different types of traversals (Inorder, Preorder and Postorder)?
- (A) Root is visited before right subtree
(B) Left subtree is always visited before right subtree
(C) Root is visited after left subtree
(D) All of the above
13. A binary search tree contains the numbers 1, 2, 3, 4, 5, 6, 7, 8. When the tree is traversed in pre-order and the values in each node printed out, the sequence of values obtained is 5, 3, 1, 2, 4, 6, 8, 7. If tree is traversed in post-order, the sequence obtained would be _____ []
- (A) 8, 7, 6, 5, 4, 3, 2, 1 (B) 1, 2, 3, 4, 8, 7, 6, 5
(C) 2, 1, 4, 3, 6, 7, 8, 5 (D) 2, 1, 4, 3, 7, 8, 6, 5
14. Suppose that we have numbers between 1 and 100 in a binary search tree and want to search for the number 55. Which of the following sequences CANNOT be the sequence of nodes examined? []
- (A) {10, 75, 64, 43, 60, 57, 55} (B) {90, 12, 68, 34, 62, 45, 55}
(C) {9, 85, 47, 68, 43, 57, 55} (D) {79, 14, 72, 56, 16, 53, 55}
15. Consider the following rooted tree with the vertex P labeled as root. The order in which the nodes are visited during in-order traversal is ____? []
- (A) SQPTRWUV (B) SQPTURWV (C) SQPTWUVR (D) SQPTRUWV



Explanation:

The only confusion in this question is, there are 3 children of R. So when should R appear – after U or after T? There are two possibilities: SQPTRWUV and SQPTWURV. Only 1st possibility is present as an option A, the 2nd possibility is not there. Therefore option A is the right answer.

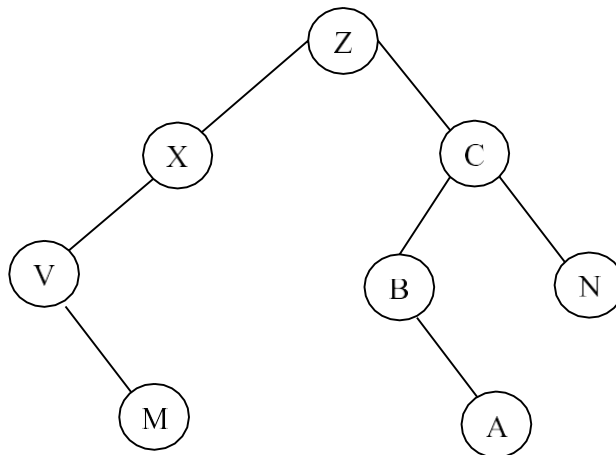
16. A _____ is a heap where the value of each parent is less than or equal to the values of its children.
17. Consider any array representation of an n element binary heap where the elements are stored from index 1 to index n of the array. For the element stored at index i of the array ($i \leq n$), the index of the left child and right child are _____.

- A) $2i+1, 2i$ B) $2i+1, \text{floor}(i/2)$ C) $2i, \text{floor}(i/2)$ D) $2i, 2i+1$

SECTION-B

Descriptive Questions

- Write recursive algorithms for Binary Search Tree Traversals.
- What is the inorder, preorder and postorder for the following binary tree?



- Construct Binary Tree for the following tree traversals. Inorder: W U R O P I T Y
E
Preorder: P O U W R I Y T E

What is the **Post order** traversal for the above constructed binary tree?

Ans: W R U O T E Y I P

4. Construct Binary Tree for the following tree

traversals.Inorder: N Z V A M C B S D

Postorder: Z A V N C S D X B M

What is the **Preorder** traversal for the above constructed binary tree?

Ans: M N V Z A B C X S D

5. Create Binary Search with the following elements.20 30 15 25 42 61 72 18 10 8

What is the **Inorder** traversal for the above constructed Binary Search tree?

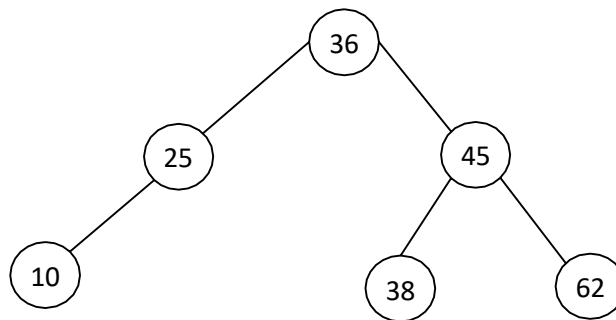
Ans: 8 10 15 18 20 25 30 42 61 72

6. Create Binary Search with the following elements.100 90 110 80 95 125 115 108
104 76 49 62

What is the **Inorder** traversal for the above constructed Binary Search tree?

Ans: 49 62 76 80 90 95 100 104 108 110 115 125

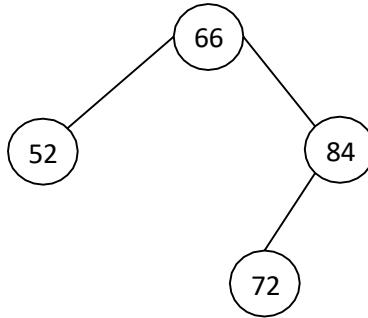
7. Consider the following Binary Search Tree and perform the following sequence of operations.



Insert the elements 55, 68, 49, 18, 28, 27, 30. Now **delete** the elements 55, 45, 36, 10 and 18.Finally what is the root node?

Ans: 38

8. Consider the following Binary Search Tree and perform the following sequence of operations.



Insert the elements 89, 46, 48, 26, 76, 98, 100. Now **delete** the elements 84, 48, 52 and 66. Finally what is the root node?

Ans: 72

9. Show the result of inserting the keys: 14, 5, 12, 6, 4, 8, 9, 13, 11, 2, 18, 30 one at a time into an initially empty Max heap with neat diagrams.
10. Show the result of inserting the keys: 10, 12, 8, 14, 6, 5, 1, 3 one at a time into an initially empty Min heap. Apply deleteMin operation on the resulting min heap
11. Construct a Max heap for the following keys: 4, 67, 23, 89, 12, 8, 7, 44, 78, 64, 70. Apply deleteMax operation on the resulting max heap.
12. Sort the following keys using Heap sort: 5, 8, 11, 3, 9, 2, 10, 1, 45, 32.

Section - C

1. Consider a binary tree T that has 200 leaf nodes. Then, the number of nodes in T that have exactly two children are? **(GATE 2016)** [] (A) 201 (B) 100 (C) 199 (D) 50
2. The maximum number of binary trees that can be formed with three unlabelled nodes is: **(GATE 2007)** []

 (A) 1 (B) 5 (C) 4 (D) 3
3. The height of a binary tree is the maximum number of edges in any root to leaf path. The maximum number of nodes in a binary tree of height h is: **(GATE 2007)** [] (A) $2^h - 1$ (B) $2^{(h-1)} - 1$ (C) $2^{(h+1)} - 1$ (D) $2^{*(h+1)}$
4. The inorder and preorder traversal of a binary tree are *d b e a f c g* and *a b d e c f g*, respectively. The postorder traversal of the binary tree is: **(GATE 2007)** []
 (A) *d e b f g c a* (B) *e d b g f c a* (C) *e d b f g c a* (D) *d e f g b c a*
5. Consider the label sequences obtained by the following pairs of traversals on a labelled binary tree. Which of these pairs identify a tree uniquely? **(GATE CS 2004)** []
 i) preorder and postorder
 ii) inorder and postorder
 iii) preorder and inorder
 iv) level order and postorder
 (A) (i) only (B) (ii), (iii) only (C) (iii) only (D) (iv) only
6. Let **LASTPOST**, **LASTIN** and **LASTPRE** denote the last vertex visited in a postorder, inorder and preorder traversal. Respectively, of a complete binary tree. Which of the following is always true? **(GATE CS 2000)** []
 (A) **LASTIN = LASTPOST** (B) **LASTIN = LASTPRE**
 (C) **LASTPRE = LASTPOST** (D) None of the above
7. While inserting the elements 71, 65, 84, 69, 67, 83 in an empty binary search tree (BST) in the sequence shown, the element in the lowest level is? **(GATE 2015)** [] (A) 65 (B) 67 (C) 69 (D) 83
8. Suppose the numbers 7, 5, 1, 8, 3, 6, 0, 9, 4, 2 are inserted in that order into an initially empty *binary search tree*. The binary search tree uses the usual ordering on natural numbers. What is the in-order traversal sequence of the resultant **(GATE CS 2003)** [] tree?
 (A) 7 5 1 0 3 2 4 6 8 9 (B) 0 2 4 3 1 6 5 9 8 7
 (C) 0 1 2 3 4 5 6 7 8 9 (D) 9 8 6 4 2 3 0 1 5 7
9. Which of the following is/are *correct* inorder traversal sequence(s) of binary search tree(s)? **(GATE 2016)** []
 I. 3, 5, 7, 8, 15, 19, 25

II. 5, 8, 9, 12, 10, 15, 25

III. 2, 7, 10, 8, 14, 16, 20

IV. 4, 6, 7, 9, 18, 20, 25

(A) I and IV only (B) II and III only (C) II and IV only (D) II only

10. Postorder traversal of a given binary search tree, T produces the following sequence of keys

10, 9, 23, 22, 27, 25, 15, 50, 95, 60, 40, 29. Which one of the following sequences of keys can

be the result of an in-order traversal of the tree T? **(GATE CS 2004)** []

(A) 9, 10, 15, 22, 23, 25, 27, 29, 40, 50, 60, 95

(B) 9, 10, 15, 22, 40, 50, 60, 95, 23, 25, 27, 29

(C) 29, 15, 9, 10, 25, 22, 23, 27, 40, 60, 50, 95

(D) 95, 50, 60, 40, 27, 23, 22, 25, 10, 9, 15, 29

11. The following numbers are inserted into an *empty binary search tree* in the given order: 10, 1, 3, 5, 15, 12, 16. What is the height of the binary search tree (the height is the maximum

distance of a leaf node from the root)? **(GATE CS 2004)** []

(A) 2 (B) 3 (C) 4 (D) 6

12. The *preorder* traversal sequence of a *binary search tree* is 30, 20, 10, 15, 25, 23, 39, 35, and

42. Which one of the following is the postorder traversal sequence of the same tree?

(GATE 2013) [] (A) 10, 20, 15, 23, 25, 35, 42, 39, 30 (B) 15, 10, 25, 23, 20, 42, 35, 39, 30

(C) 15, 20, 10, 23, 25, 42, 35, 39, 30 (D) 15, 10, 23, 25, 20, 35, 42, 39, 30

13. Let T be a binary search tree with 15 nodes. The minimum and maximum possible heights of T are: **(GATE-CS-2017 -Set 1)** [] Note:

The height of a tree with a single node is 0.

(A) 4 and 15 respectively (B) 3 and 14 respectively
(B) 4 and 14 respectively (D) 3 and 15 respectively

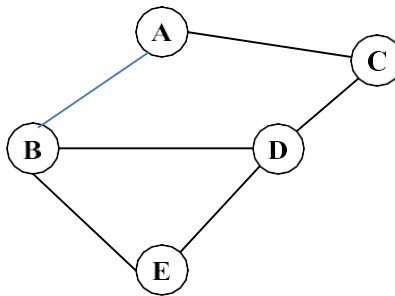
14. Let T be a tree with 10 vertices. The sum of the degrees of all the vertices in T is_.

(GATE-CS-2017 - Set 1) []

(A) 18 (B) 19 (C) 20 (D) 21

7. The node A is adjacent to _____ node. []
 A) B B) C C) D D) None
8. In the above graph there is a self loop with vertex _____. []
 A) E B) G C) H D)None
9. In a graph if $e=(u,v)$ means []
 A) u is adjacent to v but v is not adjacent to u.
 B) e begins at u and ends at v
 C) u is node and v is an edge.
 D) both u and v are edges.

Consider the following graph to answer the questions 10 to 10



10. The above graph is a _____. []
 A) Weighted graph B) Simple graph C) Acyclic Graph D) None
11. The adjacent vertices of node A are _____. []
 A) B, D, E B) B, D, C C) E, D D) None
12. The above graph is a _____. []
 A) Connected graph B) Complete graph C) Both A&B D) None
13. For an undirected graph with n vertices and e edges, the sum of the degree of each vertex is equal to []
 A) 2n B) $(2n-1)/2$ C) 2e D) $e^2/2$
14. A graph with n vertices will definitely have a parallel edge or self loop, if the total number of edges are []
 (A) more than n (B) more than n+1
 (C) more than $(n+1)/2$ (D) more than $n(n-1)/2$
15. The maximum degree of any vertex in a simple graph with n vertices is _____. []
16. An adjacency matrix representation of a graph cannot contain information of _____. []
 (A) Nodes (B) edges
 (C) Direction of edges (D) parallel edges
17. How many undirected graphs (not necessarily connected) can be constructed out of a given set $V = \{V_1, V_2, \dots, V_n\}$ of n vertices ? []
 (A) $n(n-1)/2$ (B) 2^n (C) n! (D) $2^{n(n-1)/2}$
18. The data structure required for Breadth First Traversal on a graph is _____

C). Both A & B D).

None of these

33. Primary Clustering occurs in []

A). Quadratic Probing B).

Linear Probing C).

Double hashing

D). All of the above

34. In a hash table of size 13, the elements to be inserted are 18, 31, and 44 using Division hash function. With Quadratic probing 44 can be placed in _____ cell

A). 6 B). 7 C). 8 D). 9 []

35. Primary clustering and secondary clustering are solved by _____.

36. _____ is a collision resolution technique that uses linked lists to handle collisions. []

A) . Linear probing B).

Quadratic probing C).

Double hashing D). Open

Hashing

SECTION -B

Descriptive Questions

1. Write adjacency matrix representation of graph with an example.
2. Write linked representation of graph with an example.
3. Write set representation of graph with an example.
4. Write DFS Algorithm & Write BFS Algorithm.
5. Consider the graph given below
 - a) Write the adjacency matrix of G1.
 - b) Give Linked list representation of G1.
 - c) Give Set representation of G1.
 - d) Is the graph complete?
 - e) Is the graph strongly connected?
 - f) Find out the degree of each node.
 - g) Is the graph regular?

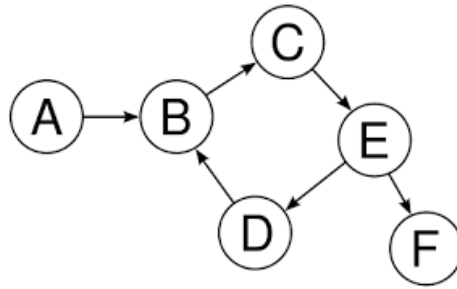
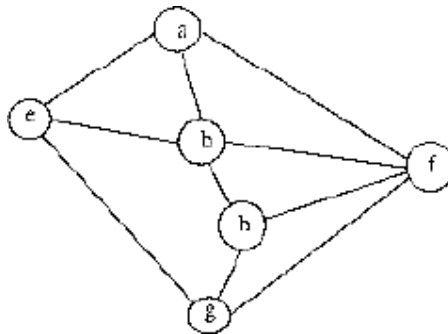


Fig. Graph G1

6. Consider the following adjacency matrix, draw the weighted graph.

$$\begin{pmatrix} 0 & 4 & 0 & 2 & 0 \\ 0 & 0 & 0 & 7 & 0 \\ 0 & 5 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 3 \\ 0 & 0 & 1 & 0 & 0 \end{pmatrix}$$

7. Consider the following graph

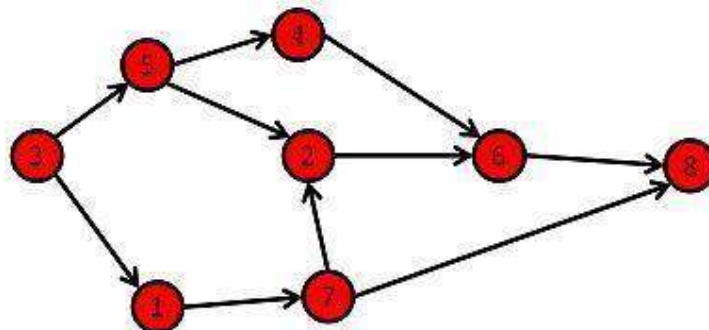


Among the following sequences

- i) a b e g h f ii) a b f e h g iii) a b f h g e iv) a f g h b e

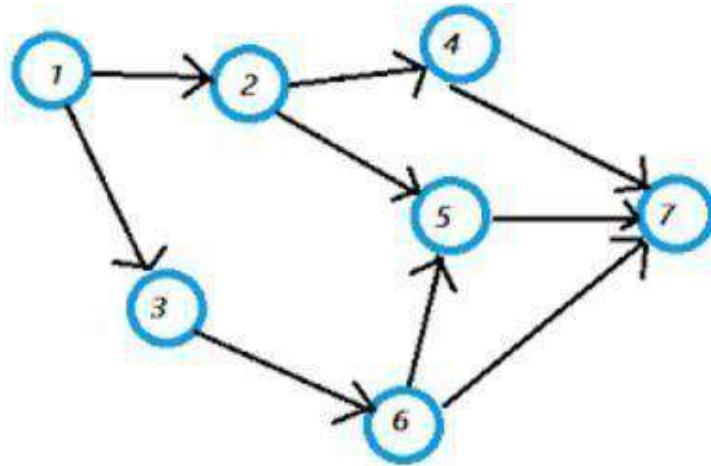
Which are depth first traversals of the above graph?

8. Consider the following graph



What is breadth first traversal of the above graph if starting vertex is 3?

9. Consider the following graph



What is the depth first traversal of the above graph if starting vertex is 1?

10. Calculate the hash table indexes using Division and Multiplication hash functions for the keys: 25, 4, 16, 100, 32, 58 with the size of the hash table as $m=11$
11. Construct the open hash table using separate chaining for the input: 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 140 using the hash function $h(k) = k \bmod 11$
12. Show the result of inserting the keys: 12, 44, 13, 88, 23, 94, 11, 39, 16 into a hash table of size $m=13$ with the primary hash function as $h(k) = k \% m$ using Linear Probing
13. Show the result of inserting the keys: 12, 44, 13, 88, 23, 94, 11, 39, 20 into a hash table of size $m=11$ with the primary hash function as $h(k) = k \% m$ using Quadratic Probing
14. Show the result of inserting the keys: 15, 11, 25, 16, 36, 47, 22 into a hash table of size $m=11$ using Double hashing with $h_1(k) = k \% m$ and $h_2(k) = R - (k \bmod R)$ where $R < m$ and is prime
15. Consider inserting the keys: 20, 29, 45, 49, 52, 59, 65 into a hash table of size $m=10$ using the primary hash function as $h(k) = k \% m$. Illustrate the result of inserting these keys using quadratic probing with $h^i(k) = (h(k) + i + 3i^2) \bmod m$
16. Consider inserting the keys 10, 22, 31, 4, 15, 28, 17 into a hash table of length $m = 11$ using the primary hashing function $h(k) = k \bmod m$. Illustrate the result of inserting these keys using Double hashing with rehashing function $h^i(k) = (h(k) + i(1 + k \bmod (m - 1))) \bmod m$.
17. Consider inserting the keys 7, 18, 48, 10, 36, 25, 47 into a hash table of size $m=10$ using linear probing. Apply hash table restructuring and show the resulting new Hash table.

Section C

Questions asked in GATE

1. Consider any array representation of an n element binary heap where the elements are stored from index 1 to index n of the array. For the element stored at index i of the array ($i \leq n$), the index of the parent is _____ (GATE-CS-2001) []

- A) $i-1$ B) $\text{floor}(i/2)$ C) $\text{ceiling}(i/2)$ D) $(i+1)/2$

2. In a Binary max heap containing n numbers, the smallest element can be found in time

(GATE 2006) []

- A) $O(n)$ B) $O(\log n)$ C) $O(\log \log n)$ D) $O(1)$

3. Which of the following sequences of array elements forms a heap? []A)

{23, 17, 14, 6, 13, 10, 1, 12, 7, 5} (GATE IT 2006)

B) {23, 17, 14, 6, 13, 10, 1, 5, 7, 12}

C) {23, 17, 14, 7, 13, 10, 1, 12, 5, 7}

D) {23, 17, 14, 7, 13, 10, 1, 5, 6, 12}

4. Consider a binary max-heap implemented using an array. Which one of the following array represents a binary max-heap? (GATE CS 2009) []

A) 25,12,16,13,10,8,14

B) 25,14,16,13,10,8,12

C) 25,14,12,13,10,8,16

D) 25,16,12,13,10,8,12

5. What is the content of the array after two delete operations on the correct answer to the previous question? (GATE CS 2009) []

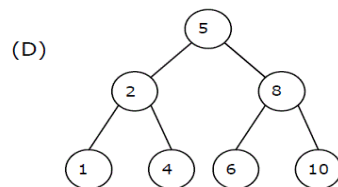
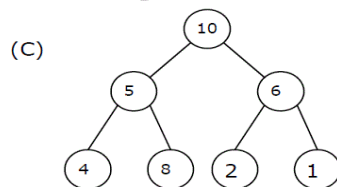
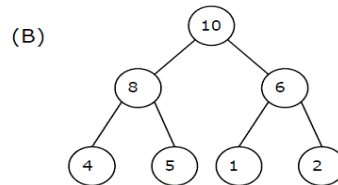
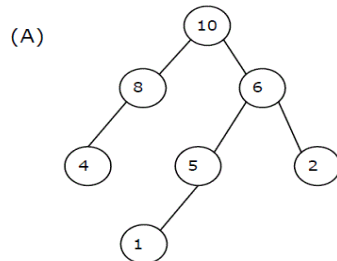
A) 14,13,12,10,8

B) 14,12,13,8,10

C) 14,13,8,12,10

D) 14,13,12,8,10

6. A max-heap is a heap where the value of each parent is greater than or equal to the values of its children. Which of the following is a max-heap? (GATE CS 2011) []



7. A priority queue is implemented as a Max-Heap. Initially, it has 5 elements. The level-order traversal of the heap is: 10, 8, 5, 3, 2. Two new elements 1 and 7 are inserted into the heap in that order. The level-order traversal of the heap after the insertion of the elements is: (GATE-CS-2014) []

(A) 10, 8, 7, 3, 2, 1, 5

(B) 10, 8, 7, 2, 3, 1, 5

(C) 10, 8, 7, 1, 2, 3, 5

(D) 10, 8, 7, 5, 3, 2, 1

8. Consider a max heap, represented by the array: 40, 30, 20, 10, 15, 16, 17, 8, 4. Now consider that a value 35 is inserted into this heap. After insertion, the new heap is

(GATE-CS-2015)[]

A) 40, 30, 20, 10, 15, 16, 17, 8, 4, 35

B) 40, 35, 20, 10, 30, 16, 17, 8, 4, 15

C) 40, 30, 20, 10, 35, 16, 17, 8, 4, 15

D) 40, 35, 20, 10, 15, 16, 17, 8, 4, 30

9. A 3-ary max heap is like a binary max heap, but instead of 2 children, nodes have 3 children. A 3-ary heap can be represented by an array as follows: The root is stored in the first location, $a[0]$, nodes in the next level, from left to right, is stored from $a[1]$ to $a[3]$. The nodes from the second level of the tree from left to right are stored from $a[4]$ location onward. An item x can be inserted into a 3-ary heap containing n items by placing x in the location $a[n]$ and pushing it up the tree to satisfy the heap property. Which one of the following is a valid sequence of elements in an array representing 3-ary max heap?

(GATE 2006)

A) 1, 3, 5, 6, 8, 9 B) 9, 6, 3, 1, 8, 5 C) 9, 3, 6, 8, 5, 1 D) 9, 5, 6, 8, 3, 1

10. Suppose the elements 7, 2, 10 and 4 are inserted, in that order, into the valid 3-ary max heap found in the above question, which one of the following is the sequence of items in the array representing the resultant heap?**(GATE CS 2006)**

A) 10, 7, 9, 8, 3, 1, 5, 2, 6, 4

B) 10, 9, 8, 7, 6, 5, 4, 3, 2, 1

C) 10, 9, 4, 5, 7, 6, 8, 2, 1, 3 D) 10, 8, 6, 9, 7, 2, 3, 4, 1, 5

11. Consider the following array of elements. $\langle 89, 19, 50, 17, 12, 15, 2, 5, 7, 11, 6, 9, 100 \rangle$. The minimum number of interchanges needed to convert it into a max-heap is

GATE-CS-2015)

A) 4

B) 5

C) 2

D) 3

12. An operator $\text{delete}(i)$ for a binary heap data structure is to be designed to delete the item in the i -th node. Assume that the heap is implemented in an array and i refers to the i -th index of the array. If the heap tree has depth d (number of edges on the path from the root

to the farthest leaf), then what is the time complexity to re-fix the heap efficiently after the removal of the element?**(GATE 2016)**

A) $O(1)$ B) $O(d)$ but not $O(1)$ C) $O(2^d)$ but not $O(d)$
D) $O(d \cdot 2^d)$ but not $O(2^d)$

13. A complete binary min-heap is made by including each integer in $[1, 1023]$ exactly once. The depth of a node in the heap is the length of the path from the root of the heap to that node. Thus, the root is at depth 0. (GATE 2016) []
 A) 6 B) 7 C) 8 D) 9
14. Which of the following statements is/are TRUE for undirected graphs?P:
 Number of odd degree vertices is even.
 Q: Sum of degrees of all vertices is even. (GATE 2013) []
 A) P only B) Q only C) Both P and Q D) Neither P nor Q
15. Let G be a simple undirected planar graph on 10 vertices with 15 edges. If G is a connected graph, then the number of bounded faces in any embedding of G on the plane is equal to_____ (GATE 2012) []
 A) 3 B) 4 C) 5 D) 6
16. Which one of the following is TRUE for any simple connected undirected graph with more than 2 vertices? (GATE 2009)
 A) No two vertices have the same degree. B) At least two vertices have the same degree.
 C) At least three vertices have the same degree. D) All vertices have the same degree.

Signature of the Faculty

Semester II: Professional Communication

Number of credits: 2

periods/hours per week : 2

Number of

A. COURSE OBJECTIVES

- a To equip the students with common employability skills (the skills required for gaining employment and performing successfully in different careers) which can enable them to perform communication tasks of increasing length and complexity.
- b To develop in them the interactional communication strategies and social graces which have the potential to add to the effectiveness of professional communication

B. LEARNING OUTCOMES

Upon successful completion of Professional Communication, the students will be able to:

- A. speak with a reasonable degree of fluency and accuracy in professional communication situations (such as arriving at a consensus through discussion, making a presentation, and taking part in a telephone conversation)
- B. add to the effectiveness of their oral communication by using communication strategies, conventions of politeness and courtesy, and stress and intonation.
- C. listen to short audio and video clips in native English accent (British and American), and gain both understanding of messages and sensitivity to native- speaker accents
- D. read fluently, comprehending texts of different kinds using multiple strategies and higher-order skills
- E. produce written discourses of different kinds (e.g. texts expressing opinions and making a convincing case for one's standpoint, professional emails, and summaries of lengthy texts) with attention to elements of writing such as content, organization, language, style, and mechanics

F. guard against grammatical errors Indians typically make in their speech and writing in English

UNIT - 1 (09 PERIODS)

| S. No. | Components | No. of Periods |
|--------|--|----------------|
| 1. | Listening: Listening comprehension – Task 1 (IWE – Chapt VII) | 1 |
| 2. | Speaking: Communication Strategies: Conversation Amith& Mahesh (IWE – Chap VII) | 2 |
| 3. | Reading: Reading Comprehension – Task 1 (IWE – Chapt VII) | 1 |
| 4. | Vocabulary: (a) GRE words – 1.3, (b) Collocations – 2.3 (VB) | 2 |
| 5. | Grammar: <i>If</i> Clause (IWE – Chapt VII) | 2 |
| 6. | Writing: Email writing (IWE – Chapt VII) | 1 |

UNIT - 2 (08 PERIODS)

| S. No. | Components | No. of Periods |
|--------|--|----------------|
| 1. | Listening: Listening comprehension – Task 2 (WR) | 1 |
| 2. | Speaking: Exercise on Communication Strategies (IWE – Chapt VII) | 1 |
| 3. | Reading: Reading Comprehension – Task 2 (DPM) | 1 |
| 4. | Vocabulary: Words often confused – 3.3, One-word substitutes – 4.3 (VB) | 2 |
| 5. | Grammar: Modal verbs (IWE – Chap VII) | 1 |
| 6. | Writing: Email writing and Argumentative Essay (IWE – Chapt VII) | 2 |

UNIT - 3 (09 PERIODS)

| S. No. | Components | No. of Periods |
|--------|--|----------------|
| 1. | Listening: Listening comprehension – Task 3 (WR) | 1 |
| 2. | Speaking: Communication Strategies – Exercise (DPM) | 1 |

| | | |
|----|---|---|
| 3. | Intensive Reading: Reading Comprehension – Task 3 (DPM)
Extensive Reading: <i>Pride and Prejudice</i> by Jane Austen | 2 |
| 4. | Vocabulary: (a) Idioms – 5.3, (b) Phrasal verbs – 6.3 (VB) | 2 |
| 5. | Grammar: Indianism (IWE – Chapt VII) | 1 |
| 6. | Writing: Argumentative Essay (DPM) | 2 |

UNIT - 4 (09 PERIODS)

| S. No. | Components | No. of Periods |
|--------|---|----------------|
| 1. | Listening: Listening comprehension – Task 4 (IWE – Chapt VIII) | 1 |
| 2. | Speaking: Communication Strategies and Presentation: Conversation between Suchitra, Lakshmi, Guhan and Karan ((IWE – Chapt VIII) | 2 |
| 3. | Reading: Reading Comprehension – Task 4 (DPM) | 1 |
| 4. | Vocabulary: (a) GRE Words – 1.4, (b) Collocations – 2.4, (c) Words Often Confused – 3.4 (VB) | 3 |
| 5. | Grammar: Indefinite Articles (IWE – Chapt VIII) | 1 |
| 6. | Writing: Presentation – Analysis (DPM) | 1 |

UNIT - 5 (08 PERIODS)

| S. No. | Components | No. of Periods |
|--------|---|----------------|
| 1. | Listening: Listening comprehension – Task 5 (WR) | 1 |
| 2. | Speaking: Communication Strategies – Exercise (IWE – Chapt VIII) | 1 |
| 3. | Intensive Reading: Reading Comprehension Task – 5 (DPM)
Extensive Reading: <i>Gulliver's Travels</i> by Jonathan Swift | 2 |
| 4. | Vocabulary: (a) One-Word Substitutes – 4.4, (b) Idioms – 5.4, (c) Phrasal verbs – 6.4 (VB) | 2 |
| 5. | Grammar: Definite Articles (IWE – Chapt VIII) | 1 |
| 6. | Writing: Presentation – Rewriting | 1 |

- IWE – *Innovate with English* by T Samson (Foundation)
- Chapt - Chapter
- DPM – Department-produced materials (handouts)

- WR – Web-resources
- VB– *Vocabulary Builder for Students of Engineering and Technology* by Vijaya Lakshmi et al (Maruthi)

Note:

- 1 To be done in 43-45 periods of 50 minutes each.
- 2 Mid I test to be set on Units 1, 2 and 3 and Mid II test on Units 4 and 5.
- 3 Where a section requires more number of periods than suggested above for one component and fewer for another, adjustments may be made in consultation with the Head of the Department.

Signature of the Faculty

1. Brief History and Scope of the Subject

“MATHEMATICS IS THE MOTHER OF ALL SCIENCES”, It is a necessary avenue to scientific knowledge, which opens new vistas of mental activity. A sound knowledge of engineering mathematics is essential for the Modern Engineering student to reach new heights in life. So students need appropriate concepts, which will drive them in attaining goals.

Scope of mathematics in engineering study :

Mathematics has become more and more important to engineering Science and it is easy to conjecture that this trend will also continue in the future. In fact solving the problems in modern Engineering and Experimental work has become complicated, time – consuming and expensive. Here mathematics offers aid in planning construction, in evaluating experimental data and in reducing the work and cost of finding solutions.

The most important objective and purpose in Engineering Mathematics is that the students become familiar with Mathematical thinking and recognize the guiding principles and ideas “Behind the science” which are more important than formal manipulations. The student should soon convince himself of the necessity for applying mathematical procedures to engineering problems.

2. Pre-Requisites

Basic Knowledge of Mathematics such as differentiation and Integration at Intermediate Level is necessary.

3. Course Objectives:

- To gain the knowledge of Laplace and inverse transforms
- To understand the concepts of Fourier series and Fourier transforms
- To find the solutions of integral problems using vector concepts

4. Course Outcomes:

Students will be able to

CO1: Evaluate improper integrals using Laplace transform technique

CO2: apply Laplace transforms to find the solutions of ODE

CO3: Express a function in Fourier series and in Fourier integral form.

CO4: apply the concepts of vector differentiation to the surfaces.

CO5: apply the concepts of vector integration to the surfaces and volumes.

5. Mapping of Course Outcomes with Program Outcomes:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3 | 2 | | | | | | | | | | | | |
| CO2 | 2 | 1 | | | | | | | | | | | | |
| CO3 | 2 | | | | | | | | | | | | | |
| CO4 | 3 | 2 | | | | | | | | | | | | |
| CO5 | 3 | 2 | | | | | | | | | | | | |

6. Prescribed Text Books

1. B.S.Grewal, Higher Engineering Mathematics : 42nd edition, Khanna Publishers,2012 , New Delhi.
2. B.V Ramana, Higher Engineering Mathematics, Tata-Mc Graw Hill Company Ltd.

7. Reference Text Books

1. U.M.Swamy, A Text Book of Engineering Mathematics – I & II : 2nd Edition, Excel

Books, 2011, New Delhi.

2. Erwin Kreyszig, Advanced Engineering Mathematics : 8th edition, Maitrey Printech Pvt. Ltd, 2009, Noida.
3. Dr. T.K.V.Iyengar, Dr. B.Krishna Gandhi, S.Ranganatham and Dr. M.V.S.S.N.Prasad, Engineering Mathematics, Volume-I, II, III: 11th edition, S.chand Publishers, 2012. New Delhi.

8. URLs and Other E-Learning Resources

Sonet CDs & IIT CDs on some of the topics are available in the digital library.

9. Digital Learning Materials:

- https://www.youtube.com/watch?v=2r_t8UaZosg&feature=youtu.be
- <https://www.youtube.com/watch?v=9UsOOxLKITc>
- <https://www.youtube.com/watch?v=x04dnqg-iPw>
- <https://www.youtube.com/watch?v=1JnayXHhjlq>
- <https://www.youtube.com/watch?v=AQhCGkK-hoA>
- <https://www.youtube.com/watch?v=o2kbrqOgzOE>

10. Lecture Schedule / Lesson Plan

| S.No | TOPIC | No of. Periods | No of. Tutorials |
|-----------------|---|----------------|------------------|
| UNIT-I | | | |
| 1 | Laplace transforms of standard functions | 1 | 1 |
| 2 | Shifting Theorems | 1 | |
| 3 | change of scale | 1 | |
| 4 | Transforms of derivatives | 1 | |
| 5 | Transforms of integrals | 1 | 1 |
| 6 | Unit step function –Dirac's delta function | 1 | |
| 7 | Evaluation of Improper Integrals | 2 | |
| 8 | Review and conclusion | 1 | |
| UNIT-II | | | |
| 9 | Inverse Laplace transforms | 1 | 1 |
| 10 | Inverse Laplace transforms by partial fractions | 2 | |
| 11 | Convolution theorem (with out proof). | 1 | |
| 12 | Inverse Laplace transforms by Convolution theorem | 1 | 1 |
| 13 | Solutions of ordinary differential equations using Laplace transforms | 3 | |
| UNIT-III | | | |
| 14 | Fourier series | 1 | 1 |
| 15 | Fourier series in an arbitrary interval | 3 | |
| 16 | Half range sine and cosine series | 2 | |
| 17 | Fourier integral theorem | 1 | 1 |
| 18 | Properties of Fourier transform (without proofs) | 1 | |
| 19 | Fourier transform, sine and cosine transforms & Problems | 1 | |
| 20 | Inverse Fourier transforms | 2 | 1 |
| 21 | Review and conclusion | 1 | |

| | | | |
|--------------|----------------------------|----|----|
| | UNIT-IV | | |
| 22 | Vector differentiation | 1 | 1 |
| 23 | Gradient,divergence,curl | 4 | |
| 24 | Laplacian operator | 2 | 1 |
| 25 | Review and conclusion | 1 | |
| | UNIT-V | | |
| 26 | Line integral-work done | 2 | 1 |
| 27 | Green's Theorem | 2 | |
| 28 | Gauss - Divergence Theorem | 2 | |
| 29 | Stoke's Theorem | 2 | |
| 30 | Review and conclusion | 1 | |
| TOTAL | | 46 | 10 |

11. Seminar Topics

- Modelling and solving higher order ODE for Electrical Circuits
- Modelling and solving PDE with Fourier Methods

Signature of the Faculty

HANDOUT ON BASIC ELECTRONIC DEVICES

Class & Sem. : I B.Tech. – II Semester

Year : 2020-21

Branch : CSE

Credits : 2

1. Brief History and Scope of the Subject

Basic electronics exploit the electronic properties of semiconductor materials, principally silicon, germanium, and gallium arsenide. Semiconductor devices have replaced thermionic devices (vacuum tubes) in most applications. They use electronic conduction in the solid state as opposed to the gaseous state or thermionic emission in a high vacuum.

Semiconductor materials are useful because their behavior can be easily manipulated by the addition of impurities, known as doping. Semiconductor conductivity can be controlled by the introduction of an electric or magnetic field, by exposure to light or heat, or by the mechanical deformation of a doped monocrystalline grid; Thus, semiconductors can make excellent sensors. Current conduction in a semiconductor occurs via mobile or "free" electrons and holes, collectively known as charge carriers.

Advanced topics in Semiconductor devices include manufacturing semiconductor devices both as single discrete devices and as integrated circuits (ICs), which consist of a number—from a few (as low as two) to billions of devices manufactured and interconnected on a single semiconductor substrate or wafer.

2. Pre-Requisites

- Semiconductor physics

3. Course Objectives:

- To familiarize the student with the basic construction, characteristics of semiconductor devices like diode, transistor, FET and MOSFET.
- To introduce various applications of semiconductor devices.

4. Course Outcomes: Students will be able to

CO1: Understand the behavior of different semiconductor devices.

CO2: Identify appropriate semiconductor devices for various applications.

CO3: Analyze the rectifier circuits with and without filters.

CO4: Describe the switching and amplification action of BJT and MOSFET.

5. Program Outcomes:

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

Student will be able to

- Design, develop, test and maintain reliable software systems and intelligent systems.
- Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3 | | 3 | | | | | | | | | | 1 | |
| CO2 | 3 | 3 | 3 | | | | | | | | | | 1 | |
| CO3 | 3 | 1 | 1 | | | | | | | | | | 1 | |
| CO4 | 3 | 1 | 1 | | | | | | | | | | 1 | |

7. Prescribed Text Books

1. Jacob Millman and Christos C Halkias, Electronic Devices and Circuits, 3rd Edition, TMH, 2014.
2. Robert L Boylested and Louis Nashelsky, Electronic Devices and Circuit Theory, 11th Edition, Pearson, 2015.

Reference Text Books

1. Ben G. Streetman, Sanjay Kumar Banerjee, Solid State Electronic Devices, 6th Edition, PHI Publications, 2013.
2. Theodore F Bogart Jr., Jeffrey S Beasley and Guiliermo Rico, Electronic Devices and Circuits, 6th Edition, Pearson Education 2004.
3. David A Bell, Electronic Devices and Circuits, 4th Edition, PHI, 2003.
4. Floyd, Thomas, Electronic Devices, Pearson Education, 9th Edition, 2015.

8. URLs and Other E-Learning Resources

1. Basic Electronics -- Prof.R.V.Raja Kumar -- 38 Units.
2. Introduction to Electronic Circuits -- Prof.S.C.Dutta Roy -- 39 Units.
3. Solid state devices -- Dr.S.Karmalkar -- 42 Units.
4. Analog Electronic Circuits -- Prof. S.C.Dutta Roy -- 51 Units.

9. Digital Learning Materials:

Video courses:

- a. Basic Electronics by Prof. Chitralkha Mahanta (IITG)
- b. Semiconductor Devices by Dr. G.S. Visweswaran (IITD)
- c. Electronics for Analog Signal Processing–I by Prof. K.RadhakrishnaRao
- d. Electronics for Analog Signal Processing – II by Prof. K. RadhakrishnaRao
- e. Analog Circuits by Prof. A.N. Chandorkar (IITB)

URLs:

- <http://newton.ex.ac.uk/teaching/CDHW/Electronics2/Electronics Resources.html>
- www.Williamson-labs.com/480_xtor.htm
- www.discovercircuits.com/resources/tutorials.html

- www.discovercircuits.com/circuit-solutions/circuit-solu4.html
- www.discovercircuits.com/other-links.html
- <http://users.pandora.be/educyclopedia/electronics/components.html>

10. Lecture Schedule / Lesson Plan

| Topic | No. of Periods |
|---|----------------|
| | Theory |
| UNIT –1: | |
| Semiconductor Diode Characteristics | |
| Review of semiconductors | 1 |
| Open circuited PN junction | 1 |
| Current components in a PN diode | 1 |
| Diode forward and reverse currents | 1 |
| The Volt-Ampere characteristics, | 2 |
| Temperature dependence of V-I characteristics | 1 |
| Diode Resistance, Diode Capacitances: (No derivation for current equation and capacitances) | 1 |
| Problems. | 1 |
| Unit –II | |
| Special Semiconductor Devices | |
| Breakdown mechanisms: Avalanche breakdown and Zener breakdown | 1 |
| Zener diode | 2 |
| Tunnel diode | 2 |
| Varactor diode | 1 |
| Photo diode | 1 |
| UJT(Only V-I Characteristics). | 2 |
| Unit –III | |
| Rectifiers and Filters | |
| Diode as a rectifier | 1 |
| Half wave rectifier | 2 |
| Full wave center tapped and bridge rectifiers | 2 |
| Comparison of rectifiers | 1 |

| | |
|---|-----------|
| Rectifier with inductor filter | 1 |
| Capacitor filter, L section filter, Π -section filter, comparison | 2 |
| Zener diode voltage regulator: (No for filters and regulator) | 1 |
| Problems. | 1 |
| Unit –IV
Bipolar Junction Transistor | |
| Construction of a transistor | 2 |
| Transistor current components | 2 |
| Transistor configurations | 1 |
| CB, CE and CC | 3 |
| Early effect | 1 |
| comparison of CB, CE and CC | 1 |
| Transistor operating regions | 1 |
| BJT as a switch and Amplifier | 1 |
| Problems. | 1 |
| Unit –V
Field Effect Transistors | |
| Classification of FETs | 1 |
| Characteristics of FET | 2 |
| FET as a voltage variable resistor | 2 |
| Transfers Characteristics | 1 |
| Comparison with BJT | 1 |
| Depletion type MOSFET | 2 |
| Enhancement type MOSFET | 2 |
| Comparison of E-MOS and D-MOS | 1 |
| MOS FET as a switch and Amplifier | 1 |
| Problems. | 1 |
| TOTAL NO. | 56 |
| OF CLASSES | |

11. Seminar Topics

- Intrinsic and Extrinsic Semiconductors.
- LED
- Photo Diode.
- Logic Gates.

Assignment – Cum - Tutorial Questions

UNIT I

1.1 Review of Semiconductors:

- In insulators, the energy gap between valence and conduction bands is
a) very large b) zero c) very small d) infinite
- In conductors, the energy gap between valence and conduction bands is
a) very large b) zero c) very small d) infinite
- In semiconductors, the energy gap between valence and conduction bands is
a) very large b) zero c) very small d) infinite
- Addition of pentavalent impurity to a semiconductor creates many
a) free electrons b) holes c) valence electrons d) bound electrons
- When we add a trivalent impurity to a pure semiconductor material, then _____ type semiconductor material is formed.
- The conductivity of an intrinsic semiconductor is given by
a) $\sigma_i = en_i^2 (\mu_n - \mu_p)$ b) $\sigma_i = en_i (\mu_n - \mu_p)$ c) $\sigma_i = en_i (\mu_n + \mu_p)$ d) $\sigma_i = en_i (\mu_n + \mu_p)^2$
- The electron and hole concentration in an intrinsic semiconductor are n_i/cm^3 at 300k. Now, if acceptor impurities are concentration of N_a/cm^3 (where $N_a \gg n_i$), the electron concentration cm^{-3} at 300k will be
(a) n_i (b) $n_i + N_a$ (c) $N_a - n_i$ (d) n_i^2/N_a
- The Probability that an electron in a metal occupies the Fermi level, at any temperature. ($> 0K$)
(a) 0 (b) 1 (c) 0.5 (d) 1.0
- In a P-type Si sample the hole concentration is $2.25 \times 10^{15}/cm^3$. The intrinsic carrier Concentration is $1.5 \times 10^{10}/cm^3$ the electron concentration is
(a) Zero (b) $10^{10}/cm^3$ (c) $10^5/cm^3$ (d) $1.5 \times 10^{25}/cm^3$
- A small concentration of minority carries is injected into a homogeneous Semiconductor crystal at one point. An electric field of 10V/cm is applied across the crystal and this moves the minority carries a distance of 1 cm in 20 μ sec. The mobility (in cm^2/v -sec) will be
(a) 1,000 (b) 2,000 (c) 5,000 (d) 500,000
- _____ is defined as the electric current due to the motion of charge carriers under the influence of electric field.
- _____ is the current which flows even in the absence of electric field provided a concentration gradient exists in the material.
- Under low level injection assumption, the injected minority carrier current for an extrinsic semiconductor is essentially the
(a) Diffusion current (b) Drift current (c) Recombination current
(d) Induced current
- Calculate the thermal voltage when the temperature is 25°C.
a) 0V b) 10V c) 0.026V d) 0.25V
- Assertion (A): Silicon is preferred over germanium in manufacture of semiconductor devices.
Reason (R): Forbidden gap in silicon is more than that in germanium.
a. Both A and R are true and R is correct explanation of A
b. Both A and R are true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true

1.2 Open Circuited P-N Junction

- The current in the open circuited p-n junction is
 - Zero
 - infinity
 - less than unity
 - None.
- The region which consists of uncovered immobile charges is called
 - Depletion region
 - Space charge region
 - Transition region
 - All the above
- What is the value of kT at room temperature?
 - 0.0256eV
 - 0.25eV
 - 25eV
 - 0.0025eV
- The potential present at the junction because of immobile positive and negative charges is called _____.
- The arrow in the symbol of the diode indicates _____.
- The boundary between p-type material and n-type material is called
 - diode
 - PN junction
 - forward biased diode
 - reverse biased diode

1.3 Current Components in a P-N Diode

- What is the total current in a diode when $x=0$?
 - $I = I_{pn}(0) - I_{np}(0)$
 - $I = I_{pn}(0) + I_{np}(0)$
 - $I = -I_{pn}(0) - I_{np}(0)$
 - $I = -I_{pn}(0) + I_{np}(0)$
- Calculate the total current when $I_{pn}(0)=1\text{mA}$ and $I_{np}(0)=2\text{mA}$.
 - 1mA
 - 1mA
 - 0
 - 3mA
- What does I_{np} represent?
 - Hole current in n region
 - Hole current in p region
 - Electron current in n region
 - Electron current in p region
- What does I_{pn} represent?
 - Hole current in n region
 - Hole current in p region
 - Electron current in n region
 - Electron current in p region

1.4 Diode Forward and Reverse Currents:

- The diode forward current equation is given as _____.
- Calculate the reverse saturation current of a diode if the current at 0.2V forward bias is 0.1mA at a temperature of 25°C and the ideality factor is 1.5.
 - 5.5×10^{-9} A
 - 5.5×10^{-8} A
 - 5.5×10^{-7} A
 - 5.6×10^{-10} A
- A forward potential of 10V is applied to a Si diode. A resistance of 1 K Ω is also in series with the diode. The current is.....
 - 10mA
 - 9.3mA
 - 0.7mA
 - 0
- In the diode equation, the voltage equivalent of temperature is.....
 - 11600/T
 - T/11600
 - T x 11600
 - 11600/T²

1.5 The Volt-Ampere Characteristics

- The knee voltage (cut in voltage) of Si diode is

- a. 0.2 V b. 0.7 V c. 0.8V d. 1.0 V
- When the diode is forward biased, it is equivalent to
 - An off-switch
 - An on-switch
 - high resistance device
 - None of the above
 - When the diode is reverse biased, it is equivalent to
 - An off-switch
 - An on-switch
 - high resistance device
 - None of the above
 - When a reverse bias is applied to a diode, it will
 - Raise the potential barrier
 - Lower the potential barrier
 - Increases the majority-carrier a current greatly
 - None of the above.

1.6 Temperature Dependence On V-I Characteristics Of A P-N Junction Diode

- Reverse saturation current in a Silicon PN junction diode nearly doubles for every
 - 2°C rise in temp.
 - 5°C rise in temp
 - 6°C rise in temp.
 - 10°C rise in temp.

1.7 Diode Resistances

- What is the resistor value of an ideal diode in the region of conduction?
 - 0Ω
 - 5KΩ
 - Infinity
 - Undefined
- The static resistance R of the diode is given by _____
 - V/I
 - V*I
 - V+I
 - V-I
- The formula for dynamic resistance is given by _____.
- Calculate the static resistance R_D of a diode having $I_D=30\text{mA}$ and $V_D=0.75\text{V}$.
 - 25Ω
 - 40KΩ
 - 0.04Ω
 - 0.025Ω

1.8 Diode Capacitances

- Which capacitance dominates in the reverse-bias region?
 - Depletion
 - Conversion
 - Diffusion
 - None of the above
- Transition capacitance is also called as _____
 - diffusion capacitance
 - depletion capacitance
 - conductance capacitance
 - resistive capacitance
- Which capacitance dominates in the forward-bias region?
 - Depletion
 - Conversion
 - Diffusion
 - None of the above

II) Subjective Questions:

1.1. Review Of Semiconductors:

- What do you understand by intrinsic semiconductors?
- Explain the formation of p-type semiconductor and draw its energy band diagram?
- Explain the formation of n-type semiconductor and draw its energy band diagram?
- Describe briefly the Drift and Diffusion currents?
- Explain mobility and conductivity of a semiconductor material?
- Differentiate between Intrinsic and Extrinsic semiconductors.
- In a P-type silicon sample, the hole concentration is $2.25 \times 10^{15} / \text{cm}^3$. If the intrinsic Carrier concentration is $1.5 \times 10^{10} / \text{cm}^3$, find out the electron concentration.
- Determine the conductivity of Germanium
 - In intrinsic condition at 300K
 - with donor impurity of 1 in 10^7
 - With acceptor impurity of 1 in 10^8
 - with both impurities simultaneously

9. Given that for Germanium at room temperature $n_i=2.5 \times 10^{13}/\text{cm}^3$, $\mu_n=3800\text{cm}^2/\text{V}\cdot\text{s}$, $\mu_p=1800\text{cm}^2/\text{V}\cdot\text{s}$ and a number of Germanium atoms/ $\text{cm}^3=4.4 \times 10^{22}/\text{cm}^3$. Find the conductivity of silicon when the donor impurity of 1 in 10^8 is applied.
10. The intrinsic value of silicon atom is $1.5 \times 10^{10} \text{ cm}^{-3}$ at 300°K . The mobility of electrons and holes are $1300\text{cm}^2/\text{V}\cdot\text{sec}$ and $500 \text{ cm}^2/\text{V}\cdot\text{sec}$ respectively. The number of silicon atoms is $5 \times 10^{25} \text{ cm}^{-3}$.
11. The intrinsic carrier concentration of silicon sample at 3000 K is $1.5 \times 10^{16}/\text{m}^3$. If after doping, the number of majority carriers is $5 \times 10^{20}/\text{m}^3$, the minority carrier density is?
12. A silicon bar is doped with donor impurities $N_D = 2.25 \times 10^{15} \text{ atoms}/\text{cm}^3$. Given the intrinsic carrier concentration of silicon at $T = 300 \text{ K}$ is $n_i = 1.5 \times 10^{10} \text{ cm}^{-3}$. Assuming complete impurity ionization, the equilibrium electron and hole concentrations are?

1.2 Open Circuited P-N Junction

1. Explain the formation of depletion region in an open – circuited p–n junction with neat sketches. (or) Explain how a barrier potential is developed at the junction?

1.3. Current Components in a P-N Diode

1. Explain the current components of diode.

1.4 Diode Forward and Reverse Currents

1. Write the expression for diode forward and reverse currents and explain?
2. The voltage across a Si diode at room temperature is 0.7V when 2mA current flows through it. If the voltage increases to 0.75V , calculate the diode current ($V_T=26\text{mV}$).

1.5. The Volt-Ampere Characteristics

1. Explain the operation of a PN junction diode under forward bias and reverse bias?
2. Draw the V-I characteristics of a pn junction diode and explain?
3. The diode current of 0.6mA when applied voltage is 0.4V and 20mA when the applied voltage is 0.5 V . Determine η and reverse saturation current of the diode.
4. The reverse saturation current of a silicon p-n junction diode is $10\mu\text{A}$. Calculate the diode current for the forward bias voltage of 0.6V at 25°C .
5. Determine the diode current at 20°C for a silicon diode with $I_S=50 \text{ nA}$ and an applied forward bias of 0.6 V .

1.6. Temperature Dependence On V-I Characteristics Of A P-N Junction Diode

1. Explain the effect of temperature on V-I characteristics of the diode.
2. In reverse bias region, the saturation current of a silicon diode is about $0.1\mu\text{A}$ ($T= 20^\circ\text{C}$). Determine its approximate value if the temperature is increased 40°C .
3. The leakage current in a p-n junction diode is $10\mu\text{A}$ at 20°C . Calculate the change in temperature required so that the leakage current may rise to $35 \mu\text{A}$.
4. For Ge diode having reverse saturation current of $1\mu\text{A}$, calculate the dynamic forward and reverse resistances at a voltage of $\pm 0.25\text{V}$ applied across the diode. Assume $V_T = 26\text{mV}$.

1.7. Diode Resistances

1. Explain briefly about diode resistances and write the expressions?
2. Determine the forward dynamic resistance of a p – n junction diode, when the forward current is 5mA at $T = 300^\circ\text{K}$. Assume silicon diode.
3. A PN junction diode has a reverse saturation current of $30\mu\text{A}$ at temperature of 125° C . At the same temperature, find the dynamic resistance for 0.2V bias in forward and reverse directions.
4. The current through a PN junction diode is 55mA at a forward bias voltage of 3V . If the temperature is 27°C , find the static and dynamic resistance of the diode?

1.8. Diode Capacitances

1. Explain the term diffusion capacitance C_D of a p-n junction diode.
2. Explain the term transition capacitance C_T of a p-n junction diode.
3. A Ge diode has cross sectional area of the junction as 1mm^2 , width of depletion

region is $1.33\mu\text{m}$. Assume $\epsilon_r = 16$. Calculate the transition capacitance of the diode.

UNIT-II: SPECIAL SEMICONDUCTOR DEVICES

D) Objective Questions

2.1 Zener Diode

- Zener breakdown occurs
 - due to normally generated minority carriers
 - in lightly doped junctions
 - due to rupture of covalent bonds
 - mostly in germanium junctions
- A breakdown which is caused by cumulative multiplication of carriers through field-induced impact ionization occurs in
 - Zener diode (b) tunnel diode (c) varactor diode (d) avalanche diode
- Zener diode is usually operated
 - in forward-bias mode (b) in reverse-bias mode (c) near cut-in voltage (d) in forward-linear region
- For a highly doped diode
 - Zener breakdown is like to take place
 - avalanche breakdown is likely to take place
 - either (a) or (b) will take place
 - neither (a) or (b) will take place
- Which one of the following diodes is used for voltage stabilization?
 - PN-junction (b) Tunnel (c) Varactor (d) Zener

2.2 Varactor Diode

- When the reverse voltage increases, the junction capacitance
 - decreases (ii) stays the same
 - increases (iv) has more bandwidth
- The device associated with voltage-controlled capacitance is a
 - LED (ii) photo-diode
 - varactor diode (iv) Zener diode
- The varactor is usually
 - forward-biased
 - reverse-biased
 - unbiased
 - in the breakdown region

2.3 Tunnel Diode

- A tunnel diode
 - is a reverse recovery diode (b) has heavy doping
 - is a power diode (d) has light doping
- Which one of the following diodes shows the negative resistance region?
 - PN-junction (b) Tunnel
 - Zener (d) Varactor
- The most important application of a tunnel diode is as a
 - rectifier (b) switching device
 - voltage controlled device (d) none of these
- The V-I characteristics of a tunnel diode exhibit a
 - multivalued function of voltage (b) multivalued function of current
 - single valued function of current (d) none of these

2.4 Photodiode

1. A photodiode is used in reverse bias because the
 - (a) majority swept are reverse across the junction
 - (b) only one side is illuminated
 - (c) reverse current is small as compared to photocurrent
 - (d) reverse current is large as compared to photocurrent
2. When the light increases, the reverse current in a photo-diode
 - (i) increases (ii) decreases
 - (iii) is unaffected (iv) none of the above
3. To display the digit 0 in a seven segment display
 - (i) A must be lighted
 - (ii) F must be off
 - (iii) G must be on
 - (iv) all segments except G should be lighted
4. Photodiode is used in the detection of
 - (i) Visible light (ii) Invisible light (iii) No light (iv) Both visible and invisible light
5. The presence of dark current decreases the sensitivity of the photodiode to light
 - (a) True
 - (b) False

2.5 UJT Characteristics

1. How many terminals are there in a unijunction transistor?
 - a) 1
 - b) 2
 - c) 3
 - d) 4
2. What are unijunction transistors used for?
 - a) Amplifying a circuit
 - b) Circuit breaker
 - c) Splitting device
 - d) On-Off switching device
3. Unijunction transistors have unidirectional conductivity and positive impedance characteristics.
 - a) True
 - b) False
4. Which type of material is the channel of a unijunction transistor made up of?
 - a) PN type
 - b) It doesn't affect the working
 - c) P type
 - d) N type
5. What are the terminals of a unijunction transistor?
 - a) Collector, Base and Emitter
 - b) Emitter, Base 1 and Base 2
 - c) Gate, Drain and Source
 - d) Gate, Drain, Body and Source

II) Subjective Questions:

2.1 Zener Diode

1. Draw the V-I characteristics of zener diode under forward and reverse bias
2. Write applications of zener diode
3. How zener diode regulate the voltage
4. Write differences between avalanche breakdown and zener break down

2.2 Varactor Diode

1. What is a varactor diode
2. Explain the working of a varactor diode
3. Give one application of varactor diode
4. How does the width of depletion layer change the capacitance of a varactor

2.3 Tunnel Diode

1. Explain the V-I characteristics of a tunnel diode.
2. What is tunnel diode
3. Explain the working of tunnel diode

2.4 Photodiode

1. What is a photo diode
2. How does photo diode is different from ordinary diode
3. What is dark resistance of phot diode
4. What do you mean by the sensitivity of photo diode

2.5 UJT Characteristics

1. Explain the V-I characteristics of a ujt
2. Explain the terminals functions of a UJT
3. Write applications of UJT
4. Draw the equivalent circuit of UJT and explain the efficiency of UJT

UNIT III: RECTIFIERS AND FILTERS

D) Objective Questions:

3.1 Diode as a Rectifier

1. A rectifier is a

| | |
|----------------------|--------------------|
| a) Bilateral device | b) Linear device |
| c) Non-linear device | d) Passive device. |

2. In a power supply diagram, which block indicates a smooth dc output?

| | |
|--------------|----------------|
| a) filter | b) transformer |
| c) rectifier | d) regulator |

3. In a power supply diagram, which block indicates a pulsating dc output?

| | |
|----------------|--------------|
| a) transformer | b) filter |
| c) rectifier | d) regulator |

3.2 Half-Wave Rectifier

1. If the frequency of the applied ac signal to a half-wave rectifier is 60 Hz, the frequency of the pulsating dc output will be
a) 30Hz b) 60Hz c) 90Hz d) 120Hz
2. The ripple factor of half wave rectifier is
a) 1.21 b) 0.48 c) 1.6 d) 0.5
3. If the input frequency of half-wave rectifier is 50 Hertz, the output frequency of half-wave rectifier is
a) 100 Hz b) 50 Hz c) 150 Hz d) 200 Hz
4. If the peak voltage of half-wave rectifier is 5 Volt, the peak inverse voltage is
a) 10V b) 5V c) 20V d) 15V
5. The efficiency of half wave rectifier is
a) 45% b) 70% c) 40.6% d) 81.2%

In Half-wave rectifier, the sine wave input is $200 \sin 300 t$. The average value of output voltage is approximately equal to

- a) 200 V b) 100 V c) 283 V d) 64V
7. In a Half-wave rectifier, the sine wave input is $50 \sin 50 t$. If the load resistance is $1k\Omega$, the average dc power output will be ____
a) 4W b) 2.5W c) 6W d) 6.77W

3.3 Center tapped Full-Wave Rectifier

1. The ripple factor of a full-wave rectifier circuit compared to that of a half wave rectifier circuit without filter is
a) half of that for a half wave rectifier
b) less than half that for a half-wave rectifier
c) equal to that of a half wave rectifier
d) none of the above.
2. Efficiency of center tapped full wave rectifier is _____
a) 40.6 % b) 50 % c) 78.5 % d) 81.2 %
3. In a center tapped full wave rectifier, the input sine wave is $20\sin 500 \pi t$. The average output voltage is _____
a) 12.73V b) 6.93V c) 11.62 V d) 3.23 V
4. In a center tapped full wave rectifier, the input sine wave is $200\sin 50 \pi t$. If load resistance is of $1k\Omega$ then average DC power output of full wave rectifier is _____
a) 12.56W b) 16.2 W c) 4.02 W d) 8.04 W

5. In a center tapped full wave rectifier, the input sine wave is $250\sin 100\pi t$. The output ripple frequency of rectifier will be _____
 a) 50 Hz b) 100 Hz c) 200 Hz d) 25 Hz
6. As compared to a full- wave rectifier, a half- wave rectifier has more ripples but less efficiency. (TRUE/ FALSE)

3.4 Bridge Rectifier

1. A bridge rectifier uses silicon diodes rated at 1.5A peak current and 0.225A average current. The transformer secondary voltage is $250V_{rms}$ and load is $3K\Omega$. If the diode drop is 1V, find PIV across each diode by assuming all diodes have identical V-I characteristics.
 a) 3.25V b) 5.25V c) 352.5V d) 532.5V
2. The PIV of a diode used in Bridge rectifier is _____.
3. The output frequency of Bridge rectifier is _____.

3.5 Comparison of Rectifiers

1. Which of the following has highest rectification efficiency?
 a) Half-wave rectifier
 b) Center-tapped full-wave rectifier
 c) Bridge rectifier
2. Which of the following has highest ripple factor?
 a) Half-wave rectifier
 b) Center-tapped full-wave rectifier
 c) Bridge rectifier

3.6 Full-Wave Rectifier with Inductor filter

1. The property of inductor is it _____ d.c and _____ a.c.
2. Inductor filter is always connected in _____ with the Load.
3. A full wave rectifier with a load resistance of $5K\Omega$ uses an inductor filter of 15 Henry. The peak value of applied voltage is 250V and the frequency is 50 cycles per second. Then the ripple factor is _____
 a) 0.1 b) 0.4 c) 0.5 d) 0.6

3.7 Full-Wave Rectifier with Capacitor filter

1. The property of capacitor is it _____ d.c and _____ a.c.
2. Capacitor filter is always connected in _____ with the Load.
3. FWR with capacitor filter with $C= 100\mu f, V_{dc} = 12V, R_L = 10K\Omega$ and $f= 50Hz$. Then the percentage ripple factor is _____
 a) 0.288% b) 2.88% c) 28.8% d) 0.028%

3.8 Full-Wave Rectifier with L-section (LC or choke) filter

1. The choke filter with $L= 10H$ and $C= 10\mu f, f= 50 Hz$ used with FWR. The ripple factor is _____
 a) 11.9 b) 0.119 c) 0.0119 d) 1.199

3.2 Half-Wave Rectifier

1. Explain the working of Half-Wave Rectifier (HWR) with the help of input and output waveforms.
2. Derive the following parameters of Half-Wave Rectifier:
 - a) V_{dc}
 - b) V_{rms}
 - c) Ripple factor
 - d) Output frequency
 - e) Rectification efficiency
 - f) Peak Inverse Voltage (PIV)
3. A half-wave rectifier has a load of $3.5K\Omega$. If diode resistance and secondary coil resistance together have a resistance of 800Ω and the input voltage has a signal of peak voltage $240V$. Find i) maximum current ii) average current iii) rms value of current iv) dc output power v) ac input power vi) efficiency of rectifier.
4. A half-wave rectifier is using $120V:120V$ transformer. If R_L connected to transformer secondary is $10K\Omega$, find i) peak value of output voltage ii) average value of output voltage iii) peak current through load iv) average current v) PIV across each diode.

3.3 Center-tapped Full-Wave Rectifier

1. Explain the operation/working of Center-tapped Full-Wave Rectifier with input and output waveforms.
2. Derive the following parameters of Half-Wave Rectifier:
 - a) V_{dc}
 - b) V_{rms}
 - c) Ripple factor
 - d) Output frequency
 - e) Rectification efficiency
 - f) Peak Inverse Voltage (PIV)
3. A $230V$, $60Hz$ voltage is applied to primary of $5:1$ transformer step down center-tapped used in a full-wave rectifier having a load of 900Ω . If the diode resistance and secondary coil resistance together has a resistance of 100Ω , find i) voltage across load ii) dc current through load iii) dc power delivered to load iv) PIV across each diode v) ripple voltage and its Frequency.

4. A 40-0-40V (rms) transformer is used with a full-wave rectifier with each diode having an internal resistance of 1Ω . If the load resistance is 19Ω , determine a) d.c load current b) current through diode c) rectifier efficiency d) d.c load power e) PIV of each diode.

3.4 Bridge Rectifier

1. Explain the working of Bridge rectifier with necessary diagrams.
2. A 230V, 60Hz voltage is applied to primary of 5:1 transformer is used in a bridge rectifier having a load of 900Ω . If the diode resistance and secondary coil resistance together has a resistance of 100Ω , find
i) voltage across load ii) dc current through load iii) dc power delivered to load iv) PIV across each diode v) ripple voltage and its

Frequency.

3.5 Comparison of Rectifiers

1. Compare Half-Wave, Full-Wave and Bridge rectifiers in all aspects.

3.6 Full-Wave Rectifier with Inductor filter

1. What is an electronic filter? Discuss types of filters.
2. Explain the operation of Full-Wave Rectifier with an Inductor filter. Write the formula for ripple factor.
3. Calculate the value of inductance to use in the inductor filter connected to a full-wave rectifier operating at 60Hz to provide a dc output with 4% ripple for a load of 100Ω .

3.7 Full-Wave Rectifier with Capacitor filter

1. Explain the operation of Full-Wave Rectifier with Capacitor filter and give the formula for its ripple factor.
2. Calculate the value of capacitance to use in capacitor filter connected to a full-wave rectifier operated at a standard aircraft power frequency of 400Hz, if the ripple factor is 10% for a load of 500Ω .
3. Determine the value of smoothing capacitor to give a ripple factor of not greater than 5% for a full wave rectifier when supplying a load at 5V with a current of 10mA from a 60Hz ac line supply.

3.8 Full-Wave Rectifier with L-section (LC or choke) filter

1. Explain the operation of Full-Wave Rectifier with L-section filter and give the formula for its ripple factor.
2. Design a filter for full-wave rectifier with LC filter to provide an output voltage of 10V with a load current of 200mA and ripple is limited to 2%.
3. An LC Filter is to be used to provide a dc output with 1% ripple from a full wave rectifier operating at 50Hz. Assuming $L/C = 0.01$, determine the required values of L and C.

3.9 Full-Wave Rectifier with CLC or π -section filter

1. Explain the operation of Full-Wave Rectifier with CLC filter and give the formula for its ripple factor.
2. Design a CLC filter for $V_{DC}=10V$, $I_L=200mA$ and $r = 2\%$.

3.10 Comparison of different filter circuits with Full-Wave Rectifier

1. Compare different filter circuits in terms of their ripple factors.

3.11 Zener Voltage Regulator

1. Explain how the Zener diode acts as voltage regulator?
2. Define line and load regulation of a voltage regulator.
3. Determine the series resistance (R_s) required for a zener diode regulator with an output voltage of 5.6V, if the supply voltage (V_s) varies from 10V to 50V. The minimum zener current is 3mA. Determine also the maximum zener current and the power dissipation.
4. In a Zener diode voltage regulator circuit, the source series resistance R_s is 20 Ω . Zener voltage $V_z=18V$ and load resistance $R_L=200\Omega$. If source voltage V_s can vary from (20 to 30)V, find the maximum and minimum current in the diode?
5. A voltage regulator is built with Zener diode having breakdown voltage of 5.8 volts connected in series with 1000 Ω resistance and a zener knee current of 0.5 mA. Find the maximum load current drawn ensuring proper functioning over the input voltage range between (20 – 30) volts.

UNIT-IV: Bipolar Junction Transistor

I) Objective Questions:

4.1 Construction of a transistor

1. BJT is a
 - a) current controlled device
 - b) voltage controlled device
 - c) power controlled device
 - d) none of the above
2. Doping concentration of BJT is high in
 - a) emitter
 - b) base
 - c) collector
 - d) none of the above
3. For the BJT, the impurity concentration in the emitter (E), base (B) and collector (C) are such that:
 - a) $E > C > B$
 - b) $E < B < C$
 - c) $C = B = E$
 - d) $C > E > B$

4.2 Transistor current components

1. Base-to-emitter voltage is forward-biased transistor decreases with the increase of temperature at the following rate:
 - a) $2.5mV/^\circ C$
 - b) $0.25mV/^\circ C$
 - c) $25mV/^\circ C$
 - d) $0.6mV/^\circ C$
2. The current flowing in collector terminal when emitter is open circuited is
 - a) I_E
 - b) I_B
 - c) I_C
 - d) I_{C_0}
3. I_{C_0} is for PNP transistor and For NPN transistor.

4.3 Transistor configurations

1. The early effect in bipolar transistor is caused by

5. When the temperature changes, the operating point is shifted due to a) change in I_{CBO} b) change in V_{CC} c) change in the values of circuit resistances d) none of the above

4.6 BJT as a switch and Amplifier

1. For proper amplification by a transistor circuit, the operating point should be located atof the d.c. load line.
a) the end point b) middle c) the maximum current point d) none of the above
2. A transistor amplifier has a voltage gain of 100. If the input voltage is 75mV, find the output voltage.
a) 7.5V b) 7.5 mV c) 0.75 V d) 75 mV

II) Subjective Questions

4.1 Construction of a transistor

- 1) Explain the construction of a Junction transistor.
- 2) Draw and explain the potential distribution across the biased junction transistor.
- 3) Can we use two p-n junction diodes connected back-to-back to obtain transistor action? Why?

4.2 Transistor current components

1. Discuss the current components of a transistor with neat diagram.
2. A transistor has $I_B = 100\mu A$ and $I_C = 2mA$. Find a) β of the transistor b) α of the transistor c) emitter current d) if I_B changes by $+25\mu A$ and I_C changes by $+0.6mA$, find the new value of β .
3. The transistor has $I_E = 10mA$ and $\alpha = 0.98$. Determine the values of I_C and I_B .
4. A p-n-p transistor has $\beta = 50$ and $I_{CO} = -2\mu A$. CE transistor configuration is used with $V_{CE} = -12V$ and collector load resistor of $4K\Omega$. What is the minimum base current required to saturate the transistor?
5. A Ge transistor with $\beta = 100$ has a base-to-collector leakage current I_{CBO} of $5\mu A$. If the transistor is connected for common-emitter operation, find the collector current for (a) $I_B = 0$ and (b) $I_B = 40\mu A$.

4.3 Transistor configurations

1. Define Early effect.
2. Explain the input and output characteristics of common base transistor configuration. Illustrate the significance of Early effect on input characteristics.
3. Explain the input and output characteristics of common emitter transistor configuration. Indicate operating regions of the transistor on output characteristics.
4. Explain the input and output characteristics of common collector transistor configuration.
5. Give the comparison of different transistor configurations.
6. The emitter current of a CB transistor is 5mA. The collector current with emitter open is (I_{CBO}) is $100\mu A$. Find the total collector current if current gain is 0.9.
7. The resistance in the collector circuit of CB transistor configuration is $R_L = 4k\Omega$ and the voltage drop across it is 4V. The current gain is 0.9. Find the base current.
8. The voltage drop across a $2K\Omega$ resistor connected in collector circuit of a CE transistor configuration is 2V. Find the base current if $\beta = 50$.

9. The collector supply voltage of a CE transistor configuration is 10V. The voltage drop across a $1\text{K}\Omega$ resistor connected in collector circuit is 1V. Find the collector-emitter voltage and base current if $\alpha = 0.9$.
10. In the n-p-n transistor, 10^8 holes/ μsec move from base to emitter region while 10^{10} electrons/ μsec move from emitter to base region. An ammeter reads the base current I_B as $16\mu\text{A}$. Determine the emitter current and the collector current.
11. Determine α if $I_E = 2.8\text{mA}$ and $I_B = 20\mu\text{A}$.
12. Find I_E if $I_B = 40\mu\text{A}$ and α is 0.98.

4.4 Comparison of CB, CE and CC

1. Obtain the relationship between α , β and γ .
2. Given $\alpha = 0.987$, determine the corresponding value of β .
3. The reverse leakage current of the transistor when connected in CB configuration is $0.2\mu\text{A}$ and it is $18\mu\text{A}$ when the same transistor is connected in CE configuration. Calculate α and β of the transistor.

4.5 Transistor operating regions

1. What are the operating regions of transistor?
2. What is operating point?

4.6 BJT as a switch and Amplifier

1. The reverse saturation current of the transistor is $2\mu\text{A}$ at 25°C and it increases by a factor of 2 for each temperature increase of 10°C .
 - a) With bias voltage $V_{BB} = 5\text{V}$, find the maximum value of R_B if the transistor is to remain cutoff at a temperature of 75°C .
 - b) With $V_{BB} = 1\text{V}$ and $R_B = 50\text{K}\Omega$, what is the maximum value of temperature at which the transistor will just come out of cutoff? $V_{BE}(\text{cutoff}) = 0.1\text{V}$ (reverse bias).
2. A BJT has $\alpha = 0.99$, $I_B = 25\mu\text{A}$, $I_{CBO} = 2\text{nA}$. Find the collector current, the emitter current and the percentage error in emitter current when leakage current is neglected.

UNIT V: FIELD EFFECT TRANSISTOR

I) Objective Questions

5.1 Classification of FETs:

1. FETs are mainly classified into
a.2 b.3 c.4 d.5
2. The full form of MOSFET is _____.
3. The full form of JFET is _____.
4. Which transistor is also renowned as 'Insulated Gate Field Effect Transistor' (IGFET)?
[]
a) Junction FET b) Metal- Oxide Semiconductor FET
c) Both a & b d) None

5.2 CONSTRUCTION OF JFETs:

1. A JFET has three terminals, namely

- a. cathode, anode, grid
 - b. emitter, base, collector
 - c. source, gate, drain
 - d. none of the above
2. A JFET is also called transistor
- a. unipolar
 - b. bipolar
 - c. unijunction
 - d. none of the above
3. The gate of a JFET is biased
- a. reverse
 - b. forward
 - c. reverse as well as forward
 - d. none of the above
4. A JFET is a driven device
- a. current
 - b. voltage
 - c. both current and voltage
 - d. none of the above
5. The input impedance of a JFET is that of an ordinary transistor
- a. equal to
 - b. less than
 - c. more than
 - d. none of the above
6. In a p-channel JFET, the charge carriers are
- a. electrons
 - b. holes
 - c. both electrons and holes
 - d. none of the above
7. When the JFET is no longer able to control the current, this point is called the
- a) depletion region b) pinch-off region c) saturation point d) breakdown region

5.3 A) CHARACTERISTICS OF FET

1. When drain voltage equals the pinch-off-voltage, then drain current with the increase in drain voltage
- a. decreases
 - b. increases
 - c. remains constant
 - d. none of the above
2. If the reverse bias on the gate of a JFET is increased, then width of the conducting channel
- a. is decreased
 - b. is increased
 - c. remains the same
 - d. none of the above.
3. A JFET can operate in
- a. Only depletion mode
 - b. Only enhancement mode

- c. Both depletion and enhancement modes
- d. Neither depletion nor enhancement modes

5.3 B) Transfer Characteristics:

1. The transfer characteristics of JFET follows the mathematical expression _____.
2. From the transfer characteristics of JFET it is observed that
 - a. Drain current, $I_D = I_{DSS}$ when $V_{GS} = 0$
 - b. Drain current, $I_D = 0$ when $V_{GS} = V_P$
 - c. Both a and b
 - d. None of the above
3. The transfer characteristic for a JFET are plots between
 - a. drain current, I_D and gate-source voltage, V_{GS} keeping drain-source voltage, V_{DS} constant
 - b. drain current, I_D and drain-source voltage, V_{DS} keeping gate-source voltage, V_{GS} constant
 - c. None of the above.

5.4 FET as Voltage-Variable Resistor (VVR)

1. In which region, FET can be used as a voltage variable resistor?
 - a. Ohmic Region/Triode region
 - b. Saturation Region
 - c. Cutoff region
 - d. None of the above
2. The resistance of JFET is controlled by _____.

5.5 Comparison of JFET and BJT

1. FET is a ----- device whereas BJT is a ----- device
 - a. Unipolar, Bipolar
 - b. Bipolar, Unipolar
 - c. Tripolar, Unipolar
 - d. Unipolar, Tripolar
2. FET is a ----- controlled device whereas BJT is a ----- controlled device
 - a. current, voltage
 - b. voltage, current
 - c. current, current
 - d. voltage, voltage
3. Which has low noise?
 - a. FET
 - b. BJT
 - c. Both a and b
 - d. None of the above
4. Which of the devices has high input impedance and low input impedance respectively.
 - a. BJT, FET
 - b. FET, BJT
 - c. None of the above

5.6 Depletion type MOSFET

1. Identify the device based on the given symbol
 - a. N-channel depletion type MOSFET
 - b. P-channel depletion MOSFET
 - c. N-channel JFET
 - d. P- channel JFET

2. Which of the following is called as **Insulated Gate Field Effect Transistor (IGFET)**?
 - a. MOSFET
 - b. JFET
 - c. BJT
 - d. UJT
3. MOSFET has greatest application in digital circuits due to
 - a. Low power consumption
 - b. Less noise
 - c. Small amount of space it takes on a chip
 - d. All of the above

5.7 Enhancement Type MOSFET:

1. Identify the device based on the given symbol
 - a. N-channel enhancement type MOSFET
 - b. P-channel enhancement MOSFET
 - c. N-channel depletion MOSFET
 - d. P-channel depletion MOSFET
2. With the E-MOSFET, when gate input voltage is zero, drain current is
 - a) at saturation
 - b) zero
 - c) I_{DSS}
 - d) widening the channel

5.8 Comparison between DMOSFET and EMOSFET

1. Which of the following MOSFET works for $V_{GS} = 0$ volts
 - a. Depletion type MOSFET
 - b. Enhancement type MOSFET
 - c. None
2. Which is called as Normally-ON device and Normally-OFF device respectively?
 - a. Depletion MOSFET and Enhancement MOSFET
 - b. Enhancement MOSFET and Depletion MOSFET
 - c. JFET and BJT
 - d. UJT and BJT

5.9 MOS FET as a switch and amplifier

1. Identify the regions of operation of FET
 - a. Triode region
 - b. Saturation region
 - c. Cut-off region
 - d. All of the above
2. Name the regions in which FET acts as switch
3. MOSFET operates as _____ switch in cut-off region.
4. MOSFET operates as _____ switch in Triode region.
5. In which region, MOSFET acts as an amplifier.
 - a. Saturation.
 - b. Triode
 - c. Cut-off
 - d. None of the above
6. In which of the following configuration does a MOSFET works as an amplifier?
 - a) Common Source (CS)
 - b) Common Gate (CG)

c) Common drain (CD)

d) All of the mentioned

7. Which of the following device increases the strength of the signal.

a. Amplifier

b. Attenuator

c. Switch

d. None of the above

II) Subjective Questions:

5.1 CLASSIFICATION OF FETs:

1. Why a Field Effect Transistor is called so?

2. Classify FETs.

5.2 CONSTRUCTION OF JFETs:

1. Give the construction details of JFET with neat sketches.

5.3 A) CHARACTERISTICS OF FET

1. Explain the working of JFET and draw its drain characteristics.

2. A FET has a drain current of 4mA. If $I_{DSS} = 8\text{mA}$ and $V_{GS(\text{off})} = -6\text{V}$. Find the values of V_{GS} and V_P .

3. An N-channel JFET has $I_{DSS} = 8\text{mA}$ and $V_P = -5\text{V}$. Determine the drain current I_D for $V_{GS} = -2\text{V}$ in the pinch off region.

4. An n-channel JFET has a pinch-off voltage V_P of -4.5V and $I_{DSS} = 9.0\text{mA}$. At what value of V_{GS} in the pinch-off region will I_D equal to 3.0mA and what is the value of $V_{DS(P)}$ when $I_D = 3.0\text{mA}$?

5. A JFET has the following parameters: $I_{DSS} = 32\text{mA}$; $V_{GS(\text{off})} = -8\text{V}$; $V_{GS} = -4.5\text{V}$. Find the value of drain current.

6. A JFET has a drain current of 5 mA. If $I_{DSS} = 10\text{mA}$ and $V_{GS(\text{off})} = -6\text{V}$, find the value of (i) V_{GS} and (ii) V_P .

7. A particular p-channel JFET has a $V_{GS(\text{off})} = +4\text{V}$, $I_{DSS} = 6\text{mA}$. What is I_D when $V_{GS} = +6\text{V}$?

5.3 B) Transfer Characteristics:

1. Explain the transfer characteristics of JFET?

2. When the reverse gate voltage of JFET changes from 4 V to 3.9 V, the drain current changes from 1.3 to 1.6mA. Find the value of transconductance.

3. Define and explain the parameters transconductance(g_m), drain resistance (r_d) and amplification factor (μ) of a JFET. Establish the relation between them.

4. The data sheet for certain type of JFET indicates that $I_{DSS} = 25\text{mA}$, $V_{GS(\text{off})} = -10\text{V}$. Determine (i) The type of JFET (ii) Drain current I_D at $V_{GS} = 0$ (iii) Drain current I_D and transconductance g_m at $V_{GS} = -4\text{V}$.

5. The data sheet of a JFET gives the following information: $I_{DSS} = 3\text{mA}$, $V_{GS(\text{off})} = -6\text{V}$ and $g_m(\text{max}) = 5000\ \mu\text{S}$. Determine the transconductance for $V_{GS} = -4\text{V}$ and find drain current I_D at this point.

6. If $V_A = 100\text{V}$, find the JFET output resistance r_o when operating in pinch-off at a current of 1 mA, 2.5 mA, and 10 mA.

5.4 FET as Voltage-Variable Resistor (VVR)

1. Explain in which region the FET can be used as a Voltage Variable Resistor.

5.5 Comparison of JFET and BJT

1. Compare JFET and BJT.

2. Explain why BJTs are called bipolar devices while FETs are called uni-polar devices.

5.6 Depletion type MOSFET

1. Why are N-channel MOSFETs preferred over P-channel MOSFETs?

2. What is MOSFET? How many types of MOSFETs are there?
3. Give the construction details and characteristics of depletion type MOSFET.
4. Given a depletion type MOSFET with $I_{DSS}=6\text{mA}$ and $V_P=-3\text{V}$, determine the drain current at $V_{GS}=-1\text{V}, 0\text{V}, 1\text{V}$ and 2V . Compare the difference in current levels between -1 and 0V with the difference between 1 and 2V . In the positive V_{GS} region, does the drain current increase at a significantly higher rate than for negative values? is there a linear or nonlinear relationship between I_D and V_{GS} ? Explain.
5. For a certain D-MOSFET, $I_{DSS} = 10 \text{ mA}$ and $V_{GS}(\text{off}) = -8\text{V}$. (i) Is this an n-channel or a p-channel? (ii) Calculate I_D at $V_{GS} = -3\text{V}$. (iii) Calculate I_D at $V_{GS} = +3\text{V}$.
6. A D-MOSFET has parameters of $V_{GS}(\text{off}) = -6\text{V}$ and $I_{DSS} = 1 \text{ mA}$. How will you plot the transconductance curve for the device?

5.7 Enhancement Type MOSFET:

1. Give the construction details and characteristics of enhancement type MOSFET.
2. Given the constant $k=0.4 \text{ m A/V}$ (of enhancement type MOSFET) and $I_{D(\text{ON})} = 3\text{mA}$ with $V_{GS(\text{ON})}=4\text{V}$, determine the threshold voltage V_T .
3. The data sheet for an E-MOSFET gives $I_{D(\text{on})} = 500 \text{ mA}$ at $V_{GS} = 10\text{V}$ and $V_{GS}(\text{th}) = 1\text{V}$. Determine the drain current for $V_{GS} = 5\text{V}$.
4. The data sheet for an E-MOSFET gives $I_{D(\text{on})} = 3 \text{ mA}$ at $V_{GS} = 10\text{V}$ and $V_{GS}(\text{th}) = 3\text{V}$. Determine the resulting value of K for the device. How will you plot the transconductance curve for this MOSFET ?

5.8 Comparison between DMOSFET and EMOSFET

1. How does the constructional feature of a MOSFET differ from that of a JFET?
2. Compare Depletion type MOSFET and Enhancement type MOSFET.

5.9 MOS FET as a switch and amplifier

1. Explain the regions of operation of MOSFET and explain how MOSFET can be used as a switch
2. Describe briefly how MOSFET can be used as an amplifier.

Signature of the Faculty

HANDOUT ON PYTHON PROGRAMMING

Class & Sem.: I B.Tech – II Semester

Year: 2020-2021

Branch : CSE

Credits: 3

1. Brief History and Scope of the Subject

Python was first developed by *Guido van Rossum* in the late 80's and early 90's at the National Research Institute for Mathematics and Computer Science in the Netherlands. It has been derived from many languages such as ABC, Modula-3, C, C++, Algol-68, Small Talk, UNIX shell and other scripting languages.

There is really a good scope in Python in today's world, In last few years Python leads among the programming languages due to some of the libraries used in the most demanding work in the world like Data Science, Machine Learning, Artificial Intelligence. By the help of Python you can do everything you want to do. But mainly due to data science and machine learning Python is on the top of demanding languages now a days. Apart from this you can create a webpage, game, Application ... also by using Python.

2. Pre-Requisites

- Knowledge on Problem Solving Through Computer Programming.

3. Course Objectives:

- To explore various problem solving approaches in Python programming
- To apply object-oriented programming concepts in problem solving.

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

CO1: Describe the basic elements of Python programming for logic building.

CO2: Use functions and modules to develop Python programs

CO3: Differentiate mutable and immutable data types.

CO4: Develop code to handle exceptions and files.

CO5: Apply object-oriented concepts to develop programs..

5. Program Outcomes:

Engineering Graduates will be able to:

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental

contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

6. Mapping of Course Outcomes with Program Outcomes:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO 1 | 2 | 2 | 2 | 1 | 2 | | | 1 | 2 | 2 | | 1 |
| CO 2 | 1 | 1 | 3 | 1 | 2 | | | 2 | 2 | 2 | 1 | 2 |
| CO 3 | 1 | 2 | 1 | 2 | 2 | | | 1 | 2 | 2 | | 2 |
| CO 4 | 1 | | | 1 | | | | | | | | 1 |
| CO 5 | 1 | 2 | 2 | 2 | 2 | | | 1 | 2 | 2 | | 2 |

7. Prescribed Text Books

1. “Python Programming – Using Problem Solving Approach “,Reema Thareja, Oxford University Press, 2014 Edition.
2. “Python Programming: A Modern Approach”, Vamsi Kurama, Pearson.

8. Reference Text Books

1. “Core Python Programming” Wesley J. Chun, 2nd Edition, Prentice Hall.
2. “Python: The Complete Reference”, Martin C. Brown, 2001 Edition, McGraw Hill.
3. Fundamentals of Python – First Programs, Kenneth A. Lambert, 2012 Edition, Cengage.
4. “Python Crash Course: A Hands-on, Project-Based Introduction to Programming”, Eric Matthes.

9.URLs and Other E-Learning Resources

<https://pythonprogramming.net/beginner-python-programming-tutorials/>

<https://www.tutorialspoint.com/python/>

<https://www.javatpoint.com/python-tutorial>

<https://www.learnpython.org/>

<https://www.programiz.com/python-programming>

10. Digital Learning Materials: <http://nptel.ac.in/courses/106106145/5>

<http://freevidelectures.com/Course/2512/Python-Programming>

[https://ocw.mit.edu/courses/electrical-engineering-and-computer-](https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-0001-introduction-to-computer-science-and-programming-in-python-fall-2016/lecture-videos/)

[science/6-0001-introduction-to-computer-science-and-programming-in-python-fall-2016/lecture-videos/](https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-0001-introduction-to-computer-science-and-programming-in-python-fall-2016/lecture-videos/)

<http://onlinevideolecture.com/?subject=python+programming>

11. Lecture Schedule / Lesson Plan

| TOPIC | Theory |
|--|--------|
| UNIT-I: Basics of Python Programming and Control Statements | |
| Features of Python | 1 |
| History of Python | 1 |
| Literal Constants | 2 |
| Data Types ,Variables | 2 |
| Operators, Operator Precedence. | 2 |
| Expressions | 1 |
| type conversion | 1 |
| Command line arguments | 1 |
| Input &Output operation | 1 |
| Conditional Statements: simple if, if-else | 1 |
| Nested if and if –elif-if | 1 |
| Iterative Statements: while | 1 |
| for and else with for and while | 1 |
| Un-conditional branching: break, continue and pass statement. | 1 |
| UNIT-II: Functions and Modules | |
| Introduction to functions ,Function definition. | 2 |
| Call, return statement. | 1 |
| Local and global variables | 2 |
| Types of arguments | 2 |
| Nesting of loops. | 1 |
| Types of Functions: Anonymous, Fruitful, Recursive function. | 1 |
| Passing functions as arguments. | 1 |
| Modules: The from...import statement | 1 |
| making your own modules | 1 |
| dir() function | 1 |
| modules and namespaces | 1 |
| types of namespaces: global, local and built in | 1 |
| packages and Modules | 2 |
| introduction to PIP | 1 |
| installing packages via PIP | 1 |
| UNIT-III: Data Structures | |
| Mutable and Immutable data structures | 2 |
| declaring and using numeric data
Types: int | |
| Float ,complex data structures | 2 |
| list, tuple data structures | 2 |
| Dictionary data structure | 2 |
| Set and string: usage | 2 |
| Set and string conversions | 1 |

| | |
|---|---|
| built-in methods and differences | 1 |
| list and dictionary comprehensions. | 2 |
| UNIT-IV: Exception and File Handling | |
| Introduction Exception Handling | 1 |
| Difference between an error and exception | 1 |
| handling Exception | 1 |
| try except block | 1 |
| raising exceptions | 1 |
| User defined exceptions. | 1 |
| Introduction to file handling | 1 |
| Significance of files | 1 |
| types of files | 1 |
| file path, file modes. | 2 |
| Understanding read functions: read(), readline() and readlines(). | 2 |
| Understanding write functions: write() and writelines() | 1 |
| manipulating file pointer using seek. | |
| UNIT-V: Object Oriented Concepts | |
| OOP principles | 1 |
| Classes, objects | 2 |
| Self variable and methods, | 2 |
| Constructor method | 1 |
| Inheritance | 2 |
| Overriding methods | 1 |
| Data hiding | 1 |

Assignment-Cum-Tutorial Questions

UNIT-I

A. Objective Questions

1. Literal is of the form a+bj is called_____
2. Identify the words which describes Python
a)Interpreted b)simple c)reliable d)all of these
3. Python allows you to specify Unicode Text by prefixing the string with which character
a)U b)R c)S d)A
4. Which of the following is a valid string literal
a)"computer" b)'computer' c)'''computer''' d) all of these
5. Which of this is valid variable name in Python
a) This is a variable b)This_is_a_variable c)This-is-a-variable d)^var
6. A Comments in python start with which symbol_____
7. All spaces and tabs with in a string are preserved in quotes
[True/False]
8. Bitwise Operator can be applied on which datatype

- a)integer b)float c)string d)list
9. Identify valid assignment statements
a)=b+1 b)a=a+1 c)a+b=10 d)a+1=1
10. _____operator perform logical negation on each bit of the operand.
11. What should be written in the blank to generate ZeroDivisionError in the case of
(25+36)/(-8+_____)
12. Predict the output of the following program
>>spam="eggs"
>>print(spam*3)
a)spamspamspam b)eggseggseggs c)"spamspamspam" d)spam*3
13. Which of the following returns true
a)>>>9=9 and 1==1
b)>>>3==5 and 7==3
c)>>>7!=1 and 5==5
d)>>>4<1 and 1>6
14. Identify the valid numeric literals in Python
a)5678 b)5,678 c)5678.0 d)0.5678 e)0.56+10
15. You can print string without using print function [True/False]
16. Predict the output of the following program
>>>print (format(56.78901, '.3f'))
a)56.789 b)5.6789 c)0.56789 d)56789
17. The following statement will produce ___lines of output
>>print('Good\nMorning\nWorld\n---Bye')
a)1 b)2 c)3 d)4
18. Identify the correct arithmetic expression in python
a)11(12+13) b)(5*6)(7+8) c)4*(3-2) d)5***3
19. Which line of code produce error
a)"one"+"2" b)'5'+6 c)3+4 d)"7"+"eight"
20. Predict the output of the following program
>>>print(abs(10-20)*3)
a)-30 b)30 c)-50 d)none of these

B. Subjective Questions

- Describe the features of Python
- Differentiate between literals and variables in python. *(November 2018 Supplementary)*
- What are literals? Explain with the help of suitable examples?
- Explain the significance of Escape sequences with relevant examples
- Write briefly about Data types in Python
- Explain in detail about Membership and Identity Operators.
- How can the ternary operator used in python? *(April 2018 Regular)*
- Give the operator precedence in python. *(November 2018 Supplementary)*
- Define Expression? Explain different types of Expressions supported by Python?
- Differentiate string with slicing operator.

11. What is tuple? What are the different operations performed on tuple? Explain with an example?
(November 2018 Supplementary)
12. Write briefly about Type Conversion process in Python. Write the meaning for the following.
str(x), chr(x), float(x), ord(x) (November 2018 Supplementary)
13. Momentum is calculated as, $e=mc^2$, where m is the mass of the object and c is the velocity. Write a Python program that accepts object's mass (in kilograms) and velocity (in meters per second) and displays its momentum.
14. a) Write a Python Program to convert temperature in Celsius to Fahrenheit
b) Write a Python Program to convert Fahrenheit to Celsius.
15. Write a Python program to calculate the area of triangle using Heron's formula

$$\text{Hint: } \sqrt{s(s-a)(s-b)(s-c)}$$

16. Evaluate the following Expression
- True and False
 - (100<0) and (100>20)
 - not(true) and false
 - not true and false or true
 - not(100<0 or 100>20)
 - 100<0 and not 100>20
17. Give an appropriate boolean expression for the each of the following
- check if variable v is greater than or equal to 0, and less than 10
 - check if variable v is less than 10 and greater than or equal to 0, or it is equal to 20.
 - check if either the name 'cse' or 'it' appears in the list of names assigned to variable last_names.
 - check if the name 'cse' appears and the name 'it' does not appear in the list of last name assigned to variable last_names.
18. Identify the datatype is best suitable to represent the following data values
- Number of days in the year
 - The circumference of a rectangle
 - Your father salary
 - Distance between moon and earth
 - Name of your best friend
 - Whether you go for the party

Unit-II

A. Objective Questions

- Python uses _____ to form a block of code.
- Which part of if statement should be indented
 - The first statement
 - All the statements
 - Statements within the if block
 - None of these
- Which of the following is placed after the **if** condition
 - ;
 - .
 - :
 - ,

4. elif and else blocks are optional [True/False]
5. How many lines will be printed by this code?
while False:
print("hello")
- a) 1 b) 0 c) 10 d) countless
6. _____ is a built-in function that is used to over a sequence of numbers.
7. Which statement is used to stop the current iteration of the loop and continue with the next one?
- a) pass b) break c)continue d)jump
8. Which statement is used to terminate the execution of the nearest enclosing loop in which it appears?
- a) pass b)break c)continue d)jump
9. Which statements indicates a NOP
- a) pass b)break c)continue d)jump
10. It is possible to use 'else suite' along with loops. [True/False]
11. x=100
y=200
_____ x>y _____
print ("in if")

print ("in else")
- a) if , else b) if ; else c)if : else : d) if | else
12. How many numbers will be printed?
- i=5
while i>=0:
print(i)
i=i-1
- a) 5 b) 6 c) 4 d)0
13. What is the output of the following code?
- i = 1
while true:
if i%3 == 0:
break
print(i)
i += 1
- a) 1 2 b) 1 2 3 c) error d) none of the mentioned
14. What is the output of the following code?
- for i in range(2.0):
print(i)
- a) 0.0 1.0 b) 0 1
c) error d) none of the mentioned
15. What is the output of the following code?
- for i in range(10):**
if i == 5:

```
break
else:
    print(i)
```

```
else:
    print("here")
```

- a) 0 1 2 3 4 here b) 0 1 2 3 4 5 here c) 0 1 2 3 4 d) 1 2 3 4 5

B. Descriptive Questions

1. Explain Conditional Statements in Python with examples.
2. Write syntax and logical flow for if-elif-else.
3. Explain the significance of for loop with else using an example.
4. Differentiate between counter-controlled loops and sentinel-controlled loops.
5. Write the differences between iteration and recursion.
6. Explain the utility of break and continue statements with the help of an example.
7. What is pass statement in python?
8. Explain with an example, how continue statement is used in python.
9. Write a program to display multiplication tables from 1 to 10.
10. Write a Python program that accepts a word from the user and reverse it
11. Write a Python program that accepts an integer (n) and computes the value of $n+nn+nnn$. (Eg. If $n=5$, find $5+55+555$).
12. Write a program to find the factorial of a given number.

Unit-III Assignment-Cum-Tutorial Questions

A) Objective Questions

1. User-defined functions are created by using the _____ keyword.
2. The _____ is used to uniquely identify the function.
3. The return statement is optional _____ [Yes/No]
4. DRY principle makes the code _____ a) Reusable b) Loop forever c) Bad and repetitive d) Complex
5. _____ of a variable determines the part of the program in which it is accessible
a) Scope b) Lifetime c) Data Type d) Value
6. Arbitrary arguments have which symbol in the function definition before the parameter name?
a) & b) # c) % d) *
7. _____dir()_____ is built-in function that lists the identifiers defined in a module.

8. Arguments may be passed in the form of expressions to the called function [yes/No]

9. In Python a string is appended to another string by using which operator?

- a) + b)* c)[] d)+=

10. Which error is generated when a character in a string variable is modified?

- a) IndexError b) NameError c) TypeError d)BoundError

11. The code will print how many numbers?

```
def display(x):
```

```
    for i in range(x):
```

```
        print(i)
```

```
    return
```

```
display(10)
```

- a) 0 b) 1 c) 9 d) 10

12. How many times will the print() execute in the code given below?

```
def display():
```

```
    print('a')
```

```
    print('b')
```

```
    return
```

```
print('c')
```

```
print('d')
```

- a) 1 b) 2 c) 3 d)4

13. What is the output of this code?

```
import random as r
```

```
print(random.randomint(1,10))
```

- a) An error occurs b) 1 c) 10 d) any random value.

14. Identify the correct way of calling a function named display() that prints Hello on the screen.

- a) print(display) b) displayHello
c) result = display() d) displayHello()

15. Find the error in following Python code.

```
Def func():
```


Name: Dev

Sequence Error:

Department: HR

Salary: 50000

b) Name: Tavisha
Department: sales

d) Indentation Error:

Salary: 100000

Department: HR

Name: Dev

Salary: 50000

19. "Cool" become "COOL", which two functions must have been applied? []

- a) strip() and upper() b) strip() and lower()
c) strip() and capitalize() d) lstrip() and rstrip()

20. Find the error in following Python code. []

]

```
str = "Hello world"
```

```
str[6] = 'w'
```

```
print(str)
```

- a) Hello world c) in line 2 use double quotes
b) 'str' object does not support item assignment d) Hello wworld

B) Subjective Questions

1. Define function and give its advantages.
2. Differentiate between local and global variables.
3. What are modules? How do you use them in your programs?
4. Write short notes on
 - a) Keyword arguments
 - b) Default arguments
5. What are docstrings?
6. Write short note on format operator.
7. With the help of an example, explain how we can create string variables in Python.
8. What are user-defined functions? Explain with the help of example.
9. Briefly describe String formatting operator with an example.
10. List out Advantages and disadvantages of Recursion.
11. Write a python program to find the factorial of a given number using recursion.
12. Write any 5 Built-in string methods and functions usage and example.

print(my_tuple[:])

- a) ('r', 'o', 'g') b) ('p', 'r', 'o')
 ('p', 'r') ('r', 'p')
 ('i', 'z') ('z', 'i')
 ('p', 'r', 'o', 'g', 'r', 'a', 'm', 'i', 'z') ('p', 'r', 'o', 'g', 'r', 'a', 'm', 'i', 'z')
- c) ('p', 'r', 'o', 'g', 'r', 'a', 'm', 'i', 'z') d) ('p', 'r', 'o', 'g', 'r', 'a', 'm', 'i', 'z')
 ('r', 'o', 'g') ('i', 'z')
 ('p', 'r') ('p', 'r')
 ('i', 'z') ('r', 'o', 'g')

15. What is the output of the program []

print((1, 2, 3) + (4, 5, 6))

print(("Repeat",) * 3)

- a) (1, 2, 3, 4, 5, 6) b) ('Repeat', 'Repeat', 'Repeat')
 ('Repeat', 'Repeat', 'Repeat') (1, 2, 3, 4, 5, 6)
- c) (1, 2, 3) + (4, 5, 6) d) ("Repeat",) * 3
 "Repeat" (1, 2, 3) + (4, 5, 6)

16. What is the output of the program []

my_tuple = ('a', 'p', 'p', 'l', 'e')

print(my_tuple.count('p'))

print(my_tuple.index('l'))

- a) 2 b) 2 c) 3 d) 3
 3 2 2 3

17. What is the output of the program []

pow2 = [2 ** x for x in range(10)]

print(pow2)

- a) [1, 2, 4, 8, 16, 32, 64, 128, 256, 512]
b) [512, 256, 128, 64, 32, 16, 8, 4, 2, 1]
c) [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
d) [1, 3, 5, 7, 9]

18. What is the output of the program []

my_list = ['p', 'r', 'o', 'b', 'e']

print(my_list[-1])

print(my_list[-5])

- a) e b) e c) p d) e
 NULL p e e

19. What is the output of the program []

odd = [1, 3, 5]

Print(odd + [9, 7, 5])

Print(["re"] * 3)

- a) [1, 3, 5, 9, 7, 5] b) [1, 3, 5, 9, 7]
 ["re", "re", "re"] ["re", "re", "re"]
c) (odd + [9, 7, 5]) d) [1, 3, 5]
 (["re"] * 3) (["re"] * 3)

20. What is the output of the program []

odd = [1, 9]

odd.insert(1, 3)

print(odd)

odd[2:2] = [5, 7]

print(odd)

- a) [1, 3, 9] b) [1, 3, 5, 7, 9] c) [1, 9, 3] d) [1, 9, 1, 3]
 [1, 3, 5, 7, 9] [1, 3, 5, 7, 9] [1, 9, 3, 5, 7] [1, 9, 1, 3, 5, 7]

B) Subjective Questions

1. What is negative index in list and tuple? [April-2018]
2. What is tuple? What are the different operations performed on tuple? Explain with an example? [NOV-2018]
3. Illustrate the ways of creating the tuple and the tuple assignment with suitable programs. [April-2018]
4. Summarize basic List operations with examples. [NOV-2018]
5. How can you access and update values in a list?
6. Explain mutability of lists?
7. Write a set of commands that covers at least five tuple functions and five list functions?
8. Write a program to find sum of all even numbers in a list?
9. Write a program that reverses a list using a loop?
10. Write a program to find whether a particular element is present in the list?
11. Write a program that finds the sum of all the numbers in a list using a while loop?
12. Write a program that forms a List of first character of every word present in another List. [NOV-2018]
13. Write a program that creates a list['a','b','c'], then create a tuple from that list.
14. Write a program that converts a list of characters into their corresponding ASCII values using map() function.
15. Write a program using filter function to list cubes of numbers from 1-10.
16. Write a code snippet in Python to Access Elements of a Tuple. [NOV-2018]
17. Write code snippets in Python for modifying and deleting Elements of Tuple. [NOV-2018]
18. "Tuples are immutable". Explain with examples. [April-2018]

Assignment-Cum-Tutorial Questions-UNIT-V

I) Objective Questions

- 1) Which of these about a dictionary is false? []
 - a) The values of a dictionary can be accessed using keys
 - b) The keys of a dictionary can be accessed using values
 - c) Dictionaries aren't ordered
 - d) Dictionaries are mutable
- 2) Which of the following statements create a dictionary? []
 - a) `d = {}`
 - b) `d = {"john":40, "peter":45}`
 - c) `d = {40:"john", 45:"peter"}`
 - d) All of the mentioned
- 3) Which of the following is not a declaration of the dictionary? []
 - a) `{1: 'A', 2: 'B'}`
 - b) `dict ([[1,"A"],[2,"B"]])`
 - c) `{1,"A",2,"B"}`

d) { }

4) What is the output of the following code? []

```
A = {1:"A",2:"B",3:"C"}
for i,j in a.items():
    print(i,j,end=" ")
```

a) 1 A 2 B 3 C b) 1 2 3 c) A B C d) 1:"A" 2:"B" 3:"C"

5) Which of the following isn't true about dictionary keys? []

- a) More than one key isn't allowed
- b) Keys must be immutable
- c) Keys must be integers
- d) When duplicate keys encountered, the last assignment wins

6) Suppose d = {"john":40, "peter":45}, to delete the entry for "john" what command do we use []

- a) d.delete("john":40)
- b) d.delete("john")
- c) del d["john"].
- d) del d("john":40)

7) Suppose d = {"john":40, "peter":45}, what happens when we try to retrieve a value using the expression d["susan"]? []

- a) Since "susan" is not a value in the dictionary, Python raises a KeyError exception
- b) It is executed fine and no exception is raised, and it returns None
- c) Since "susan" is not a key in the dictionary, Python raises a KeyError exception
- d) Since "susan" is not a key in the set, Python raises a syntax error

8) What gets printed? []

```
foo = {1:'1', 2:'2', 3:'3'}
del foo[1]
foo[1] = '10'
del foo[2]
print(len(foo))
```

a) 1 b) 2 c) 3 d) 4 e) An Exception is thrown

9) If Dict = {1:2, 3:4, 4:11, 5:6, 7:8}, then **print(Dict(Dict[3]))** will print ? []

a) 2 b) 8 c) 11 d) 6

10) Which Data type does not support indexing? [] []

a) List b) Tuple c) Dictionary d) Set

11) Which function is used to delete all entries in the dictionary _____?

12) Which methods will return all the keys and Values in a Dictionary _____?

13) What are the Data types supported for Key in Dictionary Data type _____?

14) Fill in the blanks to create a Dictionary.

```
Dict = dict(1 ___ "abc" ___ 2 ___ "hai")
Dict1= ___ 1:"abc",2:"hai" ___
15) Find the output of the below program?
D={"India":"Delhi", "Nepal":"Kathmandu", "USA":"DC"}
del D["Nepal"]
for key,val in D.items():
    print(key)
```

II) Subjective Questions

- 1) Explain the importance of Dictionary data type in python? **(Nov-2018)**
- 2) List-out various operations can be performed on Dictionary Data type?
(Nov-2018)
- 3) List-out the Built-in functions and methods of Dictionary Data type in python?
(Nov-2018)
- 4) Write a Python program to check if all dictionaries in a list are empty or not.
(Nov-2018)
- 5) How to delete items from a dictionary? Explain with an example.**(April-2008)**
- 6) Write a Python script to sort (ascending and descending) a dictionary by value.
- 7) Write a Python script to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x).
Sample:
Dictionary (n = 5): Expected Output: {1: 1, 2: 4, 3: 9, 4: 16, 5: 25}
- 8) Write a Python script to print a dictionary where the keys are numbers between 1 and 15 (both included) and the values are square of keys.
Sample Dictionary:
{1: 1, 2: 5, 3: 9, 4: 15, 5: 25, 6: 36, 7: 49, 8: 64, 9: 80, 9: 100, 11: 121, 12: 144, 13: 169, 14: 200, 105: 225}
- 9) Write a Python program to map two lists into a dictionary.
- 10) Write a python program to check if all dictionaries in a list are empty or not?
- 11) Write a Python program to combine two dictionary adding values for common keys.
d1 = {'a': 100, 'b': 200, 'c':300}
d2 = {'a': 300, 'b': 200,'d':400}
Sample output: {'a': 400, 'b': 400,'d': 400, 'c': 300}
- 12) Write a Python program to create and display all combinations of letters, selecting each letter from a different key in a dictionary
Sample data: {'1':['a','b'], '2':['c','d']}
Expected Output:
ac
ad

bc
bd

13) Write a Python program to get the top three items in a shop.

Sample data: {'item1': 45.50, 'item2':35, 'item3': 41.30, 'item4':55, 'item5': 24}

Expected Output:

item4: 55
item1: 45.5
item3: 41.3

Assignment-Cum-Tutorial Questions-UNIT-VI

A. Objective Questions

1. Identify The right way to close a file
a)File.close() b)close(file) c)close("file") d)File.closed
2. _____ is an example of volatile memory
3. A file is stored in _____ memory
a)primary b)secondary c)cache d)volatile
4. What will happen when a file is opened in write mode and then immediately closed.
a)Filecontentsaredeleted
b) Nothing Happens
c) A Blank Line is written to the file
d)an error occurs
5. The default access mode of the file is _____
6. If a file opened in 'w' mode does not exist, then
a) nothing will happen
b) File will be created
c) Data will be written to a afile that has a name similar to the specified name
d) Error will be generated
7. Identify the delimiter in the Solaris file system
a)/ b)\ c): d)|
8. By default a new file is created in which directory
a)root b)current working c)Python directory d)D Drive
9. which method is used to read a single line from the file
a)read() b)readline() c)readlines() d)reads()
10. When you open a file for appending that does not exist, then a new file is created [True/False]
11. Identify the correct way to write "Welcome to Python" in a file
a)write(file,"Welcome to python")
b)write("Welcome to Python",file)
c)file.write("Welcome to Python")
d)"Welcome to Python".write(file)
12. If the file.txt has 10 lines written in it,what will the result?
len(open('file.txt').readlines())
a)1 b)0 c)10 d)2
13. Identify the sub folder in the path
C:\Students\UnderGraduates\B.Tech_CS.docx
a)C: b) Students c)B.Tech_CS.docx d) UnderGraduates
14. Which method returns a string that includes everything specified in the path?
a)os.path.dirname(path)

b)os.path.basename(path)

c)os.path.relpath()

d)os.path.abs()

15. if count is missing or has a negative value in the read() method then, no contents are read from the file.

[True/False]

16. os.path.abs() method accepts a file path as an argument and returns True if the path is an absolute path and False otherwise

[True/False]

17. How many characters would be printed by this code (One character is one byte)_____

```
file=open("file.txt","r")
for i in range(100):
    print(file.read(10))
file.close()
```

18. Fill in the blank to open a file,read its content and prints its length

```
file=_____("file.txt","r")
text=file._____()
print(_____(text))
file.close()
```

19. Predict the output of the following program

```
f = None
```

```
for i in range (5):
```

```
    with open("data.txt", "w") as f:
```

```
        if i > 2
```

```
            break
```

```
print(f.closed)
```

a)True b) False c) None d) Error

20. Predict the output of the following program

```
with open("hello.txt", "w") as f:
```

```
f.write("Hello World how are you today")
```

```
with open('hello.txt', 'r') as f:
```

```
data = f.readlines()
```

```
for line in data:
```

```
    words = line.split()
```

```
    print (words)
```

```
f.close()
```

a. Runtime Error

b. Hello World how are you today

c. ['Hello', 'World', 'how', 'are', 'you', 'today']

d. Hello

B. Descriptive Questions

1. Define file. Explain about the importance of files in Python.
2. Define path. Distinguish between absolute and relative path with an example.
3. Discuss briefly about various types of file.
4. Write in detail about various modes of file.

5. Give an overview of File positions.
6. Explain different file operations with suitable programming examples. **(April 2018 Regular and November 2018 Supplementary)**
7. What is the purpose of opening a file using with keyword.
8. Write a Python program to count number of vowels and consonants in a given text file
9. Write a Python program that reads data from a file and Calculates the percentage of vowels and consonants in the file
10. Write a Python program that copies one file to another in such away that all comment lines are skipped and not copied in the destination file
11. Write a python program to find no of lines, words and characters in a given text file
12. Write a Python program to combine each line from first file with the corresponding line in second file.
13. Write a program that accepts file name as an input from the user. Open the file and count number of times a character appears in the file.
14. Write a program that tells and sets the position of the file pointer.

Signature of the Faculty

GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, Gudlavalleru – 521 356.

Department of Computer Science and Engineering



2020-21 SEM -II

II-B.Tech Handout

Vision of the Department

To be a centre of excellence in Computer Science and Engineering education and training to meet the challenging needs of the industry and society.

Mission of the Department

- To impart quality education through well-designed curriculum in tune with the growing software needs of the industry.
- To serve our students by inculcating in them problem solving, leadership, teamwork skills and the value of commitment to quality, ethical behavior & respect for others.
- To foster industry-academia relationship for mutual benefit and growth.

Program Educational Objectives (PEOs)

PEO1 : Identify, analyze, formulate and solve Computer Science and Engineering problems both independently and in a team environment by using the appropriate modern tools.

PEO2 : Manage software projects with significant technical, legal, ethical, social, environmental and economic considerations.

PEO3 : Demonstrate commitment and progress in lifelong learning, professional development, leadership and communicate effectively with professional clients and public.

HANDOUT ON PROBABILITY & STATISTICS

Class & Sem. : II B.Tech – II Semester

Year : 2020-21

Branch : CSE

Credits : 3

1. Brief History and Scope of the Subject

The History of Foundations of Mathematics involve non classical logics and constructive mathematics. Mathematical Foundations of Computer Science is the study of mathematical structures that are fundamentally discrete rather than continuous. Research in Discrete Structures increased in the latter half of 20th century partly due to development of digital computers, Which operate in Discrete steps and store data in discrete bits. Graph Theory is study of, Mathematical Structures used to model pair wise relations between objects from a certain collection. This course is useful in study and describing objects and problems in computer science such as computer algorithm, programming languages, Cryptography, Automated theorem proving and software development.

2. Pre-Requisites

- Mathematics background such as set theory, basics in probability & basics in statistics.

3. Course Objectives:

- To impart the concepts of probability and statistics.
- To disseminate the knowledge on sampling theory and principles of hypothesis testing.
- To introduce the correlation coefficient and lines of regression.

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

- use the concepts of probability in different real time problems.
- apply probability distribution in appropriate scenario.
- find confidence intervals for estimating population parameters.
- apply a range of statistical tests appropriately.
- measure correlation between variables and obtain lines of regression.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

| MA2501 : PROBABILITY & STATISTICS | | | | | | | | | | | | | | |
|--|---|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| Course outcomes | Program Outcomes and Program Specific Outcome | | | | | | | | | | | | | |
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1: use the concepts of probability in different real time problems. | 2 | 2 | | | | | | | | | | | | |
| CO 2: apply probability distribution in appropriate scenario. | 2 | 3 | | | | | | | | | | | | |
| CO3: find confidence intervals for estimating population parameters. | 3 | 3 | | | | | | | | | | | | |
| CO 4: apply a range of statistical tests appropriately. | 3 | 3 | | | | | | | | | | | | |
| CO5: measure correlation between variables and obtain lines of regression. | 2 | 2 | | | | | | | | | | | | |

7. Prescribed Text Books

- Dr. T. K. V. Iyengar, Dr. B. Krishna Gandhi, S. Ranganatham and Dr. M.V. S. S. N. Prasad, Probability and Statistics, S. Chand & Company Ltd., New Delhi.
- Miller, John E. Freund, Probability and Statistics for Engineers, PHI, Delhi.

8. Reference Text Books

- S.C. Gupta & V.K. Kapoor, Fundamentals of Mathematical Statistics, S.Chand & Company Ltd., New Delhi.
- B.V. Ramana, Engineering Mathematics, 4th Edition, Maitrey Printers Pvt. Ltd., 2009,India.

9. URLs and Other E-Learning Resources

So net CDs & IIT CDs on some of the topics are available in the digital library.

10. Digital Learning Materials:

- a. www.mathworld.wolfram.com
- b. www.socialresearchmethods.net/kb/samprob.php
- c. www.fourmilabch/rpkp/experiments/statistics.html
- d. www.Hypothesis-Testing.html
- e. <http://quizlet.com>
- f. www.probabilitycourse.com

10. Digital Learning Material:

- <http://www.socr.ucla.edu>
- www.statlect.com
- www.stat.ucla.edu

11. Lecture Schedule:

| Topic | No. of Periods | |
|--|----------------|----------|
| | Theory | Tutorial |
| UNIT –1: Probability | | |
| Introduction to probability | 1 | 1 |
| Simple problems | 1 | |
| Addition theorem-problems | 1 | |
| Conditional and multiplication theorem-problem | 1 | |
| Independent Events- Problems | 1 | 1 |
| Baye’s theorem-problems | 1 | |
| Applications. | 1 | |
| Random variables: Discrete Random variable, Pmf ,distribution function | 1 | 1 |
| Problems on DRV-Mean, Variance, different probabilities | 1 | |
| Problems on DRV | 1 | |
| Continuous random variable, pdf, Distribution function | 1 | |
| Problems on CRV- Mean, Variance, different probabilities | 1 | |
| Problems on CRV | 1 | |
| UNIT – 2: Standard Probability Distributions | | |
| Binomial distribution: introduction - mean and variance | 1 | 1 |
| Problems on Binomial distribution | 2 | |
| Poisson distribution : mean and variance | 2 | |
| Normal distribution – Properties | 1 | 1 |

| | | |
|---|-----------|-----------|
| Area property Problems | 2 | |
| Applications of uniform distribution | 1 | |
| Applications of exponential distribution | 1 | |
| UNIT – 3: Sampling Distributions | | |
| Population, samples, parameter, statistic, random sample, sampling distribution, standard error. | 1 | |
| Sampling distribution of mean -problems on with replacement | 2 | 1 |
| Sampling distribution of mean- Problems on without replacement | 1 | |
| Sampling distribution of difference and sums – problems | 1 | |
| Sampling distribution of difference and sums – problems | 1 | |
| Introduction to estimation – point estimation – results- Problems | 1 | 1 |
| Interval estimation: confidence Intervals for means –problems | 1 | |
| Confidence interval for proportions -problems | 1 | |
| UNIT – 4: Testing Of Hypothesis (Large Samples) | 1 | |
| Test of hypothesis- simple, composite hypotheses, Null hypothesis and alternative Hypothesis, Test statistic. Type I & Type 2 errors in sampling. | 1 | 1 |
| L.O.S – one tail and two tail tests, degrees of freedom, procedure of testing of hypothesis. | 1 | |
| Test of significance of single mean –large samples- problems. | 2 | |
| Test of significance of two mean –large samples- problems. | 1 | |
| Problems. | 1 | |
| Hypothesis concerning one proportion-problems. | 1 | 1 |
| Problems. | 1 | |
| Hypothesis concerning two proportions-problems. | 1 | |
| Problems. | 1 | 1 |
| UNIT – 5: Testing Of Hypothesis (Small Samples) | | |
| Tests of significance: students t-test – means | 1 | |
| Problems on t-test | 1 | 1 |
| Tests of significance: students t-test – two means | 1 | |
| Paired t-test -problems | 1 | |
| F-test-problems | 1 | |
| Analysis of r x c tables – chi- square test for independence | 1 | 1 |
| Chi- square test for Goodness of fit | 1 | |
| Chi- square test for Goodness of fit using Poisson distribution | 1 | |
| UNIT – 6 Correlation-Regression And Queueing Theory | | |
| Simple correlation ,types of correlation, correlation co-efficient | 2 | |
| Problems on correlation coefficient | 1 | 1 |
| rank correlation -problems | 1 | |
| Linear regression and its properties | 1 | |
| TOTAL | 56 | 14 |

12. Seminar Topics

- Probability
- Probability Distributions
- Sampling Distributions
- Significance Tests
- Correlation and Regression

UNIT-I Assignment-Cum-Tutorial Questions

SECTION-A

Objective Questions

- Given that $P(A)=0.9$, $P(B)=0.89$, $P(A \cap B)=0.84$, then $P(A \cup B)$ is
(a) 0.95 (b) 0.59
(c) 0.99 (d) 0.095
- An experiment yields three mutually exclusive events A, B, C with $P(A)=2P(B)=3P(C)$ then $P(A)$ is []
(a) $\frac{2}{11}$ (b) $\frac{3}{11}$
(c) $\frac{6}{11}$ (d) $\frac{5}{11}$
- The probability of solving a problem by the three students A, B, C respectively are $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$. Then the probability that the problem will be solved is []
(a) $\frac{1}{5}$ (b) $\frac{2}{5}$
(c) $\frac{3}{5}$ (d) none
- If two balls are drawn from a bag containing 3 white 4 black and 5 red balls, then the probability that the balls drawn are of different colours is
(a) $\frac{47}{66}$ (b) $\frac{10}{33}$
(c) $\frac{5}{22}$ (d) $\frac{2}{11}$
- A and \bar{B} are two independent events such that $P(\bar{A} \cap B) = \frac{8}{25}$ and $P(A \cap \bar{B}) = \frac{3}{25}$,
then $P(A)$ is
(a) $\frac{2}{5}$ (b) $\frac{4}{5}$
(c) $\frac{1}{5}$ (d) $\frac{3}{5}$
- If $p(x) = x + \frac{2}{k}$, $x = 1, 2, 3, 4, 5$ is the probability distribution of a discrete random variable, then $k =$ []
(a) $\frac{5}{7}$ (b) $-\frac{5}{7}$
(c) $\frac{7}{5}$ (d) $-\frac{7}{5}$
- If $f(x) = \frac{k}{(1+x^2)}$, $-\infty < x < \infty$ is a valid density function, then $k =$

- (a) $1/\pi$ (b) π
 (c) $-1/\pi$ (d) none
8. If X is a continuous random variable with probability density function
- $$f(x) = \frac{(x+1)}{8}, \text{ for } 2 < x < 4$$
- $$= 0, \text{ otherwise}$$
- Then $E(X) =$
- (a) 3.308 (b) 3.803
 (c) 3.083 (d) 3.380
9. If X is a random variable and $V(X) = 2$, then $V(2X + 3) =$ []
- (a) 2 (b) 3
 (c) 6 (d) 8
10. The relation between probability density function and cumulative density function of a random variable X is []
- (a) $F(x) = \int_{-\infty}^x f(x)dx$ (b) $F(x) = \int_x^{\infty} f(x)dx$ (c) $F(x) = \int_{-\infty}^0 f(x)dx$
 (d) $F(x) = \int_0^{\infty} f(x)dx$
11. If $f(x) = 2e^{-2x}, x > 0$ is a probability density function, then $P(X \geq 0.5) =$
- (a) e^{-1} (b) e^{-2}
 (c) e^{-3} (d) e

SECTION-B

SUBJECTIVE QUESTIONS

- If we draw a card from a pack, what is the probability that the card is either ace or king?
- A die is thrown twice. What is the probability that the sum of the spots on the die at two throws is divisible by 2 or 3?
- A bag contains 8 white and 4 red balls. One ball is drawn from the bag and it is replaced after noting its colour. In the second draw again one ball is drawn and its color is noted. What is the probability of the event that both the balls drawn are of different colours?
- A bag contains 8 white and 4 red balls. One ball is drawn from the bag and it is not replaced after noting its colour. In the second draw again one ball is drawn and its colour is noted. What is the probability of the event that both the balls selected at two successive draws are of different colours?
- A lot of 100 semiconductor chips have 20 defective chips. Two chips are selected at random without replacement from the lot.
 - What is the probability that the first one selected is defective?
 - What is the probability that the second one selected is defective, given that the first one was defective?

c) What is the probability that both are defective?

6. If A and B are mutually exclusive events, $P(A) = 0.23$, and $P(B) = 0.51$, find
 (i) $P(\bar{A})$ (ii) $P(A \cup B)$ (iii) $P(\bar{A} \cap B)$ (iv) $P(\bar{A} \cap \bar{B})$

7. Given $P(A) = 0.35$, $P(B) = 0.73$, and $P(A \cap B) = 0.14$, find
 (i) $P(A \cup B)$ (ii) $P(A \cap \bar{B})$ (iii) $P(\bar{A} \cup \bar{B})$ (iv) $P(\bar{A} \cap B)$

8. A shipment of components consists of three identical boxes. One box contains 2000 components of which 25% are defective, the second box has 5000 components of which 20% are defective and the 3rd box contains 2000 components of which 600 are defective. A box is selected at random and a component is removed at random from the box.

- (i) What is the probability that this component is defective?
 (ii) What is the probability that the defective component came from the second box?

9. Three machines A, B and C produce 55%, 25%, 20% of the total number of items of a factory. The percentage of defective output of these machines is 3%, 2% and 4%. If an item is selected at random, (i) find the probability that the item is defective (ii) if the selected item is defective, find the probability that the item is produced by machine A, machine B and machine C.

10. A random variable X has the following probability function value of X

| | | | | | | | |
|------|---|----|----|----|----|-----|-----|
| X | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| P(X) | k | 3k | 5k | 7k | 9k | 11k | 13k |

Find (i) k (ii) $P(X < 4)$ (iii) $P(x \geq 5)$ (iv) $P(X \leq x) > \frac{1}{2}$?

11. Find the mean and variance of the uniform probability distribution given by $f(x) = 1/n$ for $x = 1, 2, \dots, n$

12. A continuous random variable X has a pdf $f(x) = 4x^3$, for $0 \leq x \leq 1$. Find the values of a and b such that (i) $P(X \leq a) = P(X > a)$ (ii) $P(X > b) = 0.1$. Also find the mean and variance of the random variable X.

13. Probability density function of a random variable X is

$$f(x) = \frac{\sin x}{2}, 0 < x < \pi$$

= 0, elsewhere

calculate

the probability of X lies between 0 and $\pi/2$.

14. The daily consumption of electric power (in million of KW-hours) is a random variable having the probability density function

$$f(x) = \frac{1}{9} x e^{-x/3}, x > 0$$

= 0, $x \geq 0$

If the total production is 12 million KW-hours, determine the probability that there is power cut (shortage) on any given day. Also find the average daily consumption of electric power.

SECTION-C

QUESTIONS AT THE LEVEL OF GATE

1. A two-faced fair coin has its faced designated as head (H) and tail(T). This coin is tossed three times in succession to record the following outcomes. H, H, H. If the coin is tossed one more time. the probability (up to one decimal place) of obtaining H again, given the previous realizations of H, H and H would be _____

Answer : 0.5

GATE- 17

2. Probability density function of a random variable X is given below

$$f(x) = \begin{cases} 0.25 & 1 \leq x \leq 5 \\ 0 & \text{otherwise} \end{cases} \text{ then } P(x \leq 4) = \underline{\hspace{2cm}}$$

Answer : 0.75

GATE- 16

3. Consider the following probability mass function (p.m.f) of a random variable X.

$$p(x, q) = \begin{cases} q & \text{if } X = 0 \\ 1 - q & \text{if } X = 1 \\ 0 & \text{otherwise} \end{cases}$$

If q = 0.4, the variance of X is _____

4. The probability density function of a random variable, x is

$$f(x) = \frac{x}{4}(4 - x^2) \text{ for } 0 \leq x \leq 2$$

= 0 otherwise

The mean, μ_x of the random variable is _____

7. The number of mistakes counted in one hundred typed pages of a typist revealed that he made 2.8 mistakes on an average per page. Find the probability that (i) there is no mistake (ii) there are two or less mistakes in a page typed by him.
8. In a test on 1000 electric bulbs, it was found that the number of bulbs was normally distributed with an average life of 2040 hours and a standard deviation of 60 hours. How many bulbs are likely to be in usage for (a) more than 2150 hours (b) less than 1950 hours (c) more than 1920 hours but less than 2100 hours.
9. Life time of IC chips manufactured by a semiconductor manufacturer is approximately normally distributed with mean 5×10^6 hours and standard deviation of 5×10^5 hours. A mainframe manufacturer requires that at least 95% of a batch should have a lifetime greater than 4×10^6 hours. Will the deal be made?
10. Find the probabilities that a random variable having the standard normal distribution will take a value (i) between 0.87 and 1.28 (ii) between -0.34 and 0.62 (iii) greater than 0.85 (iv) greater than -0.655 along with neat diagrammatic representation.
11. In a certain junior Olympics, javelin throw distances are well approximated by a Gaussian distribution for which $\mu = 30\text{m}$ and $\sigma = 5\text{m}$. In a qualifying round, contestants must throw farther than 26m to qualify. In the main event, the record throw is 42m.
 - (i) What is the probability of being disqualified in the qualifying round?
 - (ii) In the main event, what is the probability that the record will be beaten?
12. Fit a Poisson distribution to the following data.

| | | | | | |
|------|-----|----|----|---|---|
| x | 0 | 1 | 2 | 3 | 4 |
| f(x) | 109 | 65 | 22 | 3 | 1 |

SECTION-C

QUESTIONS AT THE LEVEL OF GATE

1. An ISP has a link of 100Mbps which is shared by its subscribers. Considering the fact that all of its subscribers are active 50% of the time and

the probabilities of being active are independent, the ISP has promised 25 Mbps to its 6 subscribers. What is the probability that any subscriber gets degraded service (less than promised speed).

A] 1/32 B] 5/16 C] 1/2 D] 7/64 GATE - 15

[D]

2. Suppose p is the number of cars per minute passing through a certain road junction between 5 PM and 6 PM, and p has a Poisson distribution with mean 3. What is the probability of observing fewer than 3 cars during any given minute in this interval?

[C]

A] $\frac{8}{(2e)^3}$ B] $\frac{9}{(2e)^3}$ C] $\frac{17}{(2e)^3}$ D] $\frac{26}{(2e)^3}$

GATE-2013

3. The annual precipitation data of a city is normally distributed with mean and standard deviation as 1000 mm and 200 mm, respectively. The probability that the annual precipitation will be more than 1200 mm is

[A]

(A) < 50% (B) 50% (C) 75% (D) 100% GATE - 2012

4. Let X be a random variable following normal distribution with mean +1 and variance 4. Let Y be another normal variable with mean -1 and variance unknown. If $P(X \leq -1) = P(Y > -2)$, the standard deviation of Y is

[A]

A] 3 B] 2 C] $\sqrt{2}$ D] 1 GATE - 2008

5. A fair coin is tossed 10 times. What is the probability that ONLY the first two tosses will yield heads ? Ans. $[(1/2)^{10}]$ GATE - 2008

UNIT-III
SECTION-A

Objective Questions

1. The number of possible samples of size n for a population of N units with replacement is _____.
2. The number of possible samples of size n for a population of N units without replacement is _____.
3. Sample variance formula is _____.
4. The difference between sample estimate and population parameter is called _____.
5. 100 among 600 articles are defective. If the maximum error with probability 0.99 is 0.02. The sample size is _____.
6. If there are 5 defective items among 4000, one sided 99% confidence interval for proportion is _____.
7. If $n = 144$, $\sigma = 4$, $\bar{x} = 150$ then 95% confidence interval for μ is _____.
8. If the maximum error with probability 0.95 is 1.2, and standard deviation of the population 10. Then sample size is _____.
9. A sample size 100 is taken whose standard deviation is 5. What is the maximum error with probability 0.95 _____.
10. The totality of the observation called []
(a) Population (b) Sample (c) Parameter (d) None
11. The statistical constants of the population are called []
(a) Statistic (b) Parameter (c) Sample Statistic (d) One
12. The finite population correction factor is []
(a) $\frac{n-N}{N-1}$ (b) $\frac{N-n}{N-1}$ (c) $\frac{N-1}{N-n}$ (d) None
13. The standard error of the statistic sample mean (\bar{X}) is []
(a) $\frac{\sigma}{\sqrt{n}}$ (b) $\frac{\sigma^2}{\sqrt{n}}$ (c) $\sqrt{\frac{\sigma}{n}}$ (d) None
14. If \bar{X} is the mean of a random sample of size n from a finite population of size N with the mean μ and the variance σ^2 then []

- (a) $\mu \frac{\sigma^2}{n}$ (b) $\mu, \frac{\sigma^2}{n} \left(\frac{N-n}{N-1} \right)$ (c) μ, σ (d) None

15. If $\bar{X} = 157$, $\mu = 155$, $\sigma = 15$ and $n = 36$ then z is []

- (a) 0.8 (b) 0.6 (c) 0.08 (d) None

16. If $n = 40$, $\sigma = 2.06$ then the maximum error with 99% confidence is []

- (a) 0.7377 (b) 0.8387 (c) 0.6387 (d) 0.536

17. A sample of size n is taken from a population whose variance is 9. The maximum error of estimate for μ with 95% confidence is 0.5. Then $n =$

- (a) 12 (b) 68 (c) 128 (d) 139 []

18. If $n = 144$, $\sigma = 4$ and $\bar{x} = 32$ then 99% confidence interval for means is

- (a) (30.71, 33.29) (b) (30.835, 33.165) (c) (31.02, 32.98) (d) None []

19. If the maximum error with 99% confidence is 0.86 and size of the sample is 144, then the variance of the population is []

- (a) 2 (b) 4 (c) 8 (d) 16

20. If the size of the sample is 5 and size of the population is 2000. The correction factor is

- (a) 0.999 (b) 9.99 (c) 99.9 (d) None

SECTION-B

Descriptive Questions:

- A population consists of five numbers 2, 3, 6, 8 and 11. Consider all possible samples of size two which can be drawn without replacement from this population. Find the mean of the population (b) standard deviation of the population (c) mean of the sampling distribution of means (d) standard deviation of the sampling distribution of means.
- A population consists of 5, 10, 14, 18, 13, 24. Consider all possible samples of size 2 which can be drawn without replacement from the population. Find the mean of the population (b) standard deviation of the population (c) mean of the sampling distribution of means (d) standard deviation of the sampling distribution of means.
- $U_1 = \{5, 6, 7, 8\}$ $u_2 = \{10, 12, 14\}$ write (i) $u_1 + u_2$ (ii) $u_1 - u_2$ (iii) $\mu_{u_1 + u_2}$ (iv)

$$\mu_{u_1 - u_2}$$

4. Assume that the heights of 3000 male students at a college are normally distributed with mean 68 inches and standard deviation 3 inches. If 80 samples consisting of 25 students each are obtained, what would be the expected mean and standard deviation of the resulting sampling distribution of means if the sampling were done (a) with replacement (b) without replacement.
5. Determine the expected number of random samples having their means (a) between 22.39 and 22.41 (b) greater than 22.42 (c) less than 22.37 (d) less than 22.38 or more than 22.41 for the following data: $N = 1500$, $n = 36$, number of samples = 300, $\mu = 22.4$, $\sigma = 0.48$.
6. A certain type of electric light bulb has a mean life-time of 1500h and a standard deviation of 150h. Three bulbs are connected so that when one burns out, another will go on. Assuming that the life-time are normally distributed, what is the probability that lighting will take place for (a) at least 5000h and (b) at most 4200h?
7. Determine the probability that the mean breaking strength of cables produced by company 2 will be (i) at least 600N more than (ii) at least 450N more than the cables produced by company 1, if 100 cables of brand 1 and 50 cables of brand 2 are tested.
8. The mean voltage of a battery is 15 volt and s.d. is 0.2 volt. What is the probability that four such batteries connected in series will have a combined voltage of 60.8 or more volts?
9. In a random sample, 136 of 400 persons given a flu vaccine experienced some discomfort. Construct a 95% confidence interval for the true proportion of persons who will experience some discomfort from the vaccine.
10. A district official intends to use the mean of a random sample of 150 sixth grades from a very large school district to estimate the mean score which all the sixth grades in the district would get if they took a certain arithmetic achievement test. If based on experience, the official known that $\sigma = 9.4$ for such data, what can she assert with probability 0.95 about the maximum error?
11. The mean of certain normal population is equal to the standard error of the mean of samples of size 64. Find the probability that the mean of the sample size 36 will be negative.

UNIT-IV

SECTION-A

1. Critical region is also known as _____
2. Whether a test is one-sided or two-sided depends on _____ hypothesis.
3. A hypothesis is false, but accepted, this is an error of type _____
4. Rejecting H_0 when H_0 is true is _____ error.
5. The hypothesis which is under test for possible rejection is called _____ hypothesis.
6. A hypothesis contrary to null hypothesis is known as _____ hypothesis.
7. Area of critical region depends on []
(a) Size of Type-I error (b) size of Type-II error
(c) Value of the statistic (d) No. of observations
8. Test of hypothesis $H_0:\mu=1500$ against $H_1 < 1500$ leads to
(a) One-sided lower-tailed test (b) one-sided upper-tailed test
(c) Two-tailed test (d) all the above
9. Level of significance is the probability of []
(a) Type-I error (b) Type-II error (c) both I and II (d) None
10. Among 900 people in a state 90 are found to be chapatti eaters. The 99% confidence interval for the true proportion is
(a) (0.08, 0.12) (b) (0.8, 1.2) (c) (0.07, 0.13)
(d) None
11. Testing $H_0:\mu=1500$ against $H_1:\mu>1500$ leads to: []
(a) One-sided lower-tailed test (b) one-sided upper-tailed test
(c) two-tailed test (d) all the above
12. Two samples, one from urban and the other from rural adult males of sizes 400 and 600 had S.D's 165 cm and 175 cm respectively. Test of hypothesis of equality of standard deviations in the two populations at 5% level is:
(a) Accepted (b) rejected (c) no decision about H_0 (d) none of the above

SECTION-B

1. Explain One-tailed and two-tailed tests.
2. Define Type-I and type-II errors?
3. Explain the procedure for Testing of Hypothesis?
4. Define (a) Critical region (b) Level of significance (c) Left one tailed (d) Right one tailed.
5. The mean life of a sample of 1000 electric bulbs produced by a company is found to be 1570hrs with a S.D of 1200hrs. If μ is the mean life time of all the bulbs produced by the company, test the hypothesis $\mu=1600$ hrs against the alternative $\mu \neq 1600$ hrs at 5% LOS.
6. In a random sample of 60 workers the average time taken by them to get to work is 33.8 minutes with a S.D of 6.1 minutes. Can we reject the null hypothesis in favour of alternative hypothesis $\mu > 32.6$ at $\alpha=1\%$ LOS.
7. A sample of 900 members has a mean of 3.4cms and S.D 2.61cms. Is the sample from a large population of mean 3.25cms and S.D 2.61cms? If the population is normal and its mean is unknown find the 95% fiducial limits of true mean.
8. Given the following information relating to two places A & B. Test whether there is any significant difference between their mean wages.

| | A | B |
|--------------------|------|------|
| Mean wages(Rs) | 47 | 49 |
| S.D(Rs) | 28 | 40 |
| No. of workers(Rs) | 1000 | 1500 |

9. The means of two large samples of sizes 1000 and 2000 members are 67.5 inches and 68.0 inches respectively. Can the samples be regarded as drawn from the same population of S.D 2.5 inches?
10. In a big city 325 men out of 600 men were found to be smokers. Does this information support the conclusion that the majority of men in this city are smokers?
11. In a random sample of 400 industrial accidents, it was found that 231 were due at least partially to unsafe working conditions. Construct a 99% confidence interval for the corresponding true proportion.

12. A machine produced 20 defective articles in a batch of 400. After overhauling it produced 10 defectives in a batch of 300. Has the machine improved

UNIT-V
SECTION:A

1. When d.f. for χ^2 are 100 or more, Chi-square is approximated to _____
 (a) t-distribution (b) F-distribution []
 (c) Z-distribution (d) none of the above
2. Given the following 8 sample values -4,-3,-3,0,3,3,4,4, the value of student's t-test $H_0: \mu = 0$ is _____ []
 (a) 2.73 (b) 0.97 (c) 3.30 (d) 0.41
3. If all frequencies of classes are same, the value of χ^2 is _____ []
 (a) 1 (b) ∞ (c) 0 (d) none
4. Range of statistic -t is _____ []
 (a) -1 to 1 (b) $-\infty$ to ∞ (c) 0 to ∞ (d) 0 to 1
5. Range of variance of ratio F is : _____ []
 (a) -1 to 1 (b) $-\infty$ to ∞ (c) 0 to ∞ (d) 0 to 1
6. In a contingency table, the expected frequencies are computed under _____
 (a) H_0 (b) H_1
 (c) both (a) and (b) (d) no consideration of the hypothesis
7. The shape of t—distribution is similar to that of _____ []
 (a) Chi-square distribution (b) F-distribution (c) Normal distribution (d) none
8. Which test is used to test the equality of population variances ____ []
 (a) Chi-square test (b) t-test (c) F-test (d) z-test
9. If two independent random samples of sizes $n_1=13$ and $n_2= 7$, are taken from a normal population .The variances of the first sample will be at least four times as that of a second sample then F is _____
 (a) $\frac{1}{4}$ (b) 4 (c) 16 (d) non
10. chi-square distribution curve varies from _____ []
 (a) $-\infty$ to ∞ (b) $-\infty$ to 0 (c) 0 to ∞ (d) none

11. To test the goodness of fit _____ test is used []
 (a) z-test (b) F-test (c) χ^2 -test (d) t-test
12. Chi-square Coefficient of contingency is calculated when _____ []
 (a) The attributes are independent (b) the attributes are associated
 (c) both (a) and (b) (d) neither (a) nor (b)
13. When the value of coefficient of contingency $\chi^2=0$, it shows _____ []
 (a) Complete dissociation amongst attributes
 (b) Complete association amongst attributes
 (c) Both (a) and (b)
 (d) Neither (a) nor (b)

SECTION:B

1. The following are the average weekly losses of worker hours due to accidents in 10 Industrial plants before and after a certain safety programme was put into operation
- | | | | | | | | | | | |
|--------|----|----|----|-----|----|----|----|----|----|----|
| Before | 45 | 73 | 46 | 124 | 33 | 57 | 83 | 34 | 26 | 17 |
| After | 36 | 60 | 44 | 119 | 35 | 51 | 77 | 29 | 24 | 17 |
- Test whether the safety programme is effective in reducing the number of accidents at the level of significance of 0.05?
2. A machinist is making engine parts with axle diameters of 0.700 inch .A random sample of 10 parts shows a mean diameter of 0.742 inch with a standard deviation of 0.04inch. Compute the statistic you would use to test whether the work is meeting the specification at 0.05L.O.S.
3. A random sample of 6 steel beams has a mean compressive strength of 58,392 p.s.i (pounds per square inch) with a standard deviation of 648 p.s.i. Use this information and the level $\alpha = 0.05$ to test whether the true average compressive strength of the steel from which this sample came is 58,000 p.s.i. Assume normality.
4. A Random sample of 10 boys had the following I.Q's:70, 120,110,101,88,83,95,98,107 and 100.

- (a) Do these data support the assumption of a population mean I.Q of 100?
- (b) Find a reason range in which most of the mean I.Q values of samples of 10 boys lie.
5. To examine the hypothesis that the husbands are more intelligent than the wives, an investigator took a sample of 10 couples and administered them a test which measures the I.Q. The results are as follows:

| | | | | | | | | | | |
|----------|-----|-----|----|-----|-----|-----|----|----|-----|-----|
| Husbands | 117 | 105 | 97 | 105 | 123 | 109 | 86 | 78 | 103 | 107 |
| Wife's | 106 | 98 | 87 | 104 | 116 | 95 | 90 | 69 | 108 | 85 |

Test the hypothesis with a reasonable test at the L.O.S 0.05

6. The blood pressure of 5 women before and after intake of a certain drug are given below :

| | | | | | |
|--------|-----|-----|-----|-----|-----|
| Before | 110 | 120 | 125 | 132 | 125 |
| After | 120 | 118 | 125 | 136 | 121 |

Test at 0.05 L.O.S whether there is significant change in B.P.

7. The nicotine content in milligrams in two samples of tobacco were found to be as follows

| | | | | | | |
|----------|----|----|----|----|----|------|
| Sample A | 24 | 27 | 26 | 21 | 25 | ---- |
| Sample B | 27 | 30 | 28 | 31 | 22 | 36 |

Can it be said that the two samples have come from the same normal population?

8. Pumpkins were grown under two experimental conditions. Two random samples of 11 and 9 pumpkins show the sample standard deviations of their weights as 0.8 and 0.5 respectively. Assuming that the weight distributions are normal, test the hypothesis that the true variances are equal.
9. In two independent samples of sizes 8 and 10 the sum of squares of deviations of the sample values from the respective sample means were 84.4 and 102.6. Test whether the difference of variances of the population is significant are not.

10.1000 students at college level were graded to their I.Q and the economic conditions of their homes. Use chi-square test to find out whether there is any association between economic conditions at home and I.Q.

| Economic conditions | I.Q | | |
|---------------------|------|-----|-------|
| | High | Low | Total |
| rich | 460 | 140 | 600 |
| poor | 240 | 160 | 400 |
| total | 700 | 300 | 1000 |

11.From the following data, find whether there is any significant liking in the habit of taking soft drinks among the categories of employees

| Soft drinks | Employees | | |
|-------------|-----------|----------|----------|
| | Clerks | Teachers | Officers |
| Pepsi | 10 | 25 | 65 |
| Thumsup | 15 | 30 | 65 |
| Fanta | 50 | 60 | 30 |

UNIT-VI

SECTION: A

1. The functional relationship of a dependent variable with independent variable is called _____
2. If there are two or more independent variables in a regression equation, it is named as _____ regression.
3. The measure of change in dependent variable corresponding to an unit change in independent variable is called _____
4. The range of Pearson's coefficient of correlation is _____

5. If the correlation coefficient is zero, the value of regression coefficient is _____

6. Scatter diagram of the variate values (X,Y) gives the idea about: []

- (a) functional relationship (b) regression model
(c) distribution of errors (d) none of the above

7. Regression coefficient is independent of: []

- (a) Origin (b) scale (c) both (a) & (b) (d) neither (a) nor (b)

8. The range of correlation coefficient is _____ []

- (a) 0 to ∞ (b) $-\infty$ to ∞ (c) 0 to 1 (d) -1 to 1

9. One regression coefficient is positive then the other regression coefficient is _____

[]

- (a) Positive (b) negative (c) equal to zero (d) cannot say

10. When two regression lines coincide then r is []

- (a) 0 (b) -1 (c) 1 (d) 0.5

11. Coefficient of correlation is equal to _____ []

- (a) $b_{xy} * b_{yx}$ (b) $\sqrt{b_{xy} * b_{yx}}$

- (c) $\sqrt{b_{xy}}$ (d) $\sqrt{b_{yx}}$

12. Which of the following indicates the strongest relationship?___ []

- (a) $r = .5$ (b) $r = .09$ (c) $r = -.6$ (d) $r^2 = .2$

13. In calculating r with raw scores, the numerator of r represents_ []

- (a) the variance of X
(b) the variance of Y
(c) the variance of X multiplied by the variance of Y
(d) the covariance of X and Y

14. Which of the following would not allow you to calculate a correlation?

- (a) a negative relationship between X and Y []
(b) a positive relationship between X and Y
(c) a curvilinear relationship between X and Y
(d) a linear relationship between X and Y

SECTION: B

1. Find a suitable coefficient of correlation for the following data:

| | | | | | | | | |
|-------------------------|----|----|----|----|----|----|----|----|
| Fertiliser used(tonnes) | 15 | 18 | 20 | 24 | 30 | 35 | 40 | 50 |
|-------------------------|----|----|----|----|----|----|----|----|

| | | | | | | | | |
|----------------------|----|----|----|-----|-----|-----|-----|-----|
| Productivity(tonnes) | 85 | 93 | 95 | 105 | 120 | 130 | 150 | 160 |
|----------------------|----|----|----|-----|-----|-----|-----|-----|

2. Calculate Karl Pearson's correlation coefficient for the following data.

| | | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|----|----|
| X | 38 | 45 | 46 | 38 | 35 | 38 | 46 | 32 | 36 | 38 |
| Y | 28 | 34 | 38 | 34 | 36 | 26 | 28 | 29 | 25 | 36 |

What inference would you draw from estimate?

3. Determine Karl Pearson's coefficient of correlation from the data which represents father's height (X) and son's height (Y).

| | | | | | | | |
|---|----|----|----|----|----|----|----|
| X | 64 | 65 | 66 | 67 | 68 | 69 | 70 |
| Y | 66 | 67 | 65 | 68 | 70 | 68 | 72 |

Comment on the result. [II-II Supple June2017 CSE]

4. Given $n=10, \sigma_x = 5.4, \sigma_y = 6.2$ and sum of product of deviation from the mean of X and Y is 66 find the correlation coefficient.

5. Find coefficient of correlation between X and Y for the following data.

| | | | | | | |
|---|----|----|----|----|----|----|
| X | 10 | 12 | 18 | 24 | 23 | 27 |
| Y | 13 | 18 | 12 | 25 | 30 | 10 |

6. Use the formula $r = \frac{\sigma_x^2 + \sigma_y^2 - \sigma_{X-Y}^2}{2\sigma_x \sigma_y}$ to compute the correlation coefficient to the following data

| | | | | | | | | |
|---|----|----|----|----|----|----|----|----|
| X | 62 | 56 | 36 | 66 | 25 | 75 | 82 | 78 |
| Y | 58 | 44 | 51 | 58 | 60 | 68 | 62 | 84 |

[II-II Regular May2016 CSE]

7. Ten competitors in a musical test were ranked by the three judges A,B and C in the following order.

| | | | | | | | | | | |
|------------|---|---|---|----|---|----|---|----|---|---|
| Ranks by A | 1 | 6 | 5 | 10 | 3 | 2 | 4 | 9 | 7 | 8 |
| Ranks by B | 3 | 5 | 8 | 4 | 7 | 10 | 2 | 1 | 6 | 9 |
| Ranks by C | 6 | 4 | 9 | 8 | 1 | 2 | 3 | 10 | 5 | 7 |

Using rank correlation method, discuss which pair of judges has the nearest approach to common liking in music.

8. Price indices of cotton and wool are given below for the 12 months of a year.

Obtain the equations of lines of regression between the indices.

| | | | | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|----|----|----|----|
| X | 78 | 77 | 85 | 88 | 87 | 82 | 81 | 77 | 76 | 83 | 97 | 93 |
| Y | 84 | 82 | 82 | 85 | 89 | 90 | 88 | 92 | 83 | 89 | 98 | 99 |

9. Compute the two regression equations from the following data

| | | | | | |
|---|---|---|---|---|---|
| x | 1 | 2 | 3 | 4 | 5 |
| y | 2 | 3 | 5 | 4 | 6 |

Estimate the value of y when x = 2.5. [II-II Regular April2017 CSE]

10. Calculate the regression equations of Y on X from the data given below, taking deviations from actual means of X and Y.

| | | | | | | |
|-----------------|----|----|----|----|----|----|
| Price(Rs.) | 10 | 12 | 13 | 12 | 16 | 15 |
| Amount Demanded | 40 | 38 | 43 | 45 | 37 | 43 |

Estimate the likely demand when the price is Rs. 20.

11. The following calculations have been made for prices of 12 stocks (X) in stock exchange, on a certain day along with the volume of the sales in thousands of shares(Y). From these calculations find the regression equation of prices of stocks, on the volume of the sales of shares.

$$\sum X = 580, \sum Y = 370, \sum XY = 11499, \sum X^2 = 41658, \sum Y^2 = 17206$$

12. The equations of two regression lines are $7X - 16Y + 9 = 0$ and $5Y - 4X - 3 = 0$. Find the coefficient of correlation and the means of X and Y.
13. The equations of two regression lines obtained in a correlation analysis are $8x - 10y + 66 = 0$, $40x - 18y = 214$ Find (i) mean values of x and y (ii) Correlation coefficient between x and y.

[II-II Regular May2016 CSE]

14. If $X = 4Y + 5$ and $Y = kX + 4$ are the lines of regression of X on Y and Y on X respectively, show that $0 < 4k < 1$. If $k = \frac{1}{16}$, find the means of the two variables and the coefficient of correlation between them.

[II-II Supple Jan2017 CSE]

Signature of the Faculty

HANDOUT ON COMPUTER ORGANIZATION AND ARCHITECTURE

Class & Sem. : II B.Tech – II Semester

Year: 2020-21

Branch : CSE

Credits: 3

1. Brief History and Scope of the Subject

The term *Computer Architecture* was first defined in the paper by Amdahl, Blaauw and Brooks of IBM Corporation announcing IBM System/360 computer family on April 7, 1964. On that day IBM Corporation introduced, in the words of IBM spokesman, "*the most important product announcement that this corporation has made in its history*". There were six models introduced originally, ranging in performance from 25 to 1. Six years later this performance range was increased to about 200 to 1.

This was the key feature which prompted IBM's effort to design architecture for a new line of computers that are to be code compatible with each other. The recognition that *architecture* and *implementation* could be separated and that one need not imply the other led to establishment of a common System/360 machine architecture implemented in the range of models.

Recent Developments

- machine level representation of data
- assembly level machine organization
- memory system organization and architecture
- interfacing and communication

2. Pre-Requisites

- Binary arithmetic operations
- Operations of MUX, DEMUX, ENCODER, DECODER and Registers.

3. Course Objectives

- To familiarize with organizational aspects of memory, processor and I/O

4. Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: identify different types of instructions.

CO2: differentiate micro-programmed and hard-wired control units.

CO3: analyze the performance of the hierarchical organization of memory.

CO4: demonstrate various operations on fixed and floating point numbers.

CO5:summarize different data transfer techniques.

CO6:demonstrate the use of parallel processing.

5. Program Outcomes and Program Specific Outcomes

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

| CT2512 : COMPUTER ORGANIZATION AND ARCHITECTURE | | | | | | | | | | | | | | |
|--|---|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Course outcomes | Program Outcomes and Program Specific Outcome | | | | | | | | | | | | PSO1 | PSO2 |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | |
| CO1: identify different types of instructions. | 2 | | | | | | | | | | | 1 | | |
| CO2:differentiate micro-programmed and hard-wired control units. | 2 | 1 | | | | | | | | | | | | |
| CO3: analyze the performance of the hierarchical organization of memory. | 2 | 2 | | | | | | | | | | 1 | | |
| CO4: demonstrate various operations on fixed and floating point numbers. | 3 | | | | | | | | | | | 1 | | |
| CO5: summarize different data transfer techniques. | 1 | | | | | | | | | | | | | |
| CO6: demonstrate the use of parallel processing. | 1 | | | | | | | | | | | | | |

7. Prescribed Text Books

1. M.Moris Mano, Computer Systems Architecture, Pearson/PHI, 3rd edition

8. Reference Text Books

1. Carl Hamacher, Zvonks Vranesic, SafeaZaky, Computer Organization, McGraw Hill, 5th edition.
2. William Stallings, Computer Organization and Architecture, Pearson/PHI, 6th edition.
3. John L. Hennessy and David A. Patterson, Computer Architecture a quantitative approach, Elsevier, 4th Edition.

9. URLs and Other E-Learning Resources

Journals

- History of computing
- Computational science & Engineering
- Computer & Digital techniques.

URL's

1.

<https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/>

10. Digital Learning Materials:

1. SONET volumes -8
2. Computer Architecture --38 volumes
By Prof.Anshul Kumar
Dept.of Comp.sc.&Engg
I.I.T. Delhi.
3. Computer Organization –33 volumes
By Prof. S.RAMAN
Dept.of Comp.sc.&Engg
I.I.T. MADRAS.

11. Lecture Schedule / Lesson Plan

| Topic | No. of Periods | |
|---|----------------|----------|
| | Theory | Tutorial |
| UNIT –1: Register transfer language and Micro operations | | |
| Functional Units | 1 | 1 |
| Computer Registers, Register Transfer Languages | 1 | |
| Register Transfer, Bus and Memory Transfers | 1 | |
| Arithmetic Micro operations | 2 | |
| Logic Micro operations, | 1 | |
| Shift Micro operations, Arithmetic logic shift unit. | 2 | 1 |
| Instruction codes | 1 | |
| Instruction Cycle | 1 | |
| Register reference instructions | 1 | |
| Memory– Reference Instructions | 1 | 1 |
| Input – Output and Interrupt | 2 | |
| Total | 14 | 3 |
| UNIT – 2: CPU and Micro Programmed Control | | |

| | | |
|--|----------|----------|
| Instruction Formats | 1 | 1 |
| Addressing Modes | 1 | |
| Control Memory | 1 | 1 |
| Address Sequencing | 1 | |
| Design of Control Unit- Hard Wired Control, Micro Programmed Control | 2 | |
| Total | 6 | 2 |
| UNIT – 3: Memory Organization | | |
| Memory Hierarchy | 1 | 1 |
| Main Memory | 1 | |
| Auxiliary Memory | 1 | |
| Associative Memory | 1 | 1 |
| Cache Memory | 2 | |
| Virtual Memory | 1 | |
| Total | 7 | 2 |
| UNIT – 4: Computer Arithmetic | | |
| Addition and Subtraction – Fixed Point | 1 | 1 |
| Multiplication Algorithms– Fixed Point | 2 | |
| Division Algorithms– Fixed Point | 2 | |
| Floating – Point Arithmetic Operations | 2 | 1 |
| Total | 7 | 2 |
| UNIT – 5: Input-Output Organization | | |
| Peripheral Devices, Input-Output Interface | 1 | 1 |
| Asynchronous data transfer | 1 | |
| Modes of Transfer, Priority Interrupt | 2 | |
| Direct memory Access | 2 | 1 |
| Input –Output Processor (IOP) | 1 | |
| Total | 7 | 2 |
| UNIT – 6: Parallel Processing | | |

| | | |
|--|-----------|-----------|
| Parallel Processing | 1 | 1 |
| Pipelining | 1 | |
| Arithmetic Pipeline, Instruction Pipeline | 3 | |
| Multi Processors: Characteristics of Multiprocessors | 1 | |
| Interconnection Structures | 1 | 1 |
| Inter Processor Arbitration | 1 | |
| Cache Coherence. | 1 | |
| Total | 9 | 2 |
| Total No.of Periods: | 50 | 13 |

12. Seminar Topics:

Booths multiplication algorithm

Inter Processor Arbitration

Unit - I

Assignment-Cum-Tutorial Questions

Section - A

- Which language is termed as the symbolic depiction used for indicating the Operations?
 A. Random transfer language B. Register transfer language []
 C. Arithmetic transfer language D. All of these
- Micro operation is shown as? []
 A. $R1 \leftarrow R2$ B. $R1 \rightarrow R2$ C. Both A and B D. None of these
- Write the RTL code for transferring the contents of register R1 into R2, when $p=1$.
- The register that includes the address of the memory unit is termed as the _____
 []
 A. MAR B. PC C. IR D. None of these
- Operation to transfer contents into memory is termed as _____ []
 A. Read B. Write C. Both A & B D. None of these
- LOAD R2, 30FF is _____ type of instruction? []

- A. Arithmetic and Logical instruction B. Control instruction
 C. Data transfer instruction D. None of the above
7. In 3 state buffer, two states act as signals equal to? []
 A. Logic 0 B. Logic 1 C. Both A & B D. None of these
8. In 3 state buffer third position termed as high impedance state which acts as?
 A. Open circuit B. Close circuit C. Both A & B D. None of these
9. Which operations are used for addition, subtraction, increment, decrement and complement function? []
 A. Bus B. Memory transfer
 C. Arithmetic operation D. All of these
10. What are the operations that a computer performs on the data stored in a register?
 A. Register transfer B. Arithmetic C. Logical D. All of these
11. Which operation places memory address in memory address register and data in MDR?
 A. Memory read B. Memory write C. Both A & B D. None of these
12. Which operation is extremely useful in serial transfer of data? []
 A. Logical micro operation B. Arithmetic micro operation
 C. Shift micro operation D. None of these
13. A group of bits that tell the computer to perform a specific operation is known as ____ []
 A. Operation code B. Micro-operation
 C. Accumulator D. Register
14. How many bits of opcode is required to implement a CPU with 5 arithmetic and logical instructions, 2 control instructions, and 4 data transfer instructions?
 A. 1 B. 2 C. 3 D. 4
15. What is the combination of I and Opcode bits for I/O instructions?
16. The CPU of a Computer takes instruction from the memory and executes them. This process is called as _____? []
 A. Load cycle B. Time sequence
 C. Fetch-execute cycle D. None of these

17. A CPU has 24-bit instructions. A program starts at address 300 (in decimal). Which one of the following is a legal program counter (all values in decimal)?

(GATE 2006) []

- A. 400 B. 500 C. 600 D. 700

18. Assume a CPU takes 17 cycles in worst case to execute an instruction. Number of cycles required to execute the current instruction is 12. If an interrupt occurs during the execution of current instruction, then after how many cycles it will be recognized?

- A. 17 B. 11 C. 12 D. 17+2

Section - B

1. Explain how various registers and memory are connected using a common bus with diagram.
2. Design a bus system for connecting 4 registers each of size 8 bits.
3. Explain various Arithmetic Micro operations with example.
4. Design a 6-bit Adder/Subtractor circuit.
5. Design a 4-bit Incrementer Circuit.
6. Construct 6-bit arithmetic circuit.
7. Describe various Logical Micro operations.
8. What are different shift microoperations? Explain with an example.
9. Explain the working of the circuit that performs Logic operations.
10. Explain different types of instructions.
11. Explain the life cycle of an instruction with a suitable flow chart.

Unit - II

Section – A

1. The instruction ADD R1, 30FF is belongs to _____ []

a) A 3-address instruction format b) A 2-address instruction format

c) A 1-address instruction format d) A 0-address instruction format
2. Which of the following options represents the correct matching? []

| Addressing Mode | Description |
|-----------------|---|
| 1. Immediate | A. The address field contains the address (in main memory) where the operand is stored |
| 2. Direct | B. The address field refers to the address of a word in the memory, which in-turn contains the address of the operand |

| | |
|--------------------|---|
| 3. Indirect | C. The address field of the operand is a register |
| 4. Register Direct | D. Operand value is present in the instruction itself (address field) |

- a) 1→A; 2→D; 3→C; 4→B; b) 1→D; 2→A; 3→B; 4→C;
c) 1→D; 2→A; 3→C; 4→B; d) 1→A; 2→D; 3→B; 4→C;

3. The instruction, Add #45,R1 does _____ []
a) Adds the value of 45 to the address of R1 and stores 45 in that address
b) Adds 45 to the value of R1 and stores it in R1
c) Finds the memory location 45 and adds that content to that of R1
d) None of the mentioned
4. The instruction, MOV AX, 0005H belongs to the address mode _____ []
a) Register b) Direct c) Immediate d) Register relative
5. The addressing mode used in an instruction of the form ADD X, Y is _____ ?
a) Direct b) Immediate c) Indirect d) Register
6. The addressing mode used in the instruction PUSH B is _____ ? []
a) Direct b) Register c) Register indirect d) Index
7. The addressing mode, where you directly specify the operand value is _____. []
a) Immediate b) Direct c) Definite d) Relative
8. The addressing mode which makes use of in-direction pointers is _____. []
a) Indirect b) Index c) Relative d) Offset
9. A sequence of microinstructions constitutes a _____ []
a) microprogram b) microoperation
c) microinstruction d) microprocessor
10. A memory that is part of control unit is referred to as _____ []
a) cache memory b) control memory
c) main memory d) virtual memory
11. When the control signals are generated by hardware using conventional logic design techniques, the control unit is said to be _____ []

- a) programmed b) microprogrammed
 c) hardwired d) none of the above
12. The next address generator is also called _____ []
 a) microprogram sequencer b) control unit
 c) micro instruction sequencer d) microprogrammed control
13. The goals of both hardwired control and microprogrammed control units are to _____
 a) access memory b) access ALU []
 c) cost a lot of money d) generate control signals
14. Each computer instruction has its own _____ in control memory to generate the microoperations that execute the instruction. []
 a) microinstruction b) branch instruction
 c) mapping logic d) microprogram routine
15. The control _____ register specifies the address of the microinstruction, and the control _____ register holds the microinstruction read from memory.
 a) Address, data b) data, memory
 c) memory, instruction d) data , instruction
16. A control memory has 4096 words of 24 bits each. How many bits are there in the control address register? []
 a) 12 b) 24 c) 32 d) 25
17. The branch logic that provides decision making capabilities in the control unit is known as _____ []
 a) controlled branching b) conditional branching
 c) unconditional branching d) none of the above
18. The microprogram written as strings of 0's and 1's is a _____ []
 a) symbolic microinstruction b) binary microinstruction
 c) symbolic microprogram d) binary microprogram
19. Address information in the microinstruction *cannot* be _____ []
 a) single address field b) two address field
 c) variable format d) a control signal

20. Micro instruction execution is _____ []
- a) To generate the control signals needed to execute the microinstruction
 - b) To get the next microinstruction from the control memory
 - c) To get the next instruction from the main memory
 - d) To get the microinstruction from the main memory
21. Microinstruction sequencing is _____ []
- a) to get the next instruction from the main memory
 - b) to get the next microinstruction from the control memory
 - c) to get the microinstruction from the main memory
 - d) to generate the control signals needed to execute the micro instruction
22. A microprogram sequencer
- a) generates the address of next micro instruction to be executed
 - b) generates the control signals to execute a microinstruction.
 - c) sequentially averages all microinstructions in the control memory.
 - d) enables the efficient handling of a micro program subroutine.

Section – B

1. Illustrate different types of Instruction formats.
2. Describe different types of Addressing modes with examples.
3. Write short notes on control memory.
4. Explain the process of mapping with an example.
5. Explain the use of subroutine register.
6. Explain how control signals are generated using hard wired control signals.
7. Explain how control signals are generated using micro programmed control signals.
8. Define the following: Micro operations, Micro instructions, Micro program, Micro code.
9. Differentiate between hardwired control unit and micro programmed control unit.
10. What is Microprogramming? Explain with a simple example.
11. Explain how the next instruction address is generated.
12. Using the mapping procedure generate the micro instruction address for the following op-codes.
 - a. 0010
 - b. 1011
 - c. 1111
13. What are elements required in designing a Control Unit.
14. Few bits of the current micro instruction are used to generate the address of the next micro instruction to be executed. Explain why?
15. Using the mapping procedure give the first micro instruction address for the following op-code.
 - a. 0101
 - b. 1010
 - c. 0001

Section - C

1. In the absolute addressing mode: **(GATE-CS-2002)** []
- a) the operand is inside the instruction
 - b) the address of the operand is inside the instruction
 - c) the register containing address of the operand is specified inside the instruction
 - d) the location of the operand is implicit
2. Which is the most appropriate match for the items in the first column with the items in the second column: **(GATE-CS-2001)** []
- | | |
|-----------------------------|---------------------------------|
| X. Indirect Addressing | I. Array implementation |
| Y. Indexed Addressing | II. Writing re-locatable code |
| Z. Base Register Addressing | III. Passing array as parameter |
- a) (X, III) (Y, I) (Z, II)
 - b) (X, II) (Y, III) (Z, I)
 - c) (X, III) (Y, II) (Z, I)
 - d) (X, I) (Y, III) (Z, II)
3. The most appropriate matching for the following pairs: **(GATE-CS-2000)**
- | | |
|------------------------------|--------------|
| X: Indirect addressing | 1: Loops |
| Y: Immediate addressing | 2: Pointers |
| Z: Auto decrement addressing | 3: Constants |
- a) X-3, Y-2, Z-1
 - b) X-1, Y-3, Z-2
 - c) X-2, Y-3, Z-1
 - d) X-3, Y-1, Z-2
4. Which of the following addressing modes are suitable for program relocation at run time? **(GATE-CS-2004)**
- | | | |
|--------------------------|-----------------------|---------------------------|
| (i) Absolute addressing | (ii) Based addressing | (iii) Relative addressing |
| (iv) Indirect addressing | | |
- a) (i) and (iv)
 - b) (i) and (ii)
 - c) (ii) and (iii)
 - d) (i), (ii) and (iv)
5. Identify the addressing modes of below instructions and match them: []

(Paper-3 NET June 2012)

- (A) ADI (1) Immediate addressing
- (B) STA (2) Direct addressing
- (C) CMA (3) Implied addressing
- (D) SUB (4) Register addressing

- a) A – 1, B – 2, C – 3, D – 4
- b) A – 2, B – 1, C – 4, D – 3
- c) A – 3, B – 2, C – 1, D – 4
- d) A – 4, B – 3, C – 2, D – 1

6. Consider a hypothetical processor with an instruction of type LW R1, 20(R2), which during execution reads a 32-bit word from memory and stores it in a 32-bit register R1. The effective address of the memory location is obtained by the addition of a constant 20 and the contents of register R2. Which of the following best reflects the addressing mode implemented by this instruction for the operand in memory?

(GATE 2011) []

- a) Immediate Addressing
- b) Register Addressing
- c) Register Indirect Scaled Addressing
- d) Base Indexed Addressing

7. A microprogrammed control unit_____ (GATE 1987) []

- a) Is faster than hardwired control unit
- b) Facilitates easy implementation of new instructions
- c) Is useful when very small programs are run
- d) Usually refers to control unit of microprocessor

8. The effective address of MUL 5(R1,R2) instruction is_____ []

- a) $5+R1+R2$
- b) $5+(R1*R2)$
- c) $5+[R1]+[R2]$
- d) $5*([R1]+[R2])$

9. Match each of the high level language statements given on the left hand side with the most natural addressing mode from those listed on the right hand side.

- 1. $A[1] = B[J];$ A) Indirect addressing
- 2. $while [*A++];$ B) Indexed addressing
- 3. $int temp = *x;$ C) Autoincrement

- a) (1, C), (2, B), (3, A)
- b) (1, A), (2, C), (3, B)
- c) (1, B), (2, C), (3, A)
- d) (1, A), (2, B), (3, C)

Unit -III

Section - A

1. DRAM is used in implementing the_____ []
 - a.Secondary memory
 - b.Dynamic memory
 - c. Static memory
 - d. Main memory
2. ROM is a type of _____memory that is capable of holding data. []
 - a.Random Access
 - b. Plug and play
 - c. add on
 - d. Built in
3. Which type of memory is used for increasing the speed? []
 - a.Memory hierarchy
 - b. Cache memory
 - c. Virtual memory
 - d. Memory system
4. Performance of cache memory is measured in terms of quantity called as _____ []
 - a.Hit ratio
 - b. Count ratio
 - c. Miss ratio
 - d. Bit ratio
5. Cache memory works on the principle of_____ []
 - a.Locality of data
 - b. Locality of reference
 - c. Locality of memory
 - d. Locality of reference & memory
6. Ratio of cache accesses, results in a miss is known as_____
 - a.Hit miss
 - b. File caches
 - c. Hit rate
 - d. Miss rate
7. During a write operation if the required block is not present in the cache then _____ occurs.
 - a. Write latency
 - b. Write delay
 - c. Write hit
 - d. Write miss []
8. Cache memory acts between_____ []
 - a.CPU and RAM
 - b. CPU and Hard Disk
 - c. RAM and ROM
 - d. None of these
9. Write Through technique is used in which memory for updating the data _____ []
 - a.Virtual memory
 - b. Auxiliary memory
 - c. Main memory
 - d. Cache memory
10. The cache memory of 2k words uses direct mapping with a block size of 4 words. Find out the number of blocks cache can accommodate?
 - a.512 words
 - b. 128 words
 - c. 256 words
 - d. 1024 words
11. If the main memory is of 8K bytes and the cache memory is of 2K words. It uses associative mapping. Then each word of cache memory shall be_____.
 - a. 11 bits
 - b. 16 bits
 - c. 21 bits
 - d. 20 bits
12. While using the direct mapping technique, in a 16 bit system the higher order 5 bits is used for _____ []

Section – C

1. A computer has a 256 KByte, 4-way set associative, write back data cache with block size of 32 Bytes. The processor sends 32 bit addresses to the cache controller. Each cache tag directory entry contains, in addition to address tag, 2 valid bits, 1 modified bit and 1 replacement bit. The number of bits in the tag field of an address is_____ (GATE CS 2012) []
a. 11 b. 14 c. 16 d.27
2. Consider the data given in previous question. The size of the cache tag directory is_____ (GATE CS 2012) []
a. 160 Kbits b. 136 bits c. 40 Kbits d. 32 bits
3. An 8KB direct-mapped write-back cache is organized as multiple blocks, each of size 32-bytes. The processor generates 32-bit addresses. The cache controller maintains the tag information for each cache block comprising of the following. 1 Valid bit and 1 Modified bit. As many bits as the minimum needed to identify the memory block mapped in the cache. What is the total size of memory needed at the cache controller to store meta-data (tags) for the cache?(GATE CS 2011)
a. 4864 bits b. 6144 bits c. 6656 bits d. 5376 bits
4. Consider a 4-way set associative cache consisting of 128 lines with a line size of 64 words. The CPU generates a 20-bit address of a word in main memory. The number of bits in the TAG, LINE and WORD fields are respectively? (GATE-CS-2007) []
a. 9, 6, 5 b. 7, 7, 6 c. 7, 5, 8 d.9, 5, 6
5. Consider two cache organizations: The first one is 32 KB 2-way set associative with 32-byte block size. The second one is of the same size but direct mapped. The size of an address is 32 bits in both cases. A 2-to-1 multiplexer has a latency of 0.6 ns while a kbit comparator has a latency of k/10 ns. The hit latency of the set associative organization is h1 while that of the direct mapped one is h2. The value of h1 is? (GATE-CS-2006)
a. 2.4 ns b. 2.3 ns c. 1.8 ns d.1.7 ns
6. Consider two cache organizations: The first one is 32 KB 2-way set associative with 32-byte block size. The second one is of the same size but direct mapped. The size of an address is 32 bits in both cases. A 2-to-1 multiplexer has a latency of 0.6 ns while a kbit comparator has a latency of k/10 ns. The hit latency of the set associative organization is h1 while that of the direct mapped one is h2. The value

- of h2 is? (GATE-CS-2006) a. 2.4
 ns b. 2.3 c. 1.8 d. 1.7
7. Consider a direct mapped cache of size 32 KB with block size 32 bytes. The CPU generates 32 bit addresses. The number of bits needed for cache indexing and the number of tag bits are respectively? (GATE-CS-2005)[]
- a. 10, 17 b. 10, 22 c. 15, 17 d. 5, 17
8. A cache line is 64 bytes. The main memory has latency 32ns and bandwidth 1G.Bytes/s. The time required to fetch the entire cache line from the main memory is? (GATE IT 2006) []
- a. 32 ns b. 64 ns c. 96 ns d. 128 ns

Unit - IV

Section - A

1. 11110011 in signed 2's complement system is _____? []
 a. -13 b. +13 c. +14 d. -14
2. The 2's complement of binary number 10000000 is? []
 a. 00000000 c. 11111111
 b. 01111111 d. 10000000
3. The content of DR register is 0001010111001101 and AC register is 0010010111001101. After the execution of following microoperation $AC \leftarrow AC + DR$ the result in AC is? []
 a. 0011101110011010 c. 1011100011011011
 b. 1011101111011011 d. 1011101001000011
4. In computers subtraction is carried out generally by _____? []
 a. 1's complement method c. 2's complement method
 b. Signed magnitude method d. BCD subtraction method
5. For the example 0110x1001 the first and second numbers are called as _____?
 a. Multiplier, Multiplicand c. Multiplier, Multiplier
 b. Multiplicand, Multiplier d. Multiplicand, Multiplicand
6. Booth algorithm is for _____? []
 a. Addition b. subtraction c. division d. multiplication
7. For the example 1110+1001, the first and second numbers are called as _____?
 i. Augend, addend c. addend, augend
 ii. Addend, addend d. augend, augend
8. For the example 1110-1001, the first and second numbers are called as _____?
 a. minuend, subrahend c. addend, augend
 b. minuend, minued d. augend, subtrahend
9. In Booth multiplication algorithm, which logical microoperation is performed on the partial product? []
 a. Circular shift left c. Arithmetic shift right

Section - B

1. Explain addition/subtraction operations of fixed point representation with the help of a flowchart.
2. With an example, explain procedure for 2's Complement Subtraction.
3. Illustrate Hardware configuration for Signed Magnitude addition and subtraction of two fixed point numbers.
4. Write algorithm for Multiplication of Signed Magnitude data (Flowchart for multiply operation on Signed Magnitude data).
5. Perform the following Arithmetic operations using **Signed Magnitude representation** and verify whether there is *Overflow or not?*
 - i. $(+13) + (+9)$
 - ii. $(+9) + (-13)$
 - iii. $(+10) + (+18)$
 - iv. $(-14) + (-9)$
 - v. $(+18) - (-10)$
 - vi. $(+18) - (+10)$
 - vii. $(-14) - (-9)$
 - viii. $(-13) - (+6)$
6. Draw flowchart for addition and subtraction operation on Signed Magnitude representation of data (Algorithm for add and subtract operations on Signed Magnitude representation of data).
7. Apply Booth's algorithm to multiply the numbers 23 and 19 for no. of bits $n=6$ in each number.
8. Apply Booth's algorithm to multiply the numbers -15 and 20.
9. Perform the signed 2's complement multiplication for the operands: $(-22) * (-9)$.
10. Write Booth algorithm for multiplication of signed 2's complement numbers.
11. What is the 2's complement of the number: $-5/8$
12. Normalize the number 0.00530×10^5

Section - C

1. The subtraction of a binary number Y from another binary number X, done by adding 2's complement of Y to X, results in a binary number without overflow. This implies that the result is? **(GATE 1987)**
 - a. Negative and is in normal form
 - b. Negative and is in 2's complement form
 - c. Positive and is in normal form
 - d. Positive and is in 2's complement form
2. 2's complement representation of a 16 bit number (one sign bit and 15 magnitude bits) is FFFF. Its magnitude in decimal representation is? **(GATE 1997)**
 - a. 0
 - b. 1
 - c. 32,767
 - d. 65,535
3. An equivalent 2's complement representation of the 2's complement number is 1101 is? **(GATE 1998)**

7. The DMA differs from the interrupt mode by_____. []
- a) The involvement of the processor for the operation
 - b) The method accessing the I/O devices
 - c) The amount of data transfer possible
 - d) Both a and c
8. The DMA transfers are performed by a control circuit called as_____
- a) Device interface b) DMA controller
 - c) Data controller d) Over looker
9. In DMA transfers, the required signals and addresses are given by _____
- a) Processor b) Device drivers
 - c) DMA controllers d) The program itself
10. After the completion of the DMA transfer the processor is notified by_____
- a) Acknowledge signal b) Interrupt signal
 - c) WMFC signal d) None of the above
11. _____ register is used for the purpose of controlling the status of each interrupt request in parallel priority interrupt?
- a) Mass b) Mark c) Make d) Mask
12. Interrupts initiated by an instruction is called as_____
- a) Internal b) External c) Hardware d) Software
13. The DMA controller has _____ registers? []
- a) 4 b) 2 c) 3 d) 1
14. When the R/W bit of the status register of the DMA controller is set to 1?
- a) Read operation is performed
 - b) Write operation is performed
 - c) Both Read & Write operations are performed
 - d) No Read/Write operations are allowed
15. Can a single DMA controller perform operations on two different disks simultaneously...?

- a) True b) False c) can't say

16. When process requests for a DMA transfer, what will happen?

- a) Then the process is temporarily suspended
b) The process continues execution
c) Another process gets executed
d) Both a and c

17. The DMA transfer is initiated by _____

- a) Processor b) The process being executed
c) I/O devices d) OS

18. In memory-mapped I/O _____?

- a) The I/O devices and the memory share the same address space
b) The I/O devices have a separate address space
c) The memory and I/O devices have an associated address space
d) A part of the memory is specifically set aside for the I/O operation

19. To overcome the lag in the operating speeds of the I/O device and the processor use ____

- a) Buffer spaces b) Status flags c) Interrupt signals
d) Exceptions

20. The method of accessing the I/O devices by repeatedly checking the status flags is _____

- a) Program-controlled I/O b) Memory-mapped I/O
b) c) I/O mapped d) None of the above

21. The method of synchronizing the processor with the I/O device in which the device sends a signal when it is ready is?

- a) Exceptions b) Signal handling
c) Interrupts d) DMA

22. The method which offers higher speeds of I/O transfers is _____

- a) Interrupts b) Memory mapping

- c) Program-controlled I/O d) DMA
23. The return address from the interrupt-service routine is stored in _____
- a) System heap b) Processor register
- c) Processor stack d) Memory
24. The signal sent to the device from the processor to the device after receiving an interrupt is
- a) Interrupt-acknowledge b) Return signal
- c) Service signal d) Permission signal

Section - B

1. Explain briefly various peripheral devices used in a system.
2. Explain Asynchronous communication interface with a neat sketch.
3. Explain about programmed I/O for data transfer.
4. Explain block diagram of Input-Output Processor.
5. Explain how CPU and IOP communicate for data transfer?
6. With the help of a neat diagram explain how the priority of a device is decoded parallelly for servicing the interrupts.
7. Define baud Rate.
8. What is vector address?
9. Illustrate parallel transfer of data in asynchronous mode.
10. Explain different types of synchronization mechanisms used in asynchronous communication.
11. With a neat diagram illustrate Daisy chaining priority interrupt.
12. Explain DMA in detail with a neat sketch
13. Differentiate between parallel and serial priority.

Section – C

1. The size of the data count register of a DMA controller is 16 bits. The processor needs to transfer a file of 29,154 kilobytes from disk to main memory. The memory is byte addressable. The minimum number of times the DMA controller needs to get the control of the system bus from the processor to transfer the file from the disk to main memory is _____ **(GATE 2016)**
 (A) 3644 (B) 3645 (C) 456 (D) 1823

2. A hard disk with a transfer rate of 10 Mbytes/ second is constantly transferring data to memory using DMA. The processor runs at 600 MHz, and takes 300 and 900 clock cycles to initiate and complete DMA transfer respectively. If the size of the transfer is 20 Kbytes, what is the percentage of processor time consumed for the transfer operation? **(GATE 2004)**
 (A) 5.0% (B) 1.0% (C) 0.5% (D) 0.1% []

Unit - VI

Section - A

1. When multiple-instructions are overlapped during execution of program, then function performed is called_____? []
 - a) Multitasking
 - b) Multiprogramming
 - c) Hardwired control
 - d) Pipelining
2. Pipelining increases CPU instruction_____? []
 - a) Size
 - b) Through put
 - c) Cycle rate
 - d) Time
3. Each stage in pipelining should be completed within ____ cycle. []
 - a) 1
 - b) 2
 - c) 3
 - d) 4
4. The pipelining process is also called as _____. []
 - a) Superscalar operation
 - b) Assembly line operation
 - c) Vonneumann cycle
 - d) None of the mentioned
5. In pipelining the task which requires the least time is performed first. []
 - a) True
 - b) False
6. If a unit completes its task before the allotted time period, then_____.
 - a) It'll perform some other task in the remaining time
 - b) Its time gets reallocated to different task
 - c) It'll remain idle for the remaining time
 - d) None of the mentioned
7. An instruction that does no operation for changing state is known as_____?
 - a) Nope
 - b) No
 - c) No-op
 - d) Nop
8. Which of the following is not a Flynn's classification? []
 - a) Single instruction stream, single data stream
 - b) Single instruction stream, multiple data stream
 - c) Multiple Input, Multiple Output stream
 - d) Multiple instruction stream, multiple data stream

9. Which of the following is not a way to achieve parallel processing? []

- a) Pipeline processing
- b) Vector processing
- c) Array processors
- d) Link processing

10. Define parallel processing.

11. Define critical section.

12. Define tightly coupled multiprocessors.

Section - B

1. Explain in detail about three segment instruction pipeline.
2. Describe various ways of handling branch hazards in instruction pipelining.
3. Explain how the device is prioritized serially for granting the bus.
4. Explain the characteristics of multiprocessors.
5. Classify the ways for organizing memory in multiprocessors.
6. Explain Flynn's classification of systems.
7. Draw the diagram for four segment pipeline with clock.
8. Implement floating point addition and subtraction algorithm using three segment pipeline.
9. Draw and explain the functioning of a processor with multiple functional units.
10. Illustrate how to connect 4 processors and 4 memory modules using a crossbar switch.
11. Give reasons for cache inconsistency. How to overcome it?

Section - C

1. The performance of a pipelined processor suffers if _____. **(GATE 2002)**
 - a) The pipeline stages have different delays
 - b) Consecutive instructions are dependent on each other
 - c) The pipeline stages share hardware resources
 - d) All of the above
2. Comparing the time T_1 taken for a single instruction on a pipelined CPU with time T_2 taken on a non-pipelined but identical CPU, we can say that _____. **(GATE 2000)**
 - a) $T_1 \leq T_2$ b) $T_1 \geq T_2$
 - c) $T_1 < T_2$ d) T_1 is T_2 plus the time taken for one instruction fetch cycle
3. A 4-stage pipeline has the stage delays as 150, 120, 160 and 140 nanoseconds respectively. Registers that are used between the stages have a delay of 5

HANDOUT ON DATABASE MANAGEMENT SYSTEM

II B.Tech–II Semester

Year: 2020-21

Branch:CSE

Credits: 3

=====

1. Brief History and Scope Of The Subject

Database is an organized collection of data. It is the collection of schemas, tables, queries, reports, views and other objects. The data are typically organized to model aspects of reality in a way that supports processes requiring information, such as modeling the availability of rooms in hotels in a way that supports finding a hotel with vacancies. A **database management system (DBMS)** is a computer software application that interacts with the user, other applications, and the database itself to capture and analyze data. A general-purpose DBMS is designed to allow the definition, creation, querying, update, and administration of databases

2. Pre-Requisites

Students need to be aware of different storage mechanisms used for data storage

3. Course Objectives:

- a. To familiarize the concepts of database systems and different issues involved in the database design.
- b. To introduce how to write SQL for storage, retrieval and manipulation of data in a relational database.

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

CO1: recognize the importance of database system over file processing system.

CO2: analyze an information storage problem and derive an information model in the form of an entity relationship diagram.

CO3: write simple and complex queries using structured query Language(SQL) for storage, retrieval and manipulation of data in a relational database.

CO4: employ principles of normalisation for designing a good relational database schema.

CO5: describe the issues and techniques relating to concurrency and database recovery in a multi-user database environment.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

| CT2513 : DATABASE MANAGEMENT SYSTEMS | | | | | | | | | | | | | | |
|---|---|-------|-------|-------|-------|-------|-------|-------|-------|--------|--------|--------|-------|-------|
| Course outcomes | Program Outcomes and Program Specific Outcome | | | | | | | | | | | | | |
| | P O 1 | P O 2 | P O 3 | P O 4 | P O 5 | P O 6 | P O 7 | P O 8 | P O 9 | P O 10 | P O 11 | P O 12 | PSO 1 | PSO 2 |
| CO1. recognize the importance of database system over file processing system. | 1 | | | | | | | | | | | | | |
| CO 2.analyze an information storage problem and derive an information model in the form of an entity relationship diagram.. | 2 | 2 | 3 | 1 | | | | | | | | 2 | 2 | 2 |
| CO3. write simple and complex queries using Structured Query Language (SQL) for storage, retrieval and manipulation of data in a relational database. | 3 | 2 | 2 | 2 | | | | | | | | 2 | 2 | 2 |
| CO 4. employ principles of normalization for designing a good relational database schema. | 3 | 3 | 3 | 2 | | | | | | | | 2 | 1 | 1 |
| CO5. describe the issues and techniques relating to concurrency and database recovery in a multi-user database environment. | 1 | | | | | | | | | | | | | |

7. Prescribed Text Books

1. Korth & Sudarshan, Database system concept, MH.
2. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, MH.

8. Reference Text Books

1. Elmasri Navrate, Fundamentals of Database Systems, Pearson Education.
2. C.J.Date, Introduction to Database Systems, Pearson Education.

- Peter Rob & C Coronel, Database Systems design, Implementation, and Management, 7th Edition.

9. URLs and Other E-Learning Resources

- <http://www.w3schools.com/sql/>
- <http://www.mysqltutorial.org/>
- <http://www.java2s.com/Tutorial/Oracle/CatalogOracle.htm>
- <http://www.oracle.com/technetwork/tutorials/index.html>

10. Digital Learning Materials:

- <https://www.youtube.com/watch?v=rbwXdTsCk2c>
- <https://www.youtube.com/watch?v=EUzsy3W4I0g>

11. Lecture Schedule / Lesson Plan

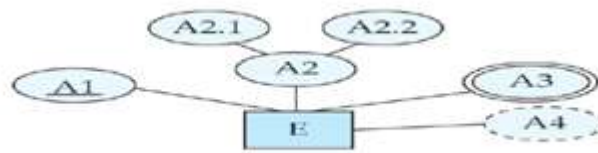
| TOPIC | No. of Periods | |
|--|----------------|----------|
| | Theory | Tutorial |
| UNIT –1: INTRODUCTION TO DATABASE | | |
| Advantages of using DBMS | 1 | 2 |
| Data Models, Schema and instances | 2 | |
| Levels of abstraction | 1 | |
| Entity- Relationship Model- Attributes and Keys | 1 | |
| Relationship Types, Weak Entity set, Strong Entity Set | 1 | |
| Enhanced E–R Modeling- specialization, generalization | 1 | |
| database design for banking enterprise | 1 | |
| reduction to relational schemas | 3 | |
| UNIT – 2: RELATIONAL MODEL & SQL | | |
| Relational model concepts | 1 | 2 |
| constraints, keys, relational algebra | 2 | |
| SQL- DDL, DML | 1 | |
| Set operations, Aggregate Functions | 1 | |
| Null values, Nested queries | 2 | |
| Defining different constraints on a table | 2 | |

| | | |
|--|-----------|-----------|
| Group by, having clauses | 1 | |
| UNIT – 3: DATABASE DESIGN | | |
| Functional Dependencies: partial, full, transitive dependencies | 2 | 3 |
| Axioms | 1 | |
| attribute closure | 2 | |
| Lossless join, dependency preserving decomposition | 2 | |
| Normal forms-First, second third normal forms | 2 | |
| Boyce- Codd normal form | 1 | |
| UNIT – 4: TRANSACTION MANAGEMENT | | |
| Transaction Management- Transaction concept | 1 | 2 |
| ACID properties, transaction state diagram | 2 | |
| Schedules: serial, concurrent, serializable | 2 | |
| serializability of schedules | 3 | |
| recoverability | 1 | |
| UNIT – 5: CONCURRENCY CONTROL | | |
| Concurrency control | 1 | 3 |
| Concurrent execution of transactions, anomalies | 2 | |
| Lock-based protocols:2PL, strict 2PL, rigorous 2PL | 2 | |
| Timestamp-based protocols | 1 | |
| Thomas write rule , Deadlock handling: deadlock prevention | 2 | |
| Deadlock detection and recovery | 1 | |
| UNIT – 6: CRASH RECOVERY | | |
| Failure classification | 1 | 2 |
| Different types of Recovery techniques-deferred update, immediate update | 3 | |
| Shadow paging, Check points | 3 | |
| Total No. of Periods: | 56 | 14 |

12. Seminar Topics

5. An ER Model includes
- I. An ER diagram portraying entity types.
 - II. Attributes for each entity type
 - III. Relationships among entity types.
 - IV. Semantic integrity constraints that reflects the business rules about data not captured in the ER diagram. []
- (A) I, II, III & IV (B) I&IV
 (C) I, II & IV (D) I & III

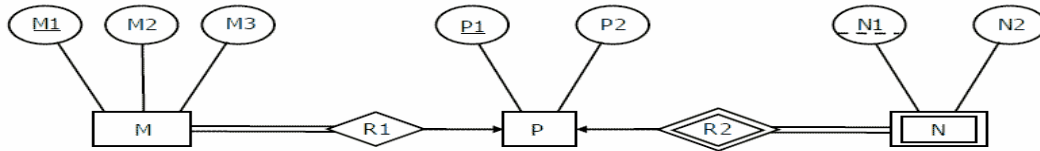
6. Refer the diagram below, where the attributes of relation E are characterized



- (A) A4 is weak attribute
 (B) A3 is multi valued attribute
 (C) A2 is a derived attribute
 (D) A3 is a foreign key attribute)
7. For a weak entity set to be meaningful, it must be associated with another entity set in combination with some of their attribute values is called as:
- (A) Neighbour set (B) Strong entity set
 (C) Owner entity set (D) Weak entity set
8. Which of the following statement is FALSE about weak entity set?
- (A) Weak entities can be deleted automatically when their strong entity is deleted.
 (B) Weak entity set avoids the data duplication and consequent possible inconsistencies caused by duplicating the key of the strong entity.
 (C) A weak entity set has no primary key unless attributes of the strong entity set on which it depends are included.
 (D) Tuples in a weak entity set are not partitioned according to their relationship with tuples in a strong entity set.
9. Every weak entity set can be converted into a strong entity set by:
- (A) Using generalization []
 (B) Adding appropriate attributes

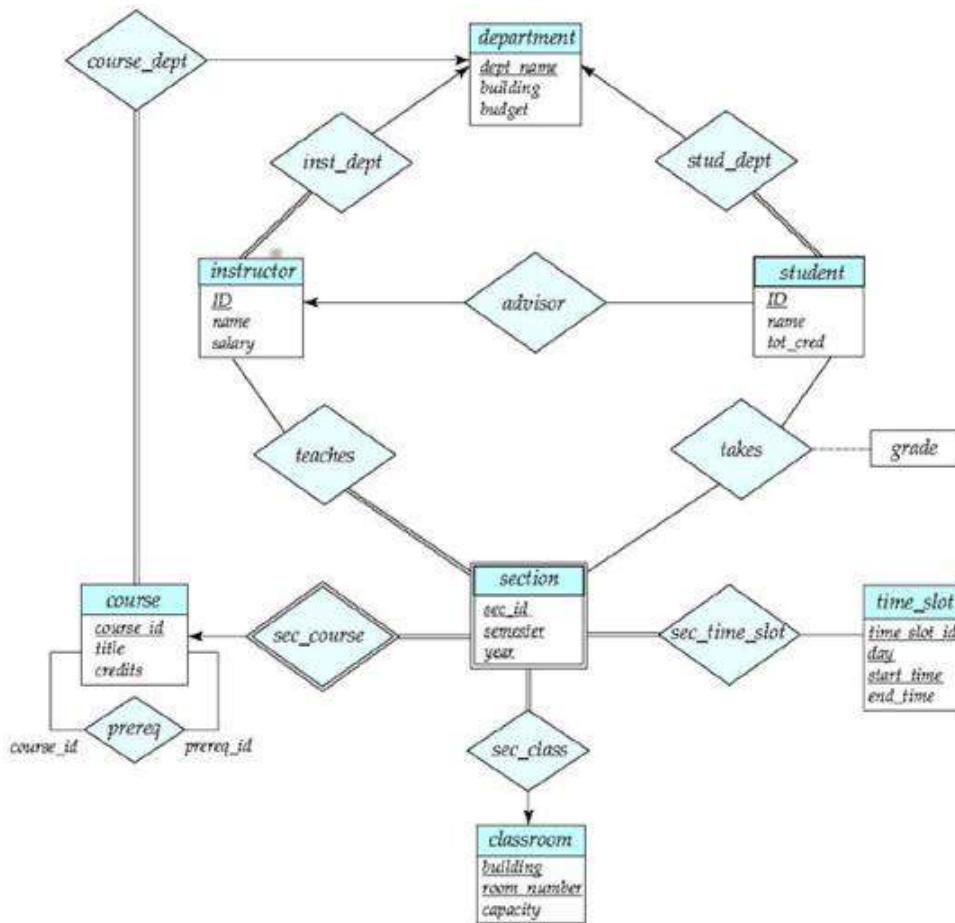
- (C) Using aggregation
- (D) None of the above

10. Consider the following ER diagram. The minimum number of tables needed to represent M, N, P, R1, R2 is []



- (A) 2
- (B) 3
- (C) 4
- (D) 5

11. Consider the ER diagram given below:



Identify the correct statement(s) based on the ER model of the university.

- (A) inst_dept is a relation set connects weak entity instructor with department.
- (B) department is a strong entity.
- (C) (time_slot_id, day) is the primary key for time_slot entity.
- (D) course_id, prereq_id are the fields of prereq relation set.

12. Given the basic ER and relational models, Which of the following is

INCORRECT?

- (A) An attribute of an entity can have more than one value
- (B) An attribute of an entity can be composite
- (C) In a row of a relational table, an attribute can have more than one value
- (D) In a row of a relational table, an attribute can have exactly one value or a NULL value

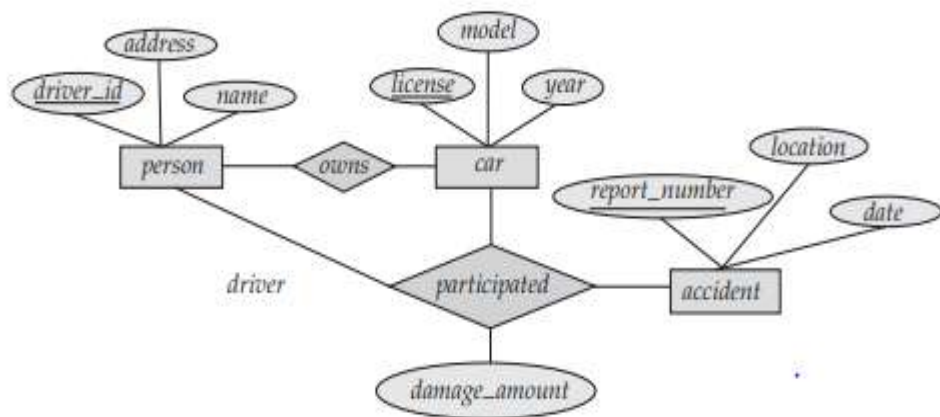
SECTION-B

SUBJECTIVE QUESTIONS

- 1) Define DBMS and explain why would choose a database system instead of simply storing data in operating system files?
- 2) What is a data model? Explain different types of data models with an example.
- 3) Briefly explain schema and instance with suitable example.
- 4) Describe purpose of ER diagrams and describe how entity, entity sets, Relationships, relationship sets are represented with an example.
- 5) What are the different types of attributes and keys used in ER model?
- 6) Quote suitable example to represent a strong and weak entity set through ER diagram.
- 7) Distinguish between weak entity set and strong entity set.
- 8) Outline the importance of EER modelling specialization and generalization with an example.
- 9) Illustrate with an example how to generate a relational-database schema from an ER model.
- 10) Illustrate with an example translation of relationship sets with participation constraints of an ER diagram to relational model.
- 11) Design a database for banking enterprise using ER Model.
- 12) Construct an ER diagram for college admission office section. The office maintains data about each class, including the instructor, the enrolment and the time and place of the class meetings. For each student class pair a grade is recorded. Determine the entities and relationships.
- 13) Design a university level database for maintaining the student details of different colleges in the university. Only consider the personal details and the college and branch details of the student belong. represent the same using an ER diagram.

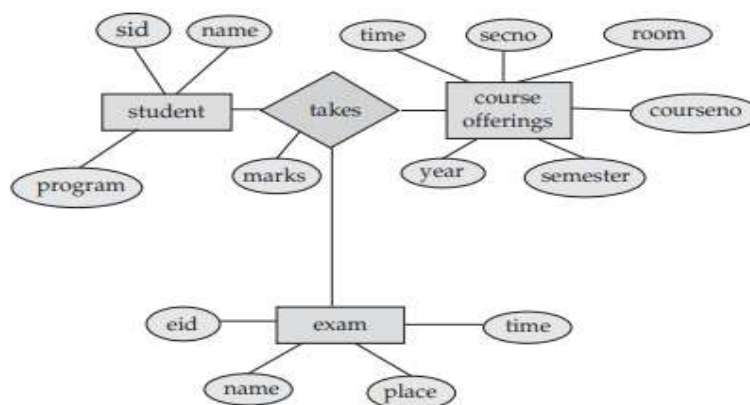
14) A company database needs to store information about employees(ssn, name, designation, salary, address, phone), departments(dno, dname, budget) and children of employees(name, age). Employee works in departments; each department is managed by an employee, a child must be identified uniquely by name when the parent(who is an employee; assume that only one parent works for the company) is known. We are not interested in information about child once the parent leaves the organization. Draw an ER diagram that captures this information.

15) Convert the following ER diagram into Relational tables.



E-R diagram for a car insurance company.

16) Convert the following ER diagram into Relational tables.

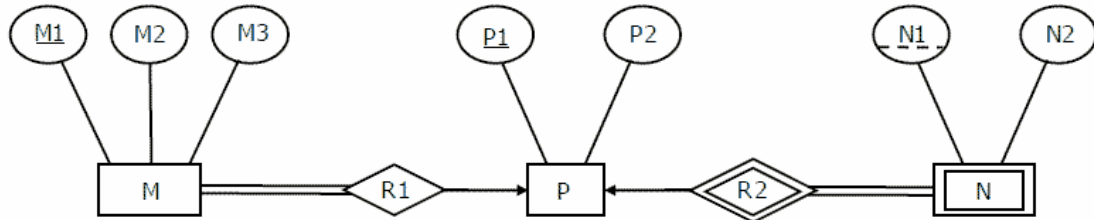


E-R diagram for marks database.

SECTION-C

QUESTIONS AT THE LEVEL OF GATE

1. Which of the following is a correct attribute set for one of the tables generated from below ER diagram. []



- a) {M1, M2, M3, P1}
- b) {M1, P1, N1, N2}
- c) {M1, P1, N1}
- d) {M1, P1}

2. Let E1 and E2 be two entities in an E/R diagram with simple single-valued attributes. R1 and R2 are two relationships between E1 and E2, where R1 is one-to-many and R2 is many-to-many. R1 and R2 do not have any attributes of their own. What is the minimum number of tables required to represent this situation in the relational model? []

- a) 2
- b) 3
- c) 4
- d) 5

UNIT-II

SECTION-A

Objective Questions

1. For every teacher record in a database, there is an attribute called Department. This attribute specifies the department name. At times, the name may contain the numeric department id concatenated with it. However, it can never comprise only of the department id. Department name is optional in a teacher record.

Identify the correct components for the domain of the attribute Department.

- a) Date
- b) Integer
- c) NULL
- d) Alphanumeric (String and Integer)

2. Identify the correct statement(s).

- a) A Candidate Key is a set of one or more attributes that, taken collectively, allows us to uniquely identify any entity in the entity set

- b) A Candidate Key for which no proper subset is also a Candidate Key is called a Super Key
- c) A Super Key is a set of one or more attributes that, taken collectively, allows us to uniquely identify any entity in the entity set
- d) A Super Key for which no proper subset is also a Super Key is called a Candidate Key

i)a,b ii) a,c,d iii) a iv) c,d

3. Identify the valid data-types, which can be used in SQL to define the type of data.

a) Varchar b) string c) real d) float

i) a,b ii) c,d iii) a iv) a,c,d

4. Consider the course table.

`course(course_id, title, dept_name, credits).`

Create a new course 'HS-001', titled 'SUPW', with 10 credits for department 'HSC'.

Identify the appropriate SQL

a) Insert into table course values('HS-001','SUPW','HSC',10)

b) Insert into course ('HS-001','SUPW','HSC',10)

c) Insert into course values('HS-001','SUPW','HSC',10)

d) Insert into table course ('HS-001','SUPW','HSC',10)

5. The command to remove rows from a table 'CUSTOMER' is: []

a) Remove From Customer ... b) Drop From Customer . . .

c) Delete From Customer Where . . . d) Update From Customer . . .

6. The primary key must be []

a) Not null b) Unique c) a or b d) Both a and b

7. The set of permitted values of each attribute is called []

a) Domain b) Tuple c) Relation d) Schema

8. SQL Query to find an employee whose Salary is equal or greater than 10000 is_____

9. SQL Query to find name of employee whose name Start with 'M' is _____ .

10. Select _____ dept_name from Instructor, Here which of the following displays the unique values of the column? []

a) All b) From c) Distinct d) Name

1. What is a relational model and explain different DDL, DML commands in SQL with syntax.
2. Outline the basic structure of SQL with suitable examples.
3. Write in detail about different types of constraints that can be specified on a relation.
4. List and explain set operations and different aggregate functions in SQL.
5. Consider the following schema :

Emp(empid, emp_name, emp_sal, Date)

- i. Query to find second highest salary of Employee.
 - ii. SQL Query to find Max Salary from each department.
 - iii. Write SQL Query to display the current date.
 - iv. Find all Employee records containing the word "Joe", regardless of whether it was stored as JOE, Joe, or joe.
6. Write the SQL expressions for the following relational database?

Sailor schema (sailor id, Boat id, sailorname, rating, age)

Reserves (Sailor id, Boat id, Day)

Boat Schema (boat id, Boatname, color)

- i) Find the age of the youngest sailor for each rating level?
- ii) Find the No.of reservations for each red boat?
- iii) Find the average age of sailor for each rating level that at least 2 sailors.

7. Consider the following relational schema:

Emp(*eid*: integer, *ename*: string, *age*: integer, *salary*: real)

Works(*eid*: integer, *did*: integer, *peLtime*: integer)

Dept(*did*: integer, *dname*: string, *budget*: real, *managerid*: integer)

- i. Give an example of a foreign key constraint that involves the Dept relation. What are the options for enforcing this constraint when a user attempts to delete a Dept tuple?
- ii. Write the SQL statements required to create the preceding relations, including appropriate versions of all primary and foreign key integrity constraints.
- iii. Define the Dept relation in SQL so that every department is guaranteed to have a manager.
- iv. Write an SQL statement to add John Doe as an employee with *eid*= 101, *age* = 32 and *salary* = 15,000.

- v. Write an SQL statement to give every employee a 10 percent raise.
- vi. Write an SQL statement to delete the Toy department. Given the referential integrity constraints.

8. For the following relational database, give the expressions in SQL:

branch schema (branch name, branch city, assets)

customer schema (customer name, customer street, customer city)

Loan schema (branch name, loan number, amount)

Borrower schema (customer name, Loan number)

Account schema (branch name, account number, balance)

Depositer schema (Customer name, account number)

- a) Find the names of all customers whose street address include substring 'Main Building'
 - b) Find average balance for each customer who lives in Harrison and at least four accounts?
 - c) Find all customer who have a loan at bank whose names are neither 'smith' nor 'james'.
9. Consider the following schemas:

Sailors (sid, sname, rating, age)

Reserves (sid, bid, day)

Boats (bid, bname, color)

- a) Find the name of sailors who have reserved boat 103.
- b) Find the names and ages of sailors with a rating above 7.
- c) Find the names of sailors who have reserved a red boat.
- d) Find the sname, bid, and day for each reservation.
- e) Find the name of sailors who have reserved at least one boat.

SECTION-C

QUESTIONS AT THE LEVEL OF GATE

1. Consider the following relation : **Cinema (theater, address, capacity)**

Which of the following options will be needed at the end of the SQL QUERY?

SELECT P1.address FROM Cinema P1, Such that it always finds the addresses of theaters of theaters with maximum capacity?

- (a) WHERE P1.capacity > = All (select P2. capacity from Cinema P2)

- (b) WHERE P1.capacity > = Any (select P2. capacity from Cinema P2)
- (c) WHERE P1.capacity > All (select max (P2. capacity) from Cinema P2)
- (d) WHERE P1.capacity >Any (select max (P2. capacity) from Cinema P2)

2. Consider the following relations:

| Student | |
|---------|--------------|
| Roll_No | Student_Name |
| 1 | Raj |
| 2 | Rohit |
| 3 | Raj |

| Performance | | |
|-------------|---------|-------|
| Roll_No | Course | Marks |
| 1 | Math | 80 |
| 1 | English | 70 |
| 2 | Math | 75 |
| 3 | English | 80 |
| 2 | Physics | 65 |
| 3 | Math | 80 |

Consider the following SQL query:

```
SELECT S. Student_Name, sum (P.Marks)
FROM Student S, Performance P
WHERE S. Roll_No =P.Roll_No
GROUP BY S.Student_Name
```

The number of rows that will be returned by the SQL query is _____.

3. A relational schema for a train reservation database is given below:

Passenger (pid, pname, age)

Reservation (pid, class, tid)

Table: Passenger

| pid | pname | age |
|-----|--------|-----|
| 0 | Sachin | 65 |
| 1 | Rahul | 66 |
| 2 | Sourav | 67 |
| 3 | Anil | 69 |

Table : Reservation

| pid | class | tid |
|-----|-------|------|
| 0 | AC | 8200 |
| 1 | AC | 8201 |
| 2 | SC | 8201 |
| 5 | AC | 8203 |
| 1 | SC | 8204 |
| 3 | AC | 8202 |

What pids are returned by the following SQL query for the above instance of the tables?

SELECT pid FROM Reservation WHERE class 'AC' ANDEXISTS (SELECT * FROM Passenger WHERE age > 65 AND Passenger. pid = Reservation.pid)

1, 0 b)1, 2 c)1, 3 d)1, 5 []

UNIT-III
SECTION-A

Objective Questions

1. The normalization of 1NF relations to 2NF involves: []
A) Removal of partial dependencies
B) Removal of full dependencies
C) Removal of transitive dependencies
D) Removal of multi-valued dependencies
2. Why do we go for normalization of databases? []
A) To avoid the repetitions B) To prevent fragmentation
C) To avoid redundancy D) To save memory
3. If a relation is in BCNF then it is in: []
A) 2 NF B) 3 NF C) 1 NF D) 1 NF and 2 NF
4. If a relation with a schema R is decomposed into two relations R1 and R2 such that $(R1 \cup R2) = R$ then which one of the following is to be satisfied for a lossless joint decomposition (\rightarrow indicates functional dependency) []
A) $R1 \cap R2 \rightarrow R1$ or $R1 \cap R2 \rightarrow R2$
B) $R1 \cap R2 \rightarrow R1$
C) $R1 \cap R2 \rightarrow R2$
D) $R1 \cap R2 \rightarrow R1$ and $R1 \cap R2 \rightarrow R2$
5. Identify the minimal key for the relational scheme R(A, B, C, D, E) with functional dependencies $F = \{A \rightarrow B, B \rightarrow C, AC \rightarrow D\}$. []
A) A B) AE C) BE D) CE
6. The best normal form of relation scheme R(A, B, C, D) along with the set of functional dependencies $F = \{AB \rightarrow C, AB \rightarrow D, C \rightarrow A, D \rightarrow B\}$ is []
A) Boyce-Codd Normal form B) Third Normal form
C) Second Normal form D) First Normal form

7. Match the following database terms to their functions: []

List-I

- (a) Normalization
- (b) Data Dictionary
- (c) Referential Integrity
- (d) External Schema

List-II

- (i) Enforces match of primary key to foreign key
- (ii) Reduces data redundancy in a database
- (iii) Define view(s) of the database for particular user(s).
- (iv) Contains metadata describing database structure.

Codes:

- (a) (b) (c) (d)
- (A) (iv) (iii) (i) (ii)
- (B) (ii) (iv) (i) (iii)
- (C) (ii) (iv) (iii) (i)
- (D) (iv) (iii) (ii) (i)

8. A relation $R=\{A,B,C,D,E,F,G\}$ is given with the following set of functional dependencies: $F=\{AD\rightarrow E, BE\rightarrow F, B\rightarrow C, AF\rightarrow G\}$. []

Which of the following is a candidate key?

- A) A
- B) AB
- C) ABC
- D) ABD

9. Consider a relational schema $R= (A, B, C, D, E, F, G, H)$ on which of the following functional dependencies hold: $\{A\rightarrow B, BC\rightarrow D, E\rightarrow C, D\rightarrow A\}$. What are the candidates keys for R?

- A) AE, BE
- B) AEH, BEH, DEH
- C) AEH, BEH, BCH
- D) AE, BE,

DE

10. From the following instance of a relational schema $R(A,B,C)$ we can conclude that

| A | B | C |
|---|---|---|
| 1 | 1 | 1 |
| 1 | 1 | 0 |
| 2 | 3 | 2 |
| 2 | 3 | 2 |

- A) B does not functionally determines C
- B) A does not functionally determine B and B does not functionally

determines C

C) A functionally determine B and B functionally determines C

D) A functionally determine B and B does not functionally determines C

11. The relational schema student_performance(name, courseno, rollno, grade) has the following functional independencies. The highest normal form of this relation is_____.

$\{name, courseno\} \rightarrow grade$

$\{rollno, courseno\} \rightarrow grade$

$name \rightarrow rollno$

$rollno \rightarrow name$

12. Given the following relation instance

| X | Y | Z |
|---|---|---|
| 1 | 4 | 2 |
| 1 | 5 | 3 |
| 1 | 6 | 3 |
| 3 | 2 | 2 |

Which of the following functional dependencies are satisfied by the instance?

A) $XY \rightarrow Z$ and $Y \rightarrow X$

B) $YZ \rightarrow X$ and $X \rightarrow Z$

C) $XY \rightarrow Z$ and $Z \rightarrow Y$

D) $YZ \rightarrow X$ and $Y \rightarrow Z$

13. Relation R with an associated set of functional dependencies F, is decomposed into BCNF. The redundancy in the resulting set of relations is

A) Zero

B) more than zero but less than that of an equivalent 3 NF decomposition

C) proportional to the size of F

D) Indeterminate

SECTION-B

SUBJECTIVE QUESTIONS

1. Outline the informal guidelines for relational schema.
2. What are the problems caused by redundancy? Explain.
3. Define decomposition and illustrate lossless and dependency preserving decompositions.

4. What is normalization? Explain 1NF,2NF,3NF and BCNF.
5. Differentiate between 3NF and BCNF.
6. Define FD, MVD and JD.
7. Describe 4NF and 5NF with an example.
8. Consider the relation schema R(ABCD) and the FDs $\{AB \rightarrow C, B \rightarrow D\}$. What is the highest normal form condition it satisfies?
9. Consider the relation schema R(ABC) and the FDs $\{AB \rightarrow C, C \rightarrow A\}$. What is the highest normal form that it satisfies?
10. Consider the relation schema R(ABC) and the following FDs $\{AB \rightarrow C, C \rightarrow B\}$. What is the highest normal form condition it satisfies?
11. Given R(A,B,C,D, E) with the set of FDs, $F\{AB \rightarrow CD, A \rightarrow E, C \rightarrow D\}$. Is the decomposition of R into R1(A, B, C), R2(B, C, D) and R3(C, D, E) lossless? Prove.
12. Given R(A,B,C,D,E) with the set of FDs, $F\{AB \rightarrow CD, ABC \rightarrow E, C \rightarrow A\}$
 - (i) Find any two candidate keys of R
 - (ii) What is the normal form of R? Justify.
13. Let R = (A, B, C, D) and F be the set of functional dependencies for R given by $\{A \rightarrow B, A \rightarrow C, BC \rightarrow D\}$. Prove $A \rightarrow D$.
14. Given R = ABCD with the FD set $F = \{A \rightarrow B, B \rightarrow C, C \rightarrow D\}$. Determine all 3NF violations. Decompose the relation into relations which are in 3NF.
15. Determine a candidate key for R = ABCDEG with the FD set $F = \{AB \rightarrow C, AC \rightarrow B, AD \rightarrow E, B \rightarrow D, BC \rightarrow A, E \rightarrow G\}$

SECTION-C

QUESTIONS AT THE LEVEL OF GATE

1. R(ABCD) is a relation. Which of the following does not have a lossless join, dependency preserving BCNF decomposition? [GATE 2001] []
 - A) $A \rightarrow B, B \rightarrow C, C \rightarrow D$
 - B) $A \rightarrow B, B \rightarrow CD$
 - C) $AB \rightarrow C, C \rightarrow AD$
 - D) $A \rightarrow BCD$
2. The following functional dependencies are given below [Gate 2005]

$AB \rightarrow CD, AF \rightarrow D, DE \rightarrow F, C \rightarrow G, F \rightarrow E, \text{ and } G \rightarrow A$

Which of the following option is false? []

- A) $\{CF\}^+ = \{ABCDEFGG\}$ B) $\{AF\}^+ = \{ABCDEFGG\}$
 C) $\{AB\}^+ = \{ABCDFG\}$ D) $\{BG\}^+ = \{ABCDG\}$

3. Which of the following is TRUE? [GATE 2012]

- A) Every relation in 3NF is also in BCNF
 B) A relation R is in 3NF if every non-prime attribute of R is fully functionally dependent on every key of R
 C) Every relation in BCNF is also in 3NF
 D) No relation can be in both BCNF and 3NF

4. Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values.

$F = \{CH \rightarrow G, A \rightarrow BC, B \rightarrow CFH, E \rightarrow A, F \rightarrow EG\}$ is a set of functional dependencies (FDs) so that F^+ is exactly the set of FDs that hold for R

How many candidate keys does the relation R have? [GATE 2013]

- A) 3 B) 4 C) 5 D) 6

UNIT-IV

SECTION-A

Objective Questions

- Identify the characteristics of transactions []
 A) Atomicity B) Durability C) Isolation D) All of the mentioned
- Which of the following has “all-or-none” property? []
 A) Atomicity B) Durability C) Isolation D) All of the mentioned
- Which one of the following is NOT a part of the ACID properties of database transactions? []
 A) Atomicity B) Isolation C) Consistency D) Deadlock-freedom
- The database system must take special actions to ensure that transactions operate properly without interference from concurrently executing database statements. This property is referred to as: []
 A) Atomicity B) Durability C) Isolation D) All of the mentioned
- The property of transaction that persists all the crashes is []
 A) Atomicity B) Durability C) Isolation D) All of the mentioned
- Consider the following transaction involving two bank accounts x and y. $read(x); x := x - 50; write(x); read(y); y := y + 50; write(y)$; The constraint that the sum of the accounts x and y should remain constant is known as:

A) Atomicity B) Isolation C) Consistency D) Durability []

7. Precedence graphs help to find a []

A) Serializable schedule C) Recoverable schedule

B) Deadlock free schedule D) Cascadeless schedule

8. Consider the following four schedules due to three transactions (indicated by the subscript) using read and write on a data item x , denoted by $r(x)$ and $w(x)$ respectively. Which one of them is conflict serializable? []

(A) $r_1(x); r_2(x); w_1(x); r_3(x); w_2(x)$

(B) $r_2(x); r_1(x); w_2(x); r_3(x); w_1(x)$

(C) $r_3(x); r_2(x); r_1(x); w_2(x); w_1(x)$

(D) $r_2(x); w_2(x); r_3(x); r_1(x); w_1(x)$

9. Consider the transactions T1, T2, and T3 and the schedules S1 and S2 given below.

T1: $r_1(X); r_1(Z); w_1(X); w_1(Z)$

T2: $r_2(Y); r_2(Z); w_2(Z)$

T3: $r_3(Y); r_3(X); w_3(Y)$

S1: $r_1(X); r_3(Y); r_3(X); r_2(Y); r_2(Z);$
 $w_3(Y); w_2(Z); r_1(Z); w_1(X); w_1(Z)$

S2: $r_1(X); r_3(Y); r_2(Y); r_3(X); r_1(Z);$
 $r_2(Z); w_3(Y); w_1(X); w_2(Z); w_1(Z)$

Which one of the following statements about the schedules is TRUE?

A) Only S1 is conflict-serializable.

B) Only S2 is conflict-serializable.

C) Both S1 and S2 are conflict-serializable.

D) Neither S1 nor S2 is conflict-serializable.

10. Consider the following two phase locking protocol. Suppose a transaction T accesses (for read or write operations), a certain set of objects $\{O_1, \dots, O_k\}$. This is done in the following manner:

Step 1. T acquires exclusive locks to O_1, \dots, O_k in increasing order of their addresses. Step 2. The required operations are performed. Step 3. All locks are released. This protocol will; []

A) guarantee serializability and deadlock-freedom

B) guarantee neither serializability nor deadlock-freedom

C) guarantee serializability but not deadlock-freedom

D) guarantee deadlock-freedom but not serializability

11. Which of the following property state that the data used during the execution of a transaction cannot be used by a second transaction until the first one is completed.

A) Consistency B) Atomicity C) Durability D) Isolation

12. Which property states that only valid data will be written to the database?

A) Consistency B) Durability C) Atomicity D) Isolation

SECTION-B

SUBJECTIVE QUESTIONS

- 1) Define Transaction and briefly explain ACID properties.
- 2) Draw transaction state diagram and describe each state that a transaction goes through during its execution.
- 3) What is schedule? Explain different types of schedules.
- 4) How can you test whether a given schedule is conflict-serializable? Is every conflict-serializable schedule is serializable? Justify.
- 5) Construct a precedence graph for serial schedule and non serial schedule.
- 6) Create a concurrent schedule for executing the following transactions;
T1: transfer funds \$1000 from account A to account B
T2: Increase the balance amount of account A to 10%
- 7) Consider the following two transactions:

T1: read(*A*);
 read(*B*);
 if *A* = 0 **then** *B* := *B* + 1;
 write(*B*).

T2: read(*B*);
 read(*A*);
 if *B* = 0 **then** *A* := *A* + 1;
 write(*A*).

Let the consistency requirement be $A = 0 \vee B = 0$, with $A = B = 0$ the initial values.

- a. Show that every serial execution involving these two transactions preserves the consistency of the database.
- b. Show a concurrent execution of *T1* and *T2* (shown in the above problem) that produces a nonserializable schedule.

- 8) Is there a concurrent execution of T_1 and T_2 (shown in the above problem) that produces a serializable schedule?
- 9) Test whether the following schedule is conflict serializable (Subscripts denote transactions)?
 $S_1: R_1(X); R_2(X); W_1(X); R_3(X); W_2(X);$
- 10) Consider the following three schedules due to three transactions (indicated by the subscript) using read and write on a data item X , denoted by $R(X)$ and $W(X)$ respectively. Construct the precedence graph for each schedule and determine which of them is conflict serializable?
 $S_1: R_2(X); R_1(X); W_1(X); R_3(X); W_2(X);$
 $S_2: R_3(X); R_2(X); R_1(X); W_2(X); W_1(X);$
 $S_3: R_2(X); W_2(X); R_3(X); R_1(X); W_1(X);$
- 11) Consider three transactions: T_1 , T_2 and T_3 . Draw the precedence graph for the following schedule consisting of these three transactions and determine whether it is serializable. If so, give its serial order(s).

| T1 | T2 | T3 |
|----------|----------|----------|
| | | read(Y) |
| | | read(Z) |
| read(X) | | |
| write(X) | | |
| | | write(Y) |
| | | write(Z) |
| | read(Z) | |
| read(Y) | | |
| write(Y) | | |
| | read(Y) | |
| | write(Y) | |
| | read(X) | |
| | write(X) | |

SECTION-C
QUESTIONS AT THE LEVEL OF GATE

1. Consider the following schedules involving two transactions. Which one of the following statements is TRUE? (GATE 2007) []

$S_1: r_1(X); r_1(Y); r_2(X); r_2(Y); w_2(Y); w_1(X)$

$S_2: r_1(X); r_2(X); r_2(Y); w_2(Y); r_1(Y); w_1(X)$

- A) Both S_1 and S_2 are conflict serializable
- B) S_1 is conflict serializable and S_2 is not conflict serializable
- C) S_1 is not conflict serializable and S_2 is conflict serializable
- D) Both S_1 and S_2 are not conflict serializable
2. Consider the following schedule **S** of transactions T1, T2, T3, T4:

| T1 | T2 | T3 | T4 |
|-----------|-----------|-----------|----------|
| | Reads(X) | Writes(X) | |
| Writes(X) | | Commit | |
| Commit | Writes(Y) | | |
| | Reads(Z) | | |
| | Commit | | |
| | | | Reads(X) |
| | | | Reads(Y) |
| | | | Commit |

Which one of the following statements is CORRECT? (GATE 2014)

- A) **S** is conflict-serializable but not recoverable []
- B) **S** is not conflict-serializable but is recoverable
- C) **S** is both conflict-serializable and recoverable
- D) **S** is neither conflict-serializable nor is it recoverable

3. Consider the following transactions with data items P and Q initialized to zero:
(GATE 2012)

T1: read (P) ;
read (Q) ;
if P = 0 then Q := Q + 1 ;
write (Q).

T2: read (Q) ;
read (P)
if Q = 0 then P := P + 1 ;
write (P).

Any non-serial interleaving of T1 and T2 for concurrent execution leads to

- A) a serializable schedule []
B) a schedule that is not conflict serializable
C) a conflict serializable schedule
D) a schedule for which precedence graph cannot be drawn
4. Which of the following scenarios may lead to an irrecoverable error in a database system? (GATE 2003) []
A) A transaction writes a data item after it is read by an uncommitted transaction
B) A transaction reads a data item after it is read by an uncommitted transaction
C) A transaction reads a data item after it is written by a committed transaction
D) A transaction reads a data item after it is written by an uncommitted transaction
4. Consider the data items D1, D2 and D3, and the following execution schedule of transactions T1, T2, and T3. In the diagram, R(D) and W(D) denote the actions reading and writing the data item D respectively.

| T1 | T2 | T3 |
|----|-------------------------|----------------|
| | R(D3)
R(D2)
W(D2) | R(D2)
R(D3) |

| | | |
|-------|-------|-------|
| R(D1) | | |
| W(D1) | | |
| | | W(D2) |
| | | W(D3) |
| | R(D1) | |
| R(D2) | | |
| W(D2) | | |
| | W(D1) | |

Which of the following statements is correct?

- A) The schedule is serializable as T2, T3, T1
- B) The schedule is serializable as T2, T1, T3
- C) The schedule is serializable as T3, T2, T1
- D) The schedule is not serializable

UNIT-V
SECTION-A

Objective Questions

1. If a transaction acquires a shared lock, then it can perform _____ operation.

- A) Read B) Write C) Read and Write D) Update

2. If a transaction obtains an exclusive lock on a row, it means that the transaction wants to _____ that row.

- A) Select B) Update C) View D) Read

3. In a two-phase locking protocol, a transaction releases locks in _____ phase.

- A) Shrinking phase B) Growing phase C) Running phase D) Initial phase

4. In time stamp based protocol, transactions are executed based on their _____

5. _____ protocol ensures that the system will never enter into a deadlock state.

6. Deadlocks can be described precisely in terms of a directed graph called _____

7. In strict 2PL

1. Locking begins in 2PL

2. All exclusive locks must be held until transaction commits

3. All shared and exclusive locks must be held until transaction commits
A) Both 1 and 2 B) Only 2 C) Only 2 D) All of the above

8. In rigorous 2PL

1. Locking be in 2pl
2. All shared and exclusive locks must be held until transaction commits
A) Both 1 and 2 B) Only 2 C) Only 1 D) None of the above

9. Two phase locking doesn't ensure

- A) Freedom from deadlock B) Cascading rollbacks
C) Both a and b D) Either a or b

10. Test whether the following schedule observes i) 2PL ii) Strict 2pl iii) Rigorous 2PL

Lock- S(A)

R(A)

Lock -X(B)

R(B)

Unlock(A)

W(B)

Unlock(B)

- A) Only I B) I & II C) I, II, & III D) None

11. Test whether the following schedules observes i) 2PL ii) Strict 2pl iii) Rigorous 2PL

Lock- S(A)

R(A)

Lock -X(B)

Write(B)

Unlock(A)

Unlock(B)

- A) Only I B) I & II C) I, II, & III D) None

SECTION-B

Descriptive Questions

1. Why concurrency control is needed? Explain the problems that would arise when concurrency control is not provided by the database system.
2. Identify the anomalies due to concurrent execution of transactions.

(Dirty Read, Unrepeatable Read, Blind Write)

3. What is a lock? List the types of lock.
4. Define 2-Phase Locking. Differentiate 2PL, Strict 2PL and Rigorous 2PL.
5. Discuss in detail about Time Stamp Based Protocol and Thomas Write Rule.
6. What is deadlock? Illustrate different deadlock handling techniques.
7. Outline the actions to be taken to recover from a deadlock.
8. Draw the waits-for graph for the following schedule and test whether this schedule leads to a deadlock?

| T1 | T2 | T3 | T4 |
|-----------|-----------------------|-----------|-----------|
| Lock-S(A) | | | |
| Read(A) | | | |
| | Lock-X(B)
Write(B) | | |
| Lock-S(B) | | Lock-S(C) | |
| | Lock-X(C) | Read(C) | |
| | | | Lock-X(B) |
| | | Lock-X(A) | |

9. Describe wait/die and wound/wait deadlock protocols.

10. Consider the following schedules;

S1: T1:R(X), T2:R(Y), T3:W(X), T2:R(X), T1:R(Y)

S2: T1:R(X), T1:R(Y), T1:W(X), T2:R(Y), T3:W(Y), T1:W(X), T2:R(Y)

For each of the above schedules, state whether timestamp-based protocol allows the actions to occur in exactly the order shown.

SECTION-C

GATE Questions

1) Which of the following concurrency control protocols ensure both conflict serializability and freedom from deadlock? [GATE 2010]

I) 2-phase locking

II) Time-stamp ordering

A) I only

B) II only

C) Both I and II

D) Neither I nor II

UNIT VI

SECTION-A

Objective Questions

1. Which of the following is under failure classification?

i. Transaction failure

ii. System crash

iii. Disk Failure

iv. Storage failure

- A) i and ii B) i , ii and iii
C) i, ii, iii and iv D) ii and iii

2. The most widely used structure for recording database modifications is called _____.

3. Identify crash recovery techniques from the following.

- A) Log-Based B) Check-pointing
C) Shadow- Paging D) All of the above

4. An update log record contains which of the following

- A) Transaction identifier B) Data item identifier
C) Old value and new value D) All of the above

5. What is the effect of the UNDO operation corresponding to a log record where T_i is the transaction, and V_1 and V_2 are the old and new values respectively of a data location X ? []

- A) No change to X C) Writes the value V_1 to X
B) Writes the value V_2 to X D) Sets X to 0

6. Consider the log of transactions below.

- < T_0 start >
< T_0 , S, 100, 120 >
< T_0 , H, 1, 3 >

Identify the correct actions, which are part of the Undo(T_0)

- A) H is restored to 3 C) S is set to 120
B) H is restored to 1 D) < T_0 , S, 100 > log record is written out

7. Identify the options which are true for Immediate-modification scheme.

- A) Allows updates of an uncommitted transaction to be made to the buffer, or the disk itself, before the transaction commits.
B) Update log record must be written after a database item is written.
C) Output of updated blocks to disk storage can take place at any time before or after transaction commit.
D) Performs updates to buffer/disk only at the time of transaction commit

8. Consider the following log sequence:

```

<T0, start>
<T0, A, 1000, 950>
<T0, B, 2000, 2050>
<T0, commit>
<T1, start>
<T1, C, 700, 600>

```

What will be the recovery action by immediate modification recovery?

- A) undo T0, redo T1 C) redo T0, redo T1
 B) redo T0, undo T1 D) undo T0, undo T1

9. Identify the incorrect statement based on checkpointing.

- A) All updates are stopped while doing check pointing.
 B) Continue scanning backwards till a record $\langle T_i \text{ start} \rangle$ is found for every transaction T_i in L.
 C) Scan backwards from end of log to find the most recent $\langle \text{checkpoint L} \rangle$ record.
 D) Scan from starting of log to find the most recent $\langle \text{checkpoint L} \rangle$ record.

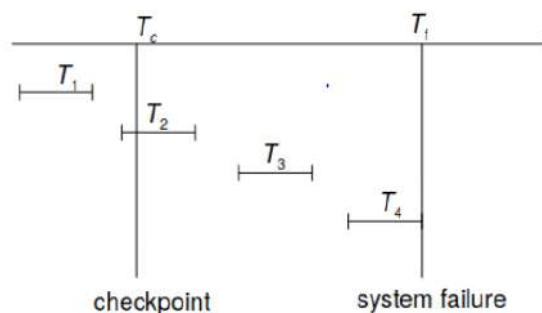
10. What is the effect of the UNDO operation corresponding to a log record $\langle T_i, Y, S, K \rangle$ where T_i is the transaction, and S and K are the old and new values respectively of a data location Y?

- A) No change to Y C) Writes the value S to Y
 B) Writes the value K to Y D) Sets Y to 0.

SECTION-B

Descriptive Questions

1. Explain the concept of failure classification.
2. Distinguish between different Storage Mechanisms
3. Explain different types of Recovery Techniques.
4. Distinguish between immediate and deferred database modification (update).
5. Illustrate check pointing with an example.
6. Summarize the importance of shadow paging.
7. Consider the following state of transactions:



and the statements below:

1. T1 can be ignored.
2. T2 and T3 redone
3. T4 undone
4. T4 redone

Mark the correct group of statements from the options below.

- A) 1), 2), 4)
B) 1), 2), 3)
C) only 1) and 2) but not 3)
D) only 2) and 3) but not 1)

8. Consider the log of transactions given below and answer the Q. No-6 and Q. No-7:

< T2 start >

< T2, H, 18, 20 >

< T3 start >

< checkpoint {T2, T3} >

< T3 commit >

< T4 start >

< T4, G, 6, 7 >

< T2, Y, 12 >

< T2 abort >

Suppose there is a crash after the record < T2 abort >.

Identify the correct statement(s) from the Redo phase

- A) The undo list initially contains T2, T3
B) The undo list initially contains T2, T3, T4
C) T3 is removed from undo list after some steps
D) T2 is removed from undo list after some steps.

9. Identify the incorrect statement(s) based on the Undo phase

- A) The undo list at the start of the undo phase contains T2, T4
B) < T4, G, 6 > log record is written out

C) The undo list at the start of the undo phase contains T2

D) $\langle T4, \text{abort} \rangle$ log record is written out

Signature of the Faculty

HANDOUT ON FORMAL LANGUAGES AND AUTOMATA THEORY

Class & Sem. : II B.Tech – II Semester

Year : 2020-21

Branch : CSE

Credits : 3

1. Brief History and Scope of the Subject

- Computer science has two major components:
 - 1) The fundamental ideas and models underlying computing,
 - 2) Engineering techniques for the design of computing systems, both hardware and software, especially the application of theory to design.
- This subject is intended as an introduction to the first area, the fundamental ideas underlying computing. Theoretical computer science had its beginnings in a number of diverse fields: biologists studying models for neural networks, electrical engineers developing switching theory as a tool to hardware design, mathematicians working on the foundations of logic, and linguists investigating grammars for natural languages. Out of these studies came models that are central to theoretical computer science.
- The notions of finite automata and regular expressions (Units 1, 2 and 3) were originally developed with neural networks and switching circuits in mind. Recently, they have served as useful tools in the design of lexical analyzers, the part of a compiler that groups characters into tokens-indivisible units such as variable names and keywords. A number of compiler-writing systems automatically transform regular expressions into finite automata for use as lexical analyzers. A number of other uses for regular expressions and finite automata have been found in text editors, pattern matching, various text-processing and file-searching programs, and as mathematical concepts with application to other areas, such as logic.
- The notion of a context-free grammar and the corresponding pushdown automaton (Units 4 and 5) has aided immensely the specification of programming languages and in the design of parsers-another key portion of a compiler. Formal specifications of programming languages have replaced

extensive and often incomplete or ambiguous descriptions of languages. Understanding the capabilities of the pushdown automaton has greatly simplified parsing. In early compilers, parser design is a difficult problem, and many of the early parsers were quite inefficient and unnecessarily restrictive. Based on context-free-grammar-based techniques, parser design is no longer a problem, and parsing occupies only a few percent of the time spent in typical compilation.

- In Unit 6, we deal with Turing machines and one of the fundamental problems of computer science; there are algorithms for computing functions. There are functions that are simply not computable; that is, there is no computer program that can ever be written.

2. Pre-Requisites:

- Mathematical Foundation of Computer Science

3. Course Objectives:

- To introduce the classification of machines by their power to recognize languages and to solve problems in computing.
- To familiarize how to employ deterministic and non-deterministic machines.

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

1. compare the automata based on their recognizing power.
2. design finite automata for regular languages.
3. reduce DFA by applying minimization algorithm.
4. write regular expressions for regular languages or for DFA by applying Arden's theorem.
5. generate grammar for CFL's.
6. use algorithm to simplify grammar.
7. design PDA's for context free languages.
8. design Turing Machine for the phrase-structured languages.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

| CT2511 : FORMAL LANGUAGES AND AUTOMATA THEORY | | | | | | | | | | | | | | | | |
|--|---|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|--|------|------|--|
| Course outcomes | Program Outcomes and Program Specific Outcome | | | | | | | | | | | | | PSO1 | PSO2 | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | | |
| CO1: Compare the automata based on their recognizing power. | 2 | 2 | | | | | | | | | | | | | | |
| CO2: Design finite automata for regular languages. . | 2 | 2 | 3 | | | | | | | | | | | | | |
| CO3: Reduce DFA by applying minimization algorithm. | 2 | 1 | 1 | | | | | | | | | | | | | |
| CO4: Write regular expressions for regular languages or for DFA by applying Arden's theorem. | 1 | 2 | 1 | | | | | | | | | 1 | | | 2 | |
| CO5: Generate grammar for CFL. . | 1 | 2 | | | | | | | | | | 1 | | | 2 | |
| CO6: Use algorithm to simplify grammar. | 2 | 2 | 1 | | | | | | | | | | | | | |
| CO7: Design PDA for context free languages. . | 2 | 2 | 3 | | | | | | | | | | | | | |
| CO8: Design Turing Machine for the phrase-structured languages. | 2 | 2 | 3 | | | | | | | | | | | | | |

7. Prescribed Text Books:

- John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman J.D., “Introduction to Automata Theory Languages and Computation”, 3rd edition, Pearson Education.
- Lewis H.R., Papdimitriou, “Elements of Theory of Computation”, 2nd edition, PHI.

8. Reference Text Books:

- Daniel I.A. Cohen, John Wiley, “Introduction to languages and the Theory of Computation”.
- Sipser, Thomson, “Introduction to Theory of Computation”, 2nd edition.

- Mishra and Chandrashekar, “Theory of computer science - Automata, Languages, and Computation”, 2nd edition, PHI.
- K.Krithivasan and R.Rama; Introduction to Formal Languages, Automata Theory and Computation; Pearson Education, 2009.

9. URLs and Other E-Learning Resources

- Basis for a Mathematical TOC:
<http://www-formal.stanford.edu/jmc/basis1.pdf>
- Finite Automata:
http://www.cs.odu.edu/~toida/nerzic/390teched/regular/fa/intr_2_fa.html
- PDA: <https://brilliant.org/wiki/pushdown-automata/>
- Turing Machine: <http://plato.stanford.edu/entries/turing-machine>

10. Digital Learning Materials:

- <http://nptel.ac.in/courses/106104028/>
- <http://nptel.ac.in/courses/106104148/>
- <http://nptel.ac.in/courses/106106049/>

11. Lecture Schedule / Lesson Plan (4)

| Topic | No. of Periods | |
|---|----------------|----------|
| | Theory | Tutorial |
| UNIT –1: Fundamentals | | |
| Strings, Alphabet, Language, Operations on strings | 1 | 1 |
| Operations on languages, Finite State System | 1 | |
| Finite Automaton Model | 1 | |
| Acceptance of strings and languages | 1 | 2 |
| Deterministic finite automaton | 2 | |
| Non deterministic finite automaton | 2 | |
| Transition diagrams, language recognizers and applications of Finite Automata | 2 | |
| Total | 10+3(T) | |

| UNIT – 2: Finite Automata | | |
|---|----------------|---|
| NFA with ϵ transitions – significance, acceptance of a language by a ϵ -NFA | 1 | 1 |
| Equivalence between NFA with and without ϵ transitions | 2 | |
| Minimization of FSM | 2 | |
| NFA to DFA conversion | 1 | |
| equivalence between two FSM's | 1 | |
| Finite automata with outputs - Moore machine, Mealy machines | 1 | 1 |
| Moore to Mealy Conversion-examples | 1 | |
| Mealy to Moore conversion-examples | 1 | |
| Total | 10+2(T) | |
| UNIT – 3: Regular Languages | | |
| Regular Sets, Identity Rules | 1 | 1 |
| Regular expressions | 2 | |
| Construction of finite Automata for a given regular expressions | 1 | 1 |
| Construction of regular expression for a given finite Automata | 1 | |
| Pumping lemma of regular sets | 1 | |
| Closure properties of regular sets, applications of regular languages. | 1 | |
| Total | 7+2(T) | |
| UNIT – 4: Grammar Formalism | | |
| Chomsky hierarchy of languages | 1 | 1 |
| Regular grammars - right linear and left linear grammars-examples | 1 | |

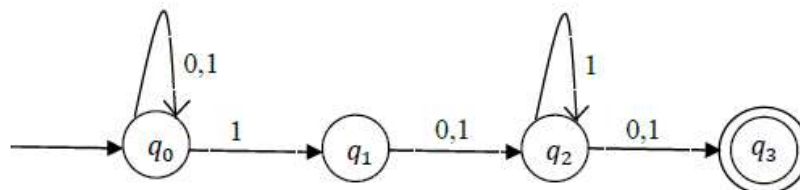
| | | |
|--|----------------|---|
| Equivalence between regular linear grammar and FA | 1 | |
| Equivalence between FA and regular grammar | 1 | |
| Context free grammar-examples | 2 | |
| Derivation- Rightmost and leftmost derivation of strings, sentential forms, Derivation trees | 2 | 1 |
| Total | 8+2(T) | |
| UNIT – 5: Context Free Grammars | | |
| Ambiguity in context free grammars | 1 | 1 |
| Minimization of Context Free Grammars | 1 | |
| Chomsky normal form | 1 | |
| Greibach normal form | 2 | |
| Pumping Lemma for Context Free Languages | 1 | |
| Enumeration of Properties of CFL (proofs not required), applications of CFLs | 1 | |
| Push down automata, model of PDA | 1 | 1 |
| Design of PDA | 2 | |
| Applications of PDA | 1 | |
| Total | 11+2(T) | |
| UNIT – 6: Turing Machine | | |
| Turing Machine, model | 1 | 1 |
| Design of TM | 2 | |
| Types of Turing Machines | 1 | 1 |
| Computable functions | 1 | |
| Recursively enumerable languages, Recursive languages | 1 | |
| Decidability of problems | 1 | |
| Undecidability of posts correspondence problem | 1 | |

| | | |
|---------------------------------|---------------|--------------|
| Total | 8+2(T) | |
| Total Number of Periods: | 54 | 13(T) |

UNIT - I
SECTION-A

Objective Questions

- The prefix of abc is
A) c B) bc C) b D) ϵ
- $\Sigma^* = \Sigma^+ \cup \epsilon$ [True | False]
- Alphabet is _____.
A) Finite collection of strings. B) Finite collection of symbols.
C) Finite collection of languages. D) All the above.
- A _____ of a string S is any trailing contiguous part of symbols of S.
- _____ is a directed graph associated with an FA in which the vertices of the graph correspond to the states of the FA.
- The transition function for NFA is a mapping function given as _____.
- The transition function for DFA is a mapping function given as _____.
- $A = \{a, b, c\}$. Power set of A = _____
- FA has
A) Unlimited memory B) no memory at all
C) Limited memory D) none of the above.
- Number of states requires to accept string ends with 10.
A) 3 B) 2 C) 1 D) can't be represented.
- Consider the finite automaton in the following figure



What is the set of reachable states for the input string 0011?

- A) $\{q_0, q_1, q_2\}$ B) $\{q_0, q_1\}$ C) $\{q_0, q_1, q_2, q_3\}$ (D) $\{q_3\}$
- Given the language $L = \{ab, aa, baa\}$, which of the following strings are in L^* ?
1) abaabaaabaa 2) aaaabaaaa

3) baaaaabaaaab

4) baaaaabaa

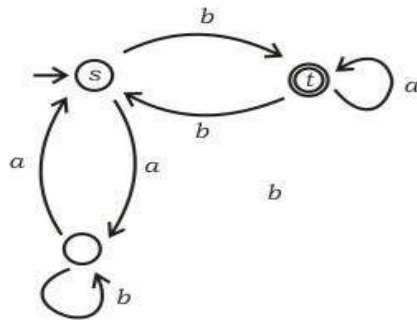
A) 1,2 and 3

B) 2,3 and 4

C) 1,2 and 4

D) 1, 3 and 4

13. In the automaton below, s is the start state and t is the only final state.



Consider the strings $u = abbaba$, $v = bab$, and $w = aabb$. Which of the following statements is true?

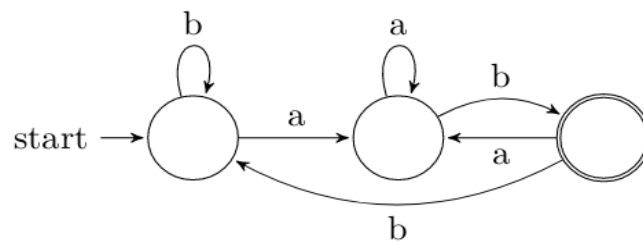
A) The automaton accepts u and v but not w

B) The automaton accepts each of u, v and w

C) The automaton rejects each of u, v and w

D) The automaton accepts u but rejects v and w

14. If the final states and non-final states in the DFA below are interchanged, then which of the following languages over the alphabet $\{a,b\}$ will be accepted by the new DFA?



A) Set of all strings that do not end with ab

B) Set of all strings that begin with either an a or a b

C) Set of all strings that do not contain the substring ab ,

D) All the above

15. The smallest finite automaton which accepts the language $\{x \mid \text{length of } x \text{ is divisible by } 3\}$ has

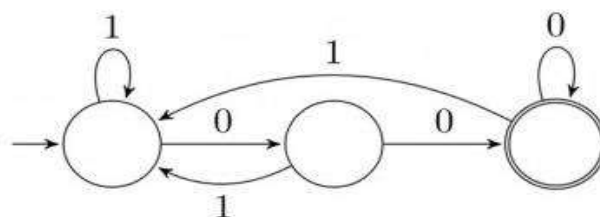
A) 2 states

B) 3 states

C) 4 states

D) 5 states

16. The below DFA accepts the set of all strings over $\{0,1\}$ that



A) begin either with 0 or 1

B) end with 0

C) end with 00

D) contain the substring 00

17. Consider a DFA over $\Sigma = \{a, b\}$ accepting all strings which have number of a's divisible by 6 and number of b's divisible by 8. What is the number of states that the DFA will have?
 A) 8 B) 14 C) 15 D) 48
18. What is the minimum number of states in the NFA accepting the language $\{a, ab\}$?
 A) 3 B) 2 C) 1 D) 4
19. What is the number of states in NFA which accepts set of all strings in which the third last symbol is 'a' over alphabet $\{a, b\}$?
 A) three B) four C) six D) five

SECTION-B

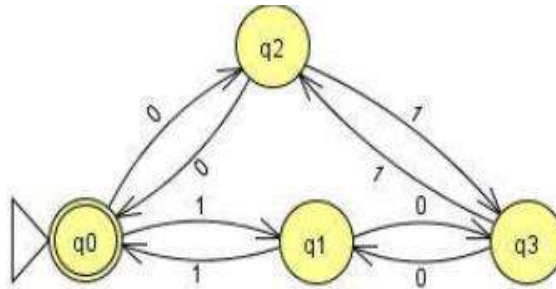
Descriptive Questions:

1. Define (i) String (ii) Alphabet (iii) Language (iv) Closure (v) Powerset
2. Explain in detail various operations performed on Strings and Languages.
3. Define i) Positive Closure ii) Kleene Closure.
4. Define Finite Automaton(FA). Explain in detail different ways to represent it.
5. Sketch and explain in detail the model of FA. Give its tuple notation.
6. Differentiate between NFA and DFA.
7. What is the difference between empty language and null string?
8. Which of the following Finite Automaton is having ambiguity and why?
 i) NFA ii) DFA
9. Draw the Finite state machine for accepting the languages \mathcal{E} and \emptyset .
10. Draw Transition diagram for the Transition table given below and check acceptance for the strings:
 i) 1000101 ii) 011001

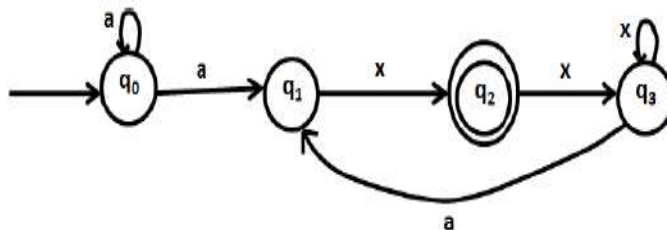
| | | |
|------|----|----|
| | 0 | 1 |
| → q0 | q1 | q0 |
| q1 | q2 | q0 |
| q2 | q3 | q0 |
| (q3) | q3 | q3 |

11. Draw the transition diagram for below FA:
 $M = \{ \{A, B, C, D\}, \{0, 1\}, \delta, C, \{A, C\} \}$
 $\delta(A, 0) = \delta(A, 1) = \{A, B, C\}$
 $\delta(B, 0) = B, \delta(B, 1) = \{A, C\}$
 $\delta(C, 0) = \{B, C\}, \delta(C, 1) = \{B, D\}$
 $\delta(D, 0) = \{A, B, C, D\}$
 $\delta(D, 1) = \{A\}.$
12. Construct DFA accepting the set of all strings beginning with 101.

13. Design a DFA for a language which contains strings of a's & b's and each string ends with aab.
14. Describe the words w in the language L accepted by the automaton in



15. Design a DFA that accepts set of all strings with abab as a substring over alphabet $\{a, b\}$.
16. Design a DFA that accepts set of all strings with three consecutive 0's over alphabet $\{0, 1\}$.
17. Design a DFA that accepts all strings over $\Sigma = \{0, 1\}$ that do not contain 101 as a substring.
18. Obtain a DFA to accept strings of a's and b's such that, each block of 5 consecutive symbols has at least two a's.
19. a) Design a DFA to accept the following language. $L = \{w : |w| \bmod 3 = 0\}$ on $\Sigma = \{a\}$
 b) Design DFA accepting the language whose binary interpretation is divisible by 5 over the alphabet $\{0, 1\}$.
20. Design a DFA that accepts set of all strings in which number of a's is divisible by 4 over alphabet $\{0, 1\}$.
21. Design a DFA to accept strings of a's and b's having even number of a's and b's.
22. For the NFA given below;
 - i. Check whether the string axxaxxa is accepted or not
 - ii. Give atleast two transition paths

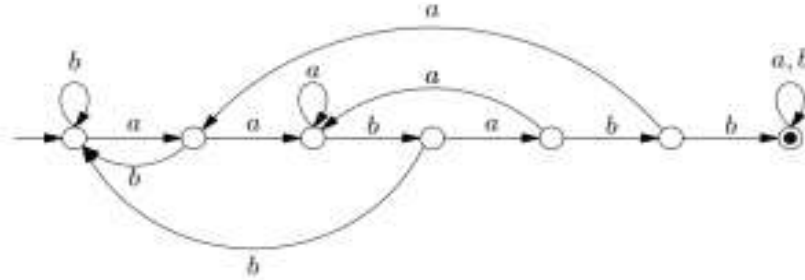


23. Design DFA accepting the set of all strings that begin with 01 and end with 11.
24. Design NFA accepting the set of all strings that begins with abb over alphabet $\{a, b\}$.
25. Design a NFA that accepts set of all strings with aba as a substring over alphabet $\{a, b\}$.
26. Design a NFA to accept strings of 0's & 1's such that each string ends with 00.

SECTION-C

Gate Questions:

1. Consider the following Deterministic Finite Automata [GATE 2017]



- Which of the following is true? A) It only accepts strings with prefix as “aababb”
 B) It only accepts strings with substring as “aababb”
 C) It only accepts strings with suffix as “aababb”
 D) None of the above

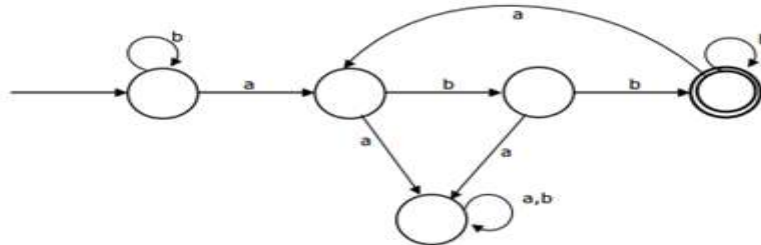
2. The possible number of states of a deterministic finite automaton that accepts a regular language. [GATE 2017]

$$L = \{w_1aw_2 \mid w_1, w_2 \in \{a,b\}^*, |w_1| = 2, w_2 \geq 3\}$$

3. Let w be any string of length n in $\{0, 1\}^*$. Let L be the set of all substrings of w . What is the number of states in a non-deterministic finite automaton that accepts L ? [GATE 2010]

- A) $n-1$ B) n C) $n+1$ D) $2n-1$

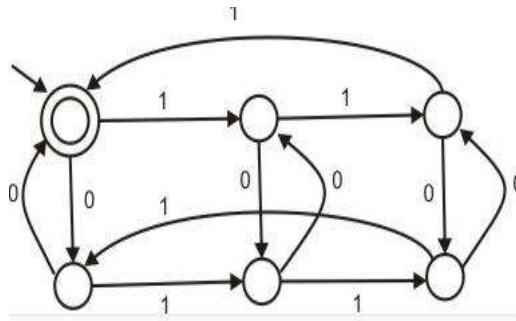
4. Consider the machine M :



[GATE 2005]

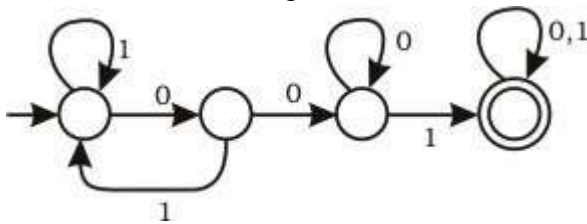
The language recognized by M is:

- A) $\{w \in \{a,b\}^* \mid \text{every } a \text{ in } w \text{ is followed by exactly two } b\text{'s}\}$
 B) $\{w \in \{a,b\}^* \mid \text{every } a \text{ in } w \text{ is followed by at least two } b\text{'s}\}$
 C) $\{w \in \{a,b\}^* \mid w \text{ contains the substring 'abb'}\}$
 D) $\{w \in \{a,b\}^* \mid w \text{ does not contain 'aa' as a substring}\}$
5. The following finite state machine accepts all those binary strings in which the number of 1's and 0's are respectively [GATE 2004]



- A) divisible by 3 and 2
- B) odd and even
- C) even and odd
- D) divisible by 2 and 3

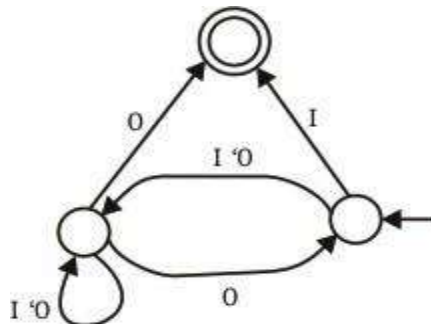
6. Consider the following deterministic finite state automaton M [GATE 2003]



Let S denote the set of seven bit binary strings in which the first, the fourth, and the last bits are 1. The number of strings in S that are accepted by M is

- A) 1
- B) 5
- C) 7
- D) 8

7. Consider the NFA M shown below.



Let the language accepted by M be L. Let L1 be the language accepted by the NFA M1, obtained by changing the accepting state of M to a non-accepting state and by changing the non-accepting state of M to accepting states. Which of the following Statements is true? [GATE 2003]

- A) $L1 = \{0,1\}^* - L$
- B) $L1 = \{0,1\}^*$
- C) $L1 \subseteq L$
- D) $L1 = L$

8. Construct a finite state machine that accepts the language, over $\{0,1\}$, of all strings that contain neither the substring 00 nor the substring 11. [GATE 2000]

9. What can be said about a regular language L over $\{a\}$ whose minimal finite state automaton has two states? [GATE 2000]

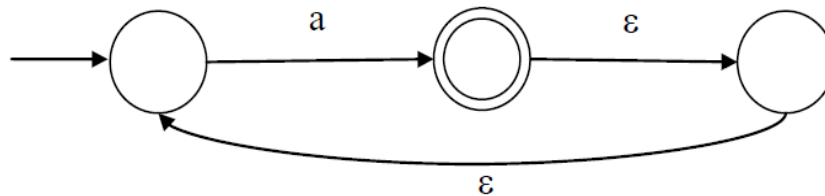
- A) L must be $\{a^n \mid n \text{ is odd}\}$
- B) L must be $\{a^n \mid n \text{ is even}\}$
- C) L must be $\{a^n \mid n \geq 0\}$
- D) Either L must be $\{a^n \mid n \text{ is odd}\}$, or L must be $\{a^n \mid n \text{ is even}\}$

UNIT - II
SECTION-A

Objective Questions

1. What is the complement of the language accepted by the NFA shown below?

[]



- (A) \emptyset (B) $\{\varepsilon\}$ (C) a^* (D) $\{a, \varepsilon\}$

2. NFA with ε can increase the processing time of NFA **[True/False]**
 3. _____ of a state is the set of states that can be reached by ε -transitions.
 4. Let N be an NFA with n states and let M be the DFA with m states recognizing the same language. Which of the following is necessarily true?
 A) $m \leq 2^n$ B) $n \leq m$ (C) M has one accept state D) $m = 2^n$
 5. Given a Non-deterministic Finite Automaton (NFA) with states p and r as initial states and final states respectively and transition table as given below:

| | | |
|---|---|---|
| | a | b |
| p | - | q |
| q | r | s |
| r | r | s |
| s | r | s |

The minimum number of states required in Deterministic Finite Automaton (DFA) equivalent to NFA is

- (A) 5 (B) 4 (C) 3 (D) 2

6. The output in _____ machine is associated with transition
 (A) Moore (B) Mealy (C) both (D) DFA
 7. The two states q_1 and q_2 are said to be _____ if both $\delta(q_1, a)$ and $\delta(q_2, a)$ reach final states or both of them reach non final states for all $a \in \Sigma$.
 8. For a Moore machine if the input string is of length n, the output string is of length n + 1. **[True/False]**
 9. In a Mealy machine if the input string is of length n, the output string is of length _____.
 (A) n (B) n+1 (C) 2n (D) n+2
 10. Choose incorrect statement. []

- (A) Moore and Mealy machines are FSM's with output capability.
 (B) Any given Moore machine has an equivalent Mealy Machine.
 (C) Any given Mealy machine has an equivalent Moore Machine.
 (D) Moore Machine is not a FSM.
11. Which of the following statement is true? []
 (A) A Mealy machine has no terminating state
 (B) A Moore machine has no terminating state
 (C) Converting from Mealy into Moore machine and vice versa is possible
 (D) All of these
12. The output alphabet in Moore machine can be represented formally as
 (A) Δ (B) Σ (C) δ (D) λ []
13. Consider the table

| Present State | Next State | | | |
|----------------|----------------|--------|----------------|--------|
| | 0 | | 1 | |
| | state | output | state | output |
| q ₀ | q ₀ | 0 | q ₁ | 1 |
| q ₁ | q ₂ | 2 | q ₀ | 0 |
| q ₂ | q ₁ | 1 | q ₂ | 2 |

- If the initial state is q₀. What is the output sequence for the string 101?
 (A) 0012 (B) 122 (C) 112 (D) 0122 []

SECTION-B

Descriptive Questions

1. Construct DFA equivalent to the NFA given below
 $M = (\{q_0, q_1, q_2, q_3\}, \{a, b\}, \delta, q_0, \{q_3\})$ where δ is given as

| | a | b |
|------------------|------------------------------------|----------------|
| → q ₀ | {q ₀ , q ₁ } | q ₀ |
| q ₁ | q ₂ | q ₁ |
| q ₂ | q ₃ | q ₃ |
| ⊙ q ₃ | - | q ₂ |

2. Construct an equivalent DFA for a NFA $M = (\{q_1, q_2, q_3\}, q_1, q_3)$ where δ is given by:

$$\delta(q_1, 0) = \{q_2, q_3\}, \quad \delta(q_1, 1) = \{q_1\},$$

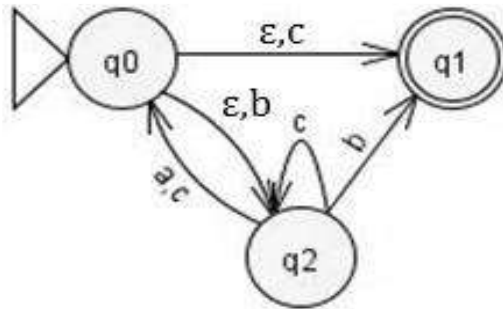
$$\delta(q_2, 0) = \{ q_1, q_2 \},$$

$$\delta(q_2, 1) = \emptyset$$

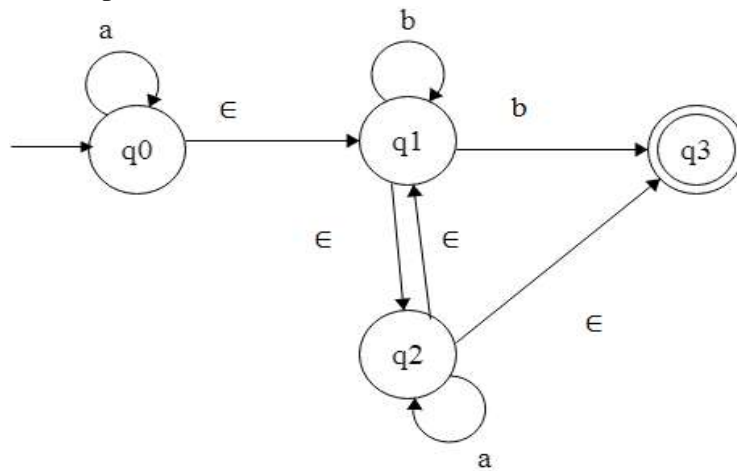
$$\delta(q_3, 0) = \{ q_2 \},$$

$$\delta(q_3, 1) = \{ q_1, q_2 \}$$

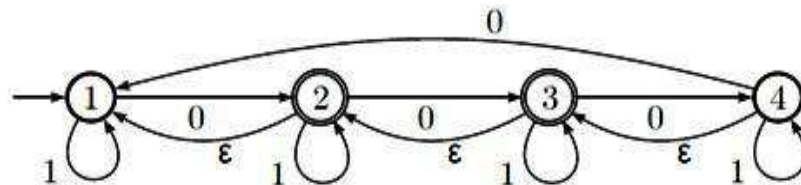
3. Define ϵ -closure. Find the ϵ -closures of the each state in the following ϵ -NFA.



4. Consider the following finite automaton with epsilon moves obtain equivalent automaton without epsilon moves.



5. Construct a NFA without ϵ for the following NFA with ϵ .

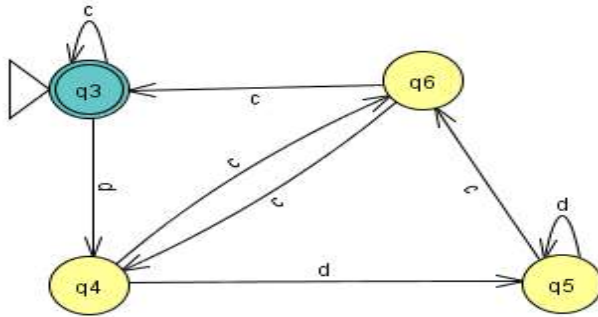
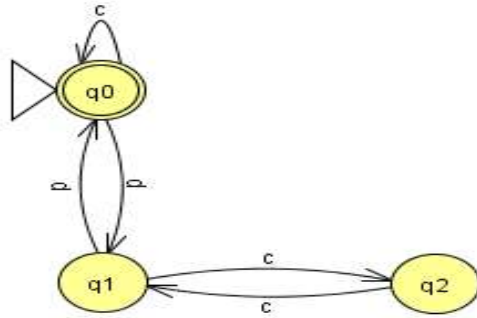


6. Verify whether the following FA is equivalent?

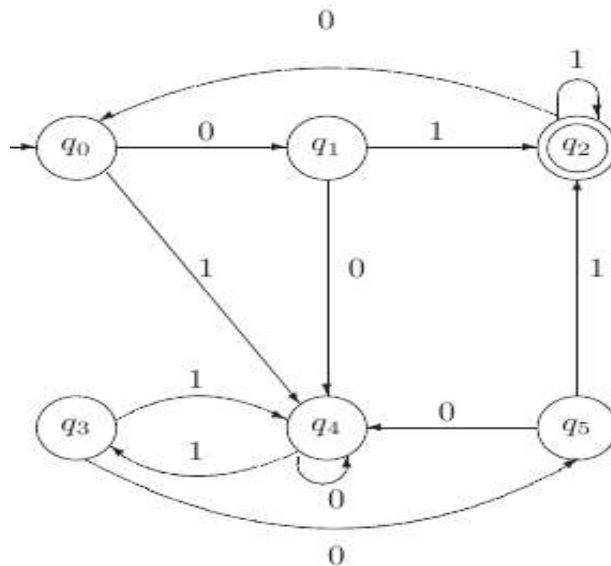
| | | |
|-----|---|---|
| | 0 | 1 |
| → A | B | D |
| (B) | A | C |
| C | D | B |
| (D) | C | A |

| | | |
|-----|---|---|
| | 0 | 1 |
| → P | R | R |
| Q | R | P |
| (R) | P | Q |

7. Find the equivalence between M1 & M2



8. Construct the minimum state automaton equivalent to the transition diagram



9. Construct a minimum state automaton equivalent to a given automaton M whose transition table is defined by table

| | 0 | 1 |
|-----|---|---|
| → A | B | D |
| B | C | E |
| C | B | E |
| D | C | E |
| ⊙ E | E | E |

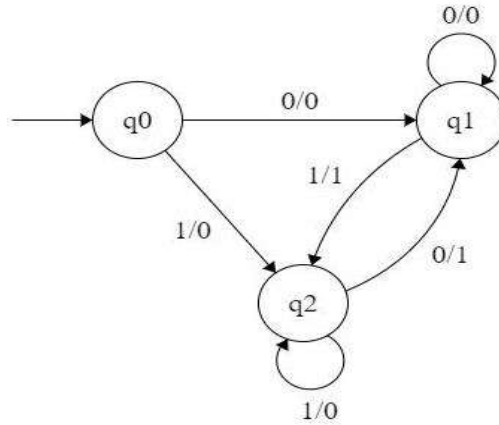
10. Design a Moore machine to determine the residue mod 4 for each binary string treated as integers.
11. Construct a Mealy machine which can output EVEN or ODD according as the total number of 1's encountered is even or odd. The input symbols are 0 and 1.
12. Design a Mealy machine to find out 2's complement of a binary number.
13. Design Moore and Mealy machines to find out 1's complement of a binary number.
14. Construct a Moore machine that takes set of all strings over {a,b} as input and prints '1' as output for every occurrence of 'ab' as a substring.
15. Design a Mealy machine that uses its states to remember the last symbol read and emits output 'y' whenever current input matches to previous one, and emits n otherwise
16. Give Mealy and Moore machines for the following process: For input from $(0+1)^*$, if the input ends in 101, output A; If the input ends in 110 output B; otherwise output C.
17. Convert the following Mealy machine to Moore machine

| Present State | Next State | | | |
|---------------|------------|--------|-------|--------|
| | a = 0 | | a = 1 | |
| | State | Output | State | Output |
| -> q0 | q3 | 0 | q1 | 1 |
| q1 | q0 | 1 | q3 | 0 |
| q2 | q2 | 1 | q2 | 0 |
| q3 | q1 | 0 | q0 | 1 |

18. Construct a Mealy machine which is equivalent to the Moore machine given in table:

| Present State | Next State | | Output |
|---------------|------------|-----|--------|
| | A=0 | A=1 | |
| → q0 | q3 | q1 | 0 |
| q1 | q1 | q2 | 1 |
| q2 | q2 | q3 | 0 |
| q3 | q3 | q0 | 0 |

19. Convert the following Mealy machine into its equivalent Moore machine



SECTION-C

Gate Questions:

1. Let δ denote the transition function and $\hat{\delta}$ denote the extended transition function of the ϵ -NFA whose transition table is given below:

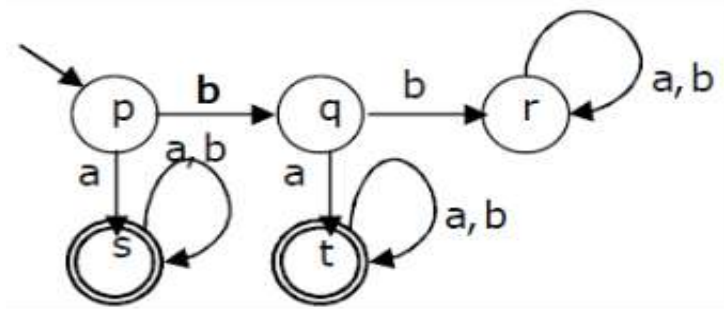
[GATE 2017 (Set 2)]

| δ | ϵ | a | b |
|-------------------|-------------|-------------|-------------|
| $\rightarrow q_0$ | $\{q_2\}$ | $\{q_1\}$ | $\{q_0\}$ |
| q_1 | $\{q_2\}$ | $\{q_2\}$ | $\{q_3\}$ |
| q_2 | $\{q_0\}$ | \emptyset | \emptyset |
| q_3 | \emptyset | \emptyset | $\{q_2\}$ |

Then $\hat{\delta}(q_2, aba)$ is

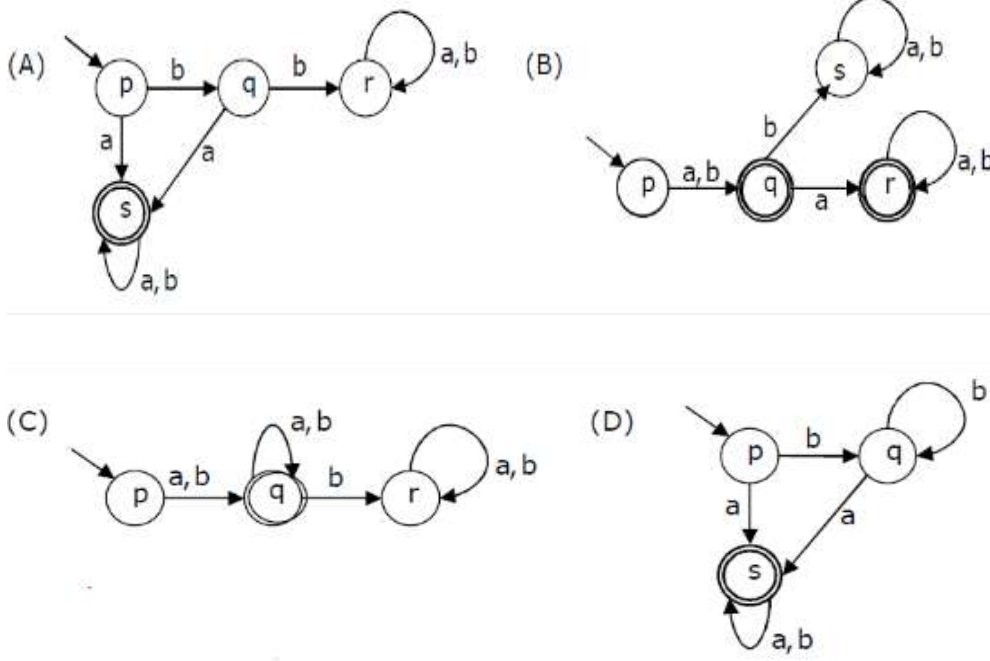
- A) \emptyset B) $\{q_0, q_1, q_3\}$ C) $\{q_0, q_1, q_2\}$ D) $\{q_0, q_2, q_3\}$

2. A deterministic finite automation (DFA) D with alphabet $\Sigma = \{a, b\}$ is given below

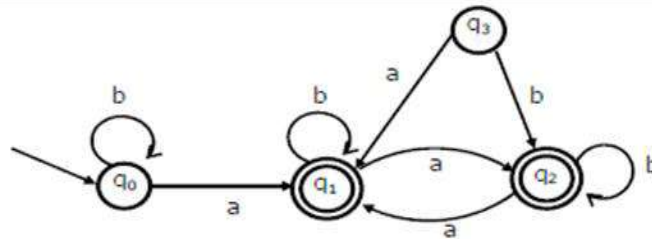


[GATE 2011]

Which of the following finite state machines is a valid minimal DFA which accepts the same language as D? []



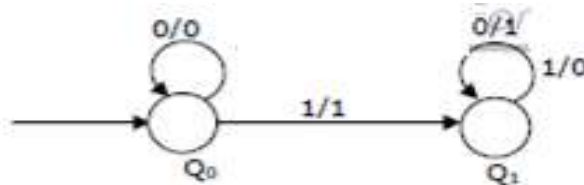
3. Consider the following finite state automaton []



The minimum state automaton equivalent to the above FSA has the following number of states [GATE 2007]

- A) 1 B) 2 C) 3 D) 4

4. The following diagram represents a finite state machine which takes as input a binary number from the least significant bit. [GATE 2005]



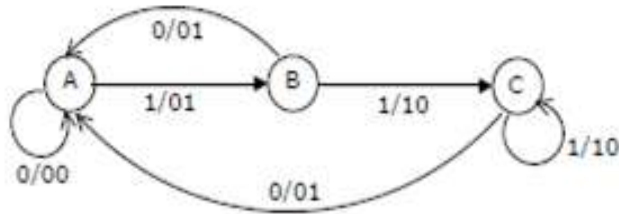
Which one of the following is true? A) It computes 1's complement of the input number

B) It computes 2's complement of the input number

C) It increments the input number

D) It decrements the input number

5. The finite state machine described by the following state diagram with A as starting state, where an arc label is x/y and x stands for 1-bit input and y stands for 2-bit output [GATE 2002]



- A) Outputs the sum of the present and the previous bits of the input B)
 Outputs 01 whenever the input sequence contains 11
 C) Outputs 00 whenever the input sequence contains 10
 D) None of the above

UNIT - III

SECTION-A

Objective Questions

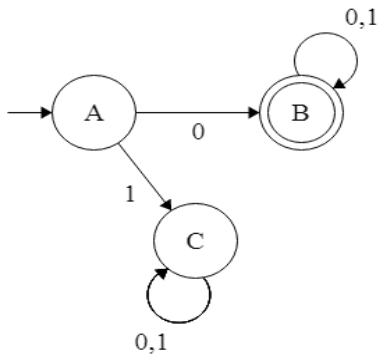
1. The languages accepted by finite automata are easily described by simple expressions called_____.
2. A language is a _____ if it is the set accepted by some finite automaton.
3. What is the solution for equation $R=Q+RP$ (if P and Q are RE and P does not contain ϵ)?
 (a) $R=QP^*$ (b) $R=QP$ (c) $R=PQ^*$ (d) $R=P^*Q^*$
4. $\emptyset + R =$ _____.
5. $\emptyset^* =$ _____.
6. $\epsilon^* =$ _____.
7. $\epsilon + r r^* = r^*$ [True / False]
8. Pumping lemma is generally used for proving
 A) a given grammar is regular
 B) a given grammar is not regular
 C) whether two given regular expressions are equivalent
 D) none of the above
9. Regular sets are closed under
 A) Union B) concatenation
 C) Kleene closure D) All of the above
10. $a + b$ denotes the set_____.
 A) $\{a, b\}$ B) $\{ab\}$ C) $\{ a \}$ D) $\{b\}$
11. The set of all strings of $\{0, 1\}$ having exactly two 0's is
 A) $1^*01^*01^*$ B) $\{(0+1)^*\}$ C) $\{11+0\}^*$ D) $\{00+11\}^*$
12. The regular expression to represent all strings with length atmost 2 over $\{a,b\}$ is_____.
 A) ϵ B) $\epsilon+(a+b)+(a+b).(a+b)$ C) $(a+b)$ D) $(a+b).(a+b)$
13. Which one of the following languages over the alphabet $\{0,1\}$ is described by the regular expression: $(0+1)^*0(0+1)^*0(0+1)^*$?

- A) The set of all strings containing the substring 00.
- B) The set of all strings containing atmost two 0's.
- C) The set of all strings containing atleast two 0's.
- D) The set of all strings that begin and end with either 0 or 1.

14. Consider the languages $L_1 = \epsilon$ and $L_2 = \{0\}$. Which one of the following represents $L_1 L_2^* + L_1^*$

- A) $\{\epsilon\}$ B) \emptyset C) 0^* D) $\{\epsilon, 0\}$

15. What is the regular expression for the given DFA?

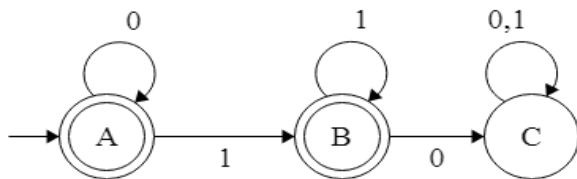


- (a) $(0+1)^*$ (b) $0(0+1)^*$ (c) 0 (d) $(0+1)^*0$

16. Which of the following languages are not regular?

- (a) $L = \{a^n \mid n \geq 1\}$ (b) $L = \{a^n b^m \mid n, m \geq 1\}$ (c) $\{a^n b^n \mid n \geq 1\}$ (d) $\{a^{2n} \mid n \geq 0\}$

17. What is the regular expression for the given DFA?



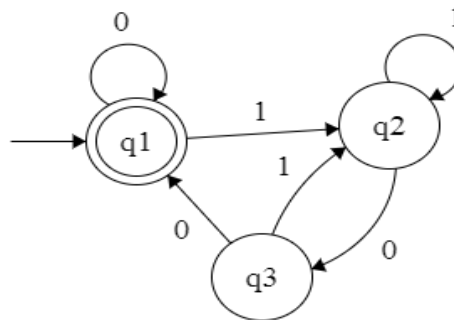
- (a) 0^*1^+ (b) 0^*1^* (c) 1^*0^* (d) 1^*0^+

SECTION-B

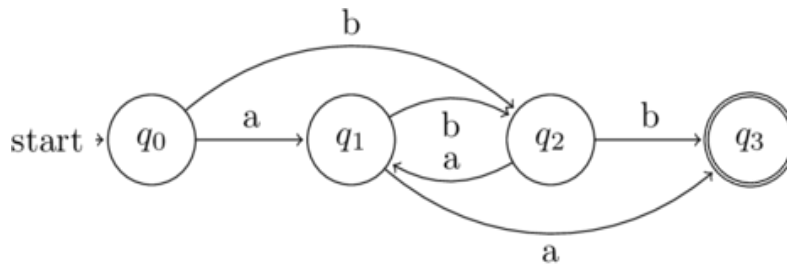
Descriptive questions

1. Define regular set and regular expression.
2. State Arden's Theorem.
3. List the closure properties of Regular Languages.
4. Explain in detail the procedure for converting Finite automata into regular expression with an example.
5. Write regular expressions for each of the following languages over $\Sigma = \{0, 1\}$
 - (i) The set of all strings representing with at least two consecutive 0's
 - (ii) The set of all strings ending in 011
 - (iii) The set of all strings starting with 101
 - (iv) The set of all strings containing 011 as substring

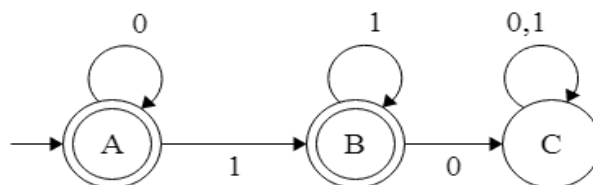
- (v) The set of all strings that start and end with same symbol
- Design a ϵ -NFA for the regular expression $a^*bc | ab^* | c^*$.
 - Construct NFA with ϵ -moves for the regular expression $10+(0+11)0^*1$
 - Construct Finite automata for the regular expression $1(01+10)^*00$.
 - Construct finite automation to accept the regular expression $(0+1)^* (00+11)(0+1)^*$.
 - Define Pumping Lemma. Apply pumping lemma and show that the language $L = \{ a^n b^{2n} \mid n > 0 \}$ is not regular.
 - What are the applications of pumping lemma? Show that the language $L = \{ a^n b^n c^n \mid n \geq 1 \}$ is not regular.
 - Using pumping lemma, show the following language is not regular:
 $L = \{ w \in \{0,1\}^* \mid \text{the number of 0's in } w \text{ is a perfect square} \}$
 - Applying Arden's Theorem construct regular expression for the DFA given below



- Construct regular expression for the following DFA.



- What is the regular expression for the given DFA?



SECTION-C

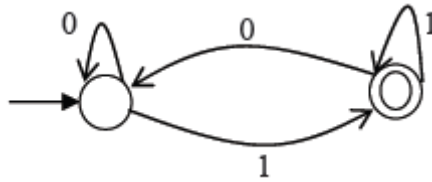
Gate Questions:

1. The number of states in the minimum sized DFA that accepts the language defined by the regular expression $(0+1)^*(0+1)(0+1)^*$ is _____.

[GATE 2016 Set-B]

2. Which of the regular expressions given below represent the following DFA?

[] [GATE 2014 Set-1]



- I) $0^*1(1+00^*1)^*$
 II) $0^*1^*1+11^*0^*1$
 III) $(0+1)^*1$

- A) I and II only B) I and III only
 C) II and III only D) I, II and III only

3. Consider the languages $L1 = \emptyset$ and $L2 = \{a\}$. Which one of the following represents $L1 L2^* \cup L1^*$ [GATE 2013]

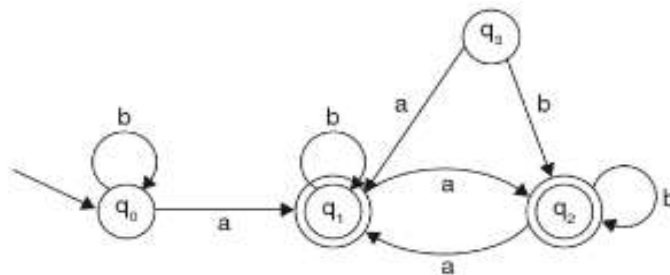
- A) $\{\epsilon\}$ B) \emptyset C) a^* D) $\{\epsilon, a\}$

4. Let $L = \{w \in (0+1)^* | w \text{ has even number of 1s}\}$, i.e. L is the set of all bit strings with even number of 1s. Which one of the regular expressions below represents L? [GATE 2010]

- A) $(0^*10^*1)^*$ B) $0^*(10^*10^*)^*$ C) $0^*(10^*1^*)^*0^*$ D) $0^*1(10^*1)^*10^*$

5. The language accepted by this automaton is given by the regular expression [GATE 2007]

- A) $b^*ab^*ab^*ab^*$ B) $(a+b)^*$ C) $b^*a(a+b)^*$ D) $b^*ab^*ab^*$



6. Consider the language $L=(111+11111)^*$.The minimum number of states in any DFA accepting this language is: [GATE 2006]

- A)3 B) 5 C) 8 D) 9

7. The number of states in the minimal deterministic finite automaton corresponding to the regular expression $(0 + 1)^*(10)$ is **[GATE 2010]**

- A) 2 B) 3 C) 4 D) 5

UNIT - IV
SECTION-A

Objective Questions

1. The C language is []
 - a) A context free language b) A context sensitive language
 - c) A regular language d) None
2. Every regular grammar is context free grammar. (True | False)
3. The finite automata accepts the following language: []
 - a) Context free language b) regular language
 - c) Context sensitive language d) all of the above
4. Context-free grammar can be recognized by []
 - a) Finite Automata b) Linear bounded Automata
 - c) Push down Automata d) both (b) and (c)
5. The language accepted by a Turing Machine: []
 - a) Type 0 b) Type 1 c) Type 2 d) Type 3
6. Match the following

| | | |
|-------------------------------|----------------------------|-------|
| 1. Context Free Language | a. Turing Machine | [] |
| 2. Recursively Enumerable | b. Finite Automata | [] |
| 3. Regular Language | c. Linear Bounded Automata | [] |
| 4. Context Sensitive Language | d. Push Down Automata | [] |
7. For every right linear grammar, there will be an equivalent FA. [True/ False]
8. Recursively Enumerable language is also called as _____.
9. A context free grammar is []
 - a) Type 0 b) Type 1 c) Type 2 d) Type 3
10. Which word can be generated by $S \rightarrow d | bA, A \rightarrow d | ccA$ []
 - a) bcccd b) aabccd c) ababccd d) abbbd
11. Which of the following strings is in the language defined by grammar

$$S \rightarrow 0A, \quad A \rightarrow 1A | 0A | 1$$
[]
 - a) 01100 b) 00101 c) 10011 d) 11111
12. Recognize the CFL for the given CFG. []

$$S \rightarrow aB | bA,$$

$$A \rightarrow a|aS|bAA,$$

$$B \rightarrow b|bS|aBB$$
 - a) strings contain equal number of a's and equal number of b's.
 - b) strings contain odd number of a's and odd number of b's.
 - c) strings contain odd number of a's and even number of b's.
 - d) strings contain even number of a's and even number of b's
13. Given the following productions of a grammar: []

$$S \rightarrow aA | aBB \quad A \rightarrow aaA | \epsilon \quad B \rightarrow bB | bbCC \rightarrow B$$

Which of the following is true?

 - a) The language corresponding to the given grammar is a set of even number of a's.

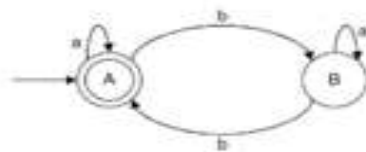
- b) The language corresponding to the given grammar is a set of odd number of a's.
- c) The language corresponding to the given grammar is a set of even number of a's followed by odd number of b's.
- d) The language corresponding to the given grammar is a set of odd number of a's followed by even number of b's.
14. A regular grammar for the language $L = \{ a^n b^m \mid n \text{ is even and } m \text{ is even} \}$ is []
- a) $S \rightarrow aSb \mid X; X \rightarrow bXa \mid \epsilon$
- b) $S \rightarrow aaS \mid X; X \rightarrow bSb \mid \epsilon$
- c) $S \rightarrow aSb \mid X; X \rightarrow Xab \mid \epsilon$
- d) $S \rightarrow aaS \mid X; X \rightarrow bbX \mid \epsilon$

15. Which of the regular expressions corresponds to this grammar? []
- $S \rightarrow AB \mid AS \quad A \rightarrow a \mid aA \quad B \rightarrow b$
- a) $(aa)^*b$ b) aa^*b c) $(ab)^*$ d) $a(ab)^*$

16. Identify the language generated by the following grammar []
- $S \rightarrow aS \mid bS \mid abA$
 $A \rightarrow aA \mid bA \mid \epsilon$
- a) $L = x \mid ab \text{ is a substring of } x, x \in \{a,b\}^*$
- b) $L = x \mid a \text{ is a substring of } x, x \in \{a,b\}^*$
- c) $L = x \mid b \text{ is a substring of } x, x \in \{a,b\}^*$
- d) $L = x \mid ba \text{ is a substring of } x, x \in \{a,b\}^*$

17. The CFG $S \rightarrow aS \mid bS \mid a \mid b$ is equivalent to the regular expression []
- a) $(a^*+b)^*$ b) $(a+b)^*$ c) $(a+b)(a+b)^*$ d) $(a+b)(a+b)$

18. The regular grammar for the given FA is []



- a) $A \rightarrow aA \mid bB \mid a$ c) $A \rightarrow aA \mid bB \mid b$
 $B \rightarrow bA \mid aB \mid b$ $B \rightarrow bA \mid aB \mid a$
- b) $A \rightarrow aA \mid bB \mid \epsilon$ d) $A \rightarrow bA \mid aB \mid a$
 $B \rightarrow bA \mid aB \mid \epsilon$ $B \rightarrow aA \mid bB \mid b$

SECTION-B

Descriptive questions

- Sketch the Venn diagram of Chomsky hierarchy language and their counterpart automata.
- Define Regular grammar with an example.
- What is sentential form? Explain with an example.

4. Explain derivation tree with an example.
5. Explain left most derivation and right most derivation with examples.
6. Define Context Free Grammar and obtain CFG for:
 - a) the set of all strings with odd palindromes over alphabet $\{0,1\}$
 - b) the set of all strings over alphabet $\{a, b\}$ with exactly twice as many a's as b's.
 - c) balanced parenthesis
7. Show that **id+id*id** can be generated by two distinct derivation trees for the grammar:

$$E \rightarrow E+E \mid E^*E \mid (E) \mid id$$

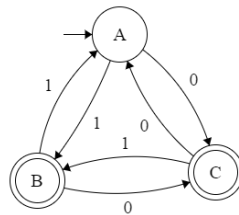
8. Let G be the grammar

$$S \rightarrow aB \mid bA$$

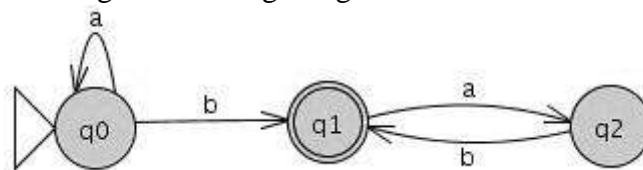
$$A \rightarrow a \mid aS \mid bAA$$

$$B \rightarrow b \mid bS \mid aBB.$$
 For the string aaabbbba find a
 - i. Left most derivation
 - ii. Right most derivation
 - iii. Parse Tree

9. Obtain the right linear grammar for the following FA.



10. Obtain a Right Linear Grammar for the language $L = \{a^n b^m \mid n \geq 2, m \geq 3\}$
11. Convert the following DFA to Regular grammar



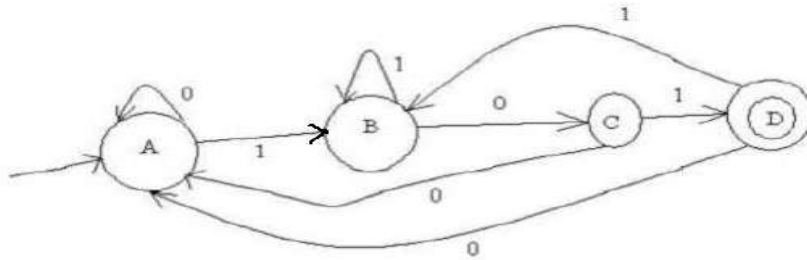
12. Is the following grammar ambiguous?

$$S \rightarrow AB \mid aaB$$

$$A \rightarrow a \mid aAa$$

$$B \rightarrow b$$
13. Find the language generated by the following grammar.

$$S \rightarrow SS \mid S \rightarrow aa \mid S \rightarrow \epsilon$$
14. Draw a derivation tree for the string abaaba for the CFG given by G where $P = \{S \rightarrow aSa \mid S \rightarrow bSb \mid S \rightarrow a \mid b \mid \epsilon\}$
15. Obtain a right linear grammar and left linear grammar for the following FA.



SECTION-C

Gate Questions

1. $G1: S \rightarrow aS \mid B, B \rightarrow b \mid bB$ **[GATE 2016]**

$G2: S \rightarrow aA \mid bB; A \rightarrow aA \mid B \mid \epsilon, B \rightarrow bB \mid \epsilon$

Which one of the following pairs of languages is generated by $G1$ and $G2$, respectively? []

- a) $\{a^m b^n \mid m > 0 \text{ or } n > 0\}$ and $\{a^m b^n \mid m > 0 \text{ and } n > 0\}$
- b) $\{a^m b^n \mid m > 0 \text{ and } n > 0\}$ and $\{a^m b^n \mid m > 0 \text{ or } n \geq 0\}$
- c) $\{a^m b^n \mid m \geq 0 \text{ or } n > 0\}$ and $\{a^m b^n \mid m > 0 \text{ and } n > 0\}$
- d) $\{a^m b^n \mid m \geq 0 \text{ and } n > 0\}$ and $\{a^m b^n \mid m > 0 \text{ or } n > 0\}$

2. $S \rightarrow aSa \mid bSb \mid a \mid b$ **[GATE 2009]**

The language generated by the above grammar over the alphabet $\{a, b\}$ is the of

- a) all palindromes
- b) all odd length palindromes
- c) strings that begin and
- d) all even length palindromes end with the same symbol

3. Consider the CFG with $\{S, A, B\}$ as the non-terminal alphabet $\{a, b\}$ as the terminal alphabet, S as the start symbol and the following set of production rules:

[GATE 2007]

- $S \rightarrow aB$ $S \rightarrow bA$
- $B \rightarrow b$ $A \rightarrow a$
- $B \rightarrow bS$ $A \rightarrow aS$
- $B \rightarrow aBB$ $S \rightarrow bAA$

Which of the following strings is generated by the grammar? []

- a) aaaabb b) aabbbb c) aabbab d) abbbba

4. How many derivation trees are there for the grammar in Question 3?

- a) 1 b) 2 c) 3 d) 4

5. Consider the regular grammar: **[GATE 2005]**

- $S \rightarrow Xa \mid Ya$
- $X \rightarrow Za$
- $Z \rightarrow Sa \mid \epsilon$
- $Y \rightarrow Wa$
- $W \rightarrow Sa$

where S is the starting symbol, the set of terminals is {a} and the set of non-terminals is {S, W, X, Y, Z}. We wish to construct a deterministic finite automaton (DFA) to recognize the same language. What is the minimum number of states required for the DFA?

- a) 2 b) 3 c) 4 d) 5

6.

[GATE 2005]

Which one of the following grammars generates the language $L = \{a^i b^j \mid i \neq j\}$?

(A)

$S \rightarrow AC \mid CB$
 $C \rightarrow aCb \mid a \mid b$
 $A \rightarrow aA \mid \epsilon$
 $B \rightarrow Bb \mid \epsilon$

(B) $S \rightarrow aS \mid Sb \mid a \mid b$

(C)

$S \rightarrow AC \mid CB$
 $C \rightarrow aCb \mid \epsilon$
 $A \rightarrow aA \mid \epsilon$
 $B \rightarrow Bb \mid \epsilon$

(D)

$S \rightarrow AC \mid CB$
 $C \rightarrow aCb \mid \epsilon$
 $A \rightarrow aA \mid a$
 $B \rightarrow Bb \mid b$

UNIT - V SECTION-A

Objective Questions

- Grammar that produce more than one Parse tree for same word is:
 - Ambiguous
 - Unambiguous
 - Complementation
 - Concatenation Intersection
- For every grammar there will an equivalent grammar in CNF.

[True/False]
- The derivation trees of strings generated by a context free grammar in Chomsky Normal Form are always binary trees

[True |False]
- Which of the following conversion is not possible (algorithmically)?
 - Regular grammar to Context-free grammar
 - Nondeterministic FSA to Deterministic FSA
 - Nondeterministic PDA to Deterministic PDA
 - All of the above
- CFL's are not closed intersection and complementation. [True | False]
- CFL's are closed under
 - union
 - concatenation
 - closure
 - All
- The grammar G with the productions

[]

 $A \rightarrow AA \mid (a) \mid \epsilon$ is an
 - Ambiguous grammar
 - Unambiguous grammar

c) Grammar d) None

8. Identify the useless symbol in the grammar given below. []

$$S \rightarrow AB \mid C \quad A \rightarrow a \quad B \rightarrow BC \quad C \rightarrow b$$

a) S b) A c) B d) C

9. Find an equivalent reduced grammar for the given grammar. []

$$S \rightarrow 0 \mid 1 \mid \varepsilon \quad S \rightarrow 0S0 \mid 1S1$$

a) $S \rightarrow 0 \mid 1, S \rightarrow 0S0 \mid 1S1 \mid 0 \mid 1$ b) $S \rightarrow 0 \mid 1, S \rightarrow SS \mid 0S1 \mid 1S1$

c) $S \rightarrow 0 \mid 1, S \rightarrow 00 \mid 11$ d) None

10. Which one of the following is a Chomsky Normal Form grammar?

(i) $A \rightarrow BC \mid a$ (ii) $A \rightarrow aA \mid a \mid b$ (iii) $A \rightarrow BCD \mid a, B \rightarrow a, C \rightarrow c, D \rightarrow d$ []

a) (i) only b) (i) and (iii) c) (ii) and (iii) d) (i),(ii) and (iii)

11. Which one of the following is not a Greibach Normal form grammar?

[]

(i) $S \rightarrow a \mid bA \mid aA \mid bB$ (ii) $S \rightarrow a \mid aA \mid AB$ (iii) $S \rightarrow a \mid A \mid aA$

$$A \rightarrow a$$

$$A \rightarrow a$$

$$A \rightarrow a$$

$$B \rightarrow b$$

$$B \rightarrow b$$

a) (i) and (ii) b) (i) and (iii) c) (ii) and (iii) d) (i),(ii) and (iii)

12. $L = \{ 0^n 1^{2n} \mid n \geq 1 \}$ is []

a) regular b) context-free but not regular

c) context-free but regular d) None

13. Recognize the language accepted by the PDA with the following moves

[]

$$\delta (q_0, a, Z_0) = (q_0, aZ_0), \quad \delta (q_0, a, a) = (q_0, aa)$$

$$\delta (q_0, b, a) = (q_1, \varepsilon), \quad \delta (q_1, b, a) = (q_1, \varepsilon)$$

$$\delta (q_1, c, Z_0) = (q_2, Z_0), \quad \delta (q_2, c, Z_0) = (q_2, Z_0)$$

a) $L = \{ a^n b^n c^n \mid n, m \geq 1 \}$ b) $L = \{ a^n b^n c^m \mid n, m \geq 1 \}$

c) $L = \{ a^m b^n c^n \mid n, m \geq 1 \}$ d) $L = \{ a^m b^n c^m \mid n, m \geq 1 \}$

14. What is the language generated by the grammar $G = (V, T, P, S)$ where $P = \{ S \rightarrow aSb, S \rightarrow ab \}$?

15. The grammars G_1 and G_2 are

$$G_1: S \rightarrow 0S0 \mid 1S1 \mid 0 \mid 1 \mid \varepsilon$$

$$G_2: S \rightarrow as \mid asb \mid X, X \rightarrow Xa \mid a.$$

Which is the correct statement?

[]

- a) G1 is ambiguous, G2 is unambiguous
- b) G1 is unambiguous, G2 is ambiguous
- c) Both G1 and G2 are ambiguous
- d) Both G1 and G2 are unambiguous

SECTION-B

Descriptive questions

1. What is an ambiguous grammar? Explain with an example.
2. Define Useless symbol and give example.
3. Define Null and Unit productions. Give examples for each.
4. List all the applications of CFG.
5. List all the closure properties of CFL.
6. Explain pumping lemma for CFL's with an example.
7. Sketch and explain in detail the model of PDA.
8. Show that the grammar is ambiguous.
 $S \rightarrow 0A \mid 1B$
 $A \rightarrow 0AA \mid 1S \mid 1$
 $B \rightarrow 1BB \mid 0S \mid 0$
9. Convert the following grammar in to GNF
 $S \rightarrow XA \mid BB$
 $B \rightarrow b \mid SB$
 $X \rightarrow b$
10. Design PDA for $L = \{wcw^r \mid w \in (0+1)^*\}$.
11. Design PDA for the language $L = \{a^n b^{n+m} c^m \mid n, m \geq 1\}$
12. What is the language generated by the grammar $G=(V,T,P,S)$ where $P=\{S \rightarrow aSb, S \rightarrow ab\}$?
13. For the following grammar :
 $S \rightarrow ABC \mid BbB, A \rightarrow aA \mid BaC \mid aaa, B \rightarrow bBb \mid a \mid D, C \rightarrow CA \mid AC, D \rightarrow \epsilon$
 - i. Eliminate ϵ -productions.
 - ii. Eliminate any unit productions in the resulting grammar.
 - iii. Eliminate any useless symbols in the resulting grammar.
 - iv. Put the resulting grammar in Chomsky Normal Form
14. Find a CFG, without ϵ productions, unit productions and useless productions equivalent to the grammar defined by
 $S \rightarrow ABaC$
 $A \rightarrow BC$
 $B \rightarrow b \mid \epsilon$
 $C \rightarrow D \mid \epsilon$
 $D \rightarrow d$
15. Obtain the PDA for the given regular language:

- a. $L = \{ww^r \mid w \text{ is in } (0+1)^*\}$.
- b. The language for even length palindrome, also show the moves of the PDA to accept the string 101101 for the above grammar.
16. Convert the following Context Free Grammar to Push Down Automata.
 $S \rightarrow aAA$
 $A \rightarrow aS \mid bS \mid a$
17. Convert the following Context Free Grammar to Push Down Automata
 $S \rightarrow (S)S \mid \epsilon$
18. Convert the following Grammar into CNF.
 $S \rightarrow AbcD / abc$
 $A \rightarrow aASB / d$
 $B \rightarrow b / cb$
 $D \rightarrow d$
19. Consider the grammar $(\{S, A, B\}, \{a, b\}, P, S)$ that has the productions:
 $S \rightarrow bA \mid aB$
 $A \rightarrow bAA \mid aS \mid a$
 $B \rightarrow aBB \mid bS \mid b$
 Find an equivalent grammar in CNF.
20. Prove that $L = \{WW \mid w \text{ is bit string}\}$ is not Context Free Language.
21. Show that $L = \{a^n b^n c^n \mid n \geq 0\}$ is not a context free language.
22. Show that $L = \{a^i b^j \mid j = i^2\}$ is not context free language.
23. Eliminate the useless symbols from the following grammar.
 $S \rightarrow aS \mid A \mid C$
 $A \rightarrow a$
 $B \rightarrow aa$
 $C \rightarrow aCb$
24. Define ambiguity and Check whether the given grammar is ambiguous or not.
 $S \rightarrow iCtS$
 $S \rightarrow iCtSeS$
 $S \rightarrow a$
 $C \rightarrow b$

SECTION-C

Gate Questions

1. Which one of the following languages over $\Sigma = \{a, b\}$ is NOT context-free?
 [] [Gate 2019]
 (a) $\{a^n b^i \mid i \in \{n, 3n, 5n\}, n \geq 0\}$ (b) $\{wa^n w^R b^n \mid w \in \{a, b\}^*, n \geq 0\}$
 (c) $\{ww^R \mid w \in \{a, b\}^*\}$ (d) $\{wa^n b^n w^R \mid w \in \{a, b\}^*, n \geq 0\}$
2. Identify the language generated by the following grammar, Where S is the start variable.
 [] [Gate 2017]
 $S \rightarrow XY$
 $X \rightarrow aX \mid a$
 $Y \rightarrow aYb \mid \epsilon$

7. The power of Non-deterministic Turing machine and deterministic Turing Machine are same. [True | False]
8. A problem whose language is recursive is called _____.
9. Recursive languages are []
- a) A proper subset of CFL c) Always recognizable by PDA
 b) Also called Type 0 languages d) Recognizable by TM
10. If L is recursively enumerable language then complement of L is also recursively enumerable. [True | False]
11. Which of the following languages are accepted by a Turing Machine?
 (i) $L = \{a^n b^n \mid n \geq 0\}$ []
 (ii) $L = \{a^n b^{2n} c^{2n} \mid n \geq 0\}$
 (iii) The set of palindromes over alphabet $\{a, b\}$
 a). Only (i) b). Only (ii) c). (i) and (iii) d). (i), (ii) and (iii)
12. A single tape Turing Machine M has three states q_0, q_1 and q_2 , of which q_0 is the starting state. The tape alphabet of M is $\{0, 1, B\}$ and its input alphabet is $\{0, 1\}$. The symbol B is the blank symbol used to indicate end of an input string. The transition function of M is described in the following table

| | 0 | 1 | B |
|-------|-------------|-------------|-------------|
| q_0 | $q_0, 1, R$ | $q_0, 0, R$ | q_1, B, L |
| q_1 | $q_1, 0, L$ | $q_1, 1, L$ | q_2, B, R |

Which of the following statements is true about M?

- a) M halts after computing 1's complement of a binary number
 b) M halts after computing 2's complement of a binary number
 c) M halts after reversing of a binary number
 d) None
13. The given table represents a Turing machine which accepts []

| Present state | 1 |
|-------------------|---------|
| $\rightarrow q_1$ | bq_2R |
| q_2 | bq_1R |

- a) even number of 1's
 b) odd number of 1's
 c) even number of 1's and odd number of 1's
 d) even number of 1's or odd number of 1's
14. The transitions of a Turing Machine are given below
 $\delta(q_0, 1) = (q_0, 1, R)$
 $\delta(q_0, B) = (q_1, 1, R)$

$$\delta(q_1, B) = (q_2, B, R)$$

The input on the tape is q_011B then the output on the tape is []

- a) $111Bq_2B$ b) $1111Bq_2B$ c) $111Bq_1B$ d) $1111Bq_1B$

SECTION-B

Descriptive questions

1. Define Turing Machine. Explain about model of Turing Machine
2. Explain various types of Turing machines.
3. Write short notes on halting problem of a Turing Machine.
4. What is post correspondence problem? Explain with an example
5. Design TM for the language $L = \{ a^n b^n c^n \mid n \geq 1 \}$
6. Design TM for the language $L = \{ a^n b^m c^{n+m} \mid n, m \geq 1 \}$
7. Design a Turing machine that accepts the language $L = \{ WW^R \mid W \in (0+1)^* \}$ and W^R is reverse of W
8. Construct a Turing Machine for checking the palindrome of the string of even length over $\Sigma = \{a, b\}$.
9. Construct a Turing machine M for $\Sigma = \{a, b\}$ which will convert lower case letters to upper case.
10. Construct a Turing machine M , which recognizes the language $L = \{ w c w \mid w \in (a + b)^+ \}$.
11. Design TM to perform addition of 2 integers.
12. Consider the TM described by the transition table given below. Which of the strings are accepted by TM? Represent the processing of strings using ID's.
a) 011 b) 0011

| Present state | Tape symbol | | | | |
|-------------------|-------------|---------|---------|----------|---------|
| | 0 | 1 | x | y | b |
| $\rightarrow q_1$ | xRq_2 | | | | bRq_5 |
| q_2 | $0Rq_2$ | yLq_3 | | yRq_2 | |
| q_3 | $0Lq_4$ | | xRq_5 | yLq_3 | |
| q_4 | $0Lq_4$ | | xRq_1 | | |
| q_5 | | | | $y1Rq_5$ | bRq_5 |
| q_6 | | | | | |

13. Design TM for subtraction of two numbers.
14. Show that the following post correspondence problem has a solution and give the solution.

| i | ListA | ListB |
|---|-------|-------|
| 1 | 11 | 11 |
| 2 | 100 | 001 |

| | | |
|---|-----|----|
| 3 | 111 | 11 |
|---|-----|----|

SECTION-C

Gate Questions

1. The set of all recursively enumerable languages is [GATE 2018] []
 - a) closed under complementation
 - b) closed under intersection
 - c) a subset of the set of all recursive languages
 - d) an uncountable set

2. Consider the following types of languages: [GATE 2016] []

L1 Regular, L2: Context-free,
L3: Recursive, L4: Recursively enumerable.

Which of the following is/are TRUE?

I. $L3 \cup L4$ is recursively enumerable II. $L2 \cup L3$ is recursive
III. $L1^* \cup L2$ is context-free IV. $L1 \cup L2'$ is context-free

 - a) I only b) I and III only c) I and IV only d) I, II and III only

3. Which of the following statements is/are FALSE? [GATE 2013] []
 1. For every non-deterministic Turing machine, there exists an equivalent deterministic Turing machine.
 2. Turing recognizable languages are closed under union and complementation.
 3. Turing decidable languages are closed under intersection and complementation.
 4. Turing recognizable languages are closed under union and intersection.
 - a) 1 and 4 only b) 1 and 3 only c) 2 only d) 3 only

4. Let $L1$ be a recursive language. Let $L2$ and $L3$ be languages that are recursively enumerable but not recursive. Which of the following statements is not necessarily true? [GATE 2010] []

(A) $L2 - L1$ is recursively enumerable (B) $L1 - L3$ is recursively enumerable
(C) $L2 \cap L1$ is recursively enumerable (D) $L2 \cup L1$ is recursively enumerable

 - a) A b) B c) C d) D

5. Which of the following is true for the language $\{a^p \mid p \text{ is a prime}\}$? [GATE 2008] []
 - a) It is not accepted by a Turing Machine
 - b) It is regular but not context-free
 - c) It is context-free but not regular
 - d) It is neither regular nor context-free, but accepted by a Turing machine

6. If L and L' are recursively enumerable, then L is [GATE 2008] []
 - a) regular b) context-free c) Context-sensitive d) recursive

7. Let $L1$ be a recursive language, and let $L2$ be a recursively enumerable but not a recursive language. Which one of the following is TRUE? [GATE 2005] []

$L1' \rightarrow$ Complement of $L1$

$L_2' \rightarrow$ Complement of L_2

- a) L_1' is recursive and L_2' is recursively enumerable
 - b) L_1' is recursive and L_2' is not recursively enumerable
 - c) L_1' and L_2' are recursively enumerable
 - d) L_1' is recursively enumerable and L_2' is recursive
8. A single tape Turing Machine M has two states q_0 and q_1 , of which q_0 is the starting state. The tape alphabet of M is $\{0, 1, B\}$ and its input alphabet is $\{0, 1\}$. The symbol B is the blank symbol used to indicate end of an input string. The transition function of M is described in the following table

[GATE 2003][]

| | 0 | 1 | B |
|-------|-------------|-------------|-------------|
| q_0 | $q_1, 1, R$ | $q_1, 1, R$ | Halt |
| q_1 | $q_1, 1, R$ | $q_0, 1, L$ | q_0, B, L |

The table is interpreted as illustrated below. The entry $(q_1, 1, R)$ in row q_0 and column 1 signifies that if M is in state q_0 and reads 1 on the current tape square, then it writes 1 on the same tape square, moves its tape head one position to the right and transitions to state q_1 . Which of the following statements is true about M ?

- a) M does not halt on any string in $(0+1)^+$
 - b) M does not halt on any string in $(00+1)^+$
 - c) M halts on all string ending in a 0
 - d) M halts on all string ending in a 1
9. Define languages L_0 and L_1 as follows : **[GATE 2003][]**

$L_0 = \{ \langle M, w, 0 \rangle \mid M \text{ halts on } w \}$

$L_1 = \{ \langle M, w, 1 \rangle \mid M \text{ does not halts on } w \}$

Here $\langle M, w, i \rangle$ is a triplet, whose first component, M is an encoding of a Turing Machine, second component, w , is a string, and third component, i , is a bit. Let $L = L_0 \cup L_1$. Which of the following is true?

- a) L is recursively enumerable, but L' is not
 - b) L' is recursively enumerable, but L is not
 - c) Both L and L' are recursive
 - d) Neither L nor L' is recursively enumerable
10. Nobody knows yet if $P = NP$. Consider the language L defined as follows :

$$L = \begin{cases} (0+1)^* & \text{if } P = NP \\ \phi & \text{otherwise} \end{cases}$$

[GATE 2003][]

Which of the following statements is true?

- a) L is recursive
 - b) L is recursively enumerable but not recursive
 - c) L is not recursively enumerable
 - d) Whether L is recursive or not will be known after we find out if $P = NP$
11. Which of the following is true? **[GATE 2002][]**
- a) The complement of a recursive language is recursive.
 - b) The complement of a recursively enumerable language is recursively enumerable.

- c) The complement of a recursive language is either recursive or recursively enumerable.
- d) The complement of a context-free language is context-free

Signature of the Faculty

HANDOUT ON OPERATING SYSTEMS

Class & Sem : II B.Tech. – II Semester

Yea : 2020-21

Branch : CSE

Credit : 3

1. Brief History and Scope of the Subject

- Computer operating systems (OS) provide a set of functions needed and used by most application programs on a computer, and the links needed to control and synchronize computer hardware. On the first computers, with no operating system, every program needed the full hardware specification to run correctly and perform standard tasks, and its own drivers for peripheral devices like printers and punched paper card readers.
- Operating systems can also be considered to be managers of the resources. An operating system determines which computer resources will be utilized for solving which problem and the order in which they will be used. In general, an operating system has three principal types of functions.
- Allocation and assignment of system resources such as input/output devices, software, central processing unit, etc.
- Scheduling: This function coordinates resources and jobs and follows certain given priority.
- Monitoring: This function monitors and keeps track of the activities in the computer system. It maintains logs of job operation, notifies end-users or computer operators of any abnormal terminations or error conditions. This function also contains security monitoring features such as any authorized attempt to access the system as well as ensures that all the security safeguards are in place .
- Throughout the history of computers, the operating system has continually evolved as the needs of the users and the capabilities of the computer systems have changed.

2. Pre-Requisites

- Basic knowledge of system programs and application programs

3. Course Objectives:

- To impart the concepts of process, memory and file management techniques.
- To familiarize with the deadlock handling techniques.

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

- **describe** the role, functions and structures of operating systems.
- **evaluate** the performance of CPU scheduling algorithms by calculating average waiting time and turnaround time.

- **compare and contrast** memory management schemes for efficient utilization of memory.
- **apply** deadlock prevention, avoidance and recovery techniques to keep the system in safe state.
- **determine** seek time of disk scheduling algorithms.
- **develop** software or hardware based solutions for critical section problems.
- **analyze** files and directory structures and implementations.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to

7. Prescribed Text Books

- i. Abraham Silberschatz, Peter B, Galvin, Greg Gagne, Operating System Principles, John Wiley, 7th edition.
- ii. Stallings, Operating Systems - Internal and Design Principles, Pearson education, 6th edition–2005.

8. Reference Text Books

- i. D. M. Dhamdhere, Operating systems- A Concept based Approach, TMH, 2nd edition.
- ii. Andrew S Tanenbaum, Modern Operating Systems, PHI, 3rd edition.

9. URLs and Other E-Learning Resources

- <http://www.nptel.iitm.ac.in/video.php?subjectId=112106134>
<http://www.preservearticles.com/2012051832397/5-important-limitation-of-operations-research.html>
<http://www.nptel.iitm.ac.in/video.php?subjectId=112106134>
<http://personal.maths.surrey.ac.uk/st/J.F/chapter7.pdf>
http://nptel.iitm.ac.in/syllabus/syllabus_pdf/111107064.pdf
<http://nptel.iitm.ac.in/courses/110106045/>
<http://nptel.iitm.ac.in/syllabus/109103021/>
<http://nptel.iitm.ac.in/video.php?subjectId=112106131>

10. Digital Learning Materials:

- <http://www.scribd.com/doc/39223153/Replacement-Models-Operation-Research#download>
<http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT-ROORKEE/INDUSTRIAL-ENGINEERING/part3/inventory/lecture2.htm>
<http://www.eolss.net/sample-chapters/c02/E6-05-05-05.pdf>

11. Lecture Schedule / Lesson Plan(3+1*)

| Topic | No. of Periods | |
|------------------------------------|----------------|----------|
| | Theory | Tutorial |
| UNIT- 1: INRODUCTION | | |
| Operating system operations | 1 | 2 |
| Operating system services | 2 | |
| System calls | 1 | |
| Types of system calls | 2 | |
| Operating –system structure | 2 | |
| UNIT-II: Process Management | | |

| | | |
|---|---|---|
| Process, Process state, Process control block (PCB) | 1 | 3 |
| Process scheduling | 1 | |
| Scheduling queues | 1 | |
| Schedulers | 1 | |
| Context switch | 1 | |
| Scheduling criteria | 1 | |
| Scheduling algorithms | 3 | |
| Operations on processes | 2 | |
| Inter process communication | 2 | |
| UNIT – III: Memory Management Strategies | | |
| Swapping | 1 | 2 |
| Contiguous memory allocation | 1 | |
| Paging | 3 | |
| Segmentation | 1 | |
| Virtual-Memory Management | 1 | |
| Demand paging | 1 | |
| Page replacement Algorithms | 2 | |
| Allocation of Frames | 1 | |
| Thrashing | 1 | |
| UNIT - IV : Deadlocks and Mass-storage structure | | |
| System model, Deadlock characterization | 1 | 2 |
| Methods for handling deadlocks: | | |
| deadlock- prevention, Avoidance | 3 | |
| Detection, recovery | 1 | |
| Mass-storage structure: | | |

| | | |
|---------------------------------------|-----------|-----------|
| Overview, Disk Scheduling | 2 | |
| Disk Management | 2 | |
| UNIT - V: Synchronization | | |
| The critical section problem | 1 | 2 |
| Peterson's solution | 1 | |
| Synchronization hardware | 1 | |
| Semaphores | 2 | |
| Classic problems of synchronization | 2 | |
| Monitors | 2 | |
| UNIT-VI: File system Interface | | |
| Concept of a file | 1 | 2 |
| Access methods | 1 | |
| Directory structure | 1 | |
| File system mounting | 1 | |
| Files sharing and protection | 1 | |
| Total No. of periods | 56 | 13 |

12. Seminar Topics

CPU Scheduling
Deadlocks
Disk Scheduling

UNIT-I

SECTION-A

Objective Questions

1. An _____ acts as an interface between the user and the computer system.
2. Which concept explains the working of an Operating System? []
 - a) It is event driven
 - b) It is object oriented
 - c) It is procedure based system software
 - d) It is a collection of procedures that interact with each other
3. A kernel is an essential part of an operating system [True/False]
4. Which of these is/are the desirable features of an Operating system
 - a) Extensible
 - b) Portable
 - c) Reliable
 - d) All[]
5. Which one of the following is the mode bit associated for user mode and kernel mode respectively []
 - a) 1 and 0
 - b) 0 and 1
 - c) 1 and 2
 - d) 2 and 1
6. CPU has two modes: privileged and non-privileged. In order to change the mode from privileged to non-privileged **(GATE-2001)**
 - a) a hardware interrupt is needed. []
 - b) a software interrupt is needed.
 - c) a privileged instruction (which does not generate an interrupt) is needed.
 - d) a non-privileged instruction (which does not generate an interrupt) is needed.
7. _____ is a mechanism which involves in ensuring that all access to system resources is controlled.
8. Some of the important activities that an Operating System performs []
 - a) Job accounting
 - b) Security
 - c) Error detecting aids
 - d) All of these
9. Which of the following system calls are used to maintain system information.
 - a) Get/set time or date. []

- b) request device, release device.
 - c) send, receive messages.
 - d) get process attributes, set process attributes.
10. _____ provides an interface to the services made available by an operating system.
11. In which of the following users do not interact with the computer directly []
- a) Batch operating system b) DOS operating system
 - c) Time-sharing Operating Systems d) None of these
12. Which of the following functionality is provided by micro kernel approach []
- a) Communication.
 - b) ease of extending of an operating system.
 - c) reliability and security.
 - d) All of the above.
13. _____ and _____ are two fundamental models of implementing communication.
14. One function of an operating system is to handle interrupts. Interrupts are []
- a) a delay in processing due to operating system overload
 - b) signals from hardware or software requesting attention from the operating system
 - c) messages received from other computers
 - d) None of the above.
14. System calls are invoked by using (NPTEL/GATE1999)
- a) software interrupt b) polling []
 - c) indirect jump d) a privileged instruction

SECTION-B

Descriptive Questions

1. Define operating system. Explain the **operations** of an operating system?
2. With a neat sketch explain the **Dual-mode** operation?
3. Explain the need of attaching **timer** in operating system?
4. With a neat sketch explain the **structure** of operating system.

9. Which combination of the following features will suffice to characterize an OS as a multi-programmed OS? **(GATE-2002)**
- I. More than one program may be loaded into main memory at the same time for execution.
- II. If a program waits for certain events such as I/O, another program is immediately scheduled for execution.
- III. If the execution of a program terminates, another program is immediately scheduled for execution. []
- A. i B. i and ii C. i and iii D. i, ii and iii
10. The processes that are residing in main memory and are ready and waiting to execute are kept on a list called _____ []
- A. Job queue B. Ready queue C. Device queue D. FIFO queue
11. Which of the following statement(s) is false about SJF? []
- S1: It causes minimum average waiting time
- S2: It can cause starvation
- A. Only S1 B. Only S2 C. Both S1 and S2 D. Neither S1 nor S2
12. Pre-emptive scheduling is the strategy of temporarily suspending a running process []
- A. before the CPU time slice expires
- B. to allow starving processes to run
- C. when it requests I/O
- D. to avoid collision
13. What is the range of a time quantum in Round-Robin Scheduling? []
- A. 10-100 ms C. 10-100 ns
- B. 100-1000 ms D. 100-1000ns
14. As a rule of thumb what percentage of the CPU bursts should be shorter than the time quantum? []
- A. 80% B. 70% C. 60% D. 50%
15. Interval between the time since submission of the job to the time its results become available, is called []
- A. Response Time C. Throughput
- B. Waiting time D. Turnaround Time

16. The scheduling in which CPU is allocated to the process with least CPU-burst time is called []
- A. Priority Scheduling C. Round Robin Scheduling
 B. Multilevel Queue Scheduling D. Shortest job first Scheduling
17. Which scheduling policy is used for a batch processing operating system
- A. Shortest-job First. C. Round-Robin. []
 B. Priority Based D. First-Come-First-Serve.
18. Which of these is a technique of improving the priority of process waiting in Queue for CPU allocation []
- A. Starvation B. Relocation C. Promotion D. Aging
19. Consider a set of n tasks with known runtimes r_1, r_2, \dots, r_n to be run on a uniprocessor machine. Which of the following processor scheduling algorithms will result in the maximum throughput? **(GATE-2001)**
- A. Round-Robin C. Shortest-Job-First []
 B. Highest-Response-Ratio-Next D. First-Come-First-Served
20. Which of the following scheduling algorithms is non-preemptive? **(GATE CS 2002)**
- A. Round Robin []
 B. First come first serve
 C. Multilevel Queue Scheduling
 D. Multilevel Queue Scheduling with Feedback

SECTION-B

Descriptive Questions

1. With a neat sketch explain **process state diagram**?
2. Explain about the contents of **process control block**?
3. Define long term scheduler and short term scheduler?
4. Compare and contrast short term, medium term and long term scheduling.?
5. Discuss **criteria** involved in scheduling a process?
6. Explain about inter process communication (**IPC**)?
7. Demonstrate two different **operations** performed on processes?
8. What is convey effect? Explain with an example?
9. Discuss the **problem** involved in priority scheduling algorithm with a suitable example and provide a **solution** to that problem?

10. Differentiate shared memory and message passing models of process communication?
11. Explain the role of schedulers with the help of process transition diagram?
12. With a suitable example explain about context switching?
13. Write about Priority and SJF(Shortest Job First) scheduling algorithms with an example.

Problems:

1. Suppose that the following processes arrive for execution at the times indicated

| <u>Process</u> | <u>Arrival Time</u> | <u>Burst Time</u> |
|----------------|---------------------|-------------------|
| P_1 | 0.0 | 8 |
| P_2 | 0.4 | 4 |
| P_3 | 1.0 | 1 |

What is the average waiting and turnaround time for these processes using

- a) FCFS scheduling algorithm
 - b) SJF Non Preemptive scheduling algorithm
 - c) SJF Preemptive scheduling algorithm
2. Consider the following processes, with the arrival time and the length of the CPU burst given in milliseconds.

| Process | Arrival Time | Burst Time |
|---------|--------------|------------|
| P_1 | 0 | 10 |
| P_2 | 3 | 6 |
| P_3 | 7 | 1 |
| P_4 | 8 | 3 |

Calculate average waiting and average turnaround time using

- a) Non preemptive priority CPU scheduling algorithm
 - b) Preemptive priority CPU scheduling algorithm
 - c) Round robin scheduling algorithm(TQ=3ms)
3. Consider the following set of processes, with the arrival times and the CPU-burst times given in milliseconds (GATE-CS-2004)

| Process | Arrival Time | Burst Time |
|---------|--------------|------------|
| P1 | 0 | 5 |
| P2 | 1 | 3 |

| | | |
|----|---|---|
| P3 | 2 | 3 |
| P4 | 4 | 1 |

What is the average turnaround time for these processes with the preemptive shortest remaining processing time first (SRPTF) algorithm ?

3. Consider the following set of Processes with CPU Burst times in milliseconds, arrival times in milliseconds and Priorities:

| Process | Burst time | Arrival Time | Priority |
|---------|------------|--------------|----------|
| P1 | 8 | 1 | 2 |
| P2 | 5 | 0 | 1 |
| P3 | 14 | 2 | 4 |
| P4 | 3 | 4 | 3 |

Draw the Gantt Chart. Calculate Average Turnaround Time and Average Waiting Time by using:

- Round Robin (if Time Quantum = 4msec)
- Priority Scheduling.(both preemption and non preemption)

SECTION-C

QUESTIONS AT THE LEVEL OF GATE

1. An operating system uses Shortest Remaining Time first (SRT) process scheduling algorithm. Consider the arrival times and execution times for the following processes:

[GATE 2007]

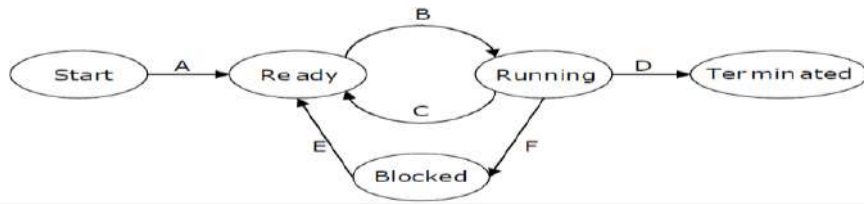
| Process | Execution time | Arrival time |
|---------|----------------|--------------|
| P1 | 20 | 0 |
| P2 | 25 | 15 |
| P3 | 10 | 30 |
| P4 | 15 | 45 |

What is the total waiting time for process P2? []

- (A) 5 (B)15 (C)40 (D)55

2. In the following process state transition diagram for a uni processor system, assume that there are always some processes in the ready state: Now consider the following statements:

[GATE 2009]



- I. If a process makes a transition D, it would result in another process making transition A immediately.
- II. A process P2 in blocked state can make transition E while another process P1 is in running state.
- III. The OS uses pre-emptive scheduling.
- IV. The OS uses non-pre-emptive scheduling.

Which of the above statements are TRUE? []

- A. I and II B. I and III C. II and III D. II and IV

3. Which of the following statements are true? [GATE 2010]

- I. Shortest remaining time first scheduling may cause starvation
- II. Pre-emptive scheduling may cause starvation
- III. Round robin is better than FCFS in terms of response time

- A. I only B. II and III only C. I and III only D. I, II and III.

4. Consider the following table of arrival time and burst time for three processes P0, P1 and P2. [GATE 2011]

| Process | Arrival time | Burst Time |
|---------|--------------|------------|
| P0 | 0 ms | 9 ms |
| P1 | 1 ms | 4 ms |
| P2 | 2 ms | 9 ms |

The pre-emptive shortest job first scheduling algorithm is used. Scheduling is carried out only at arrival or completion of processes. What is the average waiting time for the three processes?

- A. 5.0 ms B. 4.33 ms C. 6.33 D. 7.33.

5. Consider the 3 processes, P1, P2 and P3 shown in the table. [GATE 2012]

| Process | Arrival time | Time Units Required |
|---------|--------------|---------------------|
| P1 | 0 | 5 |
| P2 | 1 | 7 |
| P3 | 3 | 4 |

The completion order of the 3 processes under the policies FCFS and RR2 (round robin scheduling with CPU quantum of 2 time units) are []

- A. FCFS: P1, P2, P3
RR2: P1, P2, P3
- B. FCFS: P1, P3, P2
RR2: P1, P3, P2
- C. FCFS: P1, P2, P3
RR2: P1, P3, P2
- D. FCFS: P1, P3, P2
RR2: P1, P2, P3

6. A scheduling algorithm assigns priority proportional to the waiting time of a process. Every process starts with priority zero (the lowest priority). The scheduler re-evaluates the process priorities every T time units and decides the next process to schedule. Which one of the following is TRUE if the processes have no I/O operations and all arrive at time zero?

[GATE2013]

- A. This algorithm is equivalent to the first-come-first-serve algorithm.[]
 - B. This algorithm is equivalent to the round-robin algorithm.
 - C. This algorithm is equivalent to the shortest-job-first algorithm.
 - D. This algorithm is equivalent to the shortest-remaining-time-first algorithm.
7. An operating system uses *shortest remaining time first* scheduling algorithm for pre-emptive scheduling of processes. Consider the following set of processes with their arrival times and CPU burst times (in milliseconds):

| Process | Arrival time | Burst Time |
|---------|--------------|------------|
| P1 | 0 | 12 |
| P2 | 2 | 4 |
| P3 | 3 | 6 |
| P4 | 8 | 5 |

The average waiting time (in milliseconds) of the processes is __[GATE-2014]

8. Consider the following set of processes that need to be scheduled on a single CPU.

All the times are given in milliseconds.

| Process Name | Arrival Time | Execution Time |
|--------------|--------------|----------------|
| | | |

| | | |
|---|----|---|
| A | 0 | 6 |
| B | 3 | 2 |
| C | 5 | 4 |
| D | 7 | 6 |
| E | 10 | 3 |

Using the *shortest remaining time first* scheduling algorithm, the average process turnaround time (in msec) is **[GATE-2014]**

9. Consider a uniprocessor system executing three tasks T_1 , T_2 and T_3 , each of which is composed of an infinite sequence of jobs (or instances) which arrive periodically at intervals of 3, 7 and 20 milliseconds, respectively. The priority of each task is the inverse of its period, and the available tasks are scheduled in order of priority, with the highest priority task scheduled first. Each instance of T_1 , T_2 and T_3 requires an execution time of 1, 2 and 4 milliseconds, respectively. Given that all tasks initially arrive at the beginning of the 1st millisecond and task preemptions are allowed, the first instance of T_3 completes its execution at the end of _____ milliseconds. **[GATE-2015]**

- A. 5 B. 10 C. 12 D. 15 []

10. For the processes listed in the following table, which of the following scheduling schemes will give the lowest average turnaround time? **[GATE-2015]**

| Process | Arrival Time | Burst Time |
|---------|--------------|------------|
| A | 0 | 3 |
| B | 1 | 6 |
| C | 4 | 4 |
| D | 6 | 2 |

- A. First Come First Serve []
 B. Non – preemptive Shortest Job First
 C. Shortest Remaining Time
 D. Round Robin with Quantum value two

11. Consider the following processes, with the arrival time and the length of the CPU burst given in milliseconds. The scheduling algorithm used is preemptive shortest remaining-time first.

| Process | Arrival Time | Burst Time |
|---------|--------------|------------|
| P1 | 0 | 10 |
| P2 | 3 | 6 |
| P3 | 7 | 1 |
| P4 | 8 | 3 |

The average turnaround time of these processes is _____. [GATE-2016]

12. Consider the following CPU processes with arrival times (in milli seconds) and length of CPU bursts (in milli seconds) as given below: [GATE-2017]

| Process | Arrival time | Burst time |
|---------|--------------|------------|
| P1 | 0 | 7 |
| P2 | 3 | 3 |
| P3 | 5 | 5 |
| P4 | 6 | 2 |

If the pre-emptive shortest remaining time first scheduling algorithm is used to schedule the processes, then the average waiting time across all processes is _____ milliseconds.

13. Consider the set of processes with arrival time (in milliseconds), CPU burst time (in milliseconds) , and priority (0 is the highest priority) shown below. None of the processes have I/O burst time.

| Process | Arrival time | Burst Time | Priority |
|-----------|--------------|------------|----------|
| <i>P1</i> | 0 | 11 | 2 |
| <i>P2</i> | 5 | 28 | 0 |
| <i>P3</i> | 12 | 2 | 3 |
| <i>P4</i> | 2 | 10 | 1 |
| <i>P5</i> | 9 | 16 | 4 |

The average waiting time (in milliseconds) of all the processes using preemptive priority scheduling algorithm is _____ [GATE-2017]

8. Breaking logical memory into blocks of the same size called _____
9. Segmentation Suffers from _____ []
 A) Internal Fragmentation B) External Fragmentation
 C) Both Internal and External Fragmentation D) None
10. A routine is not loaded until it is called is referred as []
 A) Dynamic loading B) Dynamic linking
 C) Shared libraries D) Dynamic binding
11. Effective Access Time= _____
12. In paging logical address is divided into two parts _____, _____
13. In segmentation logical address is divided into _____, _____
14. Which of the following page replacement algorithms suffers from Belady's anomaly? []
 A) FIFO B) LRU C) OPTIMAL D) LFU
15. Consider a virtual memory system with FIFO page replacement policy. For an arbitrary page access pattern, increasing the number of page frames in main memory will []
 A) always decrease the number of page faults
 B) always increase the number of page faults
 C) sometimes increase the number of page faults
 D) never affect the number of page faults **(GATE-2001)**
16. The optimal page replacement algorithm will select the page that
 A) Has not been used for the longest time in the past. []
 B) Will not be used for the longest time in the future.
 C) Has been used least number of times.
 D) Has been used most number of times. **(GATE-2002)**
17. A virtual memory system uses First In First Out (FIFO) page replacement policy and allocates a fixed number of frames to a process. Consider the following statements. []
P: Increasing the number of page frames allocated to a process sometimes increases the page fault rate.
Q: Some programs do not exhibit locality of reference.
 Which one of the following is TRUE?
 A) Both P and Q are true, and Q is the reason for P
 B) Both P and Q are true, but Q is not the reason for P.

C) P is false, but Q is true

D) Both P and Q are false

(GATE-2007)

18. The essential content(s) in each entry of a page table is / are

A) Virtual page number

[]

B) Page frame number

C) Both virtual page and page frame number

D) Access right information

(GATE-2009)

19. Dirty bit for a page in a page table

[]

A) helps avoid unnecessary writes on a paging device

B) helps maintain LRU information

C) allows only read on a page

D) None of the above

(ISRO 2015)

20. Consider a 32-bit machine where four-level paging scheme is used. If the hit ratio to TLB is 98%, and it takes 20 nanosecond to search the TLB and 100 nanoseconds to access the main memory what is effective memory access time in nanoseconds?

[]

A) 126

B) 128

C) 122

D) 120

(ISRO

2011)

21. A page fault

[]

A) Occurs when a program accesses an available page on memory

B) is an error in a specific page

C) is a reference to a page belonging to another program

D) occurs when a program accesses a page not currently in memory

(ISRO2009)

22. The page replacement algorithm which gives the lowest page fault rate is

[]

A) LRU

B) FIFO

C) Optimal page replacement

D) Second chance algorithm

(ISRO 2008)

23. Which of the following statements are true?

[]

a) External Fragmentation exists when there is enough total memory space to satisfy a request but the available space is contiguous.

b) Memory Fragmentation can be internal as well as external.

c) One solution to external Fragmentation is compaction.

(NET 2018)

- A) (a) and (b) only B) (a) and (c) only
 C) (b) and (c) only D) (a), (b) and (c)

24. Consider the following segment table in segmentation scheme:

| Segment | Base | Limit |
|---------|------|-------|
| 0 | 200 | 200 |
| 1 | 500 | 12510 |
| 2 | 1527 | 498 |
| 3 | 2500 | 50 |

What happens if the logical address requested is -Segment Id 2 and offset 1000?

- A) Fetches the entry at the physical address 2527 for segment Id2
 B) A trap is generated
 C) Deadlock
 D) Fetches the entry at offset 27 in Segment Id 3

SECTION-B

Descriptive Questions

1. Compare need of swap-in and swap-out operations?
2. Explain about MVT and MFT in detail?
3. Briefly explain the concept of contiguous memory allocation.
4. Classify two Counting-Based page replacement algorithms.
5. Explain paging scheme for memory management, discuss the paging hardware and paging model.
6. Differentiate Internal and External fragmentation.
7. With a neat diagram explain how segmentation works?
8. What is the necessity of Demand Paging?
9. Illustrate the concepts of demand paging? Why it is called as lazy swappers?
10. Demonstrate in detail Copy-on-Write technique?
11. Summarize various page replacement algorithms?
 a) FIFO b) LRU c) LFU d) OPTIMAL
12. Define thrashing. Explain working set window model to handle thrashing problem.
13. Compare and Contrast First Fit, Best Fit and Worst Fit.
14. Illustrate the concept of Segmentation with neat Sketch.

Problems:

1. Find the number of page faults in FIFO and LRU page replacement algorithms for the following reference string;

7 0 2 1 3 4 2 1 0 2 1 4 3 2 1 0 0 1 2 1 (no. of frames=3)

2. Make use of the reference string **7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1**. Identify number of page faults using (Assume that there are 3 page frames which are initially empty) LRU, Optimal page replacement algorithms.
3. Make use of the reference string **7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1**. Identify number of page faults using FIFO page replacement algorithm. Assume that there are 3 page frames which are initially empty.
4. Explain Optimal page replacement algorithm. Apply the same to find out page faults for the reference string **1,2,3,4,5,3,2,1,6,7,8,7,6,9,1,2,4,3,5** by assuming frame size as 4.
5. Consider the following reference **1,2,3,4,5,3,2,1,6,7,8,7,6,9,1,2,4,3,5** String, How many Page Faults would occur for LRU and FIFO Page Replacement Algorithms for frame size of 3.
6. Consider a logical address space of 8 pages of 1024 words mapped into memory of 32 frames. How many bits are there in the logical address?
7. Consider the following page reference string : **1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6**. Which of the following options, gives the correct number of page faults related to LRU, FIFO, and optimal page replacement algorithms respectively, assuming 05 page frames and all frames are initially empty ?
8. A computer has 16 pages of virtual address space but the size of main memory is only four frames. Initially the memory is empty. A program references the virtual pages in the order **0, 2, 4, 5, 2, 4, 3, 11, 2, 10**. How many page faults occur if LRU page replacement algorithm is used?
9. Consider a virtual page reference string **1, 2, 3, 2, 4, 2, 5, 2, 3, 4**. Suppose LRU page replacement algorithm is implemented with 3 page frames in main memory. Then the number of page faults are ____.
10. A system uses 3 page frames for storing process pages in main memory. It uses the Least Recently Used (LRU) page replacement policy. Assume that all the page frames are initially empty. What is the total number of page faults that will occur while processing the page reference string given below? **4, 7, 6, 1, 7, 6, 1, 2, 7, 2**

SECTION-C

I. QUESTIONS AT THE LEVEL OF GATE

1. Suppose that the virtual Address space has eight pages and physical memory with four page frames. If LRU page replacement algorithm is used, _____ number of page faults occur with the reference string. **0 2 1 3 5 4 6 3 7 4 7 3 3 5 5 3 1 1 1 7 2 3 4 1**
A) 13 B) 12 C) 11 D) 10 **(NET 2016)**
2. Consider the data given in above question. Least Recently Used (LRU) page replacement policy is a practical approximation to optimal page replacement. For

- the reference string 1, 2, 1, 3, 7, 4, 5, 6, 3, 1, how many more page faults occur with LRU than with the optimal page replacement policy?
- A) 0 B) 1 C) 2 D) 3 **(GATE 2017)**
3. Consider six memory partitions of size 200 KB, 400 KB, 600 KB, 500 KB, 300 KB, and 250 KB, where KB refers to kilobyte. These partitions need to be allotted to four processes of sizes 357 KB, 210 KB, 468 KB and 491 KB in that order. If the best fit algorithm is used, which partitions are NOT allotted to any process?
- A) 200 KB and 300 KB B) 200 KB and 250 KB
C) 250 KB and 300 KB D) 300 KB and 400 KB **(GATE 2015)**
4. Assume that there are 3 page frames which are initially empty. If the page reference string is 1, 2, 3, 4, 2, 1, 5, 3, 2, 4, 6, the number of page faults using the optimal replacement policy is _____.
- A) 5 B) 6 C) 7 D) 8 **(GATE 2014)**
5. Consider the virtual page reference string 1, 2, 3, 2, 4, 1, 3, 2, 4, 1 On a demand paged virtual memory system running on a computer system that main memory size of 3 pages frames which are initially empty. Let LRU, FIFO and OPTIMAL denote the number of page faults under the corresponding page replacements policy. Then
- A) OPTIMAL < LRU < FIFO B) OPTIMAL < FIFO < LRU
C) OPTIMAL=LRU D) OPTIMAL=FIFO **(GATE 2012)**
6. Assume that a main memory with only 4 pages, each of 16 bytes, is initially empty. The CPU generates the following sequence of virtual addresses and uses the Least Recently Used (LRU) page replacement policy. 0, 4, 8, 20, 24, 36, 44, 12, 68, 72, 80, 84, 28, 32, 88, 92. How many page faults does this sequence cause? What are the page numbers of the pages present in the main memory at the end of the sequence?
- A) 6 and 1, 2, 3, 4 B) 7 and 1, 2, 4, 5
C) 8 and 1, 2, 4, 5 D) 9 and 1, 2, 3, 5 **GATE2008)**
7. A process has been allocated 3 page frames. Assume that none of the pages of the process are available in the memory initially. The process makes the following sequence of page references (reference string): 1, 2, 1, 3, 7, 4, 5, 6, 3, 1. If optimal page replacement policy is used, how many page faults occur for the above reference string?
- A) 7 B) 8 C) 9 D) 10 **(GATE-2007)**
8. Consider a fully associative cache with 8 cache blocks (numbered 0-7) and the following sequence of memory block requests: 4, 3, 25, 8, 19, 6, 25, 8, 16, 35, 45, 22, 8, 3, 16, 25, 7. If LRU replacement policy is used, which cache block will have memory block 7?
- A) 4 B) 5 C) 6 D) 7 **(GATE 2004)**

UNIT-IV SECTION-A

I. Objective Questions

1. A direct edge $P_i \rightarrow R_j$ is called a _____ []

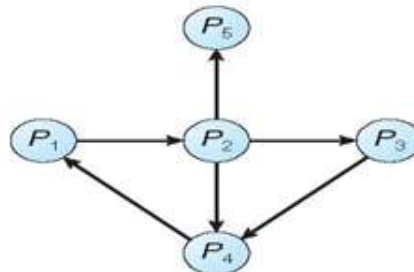
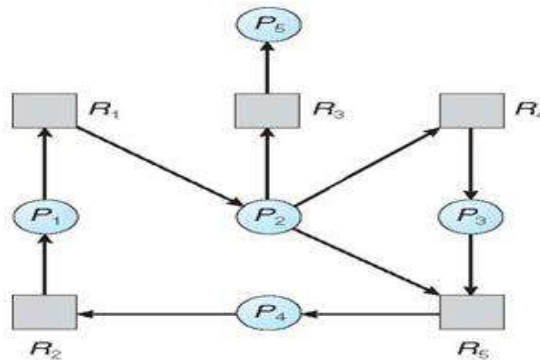
- A) Assignment edge C) Request edge
 B) Claim edge D) Release edge
2. A direct edge $R_j \rightarrow P_i$ is called a _____ []
 A) Assignment edge C) Request edge
 B) Claim edge D) Release edge
3. Deadlocks can be described in terms of a directed graph called a _____
 A) Directed Acyclic Graph []
 B) Resource allocation graph
 C) Resource request graph
 D) Resource release graph
4. If each resource type has exactly one instance, then a cycle implies that a
 deadlock has occurred. [T/F]
5. If each resource type has exactly several instances, then a cycle does not imply
 that a deadlock has occurred. [T/F]
6. The surface of a platter is logically divided into circular _____ []
 A) Sectors B) Tracks C) platters D) surfaces
7. C-SCAN refers to _____ []
 A) Coding SCAN C) Ceil SCAN
 B) Circular SCAN D) City SCAN
8. SCAN algorithm is also called as _____ []
 A) Circular SCAN B) elevator C) LOOK D)
 B) C-LOOK
9. The time to move from the disk arm to the desired cylinder is called _____
 A) Rotational latency []
 B) Seek time
 C) Transfer rate
 D) Random-access time
10. The time for the desired sector to rotate to the disk head is called _____.
 A) Rotational latency []
 B) Seek time
 C) Transfer rate
 D) Random-access time
11. Which one of the following statement about WAIT-FOR graph is true?

- A) An edge $P_i \rightarrow P_j$ exists in a wait for graph if and only if the corresponding resource allocation graph contains two edges $P_i \rightarrow R_q$ and $R_q \rightarrow P_j$ for some resource R_q .
- B) An edge $P_i \rightarrow R_j$ exists in a wait for graph if and only if the corresponding resource allocation graph contains two edges $P_i \rightarrow R_q$ and $R_q \rightarrow P_j$ for some resource R_q .
- C) An edge $P_i \rightarrow P_j$ exists in a wait for graph if and only if the corresponding resource allocation graph contains two edges $P_i \rightarrow P_j$ and $R_q \rightarrow P_j$ for some resource R_q .
- D) An edge $P_i \rightarrow P_j$ exists in a wait for graph if and only if the corresponding resource allocation graph contains two edges $P_i \rightarrow R_q$ and $P_i \rightarrow P_j$ for some resource R_q .

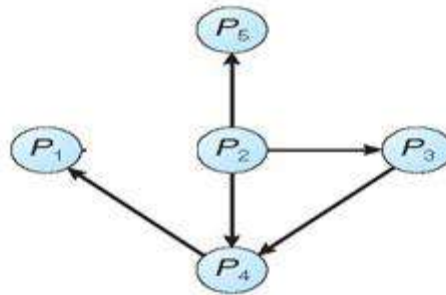
12. Which of the following approaches are used to recover from dead lock

- A) Process termination
- B) Both of the above methods
- C) Resource preemption
- D) None of the above

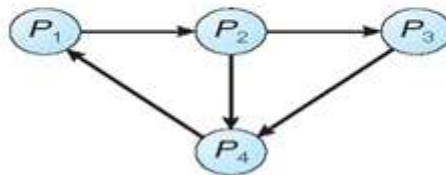
13. Which one of the following wait-for graph is equivalent to the given Resource Allocation graph?



A)



B)



C)

D) No wait-for graph for the given RAG

14. Consider a system having 'm' resources of the same type. These resources are shared by 3 processes A, B, C, which have peak time demands of 3, 4, 6 respectively. The minimum value of 'm' that ensures that deadlock will never occur is

- A) 11 B) 12 C) 13 D) 14

15. Which algorithm of disk scheduling selects the request with the least seek time from the current head positions? []

- A) SSTF scheduling C) FCFS scheduling
 B) SCAN scheduling D) LOOK scheduling

16. The circular wait condition can be prevented by []

- A) Defining a linear ordering of resource types C) Using thread
 B) Using pipes D) All of the mentioned

17. For non sharable resources like a printer, mutual exclusion []

- A) Must exist C) Must not exist
 B) May exist D) None of these

18. The disadvantage of a process being allocated all its resources before beginning its execution is : []

- A) Low CPU utilization C) Low resource utilization
 B) Very high resource utilization D) None of these

19. To ensure no preemption, if a process is holding some resources and requests another resource that cannot be immediately allocated to it :

- A) Then the process waits for the resources be allocated to it
- B) The process keeps sending requests until the resource is allocated to it
- C) The process resumes execution without the resource being allocated to it
- D) Then all resources currently being held are preempted

20. A system has 12 magnetic tape drives and 3 processes : P0, P1, and P2. Process P0 requires 10 tape drives, P1 requires 4 and P2 requires 9 tape drives.

| Process | Maximum needs | Currently allocated |
|---------|---------------|---------------------|
| P0 | 10 | 5 |
| P1 | 4 | 2 |
| P2 | 9 | 2 |

Which of the following sequence is a safe sequence?

- A) P0, P1, P2
- B) P2, P0, P1
- C) P1, P2, P0
- D) P1, P0, P2

21. The content of the matrix Need is :

- A) Allocation – Available
- B) Max – Allocation
- C) Max – Available
- D) Allocation – Max

22. An edge from process P_i to P_j in a wait for graph indicates that :

- A) P_i is waiting for P_j to release a resource that P_i needs. P_j is waiting for P_i to release a resource that P_j needs.
- B) P_i is waiting for P_j to leave the system.
- C) P_j is waiting for P_i to leave the system.

23. A computer system has 6 tape drives, with 'n' processes competing for them. Each process may need 3 tape drives. The maximum value of 'n' for which the system is guaranteed to be deadlock free is :

- A) 2
- B) 3
- C) 4
- D) 1

24. A system has 3 processes sharing 4 resources. If each process needs a maximum of 2 units then, deadlock :

- A) Can never occur.
- C) any occur.

B) Has to occur.

D) None of these.

SECTION-B

Descriptive Questions

1. Define deadlock and classify the necessary conditions for deadlock?
2. List and explain different methods used for handling deadlocks?
3. Describe in detail about BANKER'S algorithm?
4. With a neat sketch explain the overview of mass storage structure.
5. Differentiate SCAN, C-SCAN and LOOK, C-LOOK disk scheduling algorithms with an example?
6. What is sector sparing? Explain how it is useful in identifying bad blocks in mass storage?
7. Demonstrate in detail about swap-space management?

Problems:

1. Consider the snapshot of a system processes p1, p2, p3, p4, p5, Resources A, B, C, D

Allocation[0 0 1 2, 1 0 0 0, 1 3 5 4, 0 6 3 2, 0 0 1 4]

Max[0 0 1 2, 1 7 5 0, 2 3 5 6, 0 6 5 2, 0 6 5 6]

Available[1 5 2 0].

- i. What will be the content of the Need matrix?
 - ii. Is the system in safe state? If Yes, then what is the safe sequence?
2. Consider the following and find out the possible resource allocation sequence with the help of deadlock detection algorithm processes p0, p1, p2, p3, p4, Resources A, B, C

Allocation [0 1 0, 2 0 0, 3 0 3, 2 1 1, 0 0 2]

Max[0 0 0, 2 0 2, 0 0 0, 1 0 0, 0 0 2]

Available[0 0 0].

- i. What will be the content of the Need matrix?
 - ii. Is the system in safe state? If Yes, then what is the safe sequence?
3. A computer system uses the Banker's Algorithm to deal with deadlocks. Its current state is shown in the table below, where P0, P1, P2 are processes, and R0, R1, R2 are resources types.

Maximum Need

Current Allocation

Available

| | R0 | R1 | R2 | | R0 | R1 | R2 | R0 | R1 | R2 |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| P0 | 4 | 1 | 2 | P0 | 1 | 0 | 2 | 2 | 2 | 0 |
| P1 | 1 | 5 | 1 | P1 | 0 | 3 | 1 | | | |
| P2 | 1 | 2 | 3 | P2 | 1 | 0 | 2 | | | |

- i. Show that the system can be in safe state?
 - ii. What will the system do on a request by process P0 for one unit of resource type R1?
4. Four resources ABCD. A has 6 instances, B has 3 instances, C has instances and D has 2 instances.

| Process | Allocation | Max |
|---------|------------|------|
| | ABCD | ABCD |
| P1 | 3011 | 4111 |
| P2 | 0100 | 0212 |
| P3 | 1110 | 4210 |
| P4 | 1101 | 1101 |
| P5 | 0000 | 2110 |

- i. Is the current state safe?
 - ii. If P5 requests for (1,0,1,0), can this be grant
5. Why disk scheduling is needed? Schedule the given requests **98, 183, 37, 122, 14, 124, 65, 67, 10, 150** with the following disk scheduling algorithms and calculate seek time?
- a. FCFS disk scheduling
 - b. SSTF disk scheduling
 - c. SCAN disk scheduling
 - d. C-SCAN disk scheduling
 - e. LOOK disk scheduling
 - f. C-LOOK disk scheduling

SECTION-C

Previous GATE/NET questions

1. A system contains three programs and each requires three tape units for its operation. The minimum number of tape units which the system must have such that deadlocks never arise is_____ **GATE-CS-2014**

- A) 6 B) 7 C) 8 D) 9

2. A system has 6 identical resources and N processes competing for them. Each process can request atmost 2 resources. Which one of the following values of N could lead to a deadlock? **GATE-CS-2015**

- A) 1 B) 2 C) 3 D) 4

3. Considering a system with five processes P0 through P4 and three resources types A, B, C. Resource type A has 10 instances, B has 5 instances and type C has 7 instances. Suppose at time t0 following snapshot of the system has been taken: **GATE-CS-2014**

| Process | Allocation | Max | Available |
|----------------|------------|-------|-----------|
| | A B C | A B C | A B C |
| P ₀ | 0 1 0 | 7 5 3 | 3 3 2 |
| P ₁ | 2 0 0 | 3 2 2 | |
| P ₂ | 3 0 2 | 9 0 2 | |
| P ₃ | 2 1 1 | 2 2 2 | |
| P ₄ | 0 0 2 | 4 3 3 | |

- i. What will be the content of the Need matrix?
- ii. Is the system in safe state? If Yes, then what is the safe sequence?

4. An operating system uses the Banker's algorithm for deadlock avoidance when managing the allocation of three resource types X, Y, and Z to three processes P0, P1, and P2. The table given below presents the current system state. Here, the Allocation matrix shows the current number of resources of each type allocated to each process and the Max matrix shows the maximum number of resources of each type required by each process during its execution.

| | Allocation | | | Max | | |
|----|------------|---|---|-----|---|---|
| | X | Y | Z | X | Y | Z |
| P0 | 0 | 0 | 1 | 8 | 4 | 3 |
| P1 | 3 | 2 | 0 | 6 | 2 | 0 |
| P2 | 2 | 1 | 1 | 3 | 3 | 3 |

There are 3 units of type X, 2 units of type Y and 2 units of type Z still available. The system is currently in a safe state. Consider the following independent requests for additional resources in the current state:

REQ1: P0 requests 0 units of X, 0 units of Y and 2 units of Z

REQ2: P1 requests 2 units of X, 0 units of Y and 0 units of Z

Which one of the following is TRUE? **GATE-CS-2014** []

- A) Only REQ1 can be permitted.
- B) Only REQ2 can be permitted.
- C) Both REQ1 and REQ2 can be permitted.
- D) Neither REQ1 nor REQ2 can be permitted

5. Which of the following is NOT a valid deadlock prevention scheme?

GATE CS 2000 []

- A) Release all resources before requesting a new resource
- B) Number the resources uniquely and never request a lower numbered resource than the last one requested.
- C) Never request a resource after releasing any resource
- D) Request and all required resources be allocated before execution

UNIT-V SECTION A

Objective Questions

1. When several processes access the same data concurrently and the outcome of the execution depends on the particular order in which the access takes place, is called []
 - a) dynamic condition.
 - b) race condition
 - c) essential condition
 - d) critical condition
2. If a process is executing in its critical section, then no other processes can be executing in their critical section. This condition is called []
 - a) mutual exclusion
 - b) critical exclusion
 - c) synchronous exclusion
 - d) asynchronous exclusion

3. Which one of the following is a synchronization tool? []
- a) thread
 - b) pipe
 - c) semaphore
 - d) socket
4. Mutual exclusion can be provided by the []
- a) mutex locks
 - b) binary semaphores
 - c) both mutex locks and binary semaphores
 - d) none of the mentioned
5. To enable a process to wait within the monitor, []
- a) a condition variable must be declared as condition
 - b) condition variables must be used as boolean objects
 - c) semaphore must be used
 - d) all of the mentioned
6. The segment of code in which the process may change common variables, update tables, write into files is known as : []
- a) program
 - b) critical section
 - c) non – critical section
 - d) synchronizing
7. The following three conditions must be satisfied to solve the critical section problem : []
- a) Mutual Exclusion
 - b) Progress
 - c) Bounded Waiting
 - d) All of the mentioned
8. An un-interruptible unit is known as : []
- a) single
 - b) atomic
 - c) static
 - d) none of the mentioned
9. If the semaphore value is negative : []
- a) its magnitude is the number of processes waiting on that semaphore
 - b) it is invalid
 - c) no operation can be further performed on it until the signal operation is performed on it
 - d) none of the mentioned
10. The two kinds of semaphores are : []
- a) mutex & counting
 - b) binary & counting
 - c) counting & decimal
 - d) decimal & binary
11. The bounded buffer problem is also known as : []

- c) the number of variables in it
d) all of the mentioned
17. The monitor construct ensures that : []
a) only one process can be active at a time within the monitor
b) n number of processes can be active at a time within the monitor (n being greater than 1)
c) the queue has only one process in it at a time
d) all of the mentioned
18. The operations that can be invoked on a condition variable are :
a) wait & signal b) hold & wait []
c) signal & hold d) continue & signal
19. A monitor is a module that encapsulates
a) shared data structures []
b) procedures that operate on shared data structure
c) synchronization between concurrent procedure invocation
d) all of the mentioned
20. To enable a process to wait within the monitor, []
a) a condition variable must be declared as condition
b) condition variables must be used as boolean objects
c) semaphore must be used
d) all of the mentioned
21. Mutual Exclusion can be provided by the []
a) Mutex Locks b) Binary Semaphores
c) Both (a) and (b) d) None of the Mentioned
22. Process Synchronization can be done on []
a) Hardware Level b) Software Level
c) Both (a) and (b) d) None of the mentioned

SECTION-B

Descriptive Questions

1. Prove that the Peterson's Solution for critical section problem is correct with the help of flag and turn variables.
2. Discuss hardware instructions used for process synchronization.
3. Define the instructions, test and set () and swap ()

4. Explain about Synchronization Hardware.
5. What is a semaphore? What are its operations?
6. What is a Critical Section Problem? Write any two classic problems of Synchronization.
7. What is Readers-Writers problem? How it can be considered as synchronization problem? Explain its solution with Mutex locks.
8. Explain in detail how monitors are used to solve the Dining-Philosopher problem.
9. How can we use Monitors in Synchronization?
10. What is a bounded-buffer problem? Explain its solution using mutex locks.
11. Explain about solution to Dining-philosophers problem using wait() and signal() operations?

SECTION-C

Previous GATE/NET questions

1. A critical section is a program segment **GATE-1996 []**
 - a) which should run in a certain specified amount of time
 - b) which avoids deadlocks
 - c) where shared resources are accessed
 - d) which must be enclosed by a pair of semaphore operations, P and V
2. A solution to the Dining Philosophers Problem which avoids deadlock is:
 - a) ensure that all philosophers pick up the left fork before the right fork
 - b) ensure that all philosophers pick up the right fork before the left fork
 - c) ensure that one particular philosopher picks up the left fork before the right fork, and that all other philosophers pick up the right fork before the left fork
 - d) None of the above **GATE-1996 []**
3. Consider the methods used by processes P1 and P2 for accessing their critical sections whenever needed, as given below. The initial values of shared boolean variables S1 and S2 are randomly assigned.

Method Used by P1

GATE-2010

Method Used by P2

while (S1 == S2) ;

Critical Section

```

S1 = S2;
while (S1 != S2) ;
Critical Section
S2 = not (S1);

```

Which one of the following statements describes the properties achieved

- a) Mutual exclusion but not progress
 - b) Progress but not mutual exclusion
 - c) Neither mutual exclusion nor progress
 - d) Both mutual exclusion and progress
4. A counting semaphore was initialized to 10. Then 6 P (wait) operations and 4V (signal) operations were completed on this semaphore. The resulting value of the semaphore is
- GATE-1998**
- a) 0
 - b)8
 - c)10
 - d)12
5. Let $m[0] \dots m[4]$ be mutexes (binary semaphores) and $P[0] \dots P[4]$ be processes. Suppose each process $P[i]$ executes the following:

GATE-2000

```

wait (m[i]);wait (m[(i+1) mode 4]);
.....
release (m[i]); release (m[(i+1)mod 4]);

```

This could cause

- a) Thrashing
 - b) Deadlock
 - c) Starvation, but not deadlock
 - d) None of the above
6. The enter_CS() and leave_CS() functions to implement critical section of a process are realized using test-and-set instruction as follows:

GATE-2009

```

void enter_CS(X)
{
    while test-and-set(X) ;
}

```

```

void leave_CS(X)
{
    X = 0;
}

```

In the above solution, X is a memory location associated with the CS and is initialized to 0. Now consider the following statements:

- I. The above solution to CS problem is deadlock-free
- II. The solution is starvation free.
- III. The processes enter CS in FIFO order.
- IV More than one process can enter CS at the same time.

Which of the above statements is TRUE?

- a) I only
- b) I and II
- c) II and III
- d) IV only

7. The following program consists of 3 concurrent processes and 3 binary semaphores. The semaphores are initialized as S0=1, S1=0, S2=0.

| Process P0 | Process P1 | Process P2 |
|---|---------------------------------------|---------------------------------------|
| <pre> while (true) { wait (S0); print (0); release (S1); release (S2); } </pre> | <pre> wait (S1); Release (S0); </pre> | <pre> wait (S2); release (S0); </pre> |

How many times will process P0 print '0'?

GATE-2010

- a) At least twice
- b) Exactly twice
- c) Exactly thrice
- d) Exactly once

8. Fetch_And_Add(X,i) is an atomic Read-Modify-Write instruction that reads the value of memory location X, increments it by the value i, and returns the old value of X. It is used in the pseudocode shown below to implement a busy-wait lock. L is an unsigned integer shared variable initialized to 0. The value of 0

corresponds to lock being available, while any non-zero value corresponds to the lock being not available.

GATE-2012

```

AcquireLock(L){
    while (Fetch_And_Add(L,1))
        L = 1;
}
ReleaseLock(L){
    L = 0;
}

```

This implementation

- a) fails as L can overflow
- b) fails as L can take on a non-zero value when the lock is actually available.
- c) works correctly but may starve some processes
- d) works correctly without starvation

9. Consider three concurrent processes P1, P2 and P3 as shown below, which access a shared variable D that has been initialized to 100.

GATE2019

| P1 | P2 | P3 |
|-------------------|-------------------|-------------------|
| . | . | . |
| . | . | . |
| . | . | . |
| D = D + 20 | D = D - 50 | D = D + 10 |
| . | . | . |
| . | . | . |
| . | . | . |

The process are executed on a uniprocessor system running a time-shared operating system. If the minimum and maximum possible values of D after the three processes have completed execution are X and Y respectively, then the value of Y-X is _____.

[]

- (A)80
- (B)130
- (C)50
- (D) None of these

UNIT-VI
SECTION-A

Objective Questions

1. _____ is a unique tag, usually a number, identifies the file within the file system. []
a) File identifier b) File name c) File type d) None of the mentioned
2. Reliability of files can be increased by : []
a) keeping the files safely in the memory
b) making a different partition for the files
c) by keeping them in external storage
d) by keeping duplicate copies of the file
3. The main problem with access control lists is : []
a) their maintenance
b) their length
c) their permissions
d) all of the mentioned
4. Many systems recognize three classifications of users in connection with each file (to condense the access control list) : []
a) Owner b) Group c) Universe d) All of the mentioned
5. To create a file []
a) allocate the space in file system
b) make an entry for new file in director
c) allocate the space in file system & make an entry for new file in directory
d) none of the mentioned
6. File type can be represented by []
a) file name c) file extension
b) file identifier d) none of the mentioned
7. What is the mounting of file system? []
a) crating of a file system
b) deleting a file system
c) attaching portion of the file system into a directory structure
d) removing portion of the file system into a directory structure
8. Which one of the following explains the sequential file access method?
a) random access according to the given byte number []

- b) read bytes one at a time, in order
 - c) read/write sequentially by record
 - d) read/write randomly by record
9. Sequential access method _____ on random access devices. []
- a) works well
 - b) doesnt work well
 - c) maybe works well and doesnt work well
 - d) none of the mentioned
10. The direct access method is based on a _____ model of a file, as _____ allow random access to any file block. []
- a) magnetic tape, magnetic tapes
 - b) disk, disks
 - c) tape, tapes
 - d) all of the mentioned
11. For a direct access file : []
- a) there are restrictions on the order of reading and writing
 - b) there are no restrictions on the order of reading and writing
 - c) access is restricted permission wise
 - d) access is not restricted permission wise
12. A relative block number is an index relative to : []
- a) the beginning of the file
 - b) the end of the file
 - c) the last written position in file
 - d) none of the mentioned
13. For large files, when the index itself becomes too large to be kept in memory : []
- a) index is called
 - b) an index is created for the index file
 - c) secondary index files are created
 - d) all of the mentioned
14. The directory can be viewed as a _____ that translates file names into their directory entries. []
- a) symbol table
 - b) partition
 - c) swap space
 - d) cache
15. In the single level directory : []
- a) All files are contained in different directories all at the same level
 - b) All files are contained in the same directory
 - c) Depends on the operating system

- d) None of the mentioned
16. In the two level directory structure : []
- a) each user has his/her own user file directory
 - b) the system doesn't its own master file directory
 - c) all of the mentioned
 - d) none of the mentioned
17. The disadvantage of the two level directory structure is that :
- a) it does not solve the name collision problem []
 - b) it solves the name collision problem
 - c) it does not isolate users from one another
 - d) it isolates users from one another
18. In the tree structured directories: []
- a) the tree has the stem directory
 - b) the tree has the leaf directory
 - c) the tree has the root directory
 - d) all of the mentioned
19. Path names can be of two types : []
- a) absolute & relative
 - b) global & relative
 - c) local & global
 - d) relative & local
20. When keeping a list of all the links/references to a file, and the list is empty, implies that : []
- a) the file has no copies
 - b) the file is hidden
 - c) the file is deleted
 - d) none of the mentioned

SECTION-B

Descriptive Questions

1. Explain different directory structures.
2. What are the operations that can be performed on a file?
3. How Access to files is controlled?
4. What is direct access method for files?
5. Explain various file accessing methods.
6. Write about single level and two level directory Structures.
7. What is a File? Explain about Files Sharing and Protection.
8. Discuss about the Single level directory structure.

9. Discuss about the two level directory structure.
10. Explain about different file attributes?
11. Briefly explain about file system mounting?
12. Explain about file system protection?

Signature of the Faculty

HANDOUT ON OBJECT ORIENTED PROGRAMMING THROUGH JAVA

Class & Sem. : II B.Tech – I Semester

Year : 2020-21

Branch : CSE

Credits : 3

1. Brief History and Scope of the Subject

- The Java platform was developed at Sun in the early 1990s with the objective of allowing programs to function regardless of the device they were used on, sparking the slogan "Write once, run anywhere" (WORA). Java is regarded as being largely hardware- and operating system-independent.
- Java was initially promoted as a platform for client-side *applets* running inside web browsers. Early examples of Java applications were the Hot Java web browser and the Hot Java Views suite. However, since then Java has been more successful on the server side of the Internet. The platform consists of three major parts: the Java programming language, the Java Virtual Machine (JVM), and several Java Application Programming Interfaces (APIs). Java is an object-oriented programming language. Since its introduction in late 1995, it became one of the world's most popular programming languages.
- Java programs are compiled to byte code, which can be executed by any JVM, regardless of the environment. The Java APIs provide an extensive set of library routines. These APIs evolved into the *Standard Edition* (Java SE), which provides basic infrastructure and GUI functionality; the *Enterprise Edition* (Java EE), aimed at large software companies implementing enterprise-class application servers; and the *Micro Edition* (Java ME), used to build software for devices with limited resources, such as mobile devices. On November 13, 2006, Sun announced it would be licensing its Java implementation under the GNU General Public License; it released its Java compiler and JVM at that time. Java 8 was released on 18 March 2014 and included some features that were planned for Java 7 but later deferred.

2. Pre-Requisites

Basic knowledge on programming language constructs.

3. Course Objectives:

- To familiarize with the concepts of object oriented programming

- impart the knowledge of AWT components in creation of GUI

4.Course Outcomes:

CO1 : apply object oriented approach to design software .

CO2 : create user defined interfaces and packages for a given problem

CO3 : develop code to handle exceptions.

CO4 : implement multi tasking with multi threading.

CO5 : develop applets for web applications.

CO6 : design and develop GUI programs using AWT components

5.Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6.Mapping of Course Outcomes with Program Outcomes:

| CT2507 : OBJECT ORIENTED PROGRAMMING THROUGH JAVA | | | | | | | | | | | | | | | |
|---|---|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|---|
| Course outcomes | Program Outcomes and Program Specific Outcome | | | | | | | | | | | | | | |
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | |
| CO1: apply Object Oriented approach to design software. | 2 | | 2 | | | | | | | | | 1 | | 1 | 1 |
| CO2: create user defined interfaces and packages for a given problem. | 2 | 1 | 1 | | | | | | | | | 2 | | 2 | 2 |
| CO3: develop code to handle exceptions. | 2 | | | | | | | | | | | 1 | | 1 | 2 |
| CO4: implement multi tasking with multi threading. | 2 | | 1 | 1 | | | | | | | | 2 | | | 2 |
| CO5: develop Applets for web applications. | 1 | | | | | | | | | | | | | | 1 |
| CO6: design and develop GUI programs using AWT components. | 2 | 2 | 3 | 2 | | | | | | | | 2 | | 2 | 2 |

7.Prescribed Text Books

- a) Herbert Schildt, “Java The Complete Reference”, TMH, 7th edition.
- b) Sachin Malhotra, Saurabh choudhary, “Programming in JAVA”, Oxford, 2nd edition.

8.Reference Text Books

- a) Joyce Farrel, Ankit R.Bhavsar, “JAVA for Beginners”, Cengage Learning, 4th edition.
- b) Y.Daniel Liang, “Introduction to Java Programming”, Pearson, 7th edition.
- c) P.Radha Krishna, “Object Oriented Programming Through Java”, Universities Press

9.URLs and Other E-Learning Resources

CDs :

Subject: object oriented system design

Faculty: Prof. A.K. Mazundar IIT, Kharagpur

Units : 36

Websites:

www.java.sun.com

www.roseindia.net/java

www.javabeginner.com/learn-java/introduction-to-java-programming

www.tutorialspoint.com/java/index.htm

10.Digital Learning Materials:

<http://nptel.ac.in/courses/106103115/36>

<http://www.nptelvideos.com/video.php?id=1472>

<http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-00-introduction-to-computer-science-and-programming-fall-2008/video-lectures/lecture-14/>

<http://192.168.0.49/videos/videosListing/435> (our library IP)

11.Lecture Schedule / Lesson Plan

| Topic | No. of
Periods |
|---|-------------------|
| UNIT-I: Fundamentals of OOP and Java | |
| Need of OOP | 1 |
| Principles of OOP Languages | 1 |
| Procedural Languages vs OOP | 1 |
| Java Virtual Machine | 1 |
| Java Features | 1 |
| Variables, primitive data types | 1 |
| Identifiers, keywords, literals, operators | 1 |
| Arrays, type conversion and casting | 1 |
| UNIT- II: Class Fundamentals & Inheritance | |
| Class Fundamentals, Declaring Objects | 1 |
| Methods, Constructors | 1 |
| this keyword | 1 |
| Overloading methods and constructors | 1 |
| access control | 1 |
| Inheritance Basics, types | 1 |
| Using super keyword | 1 |
| Method overriding, Dynamic method dispatch | 1 |
| Abstract classes, using final with inheritance | 1 |
| Object class | 1 |
| UNIT –III: Interfaces and Packages | |

| | |
|--|---|
| Interfaces: Defining an interface, Implementing interfaces | 2 |
| Nested interfaces | 1 |
| Variables in interfaces and extending interfaces | 1 |
| Packages: Defining, Creating and Accessing a Package | 3 |
| UNIT – IV: Exception Handling & Multithreading | |
| Exception-Handling | 1 |
| Exception handling fundamentals, uncaught exceptions | 1 |
| Using try and catch, Multiple catch clauses | 1 |
| Nested try statements, throw | 1 |
| throws, finally | 1 |
| User-defined exceptions | 1 |
| Multithreading: Introduction to multi tasking | 2 |
| thread life cycle | |
| Creating threads | 1 |
| Synchronizing threads | 2 |
| thread groups | 1 |
| UNIT – V: Applets & Event Handling | |
| Applets: Concepts of Applets | 1 |
| Differences between applets applications, life and cycle of an | 1 |
| Applet | 1 |
| Creating applets | 1 |
| Event Handling: Events, Event sources | 1 |

| | |
|--|-----------|
| Event classes, Event Listeners, Delegation event model | 2 |
| Handling mouse and keyboard events | 2 |
| Adapter classes | 1 |
| UNIT – VI: AWT | |
| The AWT class hierarchy | 1 |
| User interface components- label, button | 2 |
| Checkbox, checkboxgroup | 1 |
| Choice, list, textfield | 1 |
| Scrollbar | 1 |
| Layout managers – Flow, Border | 1 |
| Grid, Card, GridBag layout | 2 |
| Total No.of Periods: | 56 |

12. Seminar Topics

- Forms of Inheritance
- AWT hierarchy
- Applet life cycle
- Menu Creation

UNIT-I

SECTION-A

Objective Questions

- 1) Java programs are _____ []
 (a) Compiled (b) Interpreted
 (c) Both Compiled & Interpreted (d) None of these
- 2) The outcome of a Java Compiler is _____ file []
 (a) .class (b) .obj (c) .exe (d) None of these
- 3) If an expression contains double, int, float, long, then whole expression will be promoted into which of these data types? []
 (a) long (b) int (c) double (d) float
- 4) Which of these can be returned by the operator & . []
 (a) int (b) boolean (c) char (d) int or boolean
- 5) Consider the statement **c=a-(b*(a/b))**. Here c contains ____ []
 (a) Difference of a and b (b) Sum of a and b
 (c) Quotient of a/b (d) Remainder of a/b
- 6) With x = 1, which of the following are legal lines of Java code for changing the value of x to 2 []
 (1) x++; (2) x=x+1; (3) x+=1; (4) x=+1
 (a) 1, 2 & 3 (b) 1 & 4 (c) 1, 2, 3 & 4 (d) 3 & 2
- 7) What is the output of the following program? []
- ```
class increment
{
public static void main(String args[])
{
double var1 = 1 + 5;
double var2 = var1 / 4;
int var3 = 1 + 5;
int var4 = var3 / 4;
System.out.print(var2 + " " + var4);
}
}
```
- (a) 1 1 (b) 0 1 (c) 1.5 1 (d) 1.5 1.0
- 8) Consider the following statements
- ```
byte b; // statement1
```

```
int i=100;    // statement2
```

```
b=i;         // statement3
```

Which of the above 3 statements will cause a compilation error:

(a) statement 1 (b) statement 2 (c) statement 3 (d)none

9)What is the output of the following program? []

```
class conversion
```

```
{
```

```
public static void main(String args[])
```

```
{
```

```
double a = 295.04;
```

```
int b = 300;
```

```
byte c = (byte) a;
```

```
byte d = (byte) b;
```

```
System.out.println(c + " " + d);
```

```
}
```

```
}
```

(a) 38 43 (b) 39 44 (c) 295 300 (d) 295.04 300

10) What will this code print? []

```
int arr[] = new int [5];
```

```
System.out.print(arr);
```

(a) 0 (b) value stored in arr[0] (c) 00000 (d) None

11) What is the output of this program? []

```
class bitwise_operator
```

```
{
```

```
public static void main(String args[])
```

```
{
```

```
int a = 3;
```

```
int b = 6;
```

```
int c = a | b;
```

```

int d = a & b;
System.out.println(c + " " + d);
}
}

```

- (a) 7 2 (b) 7 7 (c) 7 5 (d) 5 2

12) What is the output of this program? []

```

class Modulus
{
public static void main(String args[])
{
double a = 25.64;
int b = 25;
a = a % 10;
b = b % 10;
System.out.println(a + " " + b);
}
}

```

- (a) 5.6400000000000001 5 (b) 5.6400000000000001 5.0
(c) 5 5 (d) 5 5.6400000000000001

13) What is the output of this program? []

```

class Output
{
public static void main(String args[])
{
int a = 1;
int b = 2;
int c;
int d;
c = ++b;

```

```

d = a++;
c++;
b++;
++a;
System.out.println(a + " " + b + " " + c);
}
}

```

(a) 3 2 4 (b) 3 2 3 (c) 2 3 4 (d) 3 4 4

SECTION-B

SUBJECTIVE QUESTIONS

- 1) Summarize the Need of OOP.
- 2) List and explain the Principles of OOP paradigm
- 3) Differentiate Procedure Oriented Programming (POP) with Object Oriented Programming (OOP).
- 4) List and explain the Features of java.
- 5) Outline the role of JVM in making Java platform independent.
- 6) Consider the statements below:

```

byte b; // statement1
int a; // statement2
a=b; // statement3
b=a; // statement4

```

Comment about statement 3 and statement4.

- 7) Write a java program to do linear search on a list of integers
- 8) Write a java program to check whether a given number is prime or not.
- 9) Write a java to multiply 2 numbers without using * operator.
[HINT: use the operator + and loop statement]
- 10) Write a java program to sort given list of integers in ascending order.

UNIT-II

SECTION-A

Objective Questions

- 1) Which of the following is the correct syntax for creating Object []
 - A) Classname objName=new Classname
 - B) Classname objName=new Classname();
 - C) Classname objName=Classname();
 - D) objName classname=new objName();
- 2) _____ is a keyword that refers to the current object that invoked the method.
- 3) _____ is the process of reclaiming the runtime unused memory automatically.
- 4) _____ is the process of defining 2 or more methods within same class that have same name but different parameter declarations. []
 - A) Method overriding
 - B) Method overloading
 - C) Method hiding
 - D) None of the above
- 5) Which of these is correct way of inheriting class A by class B? []
 - A) class B class A { }
 - B) class B inherits class A { }
 - C) class B extends A { }
 - D) class B extends class A { }
- 6) Run-time polymorphism is achieved by using _____ []
 - A) Method Overloading
 - B) Constructor Overloading
 - C) Method Overriding
 - D) this keyword
- 7) _____ is the Super class for all the classes in Java
- 8) What is the output of this program?

```
class box
{
    int width;
    int height;
    int length;
    int vol;
    box()
    {
        width = 5;
```

```

        height = 5;
        length = 6;
    }
void volume()
{
    vol = width*height*length;
}
}
class constructor_output
{
public static void main(String args[])
{
    box obj = new box();
    obj.volume();
    System.out.println(obj.vol);
}
}

```

- A) 100 B) 150 C) 200 D) 250

9) Consider the following code

```

class A
{
private int i;
public int j;
}
class B extends A
{
int k;
void show()
{

```

```

k=i+j;
System.out.println("sum of " +i+ "and" +j+"="+k);
}
public static void main(String arg[])
    {
B b1=new B();
    }
}

```

- A) B gets only the member j through inheritance from A
- B) B gets both i, j through inheritance from A
- C) A is the sub class and B is the super class
- D) None of the above

10) what is the output of this program?
class overload

```

{
    int x;
int y;
void add(int a)
    {
        x = a + 1;
    }
    void add(int a, int b)
        {
            x = a + 2;
        }
}

```

class Overload_methods

```

{
public static void main(String args[])

```



```

{
    overload obj = new overload();
    int a = 0;

    obj.add(6,7);

    System.out.println(obj.x);
}

```

}

- a) 5 b)8 c)7 d) 6

11 The following code prints _____
class A

```

{
    int i;
    int j;
    A()
    {
        i = 1;
        j = 2;
    }
}

```

class Output

```

{
    public static void main(String args[])
    {
        A obj1 = new A();
        System.out.print(obj1.toString());
    }
}

```

- a. true
- b. false
- c. String associated with object
- d. Compilation Error

12 Predict the output of following Java Program.

```
class Grandparent
{
    public void Print( )
    {
        System.out.println("Grandparent's Print()");
    }
}

class Parent extends Grandparent
{
    public void Print( )
    {
        System.out.println("Parent's Print()");
        System.exit(0);
    }
}

class Child extends Parent
{
    public void Print()
    {
        super.Print();
        System.out.println("Child's Print()");
    }
}

public class Main
```

```

{   public static void main(String[] args)
    {
        Child c = new Child();
        c.Print();
    }
}

```

- A) Grandparent's Print()
- B) Parent's Print()
- C) Child's Print()
- D) Runtime Error

13 What is the output of the following Java program? []

```

class Test
{   int i;
}

class MainDemo
{   public static void main(String args[])
    {
        Test t = new Test();
        System.out.println(t.i);
    }
}

```

- (A) 0
- (B) garbagevalue
- (C) compilererror
- (D) runtime error

14 What is the output of the following Java program? []

```

class Point
{
    int m_x, m_y;
    public Point(int x, int y)
    {

```

```

        m_x = x;   m_y = y;
    }

    public static void main(String args[])
    {
        Point p = new Point();
    } }

```

- (A) 1 (B) garbagevalue (C) compilererror (D) runtime error

SECTION-B

SUBJECTIVE QUESTIONS

- 1) Define class. Write the steps for creating class and object? Explain it with an example?
- 2) Define constructor? Can we overload a constructor? If so, explain with an example?
- 3) Explain the usage of following keywords with examples?
 - a) this
 - b) super
 - c) final
- 4) List Different types of Inheritance? Explain with example programs?
- 5) To read an integer n and then print the nth table as below:


```

1 x n = n
2 x n = 2n
.....
10 x n = 10n

```
- 6) To read the details of a student like name, age, phone number in a method called getData() and then write another method called putData() to display the details.
- 7) To find factorial of a given number using recursion?
- 8) (a) Implement Method overloading with the following example?
 - (b) To overload a method area() which computes the area of a geometrical figure based on number of parameters. If number of parameters is 1 and is of type float it should calculate the area of circle, if it is of type int it should calculate area of square. If the number of parameters is 2 and they

are of type float calculate area of triangle, if they are of int calculate area of rectangle.

9) Implement dynamic method dispatch with an example.

10) Define Abstract class. Differentiate abstract method and concrete method?

UNIT-III

SECTION-A

Objective Questions

- 1) _____ keyword is used for implement the interface in JAVA
- 2) Which of the access specifier can be used for an Interface _____
- 3) Which of these keywords is used to define interfaces in JAVA []
(a) implement (b) interface (c) Both a & b (d) None of these
- 4) The methods of interface are _____ by default. []
(a) Abstract (b) static (c) final (d) none of these
- 5) The variables of interfaces are final and static by default (True / False)
- 6) A class can implements _____ interfaces []
(a) only one (b) one or more than one
(c) maximum two (d) minimum two
- 7) An interface contains _____ []
(a) The method definitions (b) The method declaration
(c) Both a & b (d) None
- 8) Which of the following is correct way of implementing an interface salary by class manager? []
(a) class manager extends salary {} (b) class manager implements salary {}
(c) class manager imports salary {} (d) None of the mentioned
- 9) Is it possible to create object of an interface ? (True / False)
- 10) Which of these keyword is used to define packages in JAVA ? []
(a) pkg (b) Pkg (c) package (d) Package
- 11) Which of the following is correct way of importing an entire package 'pkg' ? []
(a) import pkg. (b) import Pkg. (c) import pkg.* (d) import Pkg.*
- 12) Package consists of ? []
(1) classes (2) methods (3) variables (4) All of the above
(a) 1 and 2 (b) 2 and 3 (c) only 1 (d) 4

13) Is it possible to access the private class outside the package ?

(True / False)

14) Package is the first statement in java program ?

(True/False)

15) What is the output of this program?

[]

```
interface calculate {
    void cal(int item);
}

class display implements calculate {
    int x;
    public void cal(int item) {
        x = item * item;
    }
}

class interfaces {
    public static void main(String args[]) {
        display arr = new display();
        arr.x = 0;
        arr.cal(2);
        System.out.print(arr.x);
    }
}
```

a) 0 b) 2 c) 4 d) None of the mentioned

16) Determine output of the following code:

```
interface A { }

class C { }

class D extends C { }

class B extends D implements A { }

public class Test extends Thread{
```

```

public static void main(String[] args){
    B b = new B();
    if (b instanceof A)
        System.out.println("b is an instance of A");
    if (b instanceof C)
        System.out.println("b is an instance of C");
    }
}

```

A) Nothing.

B) b is an instance of A.

C) b is an instance of C

D) b is an instance of A followed by b is an instance of C

17) Which of the above line will give compilation error?

```

interface Test
{
    int p = 10; //line 1
    public int q = 20; //line 2
    public static int r = 30; //line 3
    public static final int s = 40; //line 4
}

```

a) 1

b) 3

c) 4

d) None of these

18) What is the output for the below code?

```

interface A{
    public void printValue();
}
public class Test{
    public static void main (String[] args){
        A a1 = new A(){
            public void printValue(){
                System.out.println("A");
            }
        }
    }
}

```


- 4) Write a short note on i) variable in interfaces ii) Nested interfaces
- 5) Can we extend interfaces? Support your argument.
- 6) Can JAVA does support multiple inheritance? Justify your answer.
- 7) Explain the concept of applying interfaces?
- 8) Define package? Write the procedure to create and import user defined package.
- 9) Explain different access specifiers supported by JAVA with an example program.
- 10) What is CLASSPATH? Explain its role in finding packages.

Write a java program to

- 1) Compute the area of rectangle using interfaces
- 2) Implement Multiple Inheritance using interface
- 3) Show how a class implements two interfaces.
- 4) show that the variables in an interface are implicitly static and final and methods are automatically public
- 5) Implements the extended interfaces
- 6) Create a package to display the given string in reverse order.
- 7) Create a package for Book details giving Book Name, Author Name, Price and Year of Publishing.
- 8) Write a java program to Create and access a user defined package where the package contains a class named CircleDemo, which in turn contains a method called circleArea() which takes radius of the circle as the parameter and returns the area of the circle.

UNIT-IV

SECTION-A

Objective Questions

1. Identify the parent class of all the exception in java is []
a)Throwable b)Throwc) Exception d)Throws
2. What are the two types of exception available in java ? []
a)Checked and compiled b) Un Checked and compiled
c)Checked and Un Checked d) Compiled and non- compiled
3. The two subclasses of Throwable are []
a)Error and AssertionError
b)Error and Exception

- c)Checked and UnChecked Exception
- d)Error and Runtime Exception
4. Choose the correct option regarding notifyAll() method. []
- a) Wakes up one threads that are waiting on this object's monitor
- b) Wakes up all threads that are not waiting on this object's monitor
- c)Wakes up all threads that are waiting on this object's monitor
- c) None of the above
5. Identify the keyword when applied on a method indicates that only one thread should execute the method at a time. []
- a)volatile b) synchronized c) native d) static
6. The built-in base class in Java, which is used to handle all exceptions is []
- a)Raise b)Exception c)Error d)Throwable
7. Which of the following exceptions is thrown when one thread has been interrupted by another thread? []
- a)ClassNotFoundException b)IllegalAccessException
- c)InstantiationException d)InterruptedException
- e)NoSuchFieldException
8. Which of the following Exception classes in Java is used to deal with an exception, where an assignment to an array element is of incompatible type? []
- a)ArithmeticException b)ArrayIndexOutOfBoundsException
- c)IllegalArgumentException d)ArrayStoreException
- e)IllegalStateException
9. A programmer has created his own exception for balance in account <1000. The exception is created properly, and the other parts of the programs are correctly defined. Though the program is running but error message has not been displayed. Why did this happen?
- a)Because of the Throw portion of exception.
- b)Because of the Catch portion of exception.

c)Because of the main() portion.

d)Because of the class portion.

e)None of the above

10. Choose the correct option for the following program

```
class demo
{
    void show() throws CalssNotFoundException{ }
}
class demo2 extends demo
{
    void show() throws IllegalAccessException, classNotFoundException,
    ArithmeticException
    {
        System.out.println("In Demo1 show");
    }
    public static void main(String arg[])
    {
        try{
            demo2 d=new demo2();
            d.show();
        }
        catch(Exception e) {}
    }
}
```

a)Does not compile

b)Compiles successfully

c)Compiles successfully and prints "In Demo1 show"

d)Compiles but does not execute.

11. Choose the best possible answer for the following program

```

class demo
{
    void show() throws ArithmeticException
        { }
}
class demo2 extends demo
{
    void show()
    {
        System.out.println("In Demo1 show");
    }
public static void main(String arg[])
{
    demo2 d=new demo2();
    d.show();
} }

```

- a.Does not compile
- b.Compiles successfully
- c.Compiles successfully and prints "In Demo1 show"
- b.Compiles but does not execute.

12. How can Thread go from waiting to runnable state?

- a)notify/notifAll
- b)bWhen sleep time is up
- c)Using resume() method when thread was suspended
- d)All

13. Predict the output of the following program

```

class A implements Runnable{
    public void run(){
        try{

```

```

        for(int i=0;i<4;i++){
            Thread.sleep(100);

System.out.println(Thread.currentThread().getName());
        }
    }catch(InterruptedException e){
    }
}

public class Test{
    public static void main(String argv[] throws Exception{
        A a = new A();
        Thread t = new Thread(a, "A");
        Thread t1 = new Thread(a, "B");
        t.start();
        t.join();
        t1.start();
    }
}

```

- a) A A A A B B B B b) A B A B A B A B
- c) Output order is not guaranteed
- d) Compilation succeed but Runtime Exception

14. What will be output of the following program code?

```

public class Test implements Runnable{
    public void run(){
        System.out.print("go");
    }
    public static void main(String arg[]) {
        Thread t = new Thread(new Test())
        t.run();
        t.run();
        t.start();
    }
}

```

- a) Compilation fails.
- b) An exception is thrown at runtime
- c) "go" is printed
- d) "gogo" is printed

15. Choose the correct option for Deadlock situation

- a) Two or more threads have circular dependency on an object
- b) Two or more threads are trying to access a same object
- c) Two or more threads are waiting for a resource
- d) None of these

16. Predict the output of following Java program

```
class Main {  
    public static void main(String args[]) {  
        try {  
            throw 10;  
        }  
        catch(int e) {  
            System.out.println("Got the Exception " + e);  
        }  
    }  
}
```

- a) Got the Exception 10
- b) Got the Exception 0
- c) Compiler Error
- d) None of the above

17. What is the output of the following program

```
class Test extends Exception { }  
  
class Main {  
    public static void main(String args[]) {  
        try {
```

```

        throw new Test();
    }
    catch(Test t) {
        System.out.println("Got the Test Exception");
    }
    finally {
        System.out.println("Inside finally block ");
    } }

```

- a)Got the Test Exception Inside finally block
- b)Got the Test Exception
- c)Inside finally block
- d)Compile error.

18. What is the output of the following program

```

class Test
{
    public static void main(String[] args)
    {
        try
        {
            int a[]={1, 2, 3, 4};
            for (int i = 1; i <= 4; i++)
            {
                System.out.println ("a[" + i + "]= " + a[i] + "n");
            }
        }
        catch (Exception e)
        {
            System.out.println ("error = " + e);
        }
    }
}

```



```
catch (ArrayIndexOutOfBoundsException e)
{
    System.out.println ("ArrayIndexOutOfBoundsException");
} } }
```

- a) Compiler error
- b) Run time error
- c) ArrayIndexOutOfBoundsException
- d) Error Code is printed
- e) Array is printed

19. Predict the output of the following program.

```
class Test
{
    int count = 0;
    void A() throws Exception
    {
        try
        {
            count++;
        }
        try
        {
            count++;
        }
        try
        {
            count++;
            throw new Exception() }
        catch(Exception ex)
        {
            count++;
            throw new Exception();
        }
    }
}
```

```

        } }
        catch(Exception ex)
        {
            count++;
        } }
        catch(Exception ex)
        {
            count++;
        } }
void display()
{
    System.out.println(count);
}

public static void main(String[] args) throws Exception
{
    Test obj = new Test();
    obj.A();
    obj.display();
} }

```

- a)4 b)5 c)6 d)Compile Error

SECTION-B

Descriptive Questions

1. Define Exception? What are the two categories of exceptions? Also discuss the advantages of exception handling
2. Explain the keywords used in exception handling.
3. Implement a multiple exception handling for the following problem

Read n+1 strings to string array and prints their lengths to get
ArrayIndexOutOfBoundsException and NullPointerException

4. Write a java program to calculate the student total marks and percentage for class test with six subjects. The marks should be 0 to 10 only, if marks entered not in the range then raise an exception MarksNotInRangeException.(Create user defined exception and throw it).
5. Can a try block be written without a catch block? Justify.
6. Can we nest a try statement inside another try statement. Write the necessary explanation and example for this.
7. Differentiate multi tasking and multithreading.
8. Draw a neat sketch of thread life cycle.
9. What is synchronization and how do we use it in java.
10. Write a Java program to create two threads from main such that one thread calculates the factorial of a given number and another thread checks whether the given number is prime or not.
11. Write a Java program to print the messages in the following sequence

For every 3 seconds “ Welcome” message

For every 2 seconds “Hello” message

For every 5 seconds “ Bye” message

UNIT-V

Section - A

Objective Questions

- 1) A Java _____ is a program that is executed by a Web browser
- 2) An HTML document uses the _____ tag to identify Java applets
- 3) What is the name of the method that is only called once whenever an applet is loaded into the Java Virtual Machine? []
A. start B. Applet C. ActionEvent D. init
- 4) The _____ method of an applet is used to draw graphics and is invoked automatically when the applet runs.

- 5) Explain in detail about Delegation event model and various events, event sources that are available in Java?
- 6) Demonstrate keyboard event handling with an example
- 7) Explain MouseEvent Class in detailed with an example
- 8) Write about Adapter classes and their importance in Event Handling
- 9) Write a program to Pass the parameters: Employee Name and ID Number to an applet
- 10) Create an Applet that displays the message like "Hai Friends How are you..?" using <param >tag.
- 11) Create an applet having the background color as black and the foreground color as white.

UNIT-VI

SECTION-A

Objective Questions

1. AWT stands for []
 - (a) Applet Windowing Toolkit
 - (b) Abstract Windowing Toolkit
 - (c) Absolute Windowing Toolkit
 - (d) None of the above
2. Which object can be constructed to show any number of choices in the visible window? []
 - (a) Labels
 - (b) Choice
 - (c) List
 - (d) Checkbox
3. Which class provides many methods for graphics programming?
 - (a) java.awt
 - (b) java.Graphics
 - (c) java.awt.Graphics
 - (d) None of the above
4. _____Layout arranges the components as a deck of cards such that only one component is visible at a time []

(a) CardLayout (b)Borderlayout (c)FlowLayout (d)GridLayout

5. At the top of the AWT hierarchy is the _____ class. []
(a) Window (b) Component (c) Panel (d)Frame
6. AWT classes are contained in the _____ package []
(a) java.awt (b) java.Awt
(c) java.classes.awt (d) java.pacakge.awt
7. BorderLayout class has ___regions to add components to it []
(a) 4 (b)7 (c)5 (d)8
8. By default FlowLayout uses _____justification. []
(a)Left (b)Right(c)Center (d)Top
9. By default page-up and page-down increment of scrollbar is___ []
(a)5 (b)10 (c)7 (d)6

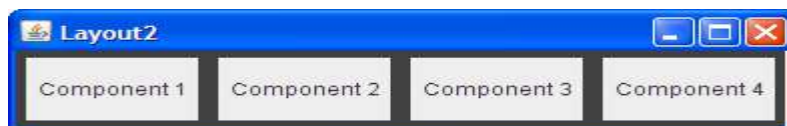
In each of the following questions, choose the layout manager(s) most naturally suited for the described layout.

- 11) The container has one component that should take up as much space as possible []



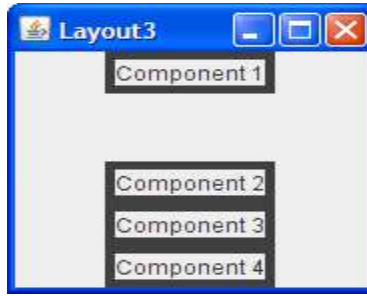
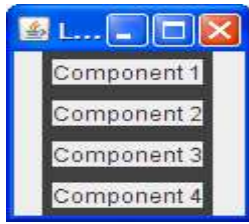
- a). BorderLayout b). GridLayout c). GridBagLayout d). a and b e). b and c

- 12). The container has a row of components that should all be displayed at the same size, filling the container's entire area.



- a). FlowLayout b). GridLayout c). BoxLayout d). a and b

- 13) The container displays a number of components in a column, with any extra space going between the first two components.



- a). FlowLayout b). BorderLayout
 c). GridLayout d). BorderLayout

14) The container can display three completely different components at different times, depending perhaps on user input or program state. Even if the components' sizes differ, switching from one component to the next shouldn't change the amount of space devoted to the component.



- a). SpringLayout b). BorderLayout
 c). CardLayout d). GridBagLayout

SECTION-B

Descriptive Questions

- 1) Explain in detail AWT class hierarchy.
- 2) Explain the following Components with an example
 A) Label B) Button
- 3) Differentiate between Checkbox and ChechboxGroup. Explain them with an Example
- 4) Explain with an example how to add Choice and List Controls to the container.
- 5) Explain with an example the following Scrollbar user Interface component
- 6) What are layout managers? Explain their importance and List them.

- 7) Explain with an example Border Layout layout Manager
- 8) Write a short note on Flow and Card Layouts. Give examples
- 9) Write an AWT program to create checkboxes for different courses belonging to a university such that the courses selected would be displayed.
- 10) Create a list of vegetables. If you click on one of the items of the list, the item should be displayed
- 11) Write a java program to show how the radio buttons can be used to change the background color of the applet window

Signature of the Faculty

HANDOUT ON COMPUTER GRAPHICS

IIB.Tech–II Semester

Year: 2020-21

OPEN ELECTIVE

Credits: 3

=====

1. Brief History and Scope Of The Subject

The precursor sciences to the development of modern computer graphics were the advances in electrical engineering, electronics, and television that took place during the first half of the twentieth century. Screens could display art since the Lumiere brothers' use of mattes to create special effects for the earliest films dating from 1895, but such displays were limited and not interactive. The first cathode ray tube, the Braun tube, was invented in 1897 - it in turn would permit the oscilloscope and the military control panel - the more direct precursors of the field, as they provided the first two-dimensional electronic displays that responded to programmatic or user input.

2. Pre-Requisites

Basics of C and graphic elements.

Equations of geometric elements.

3. Course Objectives:

To introduce computer graphics applications and functionalities of various graphic systems.

To familiarize with 2D and 3D geometrical transformations.

To disseminate knowledge on the visible surface detection and animation.

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

CO1: design a conceptual model for the mathematical model to determine the set of pixels to turn on for displaying an object.

CO2: analyze the functionalities of various display devices and visible surface detection methods

CO3: analyze the performance of different algorithms to draw different shapes.

CO4: choose different transformations and viewing functions on objects.

CO5: apply raster animations for Engine oil advertisements.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

| CT2514 : COMPUTER GRAPHICS (OPEN ELECTIVE-1) | | | | | | | | | | | | | | |
|--|---|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| Course outcomes | Program Outcomes and Program Specific Outcome | | | | | | | | | | | | | |
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO1 1 | PO1 2 | PSO 1 | PSO 2 |
| CO1:design a conceptual model for the mathematical model to determine the set of pixels to turn on for displaying an object. | 2 | 1 | 2 | | | | | | | | | | | |
| CO2:analyze the functionalities of various display devices and visible surface detection methods | 2 | 2 | | | | | | | | | | | | |
| CO3:analyze the performance of different algorithms to draw different shapes. | 3 | 2 | | | | | | | | | | | | |
| CO4:choose different transformations and viewing functions on objects. | 2 | | 1 | | | | | | | | | 1 | 1 | |
| CO5:apply raster animations for Engine oil advertisements. | 1 | | 1 | | | | | | | | | 1 | 1 | |

7. Prescribed Text Books

1. Donald Hearn, M.Pauline Baker, Computer Graphics C version, Pearson.
2. Francis S. Hill, Stephen M. Kelley, “Computer Graphics using OpenGL”, 3rd edition, Pearson Education

8. Reference Text Books

1. Foley, VanDam, Feiner, Hughes, "Computer Graphics Principles and Practice".2nd edition, Pearson Education.
2. Rajesh K Maurya, "Computer Graphics with Virtual Reality Systems", Wiley.

9. URLs and Other E-Learning Resources

- IEEE -transactions on Computer Graphics
- http://www.inf.ed.ac.uk/teaching/courses/cg/Web/intro_graphics.pdf
- <http://www.crazyengineers.com/threads/computer-graphics-project-ideas-topics-for-cs-it-students.58544/>
- <https://www.dgp.toronto.edu/~hertzman/418notes.pdf>
- <http://freevideolectures.com/Course/2275/Computer-Graphics/20>
- <http://cosmolearning.org/courses/introduction-to-computer-graphics-521/video-lectures/>

10. Digital Learning Materials:

- https://www.youtube.com/watch?v=m5YbqpL7BIY&index=1&list=PLLOxZwkBK52DkMLAYhRLA_VtePq5wW_N4
- <https://www.youtube.com/watch?v=D-tV-vZv4Co>

11. Lecture Schedule / Lesson Plan

| TOPIC | No. of Periods | |
|---|----------------|----------|
| | Theory | Tutorial |
| UNIT-I: Introduction | | |
| Applications of Computer Graphics | 1 | |
| Raster Scan Systems, Raster scan display processors | 1 | |
| Random scan systems | 1 | |
| Points and Lines | 1 | |
| Line Drawing Algorithms-DDA | 2 | |
| Bresenham,s Line Drawing Algorithm | 1 | |
| Filled Area Primitives: Inside and outside tests | 1 | |
| Boundary Fill Algorithm, Flood Fill Algorithm | 1 | |
| Scan line polygon fill algorithm | 1 | |

| UNIT-II: 2-D Geometrical Transforms | | |
|--|---|--|
| Translation, Scaling | 1 | |
| Rotation, Reflection | 2 | |
| Shear Transformations | 1 | |
| Matrix Representations | 1 | |
| Homogenous Coordinates | 1 | |
| Composite Transformations | 1 | |
| UNIT-III: 2-D viewing | | |
| The viewing pipeline | 1 | |
| Window to viewport coordinate transformation | 2 | |
| Viewing Functions | 1 | |
| Cohen Sutherland line clipping algorithm | 2 | |
| Sutherland Hogeman polygon clipping algorithm | 2 | |
| UNIT-IV: 3D Geometric Transformations | | |
| Translation, Scaling | 1 | |
| Rotation, Reflection | 2 | |
| Shear Transformations | 1 | |
| Composite Transformations | 1 | |
| 3D viewing pipeline | 1 | |
| Parallel Projections | 2 | |
| Perspective projections | 2 | |
| UNIT-V: Visible surface Detection Methods | | |
| Classification | 1 | |
| Back-face Detection | 1 | |
| Depth Buffer Method | 1 | |
| BSP tree method | 1 | |
| Area sub division method | 2 | |

| UNIT-VI: Computer Animation | | |
|------------------------------------|-----------|----------|
| Design of animation sequence | 1 | |
| Raster Animations | 1 | |
| Key frame systems | 1 | |
| Graphics programming using OpenGL | 1 | |
| drawing three dimensional objects | 1 | |
| drawing three dimensional scenes | 2 | |
| Total No. of Periods: | 48 | 0 |

12. Seminar Topics

- 3D Translation
- 3D viewing pipeline
- Key frame systems

UNIT-I SECTION-A

Objective Questions

1. The number of pixels stored in the frame buffer of a graphics system is known as
 - a. Resolution
 - b. Depth
 - c. Resolution
 - d. a & b
2. The application area of computer graphics are
 - a. Training
 - b. Education
 - c. CAD and entertainment
 - d. All of these
3. The purpose of display processor is ___ from the graphics routine task
 - a. to free the CPU
 - b. To free the secondary memory
 - c. to free the main memory
 - d. Both a & c
4. What are the components of Interactive computer graphics?
 - a. A digital memory or frame buffer
 - b. A television monitor
 - c. An interface or display controller
 - d. All of these
5. A display controller serves to pass the contents of
 - a. Frame buffer to monitor
 - b. Monitor to frame buffer
 - c. Both a & b
 - d. None of these
6. On a black and white system with one bit per pixel, the frame buffer is commonly called as
 - a. Pix map
 - b. Multi map
 - c. Bitmap
 - d. All of the mentioned
7. To store black and white images ,black pixels are represented by_____ in the frame buffer and white pixels by_____

- a. Zero and one b. One and Zero
c. Both a & b d. None of these
8. For lines with slope magnitude $|m| < 1$, x can be _____
a. A set corresponding vertical deflection
b. A set proportional to a small horizontal deflection voltage
c. Only a d. All of these
9. Aspect ratio means
a. Number of pixels
b. Ratio of vertical points to horizontal points
c. Ratio of horizontal points to vertical points
d. Both b and c
10. Which algorithm is a faster method for calculating pixel positions?
a. Bresenham's line algorithm b. Parallel line algorithm
c. Mid-point algorithm d. DDA line algorithm
11. In Bresenham's line algorithm, if the distances $d1 < d2$ then decision parameter P_k is _____
a. Positive b. Equal c. Negative d. Option a(or)c
12. A line connecting the points (1, 1) and (5, 3) is to be drawn, using DDA algorithm. Find the value of x and y increments
a. x-increments = 1; y-increments =1
b. x-increments = 0.5; y-increments =1
c. x-increments = 1; y-increments =0.5
d. None of above
13. Digitizing a picture definition into a set of intensity values is known as
a. Digitization b. Scan conversion
c. Refreshing d. Scanning
14. An accurate and efficient raster line-generating algorithm is
a. DDA algorithm b. Mid-point algorithm
c. Parallel line algorithm d. Bresenham's line algorithm

SECTION-B

SUBJECTIVE QUESTIONS

1. Define Computer Graphics. List and explain the applications of computer Graphics.
2. Explain the architecture of Raster Scan Systems and also mention the significance of graphics controller.
3. Explain the architecture of Random Scan Systems.
4. Describe the DDA scan conversion algorithm.
5. Explain Bresenham's line drawing algorithm.
6. Illustrate scan line polygon fill algorithm.

7. Discuss the methods for determining whether the point is inside or outside the region.
8. How Many k bytes does a frame buffer needs in a 600 x 400 pixel?
9. Consider two raster systems with the resolutions of 640 x 480 and 1280 x 1024. How many pixels could be accessed per second in each of these systems by a display controller that refreshes the screen at a rate of 60 frames per second?
10. Digitize the line with endpoints (0,0) and (-8,-4) using DDA line drawing algorithm.
11. Plot the intermediate pixels for a line with endpoints (20,10) and (30,18) using Bresenham's line drawing algorithm.
12. Consider three different raster systems with resolutions of 640 x 480, 1280 x 1024, and 2560 x 2048.
 - a. What size is frame buffer (in bytes) for each of these systems to store 12 bits per pixel?
 - b. How much storage (in bytes) is required for each system if 24 bits per pixel are to be stored?

UNIT-II
SECTION-A

Objective Questions

1. The most basic transformation that are applied in three-dimensional planes are []
 - a. Translation
 - b. Scaling
 - c. Rotation
 - d. All of these
2. The transformation in which an object can be shifted to any coordinate position in three dimensional plane are called []
 - a. Translation
 - b. Scaling
 - c. Rotation
 - d. All of these
3. The transformation in which an object can be rotated about origin as well as any arbitrary pivot point are called []
 - a. Translation
 - b. Scaling
 - c. Rotation
 - d. All of these
4. The transformation in which the size of an object can be modified in x-direction ,y-direction and z-direction []
 - a. Translation
 - b. Scaling
 - c. Rotation
 - d. All of these
5. Apart from the basic transformation , _____ are also used []
 - a. Shearing
 - b. Reflection
 - c. Both a & b
 - d. None of these
6. In which transformation ,the shape of an object can be modified in any of direction depending upon the value assigned to them []
 - a. Reflection
 - b. Shearing
 - c. Scaling
 - d. None of these

7. In which transformation, the mirror image of an object can be seen with respect to x-axis, y-axis, z-axis as well as with respect to an arbitrary line []
 a. Reflection b. Shearing c. Translation d. None of these
8. A translation is applied to an object by
 a. Repositioning it along with straight line path
 b. Repositioning it along with circular path
 c. Only b
 d. All of the mentioned
9. We translate a two-dimensional point by adding
 a. Translation distances b. Translation difference c. X and Y d. None
10. The translation distances (dx, dy) is called as
 a. Translation vector b. Shift vector c. Both a and b d. Neither a nor b
11. In 2D-translation, a point (x, y) can move to the new position (x', y') by using the equation
 a. $x' = x + dx$ and $y' = y + dy$
 b. $x' = x + dx$ and $y' = y + dy$
 c. $X' = x + dx$ and $Y' = y + dy$
 d. $X' = x - dx$ and $y' = y - dy$
12. The original coordinates of the point in polar coordinates are (r, Φ) and (r, Θ)
 a. $X' = r \cos(\Phi + \Theta)$
 b. $X' = r \cos(\Phi + \Theta)$ and $Y' = r \sin(\Phi + \Theta)$
 c. $X' = r \cos(\Phi - \Theta)$ and $Y' = r \cos(\Phi - \Theta)$
 d. $X' = r \cos(\Phi + \Theta)$ and $Y' = r \sin(\Phi - \Theta)$
13. The transformation that is used to alter the size of an object is]
 a. Scaling b. Rotation c. Translation d. Reflection

SECTION-B

SUBJECTIVE QUESTIONS

1. Explain the 2D basic transformations with suitable diagrams.
2. Explain the necessity of homogenous coordinates.
3. Explain reflection and shear.
4. Define composite transformations and describe various examples of composite transformations.
5. Perform the following transformations:
 - a. Scale the image two times in x-direction 5 times in y-direction.
 - b. Scale the image five times in length 1/5 times in height.
 - c. Rotate the image 35° in clockwise direction about the horizon.
 - d. Translate the image 2 units in x-direction and 3 units in y-direction.
 - e. Translate the image 5 units to the right direction and 3 units up words direction.
 - f. Translate the image 5 units to the left down words direction and 3 units down words direction.
 - g. Rotate in anticlock wise direction about 450

2. The rectangle space in which the world definition of region is displayed are called []
- Screen coordinate system
 - World coordinate system
 - Clipping window or world window
 - None of these
3. The object space in which the application model is defined []
- Screen coordinate system
 - World coordinate system
 - Clipping window or world window
 - None of these
4. The process of cutting off the line which are outside the window is called
- Shear
 - Reflection
 - Clipping
 - Clipping window
5. The process of mapping a world window in world coordinate system to viewport are called []
- viewing transformation
 - Clipping window
 - Viewport
 - Screen coordinate system
6. A method used to test lines for total clipping is equivalent to the
- logical XOR operator
 - logical AND operator
 - logical OR operator
 - both a and b
7.clips convex polygons correctly , but in case of concave polygon , it displays an extraneous line . []
- sutherland-hodgeman algorithm
 - Cohen –Sutherland algorithm
 - none of above
 - either a or b
8. The region against which an object is clipped is called a []
- Clip window
 - Boundary
 - Enclosing rectangle
 - Clip square
9. A line with endpoints codes as 0000 and 0100 is
- Partially invisible
 - Completely visible
 - Completely invisible
 - Trivially invisible
10. According to Cohen-Sutherland algorithm, a line is completely outside the window if
- The region codes of line endpoints have a '1' in same bit position.
 - The endpoints region code are nonzero values
 - If L bit and R bit are nonzero.
 - The region codes of line endpoints have a '0' in same bit position.
11. The result of logical AND operation with endpoint region codes is a nonzero value. Which of the following statement is true? []
- The line is completely inside the window
 - The line is completely outside the window
 - The line is partially inside the window
 - The line is already clipped
12. In a clipping algorithm of Cohen & Sutherland using region codes, a line is already clipped if the_____ []
- codes of the end point are same
 - logical AND of the end point code is not 0000
 - logical OR of the end points code is 0000
 - logical AND of the end point code is 0000
 - A and B
13. In displaying a clipped picture the efficient method is []
- Clipping against the window and then applying the window transformation

UNIT-IV
SECTION-A

Objective Questions

1. The subcategories of orthographic projection are
 - a. cavalier, cabinet, isometric
 - b. cavalier, cabinet
 - c. isometric, dimetric, trimetric
 - d. isometric, cavalier, trimetric
2. Engineering drawing commonly applies for
 - a. oblique projection
 - b. orthographic projection
 - c. perspective projection
 - d. None of above
3. The process of calculating the product of matrices of a number of transformations in sequence is called.....
 - a. Concatenation
 - b. Continuation
 - c. Mixing
 - d. None
4. The types of projection are
 - a. Parallel projection and perspective projection
 - b. Perpendicular and perspective projection
 - c. Parallel projection and Perpendicular projection
 - d. None of these
5. The types of parallel projection are
 - a. Orthographic projection and quadric projection
 - b. Orthographic projection and oblique projection
 - c. oblique projection and quadric projection
 - d. None of these
6. By which technique, we can take a view of an object from different directions and different distances
 - a. Projection
 - b. Rotation
 - c. Translation
 - d. Scaling
7. The process of extracting a portion of a database or a picture inside or outside a specified region are called
 - a. Translation
 - b. Shear
 - c. Reflection
 - d. Clipping
8. In Parallel projection, coordinate positions are transformed to the view plane along _____
 - a. vertical lines
 - b. Horizontal lines
 - c. perpendicular lines
 - d. parallel lines
9. Perspective projections have _____ points
 - a. composite
 - b. Vanishing
 - c. Individual
 - d. separate
10. To rotate an object about an arbitrary axis the following operations are required
What is their correct sequence?
 - i) Applying actual rotation
 - ii) Rotate the arbitrary vector such that it aligns with one of the principal axis
 - iii) Rotate the vector which is aligned with one of the principal axis to its original position
 - a. i),ii) and iii)
 - b. ii),i) and iii)
 - c. ii), iii) and i)
 - d. iii), i) and ii)

11. To perform the scaling of a 3-D object, with respect to a selected fixed position, the following operations are required. What is their correct sequence?
 - i) Translate the fixed point back to its original position
 - ii) Translate the fixed point to the origin
 - iii) Scale the object relative to coordinate origin

a. i), ii) and iii b. i), iii) and ii) c. ii), iii) and i) d. ii), i) and iii)
12. Find the incorrect statement
 - a. A perspective projection produces realistic views
 - b. A perspective projection preserves realistic dimensions
 - c. A parallel projection gives realistic representation of 3-D objects
 - d. Both b and c
13. To perform the mirror reflection of a 3-D object about xy plane, the following operations are required. What is their correct sequence?
 - i) Perform the reflection
 - ii) Align the plane normal with z-axis
 - iii) Rotate back the plane normal to its original position

a. ii), i) and iii) b. i), ii) and iii) c. iii), i) and ii) d. ii), iii) and i)

SECTION-B

SUBJECTIVE QUESTIONS

1. Describe 3D rotation about x, y, and z axes and write the corresponding transformation matrices
2. Derive the perspective projection transformation matrix
3. Differentiate between parallel and perspective projections
4. Derive the transformation matrix for rotation about an arbitrary axis which is parallel to any one of the coordinate axes in 3D
5. Derive the transformation matrix for rotation about an arbitrary axis which is not parallel to any one of the coordinate axes in 3D
6. Give the matrix representation for 3D translation, shearing and scaling
7. Give the matrix representation for 3D translation, reflection and scaling
8. Explain about types of parallel projections.
9. Calculate a 3D homogenous matrix to rotate by 45 degrees about the line passing through the point (0,0,0) and (1,0,1).
10. Derive the transformation matrix for rotation about an arbitrary axis in 3D, The arbitrary axis is passes through points A[2,1,1,] and B[3,2,2,1]
11. Determine 3D transformation matrices to scale the line PO in the x direction by 3 by keeping point P fixed. Then rotate the line by 45° anti clockwise about the z axes. Given P(1,1.5,2) and Q(4.5,6,3).
12. Prove that the multiplication of 3D transformation matrices for each of the following sequence of operation is commutative
 - i. Any two successive translation
 - ii. Any two successive scaling operation
 - iii. Any two successive rotation about any one of the coordinate axes
13. Translate a triangle with vertices at original coordinates (10,25,5), (5,10,5), (20,10,10) by $t_x=15$, $t_y=5$, $t_z=5$
14. Scale a triangle with vertices at original coordinates (10,25,5), (5,10,5), (20,10,10) by $s_x=1.5$, $s_y=2$, and $s_z=0.5$ with respect to the origin

UNIT-V

SECTION-A

Objective Questions

1. Depth buffer method is also called as _____
 - a. Back-face detection
 - b. Z-buffer
 - c. Scan-line method
 - d. Octree method
2. The method which is based on the principle of comparing objects and parts of objects to each other to find which are visible and which are hidden are called
 - a. Object-space method
 - b. image-space method
 - c. Both a & b
 - d. None
3. The method which is based on the principle of checking the visibility point at each pixel position on the projection plane are called
 - a. Object-space method
 - b. image-space method
 - c. Both a & b
 - d. None
4. The z- buffer algorithm is also referred as _____
 - a. Depth buffer
 - b. Depth sorting
 - c. Both a and b
 - d. None
5. If N is a normal to polygon surface and V is a vector in the viewing direction to the eye then this polygon is a back-face if
 - a. $V \cdot N > 0$
 - b. $v \cdot N = 0$
 - c. $V \cdot N < 0$
 - d. $V \cdot N \leq 0$
6. The painter algorithm is also referred as
 - a. Depth sorting algorithm
 - b. Depth buffer algorithm
 - c. Only b
 - d. None of these
7. Which surface algorithm is based on perspective depth
 - a. Depth comparison
 - b. subdivision method
 - c. Z-buffer or depth-buffer algorithm
 - d. back-face removal
8. BSP method refers to
 - a. Binary space partitioning
 - b. Only b
 - c. Business systems planning
 - d. None of these.
9. Depth values for a surface position (x,y) are calculated by using the following plane equation
 - a. $Z = -Ax - By$
 - b. $Z = -Ax + By$
 - c. $Z = -Ax - D$
 - d. $Z = -Ax - By - D/C$
10. No further subdivisions of a specified area are needed if one of the following conditions is true
 - a. All surfaces are outside surfaces with respect to area
 - b. Only one inside, overlapping, or surrounding surface is in the area
 - c. A surrounding surface obscures all other surfaces within the area boundaries.
 - d. Any one of the above condition.
11. Sorting is used to facilitate
 - a. depth comparisons by ordering the individual surfaces in a scene according to their distance from the view plane

- b. depth comparisons by disordering the individual surfaces in a scene according to their distance from the view plane.
 - c. depth comparisons by ordering the all surfaces in a scene according to their distance from the view plane.
 - d. None of the above.
12. Coherence methods are used
- a. to take advantage of regularities in a scene.
 - b. to take advantage of irregularities in a scene.
 - c. Both of the above.
 - d. None of the above

SECTION-B

SUBJECTIVE QUESTIONS

1. Distinguish between object-space and image space methods of visible surface detection algorithms. Give examples for each.
2. Distinguish depth-sort and z-buffer algorithms.
3. Demonstrate Back-face detection method.
4. Explain Depth-Buffer method.
5. Discuss Binary space partitioning method
6. Explain Scan-line method with an example.
7. Explain in detail about area subdivision method?
8. Demonstrate in detail about octree method
9. Given the point P1(3, 6, 20), P2(2, 4, 6) and P3(2, 4, 6) a view point C (0.0, -10), determine which points obscure the others when viewed from C.
10. Given the point P1(3, 6, 10), P2(2, 4, 8) and P3(2, 4, 8) a view point C (0.0, -20), determine which points obscure the others when viewed from C.
11. Assuming Z-buffer algorithm allows 256 depth value levels to be used, approximately how much memory would a 512X512 pixel display require to store the Z-Buffer?
12. Assuming that one allows 2^{24} depth value levels to be used, how much memory would a 1024X768 pixel display require to store the Z-Buffer?
13. Assuming that one allows 2^{24} depth value levels to be used, how much memory would a 1024X1024 pixel display require to store the Z-Buffer?

UNIT-VI
SECTION-A

Objective Questions

1. The animation can be defined as a collection of images played in
 - a. Not sequence
 - b. Defined sequence
 - c. Both a & b
 - d. None of these
2. To equalize vertex count in morphing no of points N_p is calculated as
 - a. $\text{int}(V_{\max}-1/V_{\min}-1)$
 - b. $\text{int}(V_{\max}+1/V_{\min}-1)$
 - c. $\text{int}(V_{\max}-1/V_{\min}+1)$
 - d. $\text{int}(V_{\max}+1/V_{\min}+1)$
3. _____ consist of a set of rough sketches or it could be a list of the basic ideas for the motion.
 - a. Story board layout
 - b. Object definitions
 - c. Key-frame system
 - d. In-between frames
4. To equalize vertex count in morphing no of line sections N_l is calculated as
 - a. $(V_{\max}-1)\text{mod}(V_{\min}-1)$
 - b. $(V_{\max}+1)\text{mod}(V_{\min}-1)$
 - c. $(V_{\max}-1)\text{mod}(V_{\min}+1)$
 - d. $(V_{\max}+1)\text{mod}(V_{\min}+1)$
5. We can also animate objects along two-dimensional motion paths using
 - a. color-table transformations
 - b. key-frames
 - c. languages
 - d. functions
6. To equalize the edge count, and parameters L_k and L_{k+1} denote the number of line segments in two consecutive frames. We then define
 - a. $L_{\max}=\max(L_k, L_{k-1}), L_{\min}=\min(L_k, L_{k-1})$
 - b. $L_{\max}=\max(L_k, L_{k+2}), L_{\min}=\min(L_k, L_{k+2})$
 - c. $L_{\max}=\min(L_k, L_{k+1}), L_{\min}=\max(L_k, L_{k+1})$
 - d. $L_{\max}=\max(L_k, L_{k+1}), L_{\min}=\min(L_k, L_{k+1})$
7. To equalize the vertex count, and parameters V_k and V_{k+1} denote the number of vertices in two consecutive frames. We then define
 - a. $V_{\max}=\max(V_k, V_{k-1}), V_{\min}=\min(V_k, V_{k-1})$
 - b. $V_{\max}=\max(V_k, V_{k+2}), V_{\min}=\min(V_k, V_{k+2})$
 - c. $V_{\max}=\min(V_k, V_{k+1}), V_{\min}=\max(V_k, V_{k+1})$
 - d. $V_{\max}=\max(V_k, V_{k+1}), V_{\min}=\min(V_k, V_{k+1})$
8. Divide N_e edges of keyframe \min into _____ sections in preprocessing of morphing using edge count
 - a. N_s+1
 - b. N_s-1
 - c. N_s+2
 - d. N_s-2

7. Explain about key frame systems in detail
8. Explain about motion specifications in animation
9. Explain in detail about Simulating Accelerations
10. Discuss how to equalize edge count and vertex count during preprocessing steps of morphing?

Signature of the Faculty

GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, Gudlavalleru – 521 356.

Department of Computer Science and Engineering



2020-21 SEM -II

III-B.Tech Handout

Vision

To be a Centre of Excellence in computer science and engineering education and training to meet the challenging needs of the industry and society.

Mission

- To impart quality education through well-designed curriculum in tune with the growing software needs of the industry.
- To serve our students by inculcating in them problem solving, leadership, teamwork skills and the value of commitment to quality, ethical behavior & respect for others.
- To foster industry-academia relationship for mutual benefit and growth.

Program Educational Objectives

PEO1: Identify, analyze, formulate and solve Computer Science and Engineering problems both independently and in a team environment by using the appropriate modern tools.

PEO2: Manage software projects with significant technical, legal, ethical, social, environmental and economical considerations.

PEO3: Demonstrate commitment and progress in lifelong learning, professional development, and leadership and communicate effectively with professional clients and the public.

HANDOUT ON DESIGN AND ANALYSIS OF ALGORITHMS

Class & Sem.: III B.Tech – II Semester

Year : 2020-21

Branch : CSE

Credits: 3

=====

1. Brief History and Scope of the Subject

Algorithms play the central role both in the science and practice of computing. Recognition of this fact has led to the appearance of a considerable number of textbooks on the subject. By and large, they follow one of two alternatives in presenting algorithms. One classifies algorithms according to a problem type. Such a book would have separate chapters on algorithms for sorting, searching, graphs, and so on. The advantage of this approach is that it allows an immediate comparison of, say, the efficiency of different algorithms for the same problem. The drawback of this approach is that it emphasizes problem types at the expense of algorithm design techniques.

An algorithm is a recipe or a systematic method containing a sequence of instructions to solve a computational problem. It takes some inputs, performs a well defined sequence of steps, and produces some output. Once we design an algorithm, we need to know how well it performs on any input. In particular we would like to know whether there are better algorithms for the problem. An answer to this first demands a way to analyze an algorithm in a machine-independent way. Algorithm design and analysis form a central theme in computer science

2. Pre-Requisites

- Data structures using C
- Discrete mathematical structures

3. Course Objectives

- To disseminate knowledge on analyzing the running time of algorithms using asymptotic notations.
- To introduce algorithmic design paradigms such as Divide and Conquer, Greedy Method, Dynamic Programming, Back Tracking, Branch and Bound with illustrations.

4. Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: analyze the performance of algorithms by calculating time and space complexity.

CO2: design algorithms for binary search, quick sort and merge sort by applying divide and conquer technique.

CO3: apply Greedy technique to find solution for knapsack, job sequencing, single source shortest path and minimum cost spanning trees.

CO4: design algorithm to find optimal solution to matrix chain multiplication, 0/1 knapsack, all pairs shortest paths and travelling salesperson problems using dynamic programming.

CO5: construct state space tree to find all possible solutions to various problems using back tracking and branch and bound techniques.

Program Outcomes

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

| | | | | | | | | | | | | | | | | | | | | |
|--|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|---|---|
| CO1. analyze the performance of algorithms by calculating time and space complexity. | 3 | 3 | 1 | | | | | | | | | | | | | | | | 2 | 1 |
| CO 2.design algorithms for binary search, quick sort and merge sort by applying divide and conquer technique. | 3 | 2 | 3 | 1 | | | | | | | | | | | | | | | 2 | 2 |
| CO3. apply Greedy technique to find solution for knapsack, job sequencing, single source shortest path and minimum cost spanning trees. | 3 | 1 | 2 | | | | | | | | | | | | | | | | 1 | 1 |
| CO 4. design algorithm to find optimal solution to matrix chain multiplication, 0/1 knapsack, all pairs shortest paths and travelling salesperson problems using dynamic programming | 3 | 3 | 3 | 2 | | | | | | | | | | | | | | | 2 | 2 |
| CO5. construct state space tree to find all possible solutions to various problems using back tracking and branch and bound techniques. | 3 | 1 | 2 | | | | | | | | | | | | | | | | 2 | 1 |

6. Prescribed Text Books

1. Ellis Horowitz, SatrajSahni and Rajasekharam - Fundamentals of Computer Algorithms, Galgotia publications pvt. Ltd.
2. Aho, Ullman and Hopcroft - Design and Analysis of algorithms, Pearson education.

7. Reference Text Books

1. T.H.Cormen,C.E.Leiserson, Introduction to Algorithms, PHI Pvt. Ltd./ Pearson Education, 2ndedition.
- 2.Allen Weiss, Data structures and Algorithm Analysis in C++, Pearsoneducation, 2nd edition.
- 3.M.T.Goodrich,R.Tomassia,Johnwiley and sons, Algorithm Design:Foundations, Analysis and Internet examples.
- 4.Steven S .Skiena, The algorithm Design Manual, 2nd edition, Springer.

8. URLs and Other E-Learning Resources

URLs:

- <http://freevideolectures.com/Course/2281/Design-and-Analysis-of-Algorithms>
- <http://nptel.ac.in/courses/106101060/#>

- <http://nptel.ac.in/video.php?subjectId=106101060>
- <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-2015/lecture-videos/>

E-Learning Materials:

Journals:

INTERNATIONAL JOURNALS:

- IEEE transactions on evolutionary computation.
- ACM transactions on Algorithms.

NATIONAL JOURNALS:

- Journal of Discrete algorithms.
- Journal of Graph Algorithms and applications.

9. Digital Learning Materials:

- SONET CDs –Design and analysis of Algorithms
- IIT CDs - Design and analysis of Algorithms

10. Lecture Schedule / Lesson Plan

| Topic | No. of Periods | |
|---|----------------|----------|
| | Theory | Tutorial |
| UNIT –1: Introduction | | |
| Algorithm | | 2 |
| characteristics of algorithms | 1 | |
| Performance Analysis-space complexity | 2 | |
| Time complexity | 2 | |
| Asymptotic Notations- Big oh, Omega. | 2 | |
| UNIT – 2: Divide and Conquer | | |
| Divide and conquer - General method | 1 | 1 |
| Solving recurrence relations-Substitution method | 2 | |
| Master theorem | 2 | 3 |
| Divide and conquer - General method | 1 | |
| Applications-Binary search, Quick sort, Merge sort. | 6 | |
| UNIT – 3: Greedy Method | | |

| | | |
|---|-----------|-----------|
| General method | 1 | 1 |
| Knapsack problem | 2 | |
| Job sequencing with deadlines | 2 | 2 |
| Single source shortest path problem | 2 | |
| Minimum cost spanning trees. | 3 | |
| UNIT – 4: Dynamic Programming | | |
| General method | 1 | 1 |
| Matrix chain multiplication | 2 | |
| 0/1 knapsack problem | 2 | 2 |
| All pairs shortest paths problem | 2 | |
| Travelling sales person problem. | 2 | |
| UNIT – 5: Backtracking | | |
| General method | 1 | 1 |
| n-queens problem | 3 | |
| Graph-coloring | 2 | 1 |
| Hamiltonian cycle. | 2 | |
| UNIT – 6: Branch and Bound | | |
| General method | 1 | 1 |
| Application:0/1 knapsack problem - LC BB,
FIFOBB solutions | 4 | |
| Travelling salesperson problem: LCBB solution. | 4 | 1 |
| Total No. of Periods: | 55 | 15 |

Assignment-Cum-Tutorial Questions

UNIT – I SECTION-A

Objective Questions

- For the following program fragment, the time complexity is []
for (i=0; i<n; i++)
a[i] = i;
A) $O(n-1)$ B) $O(n)$ C) $O(n^2)$ D) $O(\log n)$
- What is time complexity of fun()? []
intfun(int n)

```

{
    int count = 0;
    for (inti = n; i > 0; i /= 2)
        for (int j = 0; j < i; j++)
            count += 1;
    return count;
}

```

A) $O(n^3)$ B) $O(n)$ C) $O(n^2)$ D) $O(n \log n)$

3. For the following program portion, the running time is []

```

for (i=0; i < n; i++)
    for (j=i; j < n; j++)
        for (k=j; k < n; k++)
            s++;

```

A) $O(n)$ B) $O(n^2)$ C) $O(n^3)$ D) $O(n \log n)$

4. For the following program, the running time is []

```

for (i=0; i < n*n; i++)
    a[i] = i;

```

A) $O(n)$ B) $O(n^2)$ C) $O(n^3)$ D) $O(n \log n)$

5. What is the time complexity of the following algorithm

Algorithm Add(a, b, c, m, n)

```

{
    for i = 1 to m do
        for j = 1 to n do
            c[i,j] = a[i,j]+b[i,j];
}

```

A) $2mn+2n$ B) $2mn+2m$ C) $2mn+2m+1$ D) $2mn+2n+1$

6. Which of the given options provides the increasing order of asymptotic complexity of functions f_1 , f_2 , f_3 and f_4 ?

$f_1(n) = 2^n$
 $f_2(n) = n^{3/2}$

$f_3(n) = n \log n$
 $f_4(n) = n^{(\log n)}$

A) f_3, f_2, f_4, f_1 B) f_3, f_2, f_1, f_4 C) f_2, f_3, f_1, f_4 D) f_2, f_3, f_4, f_1

7. What does it mean when we say that an algorithm X is asymptotically more efficient than Y?

- A) X will be a better choice for all inputs
- B) X will be a better choice for all inputs except small inputs
- C) X will be a better choice for all inputs except large inputs
- D) Y will be a better choice for small inputs

8. What is the space complexity of the following algorithm

Algorithm FindFact(n)

```

{
    fact=1;
    for i=1 to n do
        fact=fact*i;
}

```


- ```

 return fact;
}

```
- A)  $2n+4$       B)  $n$       C)  $2n + 3$       D)  $n+3$
6. Given  $f(n) = \log_2^n$ ,  $g(n) = \sqrt{n}$  which function is asymptotically faster [      ]  
 A)  $f(n)$  is faster than  $g(n)$       B)  $g(n)$  is faster than  $f(n)$   
 C) Either  $f(n)$  or  $g(n)$       D) Neither  $f(n)$  nor  $g(n)$
7. Suppose  $T(n) = 2T(n/2) + n$ ,  $T(0) = T(1) = 1$ .  
 Which of the following is FALSE [      ]  
 A)  $T(n) = O(n^2)$     B)  $T(n) = \Theta(n \log n)$     C)  $T(n) = O(n \log n)$     D)  $\Omega(n^2)$
8. Arrange the following functions in increasing asymptotic order [      ]  
 i.  $n^{1/3}$     ii.  $e^n$     iii.  $n^{7/4}$     iv.  $n \log^9 n$     v.  $1.0000001^n$   
 A) i, iv, iii, v, ii    B) v, iv, iii, i, ii    C) i, ii, iv, iii, v    D) i, iii, iv, ii, v
9. Consider the following three claims  
 1.  $(n + k)^m = \Theta(n^m)$ , where  $k$  and  $m$  are constants  
 2.  $2^{n+1} = O(2^n)$   
 3.  $2^{2n+1} = O(2^n)$   
 Which of these claims are correct? [      ]  
 A) 1 and 2      B) 1 and 3      C) 2 and 3      D) 1, 2, and 3

**Problems:**

- Design an algorithm for the selection sort.
- Write recursive algorithm to find  $n^{\text{th}}$  Fibonacci number.
- The factorial function  $n!$  has value 1 when  $n \leq 1$  and value  $n * (n - 1)!$  when  $n > 1$ . Write both a recursive and an iterative algorithms to compute  $n!$ .
- Calculate the time complexity for the following program segment:

```

Algorithm Add(a, b, c, m, n)
{
 for i= 1 to m do
 for j = 1 to n do
 C[i,j]=a[i,j]+b[i,j];
}

```

- Show that the following equalities are correct:  
 i.  $5n^2 - 6n = \Theta(n^2)$       ii.  $n! = O(n^n)$   
 iii.  $2n^2 + n \log n = \Theta(n^2)$       iv.  $\sum_{i=n}^n i^2 = O(n^3)$
- Calculate the space complexity for the following piece of code:

```

intsum(int A[], int n)
{
 int sum = 0, i;
 for(i = 0; i < n; i++)
 sum = sum + A[i];
 return sum;
}

```

- Calculate the time and space complexities for the following program segment:  

```

i=1;
while(i<=n) do {
 x=x+1;
 i=i+1;
}

```

}

## SECTION-C

### GATE questions

1. The running time of the following algorithm is [ ]  
Algorithm A(n) [GATE 2002]  
{  
  If  $n \leq 2$  return 1  
  else return  $A(\sqrt{n})$   
}
- A)  $O(n)$     B)  $O(\log n)$     C)  $O(\log \log n)$     D)  $O(1)$
2. Consider the following functions  
 $f(n) = 2^n$   
 $g(n) = n!$   
 $h(n) = n^{\log n}$   
Which of the following statements about the asymptotic behavior of  $f(n)$ ,  $g(n)$ ,  $h(n)$  is true? [GATE 2008] [ ]
- A)  $f(n) = O(g(n)); g(n) = O(h(n))$     B)  $f(n) = \Omega(g(n)); g(n) = O(h(n))$   
C)  $g(n) = O(f(n)); h(n) = O(f(n))$     D)  $h(n) = O(f(n)); g(n) = \Omega(f(n))$
3. Let  $f(n) = n$  and  $g(n) = n^{(1 + \sin n)}$ , where  $n$  is a positive integer. Which of the following statements is/are correct? [GATE 2015] [ ]  
I.  $f(n) = O(g(n))$     II.  $f(n) = \Omega(g(n))$   
A) only I    B) only II    C) both I and II    D) neither I and II
4. Consider the following function;  
intfun(int n)  
{  
  inti, j;  
  for (i=1; i<=n; i++)  
    for(j=1; j<n; j+=i)  
      printf(“%d %d”, i,j);  
}
- The time complexity of fun in terms of  $\Theta$  notation is [GATE 2017]  
A)  $\Theta(n\sqrt{n})$     B)  $\Theta(n^2)$     C)  $\Theta(n \log n)$     D)  $\Theta(n^2 \log n)$
5. Consider the following functions from positive numbers to real numbers;  
 $10, \sqrt{n}, n, \log n, 100/n$   
The correct arrangement of the above functions in increasing order of asymptotic complexity is; [GATE 2017]
- A)  $\log n, 100/n, 10, \sqrt{n}, n$   
B)  $100/n, 10, \log n, \sqrt{n}, n$   
C)  $10, 100/n, \sqrt{n}, \log n, n$   
D)  $100/n, \log n, 10, \sqrt{n}, n$

**UNIT – II**  
**SECTION-A**

**Objective Questions**

1. Which of the following algorithms is NOT a divide & conquer algorithm by nature? [            ]  
A) Euclidean algorithm to compute the greatest common divisor  
B) Heap sort  
C) Merge sort  
D) Quick sort
2. Time required to merge two sorted lists of size m and n is [            ]  
A)  $O(m/n)$     B)  $O(m+n)$     C)  $O(mn)$     D)  $O(m-n)$
3. The best-case time complexity of binary search is [            ]  
A)  $O(1)$     B)  $O(\log n)$     C)  $O(n^2)$     D)  $O(n)$
4. The average-case time complexity of binary search is [            ]  
A)  $O(1)$     B)  $O(\log n)$     C)  $O(n^2)$     D)  $O(n)$
5. The worst-case time complexity of binary search is [            ]  
A)  $O(1)$     B)  $O(\log n)$     C)  $O(n^2)$     D)  $O(n)$
6. The worst-case time complexity of merge sort is [            ]  
A)  $\Theta(1)$     B)  $\Theta(\log n)$     C)  $\Theta(n^2)$     D)  $\Theta(n \log n)$
7. The average-case time complexity of merge sort is [            ]  
A)  $\Theta(n)$     B)  $\Theta(\log n)$     C)  $\Theta(n^2)$     D)  $\Theta(n \log n)$
8. Which of the following is not a limitation of binary search algorithm? [            ]  
A) Must use a sorted array  
B) Requirement of sorted array is expensive when a lot of insertion and deletions are needed  
C) There must be a mechanism to access middle element directly  
D) Binary search algorithm is not efficient when the data elements are more than 1500.
9. Quick sort exhibits worst-case time complexity when the data is already in sorting order [True/False]  
[            ]
10. The average-case time complexity of quick sort is [            ]  
A)  $\Theta(n)$     B)  $\Theta(\log n)$     C)  $\Theta(n^2)$     D)  $\Theta(n \log n)$
11. The worst-case time complexity of quick sort is [            ]  
A)  $\Theta(n)$     B)  $\Theta(\log n)$     C)  $\Theta(n^2)$     D)  $\Theta(n \log n)$

**SECTION-B**

**Descriptive Questions**

1. Write and explain the control abstraction for divide and conquer.
2. Write an algorithm for quick sort and analyze its worst-case time complexity.
3. Write an algorithm for merge sort and analyze its time complexity.
4. Write recursive binary search algorithm and analyze its time complexity.

**Multiple Choice Questions:**

1. The time complexity for calculating the articulation points of a graph G with 'n' vertices and 'e' edges once the L values are determined is [            ]  
A)  $O(n*e)$     B)  $O(n+e)$     C)  $O(n-e)$     D)  $O(n/e)$



2. If a tree has 'm' nodes which is created as a sequence of unions performed by weighted union, then the height of the tree is not greater than

[                    ]

- A)  $\log_2 m + 1$     B)  $\log_2 m - 1$     C)  $\log_2 m$     D)  $\log_2 m + c$

3. Let P be a quicksort program to sort numbers in ascending order. Let t1 and t2 be the time taken by the program for the inputs [1 2 3 4] and [5 4 3 2 1] respectively. Which of the following holds

[                    ]

- A)  $t_1 = t_2$     B)  $t_1 > t_2$     C)  $t_1 < t_2$     D)  $t_1 = t_2 + 5 \log 5$

4. The solution to the recurrence  $T(n) = T(n/2) + n$  is

[                    ]

- A)  $O(\log n)$     B)  $O(n \log n)$     C)  $O(n)$     D)  $O(n^2)$

5. The recurrence relation that arises in relation with the complexity of binary search is

[                    ]

- A)  $T(n) = T(n/2) + k$ , k is a constant  
 B)  $T(n) = 2T(n/2) + k$ , k is a constant  
 C)  $T(n) = T(n/2) + \log n$   
 D)  $T(n) = T(n/2) + n$

6. A sorting technique is called stable if

[                    ]

- A) it takes  $O(n \log n)$  time  
 B) it maintains the relative order of occurrence of non-distinct elements  
 C) it uses divide and conquer paradigm  
 D) it takes  $O(n)$  space

7. The recurrence relation

[                    ]

$$T(1) = 2$$

$$T(n) = 3T(n/4) + n$$

Has the solution  $T(n)$  equal to

- A)  $O(n)$     B)  $O(\log n)$     C)  $O(n^{3/4})$     D) None of these

8. In the following C function, let  $n \geq m$

```
intgcd(n,m)
{ if(n%m == 0) return m;
 n=n%m;
 return gcd(m,n);
}
```

How many recursive calls are made by this function?

[                    ]

- A)  $\Theta(\log n)$     B)  $\Omega(n)$     C)  $\Theta(\log \log n)$     D)  $\Theta(\sqrt{n})$

9. The worst-case running times of Insertion sort, Merge sort and Quick sort, respectively, are

[                    ]

- A)  $\Theta(n \log n)$ ,  $\Theta(n \log n)$ , and  $\Theta(n^2)$     B)  $\Theta(n^2)$ ,  $\Theta(n^2)$ , and  $\Theta(n \log n)$   
 C)  $\Theta(n^2)$ ,  $\Theta(n \log n)$ , and  $\Theta(n \log n)$     D)  $\Theta(n^2)$ ,  $\Theta(n \log n)$ , and  $\Theta(n^2)$

### Problems

1. Show how binary search algorithm works for searching 151, -14 and 9 in the following set of elements:

-15, -6, 0, 7, 9, 23, 54, 82, 101, 112, 125, 131, 142, 151

2. Draw the tree of calls of merge sort and merge for the following set.

(35, 25, 15, 10, 45, 75, 85, 65, 55, 5, 20, 18)

3. Derive the average case time complexity of a Quick sort.

- Sort the records with the following index values in ascending order using quick sort algorithm.  
65,70,75,80, 33, 60,55, 22, 50,45, 11
- A sorting method is said to be stable if at the end of the method, identical elements occur in the same order as in the original unsorted ser. Is merge sort a stable sorting method? Show this with a suitable example.
- Sort the following data in ascending order using merge sort  
35, 25,15,10,45, 75, 85, 65, 55, 5, 20, 18

### SECTION-C

#### Questions from Previous GATE Papers

- Suppose  $T(n)=2T(n/2)+n$ ,  $T(0)=T(1)$  which one of the following is false? [GATE 2005]
  - $T(n)=O(n^2)$
  - $T(n)=\Theta(n \log n)$
  - $T(n)=\Theta(n)$
  - $T(n)=O(n \log n)$
- In quick sort, for sorting  $n$  elements, the  $(n/4)^{\text{th}}$  smallest element is selected as pivot using an  $O(n)$  time algorithm. What is the worst case time complexity of the quick sort?[GATE 2009]
  - $\Theta(n)$
  - $\Theta(n \log n)$
  - $\Theta(n^2)$
  - $\Theta(n^2 \log n)$
- Which of the following correctly determines the solution of the recurrence relation with  $T(1) = 1$ ?[GATE 2014]

$$T(n) = 2T\left(\frac{n}{2}\right) + \log n$$

- $\Theta(n)$
  - $\Theta(n \log n)$
  - $\Theta(n^2)$
  - $\Theta(\log n)$
- The recurrence relation [GATE 2004]
 
$$T(1) = 1$$

$$T(n) = 2T(n-1) + n, n \geq 2$$
 Evaluates to
    - $2^{n+1} - n - 2$
    - $2^n - n$
    - $2^{n+1} - 2n - 2$
    - $2^n + n$
  - The running time of an algorithm is represented by the following recurrence relation;
 
$$T(n) = \begin{cases} n, & n \leq 3 \\ T\left(\frac{n}{3}\right) + cn, & \text{otherwise} \end{cases}$$

Which of the following represents the time complexity of the algorithm?  
[GATE 2009]

- $\Theta(n)$
- $\Theta(n \log n)$
- $\Theta(n^2)$
- $\Theta(n^2 \log n)$

### UNIT – III SECTION-A

#### Objective Questions

- Which of the following standard algorithms is not a Greedy algorithm?
  - Dijkstra's shortest path algorithm
  - Prim's algorithm

- C) Kruskal algorithm  
D) Bellman Ford Shortest path algorithm
- Which of the following is/are the operations performed by Kruskal's algorithm?
    - sort the edges of  $G$  in increasing order by length
    - keep a subgraph  $S$  of  $G$  initially empty
    - builds a tree one vertex at a time

A) i, and ii only    B) ii and iii only    C) i and iii only    D) All i, ii and iii
  - Greedy job scheduling with deadlines algorithm time complexity is  
A)  $O(n)$     B)  $\Omega(n \log n)$     C)  $O(n^2 \log n)$     D)  $O(n \log n)$
  - \_\_\_\_\_ turns out that one can find the shortest paths from a given source to all points in a graph in the same time.  
A) Kruskal's algorithm    B) Prim's algorithm  
C) Dijkstra algorithm    D) Bellman ford algorithm
  - How do you determine the cost of a spanning tree?  
A) By the sum of the costs of the edges of the tree  
B) By the sum of the costs of the edges and vertices of the tree  
C) By the sum of the costs of the vertices of the tree  
D) By the sum of the costs of the edges of the graph
  - The result of Prim's algorithm is a total time bound of  
A)  $O(\log n)$     B)  $O(n \log n)$     C)  $O(n^2)$     D)  $O(n^3)$
  - In Knapsack problem, the best strategy to get the optimal solution, where  $P_i$ ,  $W_i$  is the Profit, Weight associated with each of the  $X_i^{\text{th}}$  object respectively is to  
A) Arrange the values  $P_i/W_i$  in ascending order  
B) Arrange the values  $P_i/X_i$  in ascending order  
C) Arrange the values  $P_i/W_i$  in descending order  
D) Arrange the values  $P_i/X_i$  in descending order
  - The time complexity of Greedy knapsack algorithm is  
A)  $O(\log n)$     B)  $O(n \log n)$     C)  $O(n^2)$     D)  $O(n)$
  - Prim's algorithm is based on \_\_\_\_\_ method.  
A) Divide and conquer method    B) Dynamic programming  
C) Greedy method    D) Branch and bound

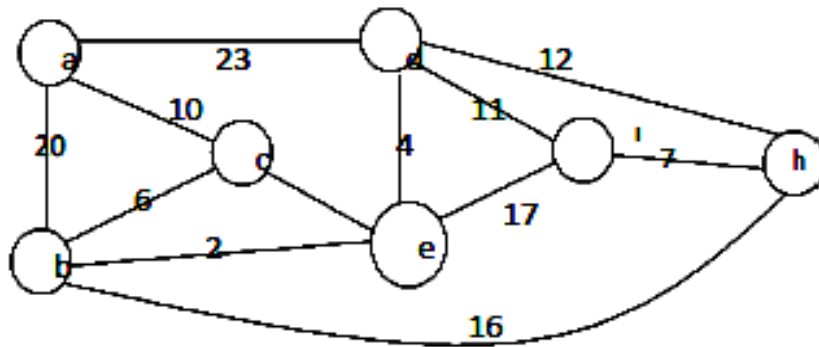
## SECTION-B

### *Descriptive Questions*

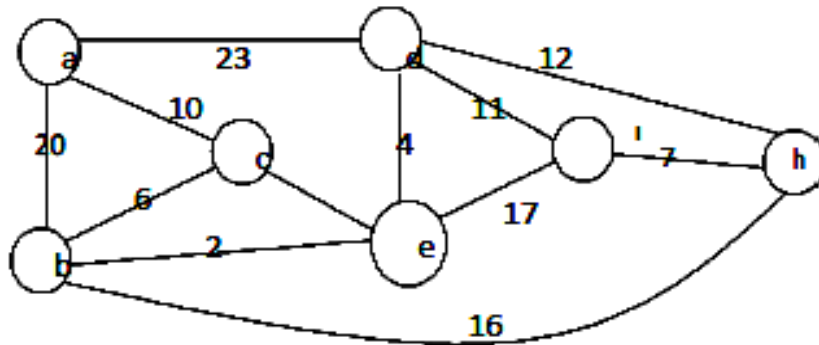
- Differentiate between divide and conquer and Greedy method
- What is Greedy method? Write the control abstraction for it.
- Explain the knapsack problem with appropriate example.
- Explain single source shortest path problem with appropriate example.
- Explain the Job Sequencing with deadlines problem with appropriate example.
- Differentiate between Prim's and Kruskal's algorithms.
- Explain Prim's algorithm with suitable example.
- Illustrate Kruskal's method with an example.
- Write the Greedy knapsack algorithm and analyze its time complexity.
- Write the Greedy knapsack algorithm and analyze its time complexity.

### *Multiple Choice Questions*

- Cost of minimum spanning tree using Prim's method is



- A) 40    B) 39    C) 41    D) 47
2. Cost of minimum spanning tree using Kruskal's method is



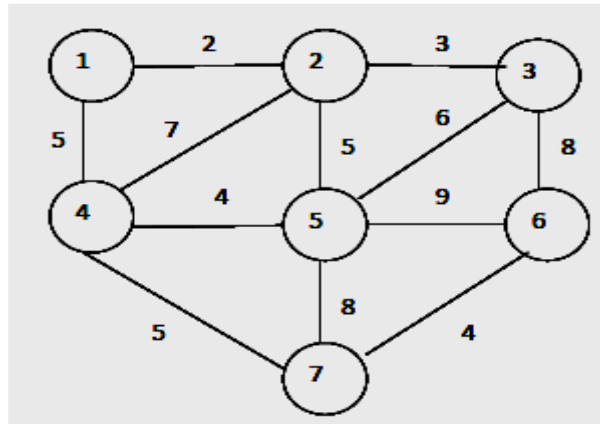
- A) 40    B) 39    C) 41    D) 47
3. Which is not feasible solution in the case of job sequence problem?
- |          |   |     |    |    |    |
|----------|---|-----|----|----|----|
| item     | : | 1   | 2  | 3  | 4  |
| profit   | : | 100 | 10 | 15 | 27 |
| deadline | : | 2   | 1  | 2  | 1  |
- A) (1,4)    B) (2,4)    C) (4,3)    D) (1,2)
4. Find the optimal solution for the following job sequence problem.
- |          |   |    |    |    |   |   |
|----------|---|----|----|----|---|---|
| item     | : | 1  | 2  | 3  | 4 | 5 |
| profit   | : | 20 | 15 | 10 | 5 | 1 |
| deadline | : | 2  | 2  | 3  | 3 | 3 |
- A) (1,3,4)    B) (1,2,4)    C) (4,2,3)    D) (1,5,2)
5. Find the optimal solution for the following job sequence problem.
- |          |   |   |   |    |    |   |   |    |
|----------|---|---|---|----|----|---|---|----|
| item     | : | 1 | 2 | 3  | 4  | 5 | 6 | 7  |
| profit   | : | 3 | 5 | 20 | 18 | 1 | 6 | 30 |
| deadline | : | 1 | 3 | 4  | 3  | 2 | 1 | 2  |
- A) (1,5,6,4)    B) (2,3,1,7)    C) (7,6,4,3)    D) (1,2,3,4)
6. Which is the optimal solution to the fractional knapsack problem with capacity of Knapsack is 20
- |        |   |    |    |    |
|--------|---|----|----|----|
| item   | : | 1  | 2  | 3  |
| profit | : | 25 | 24 | 15 |
| weight | : | 18 | 15 | 10 |
- A) 498    B) 499    C) 480    D) 485
7. Which is the optimal solution to the fractional knapsack problem with capacity of Knapsack is 10
- |        |   |    |    |    |    |    |
|--------|---|----|----|----|----|----|
| Item   | : | 1  | 2  | 3  | 4  | 5  |
| Profit | : | 12 | 32 | 40 | 30 | 50 |

Weight : 4 8 2 6 1  
 A) 345 B) 354 C) 384 D) 350

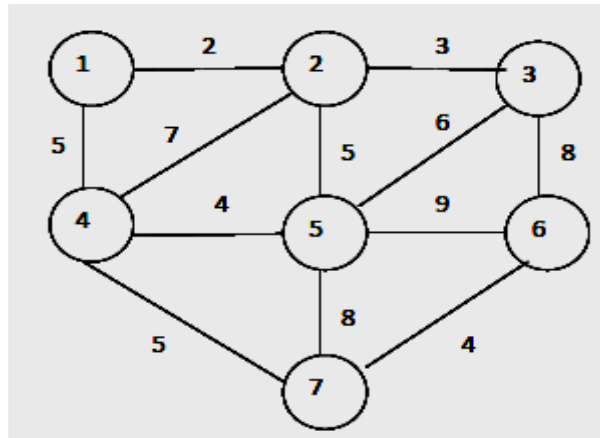
8. If the graph is represented as an adjacency matrix then the time complexity of Kruskal's algorithm is (V-set of vertices, E – set of edges)  
 A)  $O(E \log E)$  B)  $O(V \log V)$  C)  $O(V^2)$  D)  $O(\log E)$

**Problems**

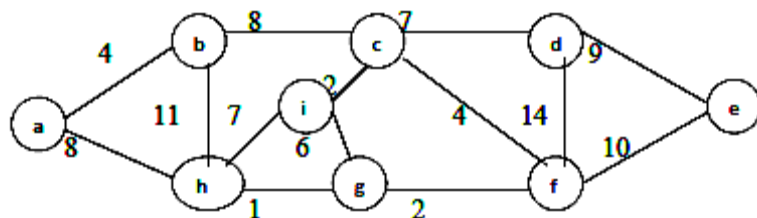
1. Apply Kruskal's algorithm on the following graph to find minimum-cost spanning Tree(MCST).



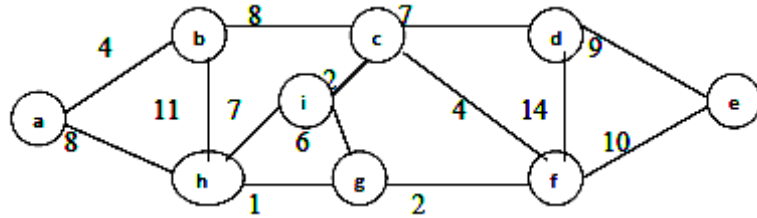
2. Apply Prim's algorithm on the following graph to find minimum-cost spanning tree (MCST).



3. Are the Minimum spanning tree of any graph is unique? Apply Prim's algorithm to find a minimum cost spanning tree for the following. (a is a starting vertex).



4. Apply Kruskal's algorithm to find a minimum cost spanning tree for the following. (a is a starting vertex).



- Find the optimal solution to the knapsack instance  $n=5$ ,  $M=10$   
 $(P_1, P_2, \dots, P_5) = (12, 32, 40, 30, 50)$  and  $(W_1, W_2, \dots, W_5) = (4, 8, 2, 6, 1)$ .
- Let  $S = \{a, b, c, d, e, f, g\}$  be a collection of objects with Profit-Weight values as follows:  
 $a:(12,4)$ ,  $b:(10,6)$ ,  $c:(8,5)$ ,  $d:(11,7)$ ,  $e:(14,3)$ ,  $f:(7,1)$  and  $g:(9,6)$ . What is the optimal solution to the *fractional* knapsack problem for  $S$ , assuming we have a knapsack that can hold objects with total weight of 18? What is the *complexity* of this method?

### SECTION-C

#### Questions for Analysis / Analyzing

- Analyze the time complexity of deriving minimum spanning tree from the weighted connected graph using Kruskal's algorithm.
- Analyze the time complexity of deriving minimum spanning tree from the weighted connected graph using Prim's algorithm.
- Write the greedy algorithm for single source shortest path problem and analyze its time complexity.

#### Questions from Previous GATE Papers

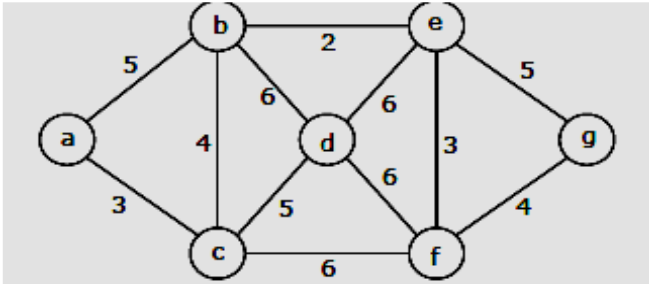
- Let  $G$  be a complete undirected graph on 4 vertices, having 6 edges with weights being 1, 2, 3, 4, 5, and 6. The maximum possible weight that a minimum weight spanning tree of  $G$  can have is \_\_\_\_\_ [GATE 2016]
- $G = (V, E)$  is an undirected simple graph in which each edge has a distinct weight, and  $e$  is a particular edge of  $G$ . Which of the following statements about the minimum spanning trees (MSTs) of  $G$  is/are TRUE? [GATE 2016]
  - If  $e$  is the lightest edge of some cycle in  $G$ , then every MST of  $G$  includes  $e$
  - If  $e$  is the heaviest edge of some cycle in  $G$ , then every MST of  $G$  excludes  $e$
 A) I only      B) II only      C) both I and II      D) neither I nor II
- Consider a complete undirected graph with vertex set  $\{0, 1, 2, 3, 4\}$ . Entry  $W_{ij}$  in the matrix  $W$  below is the weight of the edge  $\{i, j\}$ .

$$W = \begin{pmatrix} 0 & 1 & 8 & 1 & 4 \\ 1 & 0 & 12 & 4 & 9 \\ 8 & 12 & 0 & 7 & 3 \\ 1 & 4 & 7 & 0 & 2 \\ 4 & 9 & 3 & 2 & 0 \end{pmatrix}$$

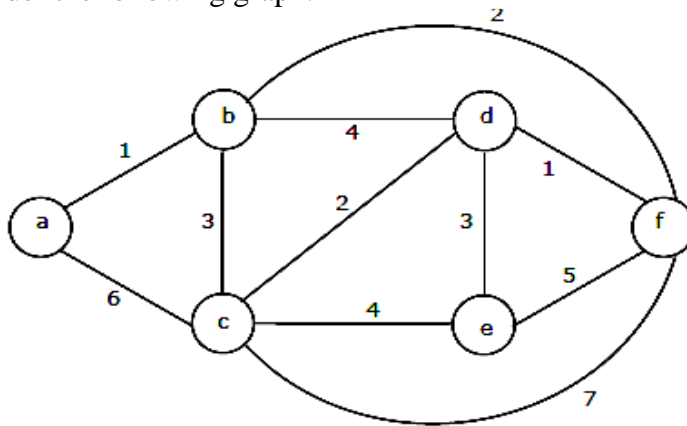
[GATE 2010]

What is the minimum possible weight of a spanning tree  $T$  in this graph such that vertex 0 is a leaf node in the tree  $T$ ?

- A) 7      B) 8      C) 9      D) 10
- Consider the following graph: [GATE 2009]



- Which one of the following is NOT the sequence of edges added to the minimum spanning tree using Kruskal's algorithm?
- A) (b,e) (e,f)  
 (a,c) (b,c) (f,g) (c,d) B) (b,e) (e,f) (a,c) (f,g) (b,c) (c,d)  
 C) (b,e) (a,c) (e,f) (b,c) (f,g) (c,d) D) (b,e) (e,f) (b,c) (a,c) (f,g) (c,d)
5. Consider the following graph:



- Which one of the following cannot be the sequence of edges added, in that order, to a minimum spanning tree using Kruskal's algorithm?
- A)  $\langle a, b \rangle, \langle d, f \rangle, \langle b, f \rangle, \langle d, c \rangle, \langle d, e \rangle$   
 B)  $\langle a, b \rangle, \langle d, f \rangle, \langle d, c \rangle, \langle b, f \rangle, \langle d, e \rangle$   
 C)  $\langle d, f \rangle, \langle a, b \rangle, \langle d, c \rangle, \langle b, f \rangle, \langle d, e \rangle$   
 D)  $\langle d, f \rangle, \langle a, b \rangle, \langle b, f \rangle, \langle d, e \rangle, \langle d, c \rangle$

## UNIT – IV SECTION-A

### ***Objective Questions***

1. We use dynamic programming approach when
  - A) It provides optimal solution
  - B) The solution has optimal substructure
  - C) The given problem can be reduced to sub problems
  - D) It's faster than Greedy
2. Dynamic programming divides problems into a number of
  - A) Conflicting objective functions.
  - B) Policies.
  - C) Unrelated constraints.
  - D) Decision stages.
3. In dynamic programming, the output to stage n becomes the input to
  - A) Stage n-1.
  - B) Stage n itself.
  - C) Stage n+1.
  - D) Stage n-2.

4. Which of the following statement(s) is/are the characteristic(s) of dynamic programming?
- The decision at one stage transforms one state into a state in the next.
  - The problem can't be divided into a finite number of stages.
  - The final stage must be solvable by itself.
- A) i & ii are correct                      B) i & iii are correct  
 C) ii & iii are correct                  D) i, ii & iii are correct
5. Dynamic programming is based on \_\_\_\_\_.
6. Matrix chain multiplication technique is used to
- multiply the given matrices.
  - find total number of elements in all matrices.
  - write recurrence relations
  - determine the optimal parenthesization of a product of matrices
7. Travelling Salesman Problem is to find
- the shortest possible route that visits every city not exactly once and returns to the starting point.
  - the shortest possible route that visits every city exactly once and returns to the starting point.
  - the shortest possible route that visits every city exactly once and doesn't return to the starting point.
  - None of the above
8. What is the computing time of optimal binary search tree?
- A)  $O(n)$       B)  $O(n^2)$  C)  $O(n \log n)$       D)  $O(n^3)$

### **SECTION-B**

#### ***Descriptive Questions***

- Distinguish between Dynamic Programming and Greedy method.
- Write an algorithm for matrix chain multiplication problem using dynamic programming.
- Write an algorithm for all pairs shortest path problem using dynamic programming.
- What is 0/1 knapsack problem? Explain with suitable example how it is solved using dynamic programming.
- Write an algorithm for 0/1 knapsack problem using dynamic programming.
- Describe the Travelling salesman problem & discuss how to solve it using dynamic programming.
- Discuss the applications of travelling salesman.

#### ***Multiple Choice Questions:***

- Let  $A_1, A_2, A_3,$  and  $A_4$  be four matrices of dimensions  $10 \times 5, 5 \times 20, 20 \times 10,$  and  $10 \times 5,$  respectively. The minimum number of scalar multiplications required to find the product  $A_1 A_2 A_3 A_4$  using the basic matrix multiplication method is  
 A) 1500                      B) 2000                      C) 500                      D) 100
- Let  $A_1, A_2, A_3,$  and  $A_4$  be four matrices of dimensions  $10 \times 5, 5 \times 20, 20 \times 10,$  and  $10 \times 5,$  respectively. The minimum number of scalar multiplications required to find the product  $A_1 A_2 A_3 A_4$  using dynamic programming is  
 A) 1500                      B) 2000                      C) 500                      D) 100
- Consider a 0/1 knapsack with capacity,  $w=20$ . The weights and values of five items are given below.



Item(I)	I1	I2	I3	I4	I5
$W_i$	3	4	7	8	9
$P_i$	4	5	10	11	13

What is the maximum value of knapsack subject to its capacity?

- A) 27      B) 26      C) 28      D) none of the above

4. What is the optimal TSP tour for the following distance matrix?

$$\begin{pmatrix} 0 & 2 & 9 & 10 \\ 1 & 0 & 6 & 4 \\ 15 & 7 & 0 & 8 \\ 6 & 3 & 12 & 0 \end{pmatrix}$$

- A) 1→3→2→4→1      B) 1→3→4→2→1  
 C) 1→3→4→2→1      D) 1→2→4→3→1

5. Find the optimal tour for the following distance matrix?

0	5	6	8
10	0	13	8
15	9	0	9
20	10	12	0

- A) 1→3→2→4→1      B) 1→3→4→2→1  
 C) 1→4→2→3→1      D) 1→2→4→3→1

6. Find out the correction solution for the given 0/1 Knapsack problem using Dynamic Programming.  $P=(11,21,31,33)$ ,  $W=(2,11,22,15)$ ,  $c=40$ ,  $n=4$ .

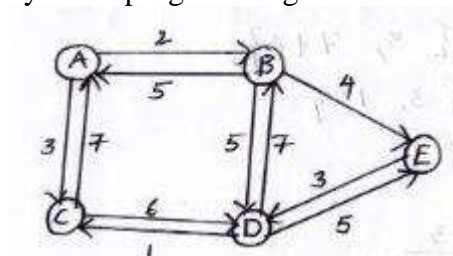
- A) {1,0,1,1}      B) {1,1,0,1}      C) {1,1,1,0}      D) {1,0,1,0}

7. Find optimal solution for 0/1 Knapsack problem  $(w_1, w_2, w_3, w_4)=(10,15,6,9)$ ,  $(p_1, p_2, p_3, p_4)=(2,5,8,1)$  and  $m=30$ .

- A) (0,1,1,1)      B) (1,0,0,0)      C) (1,1,0,0)      D) (1,0,1,0)

### Problems

- Find the minimum no of operations required for the following chain matrix multiplication using dynamic programming  $A(5,3) * B(3,4) * C(4,2) * D(2,6)$
- Find the minimum no of operations required for the following chain matrix multiplication using dynamic programming  $A(30,40) * B(40,5) * C(5, 15) * D(15, 6)$
- Find an optimal solution for the dynamic programming 0/1 knapsack instance for  $n=3$ ,  $m=6$ , profits are  $(p_1, p_2, p_3) = (1,2,5)$ , weights are  $(w_1, w_2, w_3)=(2,3,4)$ .
- Define Principle of Optimality? solve the following all pairs shortest path problem using dynamic programming.



5. Solve the following 0/1 Knapsack problem using dynamic programming ( $p_1, p_2, \dots, p_4$ )  $= (1, 2, 5, 6)$ ,  $(w_1, w_2, \dots, w_4) = (2, 3, 4, 5)$ ,  $m=8$ ,  $n=4$ .

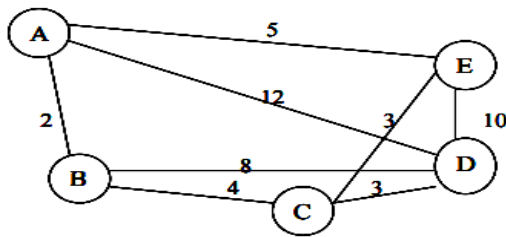
6. Solve the following all pairs shortest path problem using dynamic programming.

A	1	2	3
1	0	4	11
2	6	0	2
3	3	0	0

7. Construct an optimal travelling sales person tour using Dynamic Programming.

0	10	9	3
5	0	6	2
9	6	0	7
7	3	5	0

8. Consider the following set of cities and find the optimal tour and minimum cost by applying TSP approach.



### SECTION-C

#### Questions for Analysis / Analyzing

1. Analyze the time and space complexity of dynamic programming travelling sales person algorithm.
2. Analyze the time and space complexity of matrix chain multiplication algorithm.

#### Questions from Previous GATE Papers

1. Four matrices  $M_1, M_2, M_3, M_4$  of dimensions  $p \times q, q \times r, r \times s$  and  $s \times t$  respectively can be multiplied in several ways with different number of total scalar multiplications. For example when multiplied as  $((M_1 \times M_2) \times (M_3 \times M_4))$ , the total number of scalar multiplications is  $pqr + rst + prt$ . When multiplied as  $((M_1 \times M_2) \times M_3) \times M_4$ , the total number of scalar multiplications is  $pqr + prs + pst$ . If  $p=10, q=100, r=20, s=5$ , and  $t=80$ , then the minimum number of scalar multiplications needed is (GATE 2011)

- A) 248000      B) 44000      C) 19000      D) 25000

### UNIT-V SECTION-A

#### Objective Questions

1. Which of the following is not a backtracking algorithm? [      ]
  - a) Hamiltonian cycle problem
  - b) N queen problem
  - c) Tower of hanoi
  - d) Graph coloring problem

2. Which algorithm design technique is used in solving the 8 Queens problem? [ ]
  - a) Greedy
  - b) Dynamic programming
  - c) Branch and Bound
  - d) Backtracking.
3. Sum of subsets problem can be solved by using \_\_\_\_ formulation. [ ]
  - a) fixed sized tuples
  - b) variable sized tuples
  - c) both
  - d) none
4. Define a planar graph.
5. Graph coloring is applied in \_\_\_\_\_. [ ]
  - a) Clustering
  - b) Data Mining
  - c) Networking
  - d) All the above
6. The smallest number of colors needed to color a graph G is called \_\_\_\_ [ ]
  - a) Chromatic Number
  - b) Vertex Number
  - c) Edge count
  - d) None
7. The common graph coloring problem is to color \_\_\_\_\_. [ ]
  - a) Edges
  - b) Vertices
  - c) Faces
  - d) All of these
8. \_\_\_\_ are the rules that restrict  $x_i$  to take on values only from a given set. [ ]
  - a) Explicit constraints
  - b) Implicit constraints
  - c) Dynamic constrains
  - d) None
9. \_\_\_\_\_ are the rules that determine which of the tuples in the solution space of I satisfy the criterion function. [ ]
  - a) Explicit constraints
  - b) Implicit constraints
  - c) Dynamic constrains
  - d) None
10. What is a Hamiltonian cycle?

### SECTION-B

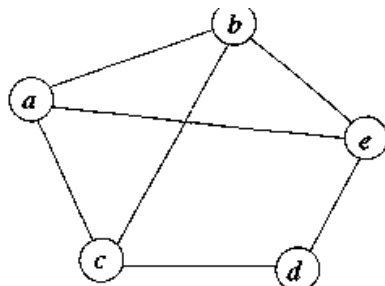
#### *Descriptive Questions*

1. Write the differences between brute force approach and Backtracking.
2. Design a recursive algorithm for backtracking.
3. Develop an iterative algorithm for backtracking.
4. Write a recursive backtracking algorithm for N queen's problem.
5. Develop a recursive backtracking algorithm for sum of subsets problem.
6. Devise an algorithm for finding all m-colorings of a graph.
7. Formulate an algorithm for finding all Hamiltonian cycles of a graph.

#### *Multiple Choice Questions:*

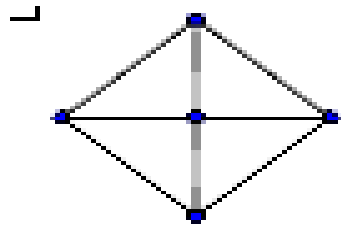
1. In which of the following cases n-queen problem does not exist [ ]
  - a.  $n=2$  &  $n=4$
  - b.  $n=4$  &  $n=6$
  - c.  $n=2$  &  $n=3$
  - d.  $n=4$  &  $n=8$
2. A following is the solution for 8-queen's problem? [ ]
  - a. (4,6,8,2,7,1,3,5)
  - b. (4,4,5,6,7,8,1,2)
  - c. (5,6,7,8,4,5,3,2)
  - d. (4,3,3,2 6,1,7,8)
3. The time complexity of n-queens problem is \_\_\_\_\_. [ ]
  - a.  $O(n^2)$
  - b.  $O(n!)$
  - c.  $O(n^3)$
  - d.  $O(n)$
4. A problem is said to be solved by finding a vector that \_\_\_\_\_ the Criterion function. [ ]
  - a. maximizes
  - b. Minimizes
  - c. Satisfies
  - d. All the above

5. The

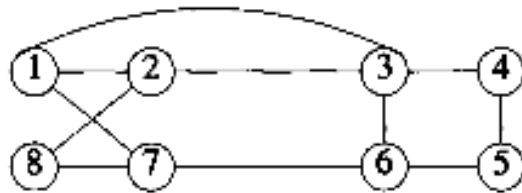


chromatic number for the following graph is \_\_\_\_\_ [ ]

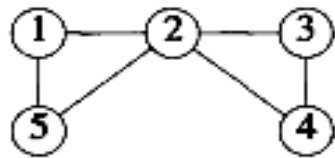
- a. 1            b. 2            c. 3            d. 4
6. An n-tuple permutation tree consists of \_\_\_\_\_ permutations.            [   ]
- a. n            b. n-1            c. n!            d. n+1
7. The chromatic number for the following graph is \_\_\_\_\_            [   ]



- a. 2            b. 3            c. 4            d. 5
8. The solution to the 4-queens problem is \_\_\_\_\_            [   ]
- a. (2,4,1,3)    b. (2,2,1,4)    c. (1, 1,3,4)    d. (2,3,4,4)
9. The Hamiltonian Cycle for the following graph is :            [   ]

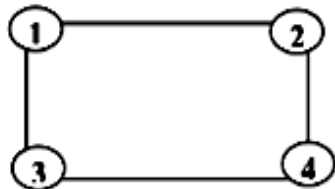


- a. 1,2,8,7,6,5,4,3,1
- b. 1,3,4,5,6,7
- c. 1,2,7,8            d. 1,7,8,2
10. Does the following contains Hamiltonian cycle ?            Yes/No

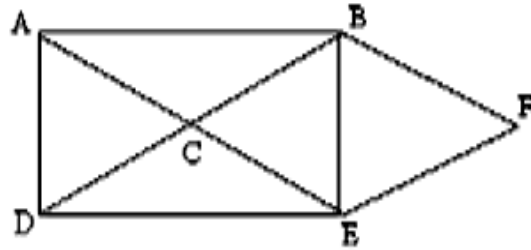


**Problems:**

1. Draw the tree organization of the 4-queen solution space and number the nodes using DFS.
2. Draw the state space tree for m coloring when n=3 and m=3.
3. For the graph given below, draw the portion of state space tree generated by M Coloring.



4. Find the Hamiltonian circuit in the following graph using backtracking:



### UNIT-VI SECTION-A

#### *Objective Questions*

1. Bounding functions are used to avoid the expansion of \_\_\_\_\_ that do not contain an answer node.
2. BFS like state space search will be called \_\_\_\_\_ Branch and Bound technique.
3. D-search like state space search will be called \_\_\_\_\_ Branch and Bound technique.
4. Which data structure is used in BFS like state space search [    ]  
(a) Array (b) Stack (c) Queue (d) Linked list
5. Which data structure is used in D-Search [    ]  
(a) Array (b) Stack (c) Queue (d) Linked list
6. Each row of a matrix consists at least one zero and atleastall remaining entries are non-negative is called \_\_\_\_\_ [    ]  
a) reduced row b) reduced column c) reduced matrix  
d) none of the above
7. When do you say that a column is reduced?
8. Reduced matrix cost is calculated by using \_\_\_\_\_ [    ]  
a)  $c^{\wedge}(S) = c^{\wedge}(R) + A(i,j)$   
b)  $c^{\wedge}(S) = c^{\wedge}(R) + A(i,j) + r$   
c)  $c^{\wedge}(S) = A(i,j) + r$   
d)  $c^{\wedge}(S) = c^{\wedge}(R) + r$

### SECTION-B

#### *Descriptive Questions*

1. Explain the General method of Branch and Bound.
2. Write the control abstraction for least cost search.
3. Explain the principles of LIFO & FIFO branch and bound
4. Describe the steps in solving Travelling Salesperson Problem with LCBB.
5. Explain process of solving the 0/1 Knapsack problem with FIFIBB.
6. Differentiate between Backtracking and branch and bound

#### *Multiple Choice Questions:*

1. An airport limousine service which parks all its limos at the airport can minimize its cost by using a proper order to pick up passengers from their houses and return to the airport using \_\_\_\_\_ [    ]

- a. set covering problem                      b. traveling salesman problem  
 c. knapsack problem                          d. fixed charge problem
2. An Avon lady carrying her tote containing makeup materials can maximize her profit from one trip to the rural Mississippi hinterland if she models the process of loading her bag (with the "right" materials having maximum profitability per unit volume) by using\_\_\_\_\_ [   ]

- a. set covering problem                      b. traveling salesman problem  
 c. knapsack problem                          d. fixed charge problem
3. Consider Knapsack instance  $n=4$  with capacity  $m=15$ . such that,

Object i:	1	2	3	4
profits :	10	10	12	18
Weights :	2	4	6	9

What is its LCBB solution vector? [   ]  
 a. (1,1,0,1)   b. (1,0,0,1)   c. (1,1,1,0)   d. (0,1,0,1)

4. What is the cost of reducing ROW 1 in solving the TSP for the following cost matrix? [   ]

$\infty$	20	30	10	11
15	$\infty$	16	4	2
3	5	$\infty$	2	4
19	6	18	$\infty$	3
16	4	7	16	$\infty$

- a. 20      b. 10      c. 30      d. 30

5. Determine the cost of reducing coloumn 4 in solving the TSP for the following cost matrix? [   ]

$\infty$	11	10	9	6
8	$\infty$	7	3	4
8	4	$\infty$	4	8
11	10	5	$\infty$	5
6	9	5	5	$\infty$

- a. 6      b. 5      c. 4      d. 8

6. Find the total cost of reducing the matrix in solving the TSP for the following cost matrix? [   ]

$\infty$	20	30	10	11
15	$\infty$	16	4	2
3	5	$\infty$	2	4
19	6	18	$\infty$	3
16	4	7	16	$\infty$

- a. 30      b. 15      c. 25      d. 10

7. What is the optimal tour of a TSP for the following cost matrix? [   ]

$\infty$	11	10	9	6
8	$\infty$	7	3	4
8	4	$\infty$	4	8

11	10	5	$\infty$	5
6	9	5	5	$\infty$

- a) 1->4->5->2->3->1      b) 1->4->2->5->3->1  
c) 1->5->4->2->3->1      d) 1->3->5->2->4->1

8. Consider Knapsack instance  $n=4$  with capacity  $m=15$ . such that,

Object i:	1	2	3	4
profits :	10	10	12	18
Weights :	2	4	6	9

What are the initial upper and lower bound values for the above instance?

- a. -30, -35      b. -38, -32      c. -32, -38      d. -32, -32

**Problems:**

1. Draw the portion of state space tree generated by LCBB for the knapsack instance  $n=4$ ,  $(p_1, p_2, p_3, p_4) = (10, 10, 12, 18)$ ,  $(w_1, w_2, w_3, w_4) = (2, 4, 6, 9)$  and  $m=15$ .
2. Draw the portion of state space tree generated by FIFOBB for the knapsack instance  $n=5$ ,  $(p_1, p_2, p_3, p_4, p_5) = (10, 15, 6, 8, 4)$ ,  $(w_1, w_2, w_3, w_4, w_5) = (4, 6, 3, 4, 2)$  and  $m=12$ .
3. Solve the knapsack instance  $n=5$ ,  $(p_1, p_2, p_3, p_4, p_5) = (4, 4, 5, 8, 9)$  and  $m=15$  using LCBB.
4. Solve the knapsack instance  $n=5$ ,  $(p_1, p_2, p_3, p_4, p_5) = (4, 4, 5, 8, 9)$  and  $m=15$  using FIFOBB.
5. Consider an instance for TSP given by cost matrix Gas,

$\infty$	20	30	10	11
15	$\infty$	16	4	2
3	5	$\infty$	2	4
19	6	18	$\infty$	3
16	4	7	16	$\infty$

- a) obtain the reduced cost matrix.
  - b) Draw a state space tree generated by LCBB.
  - c) Find cost of the optimal TSP tour.
6. Apply the least cost branch and bound method to solve the TSP for the following cost matrix

$\infty$	11	10	9	6
8	$\infty$	7	3	4

8	4	$\infty$	4	8
11	10	5	$\infty$	5
6	9	5	5	$\infty$

a. Draw a state space tree and find the optimum cost of the tour?

7. Solve TSP problem having the following cost matrix using LCBB.

$\infty$	5	2	3
4	$\infty$	1	5
4	2	$\infty$	3
7	6	8	$\infty$

**Signature of the Faculty**



## HANDOUT ON DATA WAREHOUSING AND MINING

Class & Sem. : III B.Tech – II Semester

Year : 2020-21

Branch: CSE

Credits : 3

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### **1. Brief History and Scope of the Subject**

The term “Data Mining” was only introduced in the 1990s. Data mining is part of the knowledge discovery process that offers a new way to look at data. Data mining consists of the nontrivial extraction of implicit, previously unknown, and potentially useful information from data. It uses machine learning, statistical and visualization techniques to discover and present knowledge in a form that is easily comprehensible to humans. Data mining is then the process of discovering meaningful new correlations, patterns and trends by sifting through vast amounts of data using statistical and mathematical techniques.

As Fortune 500 organizations continue to amass substantial quantities of information into their respective databases, data mining can offer the opportunity to learn from this data. Furthermore, current trends indicate that more companies implementing Enterprise Resource Planning systems or contracting with ASP vendors could further benefit in using data mining techniques. Integrating a data mining technique alongside these two added value services can prove to be an optimum solution in understanding a company’s data.

### **2. Pre-Requisites**

Database Management Systems, Basics of Probability and Statistics

### **3. Course Objectives:**

- To introduce the concepts of Data warehousing and Data mining.
- To familiarize with the concepts of association rule mining, classification, clustering techniques and algorithms.

### **4. Course Outcomes:**

CO1: Outline different types of databases used in data mining

CO2: Apply pre-processing methods on raw data to make it ready for mining.

CO3: Illustrate the major concepts and operations of multi dimensional data models.

CO4: Analyze the performance of association rules mining algorithms for finding frequent item sets from the large databases

CO5: Simplify the data classification procedure by selecting appropriate classification methods / algorithms

CO6: Classify various clustering methods and algorithms on data sets to create appropriate clusters.

### **5. Program Outcomes:**

#### **Computer Science and Engineering Graduates will be able to:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### Program Specific Outcomes (PSOs)

**PSO1 :** Design, develop, test and maintain reliable software systems and intelligent systems.

**PSO2 :** Design and develop web sites, web apps and mobile apps.

### 6. Mapping of Course Outcomes with Program Outcomes:

CT2528 : DATA WAREHOUSING AND DATA MINING															
Course outcomes	Program Outcomes and Program Specific Outcome														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO1: outline different types of databases used in data mining.	1														
CO2:apply pre-processing methods on raw data to make it ready for mining.	1	2													
CO3: illustrate the major concepts and operations of multi dimensional data models.	1	2	2	2											
CO4: analyze the performance of association rules mining algorithms for finding frequent item sets from the large databases.	2	3	2									1	1		

CO5: simplify the data classification procedure by selecting appropriate classification methods / algorithms.	2	2	1	2		1						1	2
CO6: classify various clustering methods and algorithms on data sets to create appropriate clusters.	1	2		1		1						1	1

## 7. Prescribed Text Books

1. Jiawei Han & Micheline Kamber, & Jian pei, “Data Mining Concepts and Techniques”, 3<sup>rd</sup> edition, Morgan Kaufmann Publisher an imprint of Elsevier.

## 8. Reference Text Books

- a. Pang-Ning Tan, Michael Steinbach, Vpin Kumar “Introduction to Data Mining”, 1<sup>st</sup> edition, Pearson.
- b. Margaret H Dunham, “Data Mining Introductory and Advanced Topics”, 1<sup>st</sup> edition, Pearson Education

## 9. URLs and Other E-Learning Resources

- a. <http://www.cs.sfu.ca/~han/dmbook>
- b. <http://db.cs.sfu.ca/>
- c. <http://www.cs.sfu.ca/~han>

## 10. Digital Learning Materials:

- <http://192.168.0.49/videos/videosListing/270#>

## 11. Lecture Schedule / Lesson Plan

Topic	No. of Periods
<b>UNIT - I: INTRODUCTION</b>	
Motivation and importance of data mining	2
Types of data to be mined: Relational database, datawarehouses, transactional databases, advanced database systems	4
Data Mining Functionalities	2

	<b>8</b>
<b>UNIT - II: DATA PRE-PROCESSING</b>	
Major tasks in data pre-processing	1
Data cleaning: Missing values, Noisy Data	2
Data reduction: Overview of data reduction strategies, Principal components analysis Attribute subset selection, histograms, sampling	4
Data Transformation: Data transformation strategies overview, data transformation by normalization	3
	<b>10</b>
<b>UNIT - III: DATA WAREHOUSING AND ONLINE ANALYTICAL PROCESSING</b>	
Data warehouse: Basic concepts, OLAP vs OLTP	2
Data warehouse: A multi-tiered architecture	1
Data warehouse modeling : Data cube and OLAP	2
Data cube: A multidimensional data model, star, snowflake and fact constellation schemas for multidimensional data models	3
The role of concept hierarchies	1
Typical OLAP operations	1
	<b>10</b>
<b>UNIT - IV: MINING FREQUENT PATTERNS, ASSOCIATIONS, AND CORRELATIONS</b>	
Basic concepts, Frequent item sets, closed item sets and association rules	2
Frequent item set mining methods: Apriori Algorithm, generations, association	3

rules from frequent item sets	
A Pattern-Growth approach for mining frequent item sets	2
	<b>7</b>
<b>UNIT - V: CLASSIFICATION</b>	
Basic concepts, What is classification, general approach to classification	2
Decision Tree Induction	2
Attribute selection measures : Information gain	3
Bayes classification methods: Bayes' theorem	2
Naïve Bayesian classification	2
	<b>11</b>
<b>UNIT - VI: CLUSTER ANALYSIS</b>	
Introduction, Overview of basic clustering methods	2
Partitioning methods: k-means, k-medoids	3
Hierarchical methods: Agglomerative versus divisive hierarchical clustering	3
Density based method: DBSCAN	2
	<b>10</b>
Total No.of Periods:	<b>56</b>

## 12. Seminar Topics:

In order to enhance the understanding capability and to prepare the student to face the interviews and audience, to enhance the communication skills and to eliminate stage fear, seminars and group discussions are conducted.

- Data Warehouse and OLAP

- Concept Hierarchy Generation
- Bayesian Classification
- Density-Based Method

**Assignment-Cum-Tutorial Questions**  
**UNIT-I**  
**SECTION-A**

**Objective Questions**

- \_\_\_\_\_ is the process of discovering interesting patterns and knowledge from large amounts of data.
- The full form of KDD is \_\_\_\_\_
- Goal of data mining includes which of the following [ ]
  - To explain some observed event or condition
  - To confirm that data exists
  - To analyze data from expected relationships
  - To create a new data warehouse
- The Synonym for data mining is [ ]  
A Data warehouse B) Knowledge Discovery from Data C) ETL D) OLAP
- Data mining tasks are classified in to \_\_\_\_\_ and \_\_\_\_\_.
- Match the Following: [ ]
 

a) Data Cleaning.	i) Multiple data sources may be combined
b) Data Transformation	ii) Remove noise and inconsistent data
c) Data Selection	iii) Data transformed into forms appropriate for mining
d) Data Integration	iv) Relevent data is retrived from database for analysis.

A. i,ii,iii,iv      B. i,iii,iv,ii      C. ii,iii,iv,i      D. iv,ii,iii,i
- Data mining helps in \_\_\_\_\_. [ ]
 

A. inventory management.	C.sales promotion strategies
B. marketing strategies.	D.All of the above
- Which of the following is not a data mining functionality? [ ]
 

A. Characterization and Discrimination	C. Classification and regression
B. Selection and interpretation	D. Clustering and Analysis
- Extreme values that occur infrequently are called as \_\_\_\_\_. [ ]
 

A. outliers.	B. rare values.	C. dimensionality reduction.	D. All
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- Grouping of similar objects is known as \_\_\_\_\_





6. Differentiate operational databases and data warehousing.
7. What are Data mining Functionalities? Explain.

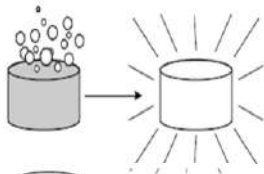
## UNIT-II SECTION-A

### Objective Questions

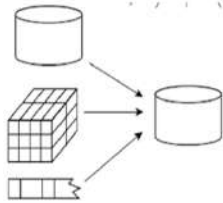
1. Real world data may contains \_\_\_\_\_ and \_\_\_\_\_ data.
2. When to apply the data preprocessing techniques for mining the data
  - A) Before mining.
  - B) During mining.
  - C) After mining.
  - D) All of the time.
3. Match the following :

$-2, 32, 100, 59, 48 \rightarrow -0.02, 0.32, 1.00, 0.59, 0.48$

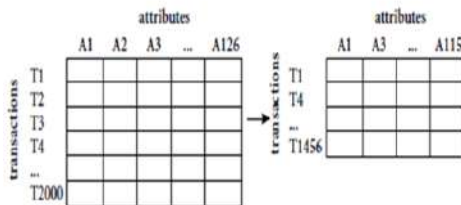
**Data reduction**



**Data integration**



**Data transformation**



**Data cleaning**

4. Use the attribute mean to fill the missing value of data [ ]  
 $1, 2, 3, 4, 5, 6, \_, 7, 8, 9, 10.$ 
  - A) 2.0
  - B) 3.0
  - C) 5.5
  - D) 5.0
5. Data for Attendance : 50, 55, 60, 65, 70, 75, 80, 85, 90, 95  
 Partition the above attendance data into equidepth bins of depth 5. [ ]
  - A) Bin 1: 50, 55, 60, 65, 70      Bin 2: 75, 80, 85, 90, 95
  - B) Bin 1: 50, 55, 60, 65      Bin 2: 70, 75, 80, 85, 90, 95
  - C) Bin 1: 50, 55, 60, 65, 70, 75      Bin 2: 75, 80, 85, 90, 95
  - D) Bin 1: 50, 55, 60      Bin 2: 65, 70, 75, 80, 85, 90, 95
6. For the above attendance apply bin means smoothing technique [ ]
  - A) Bin 1: 65, 65, 65, 65, 65      Bin 2 : 85, 85, 85, 85, 85

- B) Bin 1: 60,60,60,60,60      Bin2 : 85,85,85,85,85  
 C) Bin 1: 65,65,65,65,65      Bin2 : 80,80,80,80,80  
 D) Bin 1: 75,75,75,75,75      Bin2 : 85,85,85,85,85
7. For the above attendance apply bin medians smoothing technique.  
 A) Bin 1: 60,60,60,60,60      Bin2 : 85,85,85,85,85      [   ]  
 B) Bin 1: 65,65,65,65,65      Bin2 : 85,85,85,85,85  
 C) Bin 1: 65,65,65,65,65      Bin2 : 80,80,80,80,80  
 D) Bin 1: 75,75,75,75,75      Bin2 : 85,85,85,85,85
8. Data for Attendance : 4,8,15 Smoot by bin boundaries      [   ]  
 A) 4,4,15                      B) 4,15,15                      C) 4,4,4                      D) 15,15,15
9. Data Reduction is the process of reduced representation of data in size not in values.  
 [ T/F ]
10. Reducing the number of attributes to solve the high dimensionality problem is called as \_\_\_\_\_.  
 [   ]
- A) Curse of dimensionality.                      B) Dimensionality reduction.  
 C) Cleaning.                                      D) Over fitting.
11. \_\_\_\_\_ and \_\_\_\_\_ are the popular and effective methods of lossy data compression technique.
12. \_\_\_\_\_ is the method of fitting the data values into a fixed model      [   ]  
 A) Clustering.                      B) Regression.                      C. Smoothing.                      D) Aggregation.
13. Use min-max normalization transformation technique for finding transformed income value of \$10000 with min\_income=1000, max\_income=50000 and mapping range of income [0.0,1.0] The Transformed income value=\_\_\_\_\_.  
 [   ]  
 A) 0.225                      B) 0.325                      C) 0.425                      D) 0.525

## SECTION-B

### SUBJECTIVE QUESTIONS

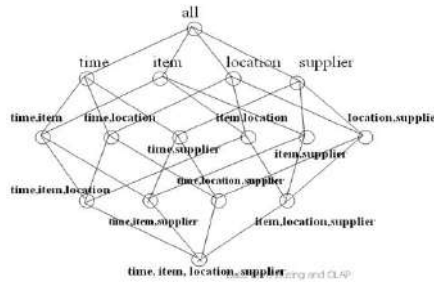
1. Illustrate the need for data preprocessing. List and explain various data preprocessing techniques.
2. What is data cleaning? Describe the approaches to fill missing values.
3. Define noisy data. Describe various techniques for smoothing noisy data.
4. Discuss the issues to be considered for data integration.
5. What is data normalization? Explain any two Normalization methods.
6. Outline about Data Cube Aggregation as a data reduction technique.
7. Elaborate different attribute subset selection methods with examples
8. What is a concept hierarchy? Explain different techniques used to generate concept hierarchy for categorical data.
9. Write short notes on Sampling in Numerosity Reduction.
10. Write short notes on Histograms in Numerosity Reduction.
11. Explain different sampling approaches used in data Reduction

### Problems

12. Suppose that the data for analysis includes the attribute age. The age values for the data tuples are 13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 25, 25, 30, 33, 33, 35, 35, 35, 35, 36, 40, 45, 46, 52, 70.



9. Fact tables are \_\_\_\_\_ [ ]
- A) Completely demoralized. C. Partially demoralized.  
 B) Completely Normalized. D. Partially normalized.
10. A concept hierarchy defines a sequence of mapping from a set of \_\_\_\_\_ - level concepts to \_\_\_\_\_-level concepts.
11. Match the following in OLAP operations on multidimensional data
- |                   |                                           |
|-------------------|-------------------------------------------|
| a) Roll-Up        | i) Selection on One dimension of the cube |
| b) Drill-Down     | ii) Rotate the data Access                |
| c) Slice and Dice | iii) Step down Dimension                  |
| d) Pivot          | iv) Climbing Up dimension                 |
- A) i,iii,ii,iv B) iii,iv,ii,i C) iv,iii,i,ii D) iv,iii,ii,i [ ]
11. \_\_\_\_\_ is a subset of the data warehouse and is usually oriented to a specific business line or team.
12. The following figure shows \_\_\_\_\_



## SECTION-B

### SUBJECTIVE QUESTIONS

1. Define Data warehouse and Write about the need of a separate Data Warehouse.
2. Differentiate between the main functionalities of OLTP and OLAP.
3. Develop various multi dimensional data model schemas.
4. Elaborate OLAP operations in multidimensional data model.
5. Describe three tier data warehouse architecture with a neat diagram.
6. Draw a concept hierarchy for dimension location, by considering the location values as Village < mandal < district < state.
7. Suppose that a data warehouse consists of the three dimensions time, doctor, and patient, and the two measures count and charge, where charge is the fee that a doctor charges a patient for a visit.
  - Draw star schema and snowflakes schema for the above data warehouse.
8. Draw a lattice of cuboids for the dimension containing five levels (including all), such as “student < major < status < university < all”?
9. Outline the implementation of data warehouse.

**UNIT-IV**  
**SECTION-A**

**Objective Questions**

1. The market basket analysis is a typical example of \_\_\_\_\_.
2. The interestingness measures of Association rule mining are \_\_\_\_\_ and \_\_\_\_\_.
3. Association rules are considered interesting if they satisfy\_\_\_\_\_ [ ]  
 A) Minimum support threshold.                      B) Minimum confidence threshold.  
 C) Both A & B.                                              D) Either A or B.
4. The formula for Support( $A \Rightarrow B$ )=
5. The formula for Confidence ( $A \Rightarrow B$ )=
6. An association rule mining is a two step process which contains\_\_ [ ]  
 A) Finding support and confidence.  
 B) Finding all frequent itemsets.  
 C) Generate strong association rules from the frequent itemsets.  
 D) Both A & B.                                              E. Both B & C.
7. All nonempty subset of a frequent itemset must also be frequent is \_\_\_\_\_ property.
8. Apriori method mines the frequent itemsets without candidate generation [T/F]  
 [ ]
9. For the given transactional data find the Support(I1I2)=\_\_\_\_\_. [ ]

ID	ITEMS
1	I1,I2,I4
2	I2,I4,I5
3	I1,I2
4	I1,I2,I3
5	I1,I2,I5

- A) 1      B) 2      C) 3      D) 4
10. How many number of scans were required in FP-Growth for finding frequent itemsets with 10 distinct items \_\_\_\_\_.  
 [ ]  
 A) 1      B) 2      C) 3      D) 100
  11. The rules which involves items at different levels of abstraction are  
 A) Multidimensional Association rules.    B) Multilevel Association rules.  
 C) Rules interested at different levels.    D) Predefined rules.                      [ ]
  12. For the given transactional database find the Support(AB)=\_\_\_\_\_

TID	A	B	C	D	E
1	1	1	1	0	1
2	0	1	0	1	1
3	1	1	1	0	1
4	0	1	0	1	0
5	1	1	0	1	1

- A) 1      B) 2      C) 3      D) 4                      [ ]

## SECTION-B

### SUBJECTIVE QUESTIONS

1. What is Association Rule Mining? Define Support and Confidence with example.
2. Generate frequent itemsets using the Apriori algorithm for the following data with the minimum support count 2.

TID	List of items_IDs
T100	I1,I2,I5
T200	I2,I4
T300	I2,I3
T400	I1,I2,I4
T500	I1,I3
T600	I2,I3
T700	I1,I3
T800	I1,I2,I3,I5
T900	I1,I2,I3

3. Explain how the association rules were generated from the frequent itemsets.
4. List and brief several methods to improve the efficiency of Apriori.
5. Find all frequent item sets using FP-Growth for the following data with  $\min \text{sup} = 60\%$  and  $\min \text{conf} = 80\%$ .

TID	ITEMS_BOUGHT
T100	{K,A,D,B}
T200	{D,A,C,E,B}
T300	{C,A,B,E}
T400	{B,A,D}

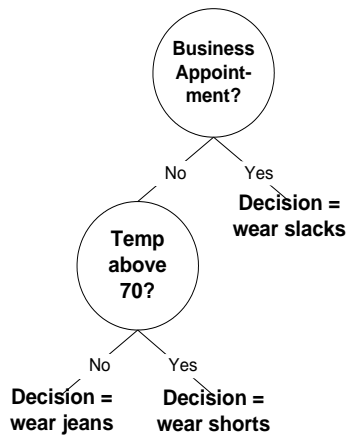
6. Design the node structure for representing the FP-Tree.

## UNIT-V SECTION-A

### Objective Questions

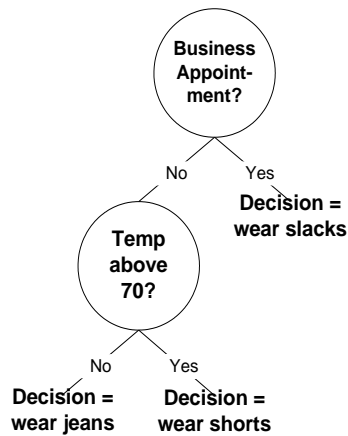
1. Data Classification process involves \_\_\_\_\_, \_\_\_\_\_.
2. Classification is a supervised learning. [T/F]
3. \_\_\_\_\_ measure is used to select the test attribute at each node in the decision tree. [ ]
  - A) Information Gain.
  - B) Attribute Selection.
  - C) Measure of the goodness of split.
  - D) All of the above
4. Posterior probability can be calculated by \_\_\_\_\_ theorem. [ ]
  - A) Bayes.
  - B) Apriori.
  - C) Entropy.
  - D) All

5. The neural network learns By adjusting the \_\_\_\_\_ . [ ]  
 A) Heights.      B) Weights.      C) Depths.      D) All
6. The process of forming general concept definitions from examples of concepts to be learned. [ ]  
 A) Deduction.      B) Disjunction.      C) Induction.      D) Conjunction.
7. Data used to build a data mining model. [ ]  
 A) Validation Data.      B) Hidden Data.      C) Test Data.      D) Training Data.
8. Which of the following is a valid production rule for the decision tree below?



- A) IF Business Appointment = No & Temp above 70 = No  
 THEN Decision = wear slacks
- B) IF Business Appointment = Yes & Temp above 70 = Yes  
 THEN Decision = wear shorts
- C) IF Temp above 70 = No  
 THEN Decision = wear shorts
- D) IF Business Appointment= No & Temp above 70 = No  
 THEN Decision = wear jeans [ ]

9. Which of the following is a valid production rule for the decision tree below?



- A) IF Business Appointment = No & Temp above 70 = yes  
THEN Decision = wear shorts.
- B) IF Business Appointment = Yes & Temp above 70 = Yes  
THEN Decision = wear shorts
- C) IF Temp above 70 = No  
THEN Decision = wear shorts
- D) IF Business Appointment= No & Temp above 70 = No  
THEN Decision = wear slack.

[ ]

10. Decision tree is a type of \_\_\_\_\_ algorithm.

[ ]

- A) Brute force approach. B) Randomized . C) Greedy

D) None

### SECTION-B

#### SUBJECTIVE QUESTIONS

1. With a neat diagram explain Data Classification Process.
2. Elaborate the issues regarding Classification and Prediction.
3. Illustrate the process of classification by Decision Tree Induction.
4. Build a decision tree for the concept buys\_computer using the below database.



Class-labeled training tuples from the *AllElectronics* customer database.

RID	age	income	student	credit_rating	Class: buys_computer
1	youth	high	no	fair	no
2	youth	high	no	excellent	no
3	middle_aged	high	no	fair	yes
4	senior	medium	no	fair	yes
5	senior	low	yes	fair	yes
6	senior	low	yes	excellent	no
7	middle_aged	low	yes	excellent	yes
8	youth	medium	no	fair	no
9	youth	low	yes	fair	yes
10	senior	medium	yes	fair	yes
11	youth	medium	yes	excellent	yes
12	middle_aged	medium	no	excellent	yes
13	middle_aged	high	yes	fair	yes
14	senior	medium	no	excellent	no

5. What is the need for Tree Pruning?
6. Describe how classification rules are extracted from the decision tree with the following example.



7. Briefly explain about Bayesian classification.

## UNIT-VI SECTION-A

### Objective Questions

1. The process of grouping a set of physical or abstract objects into classes of similar objects is called clustering. [T/F]
2. Clustering is a \_\_\_\_\_ type of learning. [ ]  
 A) Supervised. B) Unsupervised. C) Both A & B. D) None of the above.

3. The formula for Euclidean distance  $d(i,j)=$  \_\_\_\_\_ with  $i=(x_{i1},x_{i2},\dots,x_{ip})$  and  $j=(x_{j1},x_{j2},\dots,x_{jp})$  are p-Dimensional data objects.
4. The formula for Manhattan distance  $d(i,j)=$  \_\_\_\_\_ with  $i=(x_{i1},x_{i2},\dots,x_{ip})$  and  $j=(x_{j1},x_{j2},\dots,x_{jp})$  are p-Dimensional data objects.
5. The formula for Minkowski distance  $d(i,j)=$  \_\_\_\_\_ with  $i=(x_{i1},x_{i2},\dots,x_{ip})$  and  $j=(x_{j1},x_{j2},\dots,x_{jp})$  are p-Dimensional data objects.
6. In \_\_\_\_\_ the class label of object/sample is not known. [ ]  
 A) Association rule mining.      B) Classification.  
 C) Clustering                      D) None of the above.
7. Main memory-based clustering algorithms use following \_\_\_\_\_ data structures. [ ]  
 A) Data Matrix.                      B) Dissimilarity Matrix  
 C) Clustering Matrix.              D) Both A and B.
8. Which of the following are the examples of Interval-scaled variables.  
 A) Weight.    B) Height.    C) Weather Report.    D) All of the above. [ ]
9. The Euclidean distance of an object to itself is \_\_\_\_\_. [ ]  
 A) Zero.            B) One.            C) Two.            D) Three.
10. \_\_\_\_\_ methods discover the cluster with arbitrary shape. [ ]
11. A) Partitioning.                      B) Hierarchical.  
 C) Density-Based.                      D) All of the above.

### SECTION-B

#### SUBJECTIVE QUESTIONS

1. What is cluster analysis? Explain any four requirements for clustering data.
2. Distinguish between the Binary, Nominal, Ordinal, and Ratio-Scaled variables.
3. Categorize major clustering methods.
4. Write a K-Means clustering algorithm.
5. Suppose that the data mining task is to cluster the following 8 points (with (x,y) representing location) into three clusters.  
 $A_1(2,10)$ ,  $A_2(2,5)$ ,  $A_3(8,4)$ ,  $B_1(5,8)$ ,  $B_2(7,5)$ ,  $B_3(6,4)$ ,  $C_1(1,2)$ ,  $C_2(4,9)$ .  
 The distance function is Euclidean distance. Suppose initially we assign  $A_1$ ,  $B_1$  and  $C_1$  as a center of each cluster, respectively. Use the K-Means algorithm to show only
  - i. The 3 cluster centers after the first round execution.
  - ii. The final 3 clusters.
6. Briefly Explain the k-Medoids clustering algorithm with an example.
7. With an example explain about the DBSCAN clustering method.

**Signature of the Faculty**

## HANDOUT ON UML AND DESIGN PATTERNS

Class & Sem. : III B.Tech – II Semester

Year : 2020-21

Branch : CSE

Credits : 3

=====

### **1. Brief History and Scope of the Subject**

“**UML and Design Patterns** is the procedure of identifying software engineering requirements and developing software specifications in terms of a software system’s object model, which comprises of interacting objects.”

The object-oriented paradigm took its shape from the initial concept of a new programming approach, while the interest in design and analysis methods.

- The first object-oriented language was Simula, developed in 1960 by researchers at the Norwegian Computing Center.
- In 1970, Alan Kay and his research group at Xerox PARK created the first pure object-oriented programming language (OOPL) - Smalltalk.
- In the 1980s, Grady Booch published a paper titled Object Oriented Design that mainly presented a design for the programming language, Ada. In the ensuing editions, he extended his ideas to a complete object-oriented design method.

Unified Modeling Language (UML) is a standardized (ISO/IEC 19501:2005), general-purpose modeling language in the field of software engineering. The Unified Modeling Language includes a set of graphic notation techniques to create visual models of object-oriented software-intensive systems.

The Unified Modeling Language was developed by Grady Booch, Ivar Jacobson and James Rumbaugh at Rational Software in the 1990s. It was adopted by the Object Management Group (OMG) in 1997, and has been Language was accepted by the International Organization for Standardization (ISO) as industry standard for modeling software-intensive systems. The

current version of the UML is 2.5 published by the OMG in March 2015. managed by this organisation ever since. In 2000 the Unified Modeling

## **2. Pre-Requisites**

- Software Engineering
- Basic concepts of Object-Oriented Programming

## **3. Course Objectives:**

- To get familiar with the Object Oriented Analysis and Design in software development, develop UML structural and behavioral models of an application.
- To describe and choose an appropriate Design Pattern to refine the model.

## **4. Course Outcomes:** Students will be able to

CO1: apply the object oriented concepts and designs in software development

CO2: familiar with the UML diagrams and UML tools.

CO3: create static and dynamic models of the system to meet the user needs.

CO4: architectural and design patterns.

CO5: describe and choose an appropriate Design Pattern to refine the model.

## **5. Program Outcomes:**

### **Computer Science and Engineering Graduates will be able to:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.



CO2: develop static conceptual models of the system.	2	2	2		2						2	2		2	
CO3:generate dynamic behavioral models of the system to meet user needs	2	2	2		3						2	2		2	
CO4: design object oriented architecture models.	1	1	2		2						1	2		1	
CO5: describe and select an appropriate design pattern to refine the model.	1	1	1		2							1			
CO6: classify and explain given design pattern.	2														

### 7. Prescribed Text Books

- a) Booch, James Rumbaugh, Ivar Jacobson, “The Unified Modeling Language User Guide”, 2nd edition, Pearson Education.
- b) Erich Gamma, Ralph Johnson, John Vlissides, Richard Helm, “Design Patterns: Elements of Reusable Object-Oriented Software”, 1st edition, Pearson.

### 8. Reference Text Books

- a) Meilir Page-Jones, “Fundamentals of Object Oriented Design in UML”, Pearson Education.
- b) Grady Booch, “Object Oriented Analysis and Design with Applications” Pearson Education Asia, 2nd edition.
- c) Wolfgang Pree, “Design Patterns for Object-Oriented Software Development”, Addison Wesley, ACM Press.

### 9. URLs and Other E-Learning Resources

**UML :** [www.uml.org](http://www.uml.org)

[www.iitb.ac.in](http://www.iitb.ac.in)

[www.wap.com](http://www.wap.com)

[www.uml-diagrams.org](http://www.uml-diagrams.org)

#### **Design Patterns:**

<https://plus.google.com/114293328244152724415/posts/ckxcuQg494q>

<http://www.developer.com/design/article.php/3309461/Using-Design->

[UML.html](#)

Patterns-in

**Journals:** IEEE/ACM transactions on Design Modeling.

### 10. Digital Learning Materials:

[http://www.tutorialspoint.com/uml/uml\\_tutorial.pdf](http://www.tutorialspoint.com/uml/uml_tutorial.pdf)

<http://nptel.ac.in/course.php?disciplineId=106> <http://www.sparxsystems.com/uml-tutorial.html>

<http://www.ibm.com/developerworks/rational/library/769.html>

<https://www.youtube.com/watch?v=nJSDkr0CtOw>

## 11. Lecture Schedule / Lesson Plan

Topic	No. of Periods	
	Theory	Tutorial
<b>UNIT –1:</b>		
<b>Introduction to UML</b>	1	2
Importance of modeling, principles of modeling	1	
Object oriented modeling	1	
Conceptual model of the UML	3	
Demonstration of Visual Paradigm software tool for UML.	1	
<b>UNIT – 2: Structural Modeling</b>		
Introduction to Structural Modeling	1	2
Classes, Relationships	1	
Relationships-Dependency, Generalization, Realization, Association Advanced features of association	2	
Class diagrams	2	
Object Diagrams	1	
Case study: Online shopping	2	
Create a requirement model using UML class notations for railway reservation system and ATM application.	2	
Develop class diagram for railway reservation system and ATM application.	2	
<b>UNIT – 3: Behavioral and Advanced Behavioral Modelling</b>		
Behavioral modelling: Interaction diagrams	2	2
Sequence diagram, Collaboration diagram	2	
Usecase diagram	1	
Activity diagram	2	
Case study: Online shopping	2	

Develop interaction diagram, state chart and activity diagrams for railway reservation system and ATM application.	2	
<b>UNIT – 4: Advance Behavioral and Architectural Modelling</b>		
Introduction to Advanced Behavioral Modeling	1	2
Events and signals	1	
State machines	1	
State chart diagrams.	2	
Components, Component diagrams	1	
Deployment, Deployment diagrams	1	
Case study: Online shopping	2	
Develop component and deployment diagrams for railway reservation system and ATM application.	2	
<b>UNIT – 5: Introduction to Design patterns</b>		
What is a design pattern	1	2
describing design patterns, how to select a design pattern,	2	
How to use a design pattern.	2	
<b>UNIT – 6: Types of Design patterns</b>		
Creational design patterns - Factory method, Prototype	2	2
Structural design patterns – Bridge, Facade	2	
Behavioral design patterns - Chain of responsibility	2	
Template method	1	
Using UML designs develop factory method, facade design patterns.	2	
User gives a print command from a word document. Design to represent this chain of responsibility design pattern.	2	
<b>Total No.of Periods:</b>	<b>58</b>	<b>12</b>

## 12. Seminar Topics

- Behavioral Modeling



- Advanced Behavioral Modeling
- Structural Modeling
- Advanced Structural Modeling
- Design patterns
- Different types of design patterns
- Behavioral Patterns
- Structural Patterns

## Assignment-Cum-Tutorial Questions UNIT-I

### SECTION-A

#### Objective Questions

- UML stands for..... [   ]
  - Unified Metadata Language
  - Universal Micro Language
  - Unified Modeling Language
  - Universal Modeling Language
- The use of object-oriented technology will always result in efficient, useful, compact systems. [True/False]
- Modeling is simplification of -----
- Single model is sufficient to explain the entire system [True/False]
- The UML is a language for..... [   ]
  - Visualizing, Specifying, Constructing, Deploying.
  - Visualizing, Specifying, Constructing, Documenting.
  - Specifying, Adornment, Common division, Extensibility mechanism.
  - Inception, Elaboration, Construction, Transition.
- UML supports..... phase of software development.
- Class diagram, component, object and deployment diagrams are considered as types of [   ]
  - Structural Diagrams
  - Behavioral Diagrams
  - Non-Structural Diagrams
  - Non-Behavioral Diagrams
- One UML component can be related with any other UML component by \_\_\_\_\_

9. The Rules of UML encourages & forces you to apply strictly [True/False]

10. Which of the two diagrams are isomorphic..... [ ]

- a) Class diagram and Object diagram
- b) Sequence and Collaboration diagram
- c) Statechart and Activity diagram
- d) Component and Deployment diagrams

11. Stereotypes, tagged values, constraints include in..... [ ]

- a) Adornments
- b) Specifying
- c) Construction
- d) Extensibility mechanisms

12. Match the following [ ]

- i. Structural Things
  - ii. Behavioral Things
  - iii. Grouping Things
  - iv. Annotational Thing
- a) Dynamic parts of UML
  - b) Nouns of the UML
  - c) Explanatory parts of UML
  - d) Organizational parts of UML
- a) i-b, ii-a, iii-d, iv-c      c) i-b, ii-a, iii-c, iv-d  
b) i-a, ii-b, iii-d, iv-c      d) i-a, ii-b, iii-c, iv-d

### SECTION-B

#### SUBJECTIVE QUESTIONS

1. Explain about principles of modeling?
2. What is modeling? Give the importance of modeling in designing a system?
3. Briefly explain object oriented modeling?
4. Explain about the conceptual model of the UML?
5. What is a well formed model? Write down the rules of UML?

## UNIT-II

### SECTION-A

#### Objective Questions

1. Which of the following UML diagrams has a static view? [ ]  
a) Collaboration b) Use case c) State chart d) Component
2. Which diagram in UML shows a complete or partial view of the structure of a modeled system at a specific time? [ ]  
a) Sequence Diagram b) Collaboration Diagram  
c) Class Diagram d) Object Diagram
3. Structure diagrams emphasize the things that must be present in the system being modeled. [ ]  
a) True b) False
4. Which UML diagram is shown below? [ ]  
a) Deployment diagram b) Collaboration Diagram  
c) Object Diagram d) Class Diagram
5. Classes and interfaces are a part of [ ]  
a) Structural things b) Behavioral things  
c) Grouping things d) Annotational things
6. What is an object? [ ]  
a) An object is an instance of a class.  
b) An object includes encapsulation of data  
c) An object is not an instance of a class
7. What does a simple name in UML Class and objects consists of ? [ ]  
a) Letters b) Digits c) Punctuation Characters d) All of the mentioned
8. An operation can be described as? [ ]  
a) Object behavior b) Class behavior  
c) Functions d) a, b e) None of the mentioned
9. An attribute is a data item held by which of the following ? [ ]  
a) Class b) Component  
c) Use case d) None of the mentioned

### SECTION-B

#### SUBJECTIVE QUESTIONS

1. Briefly describe the various types of the relationships in UML?
2. What is the main use of class diagram? Explain with an example?
3. What is an association relationship? Explain association qualifier and association class with suitable examples.

4. Describe different activities involved in designing classes.
5. Discuss the usage of interface and their relationships in designing a system.

### UNIT-III

#### SECTION-A

#### Objective Questions

1. Which of the two diagrams are isomorphic..... [    ]
  - a) Class diagram and Object diagram
  - b) Sequence and Collaboration diagram
  - c) State chart and Activity diagram
  - d) Component and Deployment diagrams
2. An interaction is a behavior that exchange messages among.....
3. .... diagram emphasizes time ordering of messages.
4. ....diagram emphasizes the organization of the objects that participates in an interaction.
5. Modeling the flow of control by organization..... [    ]
  - a) Sequence Diagrams                      b) Collaboration Diagrams
  - c) Use Case Diagrams                      d) Activity Diagrams
6. Branching can be represented in an Activity diagram with... [    ]
  - a) Ellipse      b) Diamond      c) Circle                      d) Rounded Rectangle
7. In activity diagram Action states can't be decomposed                      [True/False]    [    ]
8. .... is a one incoming transitions with one or more outgoing transitions.
9. ....the synchronization of two or more concurrent flow of control.
10. In use case diagram can have packages and notes                      [True/False]

#### SECTION-B

#### SUBJECTIVE QUESTIONS

1. Explain about Use cases and Use case diagrams with an example?
2. Briefly explain about the Interaction diagrams?
3. How sequence and collaboration diagrams are differ with each other. Draw interaction diagram for Library Management System.

4. What is sequencing. What are the uses of different stereotypes used in interaction?
5. Exemplify about Activity diagram?
6. How Forking and Joining will used in Activity diagram. Explain with an example.
7. With an example explain about the use of swimlanes and object flow in Activity diagram?
8. Explain how usecase diagrams are useful to specify system requirements.

## UNIT-IV

### SECTION-A

#### Objective Questions

1. ....events are those that pass among the objects that live inside the system.
2. ....is a kind of event that represents the specification of an asynchronous stimulus communicated between instances.
3. In state chart diagrams, element which is shown with help of double line filled black circle surrounded by an unfilled circle [ ]
  - a) two degree state                      b) zero degree state
  - c) Initial state                              d) final state
4. ....event is an event that represents a change in state or the satisfaction of some condition.
5. .... is ongoing non atomic execution within a state machine.
6. To model a time event by using the keyword.....followed by some expression that evaluates to a period of time [ ]
  - a)when              b)after              c)before              d)drop
7. A call event represents the dispatch of an operation. [True/False]
8. Entry and exit actions may have arguments or guard conditions. [True/False]
9. An *event* is the specification of a significant occurrence that has a location in ..... and .....
10. Graphically, a state is rendered as a rectangle with..... [ ]
  - a) Rectangle    b) rounded rectangle              c) circle              d) ellipse
11. Graphically, Components are representing with the symbol... [ ]
  - a) rectangle    b) rectangle with two tabs c) cube    d) ellipse

12. Graphically, Deployment are representing with the symbol... [ ]
- a) rectangle b) rectangle with two tabs c) cube d) ellipse

### SECTION-B

#### SUBJECTIVE QUESTIONS

1. A) What is event and signal? Explain with an example?  
B) How to model a family of signals?
2. Compare and contrast benefits of events and signals?
3. What is a domain state model? Explain nested state with appropriate diagram?
4. Explain substates? Explain about Sequential substates, concurrent substates.
5. Describe in detail about state chart diagrams with an example.
6. Explain about components and deployments with an example?

### UNIT-V

#### Assignment-Cum-Tutorial Questions

#### SECTION-A

##### *Objective Questions*

1. The \_\_\_\_\_ is a handle we can use to describe a design problem  
a) Problem [ ]  
b) Solution  
c) Pattern name  
d) Consequences
2. \_\_\_\_\_ describes specific design problems such as how to represent algorithms as objects.  
a) Problem [ ]  
b) Solution  
c) Pattern name  
d) Consequences
3. \_\_\_\_\_ describes the elements that make up the design, their relationships, responsibilities, and collaborations.  
a) Problem [ ]  
b) Solution  
c) Pattern name  
d) Consequences
4. Which one of the following approach is used to find the right design pattern for our problem? [ ]  
a) Scan Intent sections.  
b) Study how patterns interrelate.  
c) Study patterns of like purpose.  
d) All the above







- a) Command and iterator
  - b) Adapter and bridge
  - c) Abstract factory and builder
  - d) None of the above
5. Design patterns can be classified by criteria \_\_\_\_\_ , \_\_\_\_\_
- a) Visibility, scope [ ]
  - b) Purpose, scope
  - c) Literature survey, purpose
  - d) None of the above.
6. \_\_\_\_\_ Pattern Allow an object to alter its behavior when its internal state changes
- [ ]
- a) State          b) Strategy          c) Template Method   d) Bridge
7. \_\_\_\_\_ Pattern provide a surrogate or placeholder for another object to control access to it.
- [ ]
- a) Singleton    b) Proxy    c) State          d) Strategy
8. \_\_\_\_\_ Uses sharing to support large numbers of fine-grained objects efficiently.
- [ ]
- a) Interpreter    b) Iterator          c) Fly weight          d) Mediator
9. \_\_\_\_\_ Provide a unified interface to a set of interfaces in a subsystem
- a) Factory method [ ]
  - b) Façade
  - c) Fly weight
  - d) Mediator
10. \_\_\_\_\_ of design pattern specifies whether the pattern applies primarily to classes or to objects
- [ ]
- a) Purpose   b) Scope          c) Visibility          d) Type
11. Purpose of deign patterns is divided into:\_\_\_\_\_ [ ]
- a) Class , object
  - b) Creational, Structural, Behavioral
  - c) Both of the above
  - d) None of the above

## SECTION-B

### ***DESCRIPTIVE QUESTIONS***

1. What is Gang of Four (GOF)? State how a catalog is organized in design pattern.
2. a) Briefly explain about the class creational patterns.  
b) Briefly explain about the object creational patterns.
3. Briefly describe about the structural patterns.
4. a) Write about Abstract Factory design pattern with an example?  
b) Explain about responsibilities of Method pattern.
5. Explain about observer Vs mediator.
6. What are behavioral patterns? Explain them briefly.
7. Write about when Prototype pattern is to be used? Give an example.
8. With an example explain about adapter pattern?
9. What are the drawbacks of using singleton design pattern?
10. Which design pattern will you use to create a complex object? Explain with an example.
11. What is the difference between factory and abstract factory design pattern?
12. What is the benefit of using prototype design pattern?

**Signature of the Faculty**

## HANDOUT ON ARTIFICIAL INTELLIGENCE

Class & Sem. : III B.Tech – II Semester

Year : 2020- 21

Branch : CSE

Credits : 3

=====

### 1. Brief History and Scope of the Subject

The seeds of modern AI were planted by classical philosophers who attempted to describe the process of human thinking as the mechanical manipulation of symbols. This work culminated in the invention of the [programmable digital computer](#) in the 1940s, a machine based on the abstract essence of mathematical reasoning. This device and the ideas behind it inspired a handful of scientists to begin seriously discussing the possibility of building an electronic brain.

The field of [AI](#) research was founded at a [workshop](#) held on the campus of [Dartmouth College](#) during the summer of 1956. Those who attended would become the leaders of AI research for decades. Many of them predicted that a machine as intelligent as a human being would exist in no more than a generation and they were given millions of dollars to make this vision come true.

In the 1940s and 50s, a handful of scientists from a variety of fields (mathematics, psychology, engineering, economics and political science) began to discuss the possibility of creating an artificial brain. The field of artificial intelligence research was founded as an academic discipline in 1956.

### 2. Pre-Requisites

- Mathematical Logic
- Formal Reasoning

### 3. Course Objectives:

- To familiarize the concepts of AI for representation of knowledge and problem solving

### 4. Course Outcomes:

At the end of the course, the students will be able to

**CO1:** Analyze different problem solving and game playing techniques.

**CO2:** Compare different approaches to represent knowledge.

**CO3:** Analyze expert systems and their applications.

**CO4:** Apply probability theory for real world problems.

### 5. Program Outcomes:

**Computer Science and Engineering Graduates will be able to:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### Program Specific Outcomes (PSOs)

**PSO1 :** Design, develop, test and maintain reliable software systems and intelligent systems.

**PSO2 :** Design and develop web sites, web apps and mobile apps.

### 6. Mapping of Course Outcomes with Program Outcomes:

CT2521 : ARTIFICIAL INTELLIGENCE (PROFESSIONALELECTIVE –II)															
Course outcomes	Program Outcomes and Program Specific Outcome														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO1. identify the problems that are amenable and can be solved by using AI techniques..	1														
CO 2.analyse the problem solving and game playing techniques.	3	3	2	1								1			
CO3. specify the classical Artificial Intelligence algorithms, which are used to solve the heuristic search and game playing problems.	2		1									1			
CO 4. apply the basic principles and algorithms of Artificial Intelligence to recognize, model and solve the state space search, knowledge representation and reasoning problems.	3	2	2	1								1	1		
CO5. formulate the Reasoning model and state the conclusion for the uncertainty problems using actions and their effects over the time.	3	1	1									1	1		
CO6. describe expert systems and their applications.	2														

### 7. Prescribed Text Books

1. Elaine Rich & Kevin Knight, ‘Artificial Intelligence’, Tata McGraw Hill Edition, 2nd Edition.
2. Stuart J. Russell,Artificial Intelligence: A Modern Approach,2nd Edition.

### 8. Reference Text Books

1. Patrick Henry Winston, 'Artificial Intelligence', Pearson Education.
2. Russel and Norvig, 'Artificial Intelligence', Pearson Education/ PHI.

**9. URLs and Other E-Learning Resources URLs:**

- <https://nptel.ac.in/courses/106105077/>
- <https://nptel.ac.in/courses/106105079/>
- <https://ocw.mit.edu/courses/electrical...and...artificial-intelligence.../lecture-videos/>

**Journals:**

- International Journal on Artificial Intelligence Tools
- Journal of Artificial Intelligence Research
- Applied Artificial Intelligence

**10. Lecture Schedule / Lesson Plan**

Topic	No. of Periods	
	Theory	Tutorial
<b>UNIT - I : Introduction to artificial intelligence</b>		
Introduction	1	1
History	1	
Intelligent systems	1	
Foundations of AI	1	1
Applications	2	

tic-tac-toe game playing	2	
Current trends in AI	2	
<b>UNIT - II: Problem solving and game playing</b>		
<b>Problem solving:</b> state-space search and control strategies	2	1
Introduction, general problem solving	1	
Characteristics of problem	1	1
Exhaustive searches	2	
Heuristic search techniques	2	
Iterative-deepening a*	2	
Problem reduction	2	
Constraint satisfaction	2	
<b>Game playing:</b> Introduction	1	1
Game playing	2	
Alpha-beta pruning	2	
Two-player perfect information games	1	
<b>UNIT - III: Logic Concepts</b>		
Introduction	1	1
Propositional calculus	1	
Proportional logic	1	
Natural deduction system	1	
Axiomatic system	1	

Semantic tableau system in propositional logic	1	1
Resolution in propositional logic	1	
Predicate logic	1	
<b>UNIT - IV: Knowledge representation</b>		
Introduction	1	1
Approaches to knowledge representation	1	
Knowledge representation using semantic network	1	
Extended semantic networks for KR	1	
Knowledge representation using frames	1	
Advanced knowledge representation techniques: Introduction	1	
Conceptual dependency theory	1	1
Script structure	1	
Semantic web	1	
<b>UNIT - V: Expert system and applications</b>		
Introduction phases in building expert systems	1	1
Expert system versus traditional systems	1	
Rule-based expert systems	1	
Blackboard systems truth maintenance systems	1	1
Application of expert systems	1	
List of shells and tools	1	
<b>UNIT - VI: Uncertainty measure</b>		
Introduction	2	1
Probability theory	2	
Bayesian belief networks	2	1
Certainty factor theory	1	
<b>Total No.of Periods:</b>	<b>60</b>	<b>13</b>



## Unit- I

### Assignment-Cum-Tutorial Questions

#### SECTION-A

##### *Objective Questions*

1. Define Artificial Intelligence.
2. A system is said to be \_\_\_\_\_ if it does the right thing, given known facts.
3. The study of how to make computers do things at which, at the moment, people are better-is a characteristic of \_\_\_\_\_. [     ]  
(a) Systems that think like humans                      (b) Systems that think rationally  
(c) Systems that act like humans                      (d) Systems that act rationally
4. The “Turing Test approach” is used to test whether a system \_\_\_\_\_ [     ]  
(a) think like humans                      (b) think rationally  
(c) act like humans                      (d) act rationally
5. The “Cognitive Modelling” approach is used to test whether a system \_\_\_\_\_ [     ]  
(a) think like humans                      (b) think rationally  
(c) act like humans                      (d) act rationally
6. The “Laws of Thought” approach is used to test whether a system \_\_\_\_\_. [     ]  
(a) think like humans                      (b) think rationally  
(c) act like humans                      (d) act rationally
7. For artificial intelligence to succeed, we need \_\_\_\_\_. [     ]  
(a) intelligence                      (b) artifact                      (c) both a & b                      (d) none
8. Understanding language requires an understanding of \_\_\_\_\_. [     ]  
(a) subject matter                      (b) context                      (c) structure of sentences                      (d) only a & b
9. GPS was probably the first program to embody \_\_\_\_\_ approach. [     ]  
(a) thinking humanly                      (b) acting humanly  
(c) thinking rationally                      (d) acting rationally
10. The \_\_\_\_\_ program solves the problem of inferring molecular structure from the information provided by a mass spectrometer. [     ]  
(a) MYCIN                      (b) DENDRAL                      (c) both a & b                      (d) none

11. \_\_\_\_\_ diagnoses blood infections. [     ]  
 (a) MYCIN                      (b) DENDRAL                      (c) both a & b                      (d) none
12. \_\_\_\_\_ teaches Air Force technicians to diagnose electrical systems problems in aircraft. [     ]  
 (a) SHERLOCK                      (b) DARPA                      (c) DENDRAL                      (d) none
13. DARPA stands for\_\_\_\_\_.

## SECTION-B

### SUBJECTIVE QUESTIONS

1. Summarize AI definition categories?
2. Illustrate the capabilities that a computer must possess to pass Turing Test?
3. Explain the areas from which Artificial Intelligence laid its foundation?
4. Explain the history of Artificial Intelligence?
5. List the applications of Artificial Intelligence?
6. Outline the current trends in Artificial Intelligence?
7. What is an Intelligent System? Explain its characteristics?
8. Interpret the steps to solve tic-tac-toe problem.

## UNIT-II

### SECTION-A

#### Objective Questions

1. Define the term “state space”.
2. Define the term “Operationalization”.
3. A \_\_\_\_\_ is a technique that improves the efficiency of a search process.  
 (a) Heuristic                      (b) Control Strategy                      (c) GPS                      (d) none
4. List the steps for solving the problem.
5. In Theorem Proving, the solution steps can be\_\_\_\_\_. [     ]  
 (a) Ignored                      (b) Recoverable                      (c) Irrecoverable (d) none
6. Problems in which solution steps cannot be undone are\_\_\_ \_ [     ]  
 (a) Ignored                      (b) Recoverable                      (c) Irrecoverable (d) none
7. Travelling Salesman problem is an example of\_\_\_\_\_. [     ]  
 (a) Best-Path                      (b) Any-Path                      (c) Both                      (d) none
8. \_\_\_\_\_are the problems in which the computer is given a problem description and produces an answer with no intermediate communication.  
 (a) Conversational                      (b) Solitary (c) Ignorable                      (d) None
9. \_\_\_\_\_is the list of nodes that have been generated and have had the heuristic function applied to them but which have not yet been examined.  
 (a) OPEN                      (b) CLOSED                      (c) NODES                      (d) none
10. The function \_\_ is a measure of the cost of getting from the initial state to the current node.  
 (a)  $f^1$                       (b) g                      (c)  $h^1$                       (d) none

11. \_\_\_\_\_ is useful for representing the solution of problems that can be solved by decomposing them into a set of smaller problems, all of which must then be solved.
12. \_\_\_\_\_ function uses whatever information it has to evaluate so that the best next move can be chosen.  
 (a) static evaluation (b) dynamic evaluation  
 (c) Threshold evaluation (d) none
13. DEEP-ENOUGH will take two parameters: \_\_\_\_\_ and \_\_\_\_\_.
14. MINIMAX returns a structure containing both results: \_\_\_\_\_ and \_\_\_\_\_.
15. A lower bound on the value that a maximizing node may ultimately be assigned called \_\_\_\_\_.  
 (a) alpha (b) beta (c) gamma (d) none
16. An upper bound on the value that a minimizing node may be assigned called \_\_\_\_\_.  
 (a) Alpha (b) beta (c) gamma (d) none

## SECTION-B

### SUBJECTIVE QUESTIONS

1. List the steps for General Problem Solving.
2. Give an example of a problem for which breadth -first search would work better than depth-first search. Give an example of a problem for which depth- first search would work better than breadth-first search.
3. Describe the state space of water jug problem and also explain its solution.
4. List the steps necessary to provide a formal description of a problem.
5. What are the requirements of a control strategy? Develop an algorithm for:
  - (i) Breadth First Search
  - (ii) Depth First Search
6. Summarize the advantages and disadvantages of control strategies.
7. Outline the factors that are necessary for analyzing a problem to choose most appropriate heuristic method.
8. Explain non-decomposable problem with suitable example.
9. Distinguish between Ignorable, Recoverable and Irrecoverable problems with necessary examples.
10. Distinguish between:
  - (i) Certain Outcome Vs Uncertain Outcome problems
  - (ii) Best path and Any-path problems
  - (iii) Problems whose solution is a state and whose solution is a path to state.

(iv) Solitary Vs Conversational problems

11. Explain an algorithm for Best-first Search.
12. Explain Problem Reduction using AND-OR graph with an algorithm.
13. Explain AO\* algorithm.
14. Explain the procedure of Constraint Satisfaction with an example.
15. Explain Minimax procedure with an example.
16. Explain Alpha-Beta Pruning with an example.
17. Solve the Cryptarithmic problem using Constraint Satisfaction:

**Unit- IV**  
**Artificial Intelligence: Knowledge Representation**

**(Open Elective –I)**

**Assignment-Cum-Tutorial Questions**

***I) Objective Questions***

1. The two different kinds of entities in AI are \_\_\_\_\_ and \_\_\_\_\_.
2. The \_\_\_\_\_ mappings exist between facts and representations.  
(a) One-way (b) two-way (c) no mapping (d) both (a) & (b)
3. The forward representation mapping maps from \_\_\_\_\_ to \_\_\_\_\_.  
(a) representations, facts                      (b) facts, representations  
(c) facts, facts                                      (d) representations, representations
4. The ability to represent all of the kinds of knowledge that are needed in that domain is called \_\_\_\_\_.  
(a) Referential Efficiency              (b) Representational Adequacy  
(c) Inferential Efficiency              (d) Acquisitional Efficiency
5. The ability to acquire new information easily is called \_\_\_\_\_.  
(a) Referential Efficiency              (b) Representational Adequacy  
(c) Inferential Efficiency              (d) Acquisitional Efficiency
6. The two important attributes of inheritance are \_\_\_\_\_ and \_\_\_\_\_.
7. Weak slot-and-filler structures are \_\_\_\_\_ and \_\_\_\_\_.
8. Strong slot-and-filler structures are \_\_\_\_\_ and \_\_\_\_\_.
9. Procedural knowledge is \_\_\_\_\_.  
(a) Declarative    (b) Operational    (c) progressive (d) none
10. Procedural Knowledge get low scores for the properties\_\_\_\_\_

(a) Inferential Adequacy (b) Acquisitional Efficiency

(c) Inferential Efficiency (d) both (a) and (b)

11. The most commonly used technique for representing procedural knowledge in AI Programs is the use of \_\_\_\_\_.

(a) Production rules (b) symbols (c) facts (d) both (b) & (c)

12. The structure in which information is represented as a set of nodes connected to each other by a set of labeled arcs, which represent relationships among the nodes is called \_\_\_\_\_.

13. Define the term “frame”.

14. \_\_\_\_\_ theory provides a good basis for understanding frame systems.

(a) set (b) Graphics (c) Logic (d) none

15. The classes whose elements are themselves classes are called \_\_\_\_\_.

(a) Sub class (b) Base class (c) Meta class (d) Parent class

16. \_\_\_\_\_ is a theory of how to represent the kind of knowledge about events that is usually contained in natural language sentences.

17. The primitive that represents transfer of an abstract relationship is \_\_\_\_\_.

(a) PTRANS (b) ATRANS (c) MOVE (d) GRASP

18. A \_\_\_\_\_ is a structure that describes a stereotyped sequence of events in a particular context.

## ***II) Descriptive Questions***

1. Enlist the four properties that a knowledge representation system must have?

2. Explain four knowledge representation techniques.

3. Enumerate the basic mechanism of retrieving a value of an attribute, using inheritance.

4. How non binary predicates are represented using semantic net. Explain with suitable example.

5. Represent the following facts using semantic nets:

**John gave the book to Mary**

**John is 6 feet tall and that he is taller than Bill.**

6. Justify the statement- “Set theory provides a good basis for understanding frame systems”.

7. List the ways in which classes are related to each other in frames, with suitable example?

8. List the set of primitives and conceptual tenses used in Conceptual Dependency.

9. Explain the rules used in Conceptual Dependency.

11. Represent the following sentence in CD:

**Since smoking can kill you, I stopped.**

12. Describe the important components of a script, with a suitable example.

**Unit- V**  
**Artificial Intelligence: Reasoning in Uncertain Situations**  
**(Open Elective –I)**  
**Assignment-Cum-Tutorial Questions**

**I) Objective Questions**

1. In \_\_\_\_\_ reasoning, the axioms/or the rules of inference are extended to make it possible to reason with incomplete information. [ ]  
(a) Monotonic (b) Non monotonic (c) Logical (d) Inferential
2. Define the term “Monotonicity”.
3. \_\_\_\_\_ Any inference that depends on the lack of some piece of knowledge is a \_\_\_\_\_ inference. [ ]  
(a) Monotonic (b) Non monotonic (c) Logical (d) Inferential
4. What is a “Justification”?
5. \_\_\_\_\_ In non monotonic logic, operator **M** is read as \_\_\_\_\_.
6. \_\_\_\_\_ categorizes and organizes the information in a meaningful way. [ ]  
(a) Knowledge Engineer (b) Human Expert (c) User (d) Tool
7. What is “default logic”?
8. Given two axioms:  
 $\forall x : A(x) \rightarrow B(x)$   
 $A(C)$   
We can conclude \_\_\_\_\_ using deduction. [ ]  
(a) B(C) (b) B(x) (c) A(x) (d) none
9. A justification is valid if every assertion in the IN-list is believed and none of those in the OUT list is. ( TRUE/FALSE) [ ]
10. \_\_\_\_\_ refers to the process of computing several steps of a problem-solving procedure before executing any of them.
11. The process which process explores entire plans at one level of detail before it looks at the lower-level details of any one of them is called \_\_\_\_\_ first search. [ ]  
(a) Length (b) Breadth (c) Best (d) Depth

**II) Descriptive Questions**

1. Discuss ABC murder story and how reasoning is performed using non-monotonic reasoning?
2. Illustrate the situations where conventional reasoning is inadequate and how non monotonic reasoning serves the purpose?
3. Explain the logics of non monotonic reasoning?
4. Explain the following:  
(i) Non monotonic logic  
(ii) Default Logic  
(iii) Abduction
5. Illustrate how knowledge can be reasoned using JTMS?
6. Discuss about dependency directed backtracking.
7. How can knowledge be reasoned using ATMS? Explain.
8. What is Planning? List the components of Planning?

9. Explain about Goal Stack Planning with a suitable example.
10. Explain about hierarchical planning

### Unit- VI

#### II) Objective Questions

1. Define the term "Expert System".
2. The components of expert system are \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.
3. Knowledge comprises of \_\_\_\_\_.  
[ ]  
(a) Data (b) Information (c) Past Experience (d) All the above
4. The information that is widely accepted by the Knowledge Engineers and scholars in the task domain is called \_\_\_\_\_ knowledge. [ ]  
(a) Factual (b) Heuristic (c) Domain (d) none
5. \_\_\_\_\_ Knowledge that is about practice, accurate judgment, one's ability of evaluation, and guessing is called \_\_\_\_\_ knowledge.  
[ ]  
(a) Factual (b) Heuristic (c) Domain (d) none
6. \_\_\_\_\_ categorizes and organizes the information in a meaningful way.  
[ ]  
(a) Knowledge Engineer (b) Human Expert (c) User (d) Tool
7. \_\_\_\_\_ is a strategy of an expert system to answer the question, "What can happen next?" [ ]  
(a) Forward Chaining (b) Backward chaining (c) both (d) none
8. \_\_\_\_\_ is a strategy of an expert system finds out the answer to the question, "Why this happened?" [ ]  
(a) Forward Chaining (b) Backward chaining (c) both (d) none
9. \_\_\_\_\_ is an expert system without knowledge base.  
[ ]  
(a) Tool (b) Shell (c) Task (d) none
10. In an Expert System, the entire problem related expertise is encoded in \_\_\_\_\_.  
[ ]  
(i) Data Structures  
(ii) Programs  
(a) Only (i) (b) Only (ii) (c) Both (i) and (ii) (d) none
11. In a traditional system, the entire problem related expertise is encoded in \_\_\_\_\_. [ ]  
(i) Data Structures  
(ii) Programs  
(a) Only (i) (b) Only (ii) (c) Both (i) and (ii) (d) none
12. The knowledgebase in a Rule-base system consists of \_\_\_\_\_.  
(a) Rules (b) Facts (c) Both a & b (d) productions
13. Truth maintenance system supports \_\_\_\_\_ reasoning. [ ]  
(a) Monotonic (b) Non-Monotonic (c) Both a & b (d) none
14. MYCIN is a \_\_\_\_\_ expert system. [ ]
15. (a) Forward Chaining (b) Backward chaining (c) both (d) none
16. DENDRAL was written in the \_\_\_\_\_ programming language [ ]  
(a) PROLOG (b) LISP (c) FORTRAN (d) PYTHON

## ***II) Descriptive Questions***

11. List the characteristics and capabilities of Expert System.
12. Explain the components of an expert system.
13. Distinguish between Forward chaining and Backward chaining.
14. Enlist the application of Expert systems.
15. Describe the phases of developing an Expert system.
16. What do you mean by expert system technology? Explain.
17. Distinguish Expert system and Traditional system.
18. Explain about Rule-based Systems.
19. Explain Justification-based Truth maintenance system.
20. Write short notes on:
  - (i) MYCIN
  - (ii) DENDRAL
  - (iii) R1

**Signature of the Faculty**



## HANDOUT ON CLOUD COMPUTING

Class & Sem. :III B.Tech – II Semester (Vertical Mobility)

Year :2020-21

Branch :CSE

Credits : 3

=====

### **1. Brief History and Scope of the Subject**

Cloud computing is an information technology (IT) paradigm that enables ubiquitous access to shared pools of configurable system resources and higher-level services that can be rapidly provisioned with minimal management effort, often over the Internet. Cloud computing relies on sharing of resources to achieve coherence and economy of scale, similar to a utility.

Third-party clouds enable organizations to focus on their core businesses instead of expending resources on computer infrastructure and maintenance. Advocates note that cloud computing allows companies to avoid or minimize up-front IT infrastructure costs. Proponents also claim that cloud computing allows enterprises to get their applications up and running faster, with improved manageability and less maintenance, and that it enables IT teams to more rapidly adjust resources to meet fluctuating and unpredictable business demand. Cloud providers typically use a "pay-as-you-go" model, which can lead to unexpected operating expenses if administrators are not familiarized with cloud-pricing models

Since the launch of Amazon EC2 in 2006, the availability of high-capacity networks, low-cost computers and storage devices as well as the widespread adoption of hardware virtualization, service-oriented architecture, and autonomic and utility computing has led to growth in cloud computing.

### **2. Pre-Requisites**

- Computer Networks
- Network Security
- Distributed Computing

### **3. Course Objectives:**

- To understand Virtualization, Virtual Machine and different models of VM.
- To familiarize Cloud computing architecture and its security aspects.

#### 4. Course Outcomes:

At the end of the course, students will be able to

CO1: Differentiate the stages in historical evolution of cloud computing.

CO2: Use suitable cloud services to define the cloud for the enterprise.

CO3: Demonstrate hardware level and OS level virtualization to implement virtual machines.

CO4: Design machine images, web applications and databases for virtual machines.

CO5: Apply data, network and host security for the cloud.

#### 5. Program Outcomes:

**Computer Science and Engineering Graduates will be able to:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and

write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### Program Specific Outcomes (PSOs)

**PSO1 :** Design, develop, test and maintain reliable software systems and intelligent systems.

**PSO2 :** Design and develop web sites, web apps and mobile apps.

### 6. Mapping of Course Outcomes with Program Outcomes:

CT2540 : CLOUD COMPUTING (PROFESSIONAL ELECTIVE – V)															
Course outcomes	Program Outcomes and Program Specific Outcome														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO1:differentiate the stages in historical evolution of cloud computing.	2	1													
CO2:use suitable cloud services to define cloud for the enterprise.	2	2	1									2		1	
CO3:demonstrate hardware level and OS level virtualization to implement virtual machines	3											2		1	2
CO4:design machine images, web applications and databases for virtual machines.	2	1	3					1				2		2	2
CO5:apply data, network and host security for the cloud.	1		2					1				2		2	2
<b>CLOUD COMPUTING</b>	2	1	2									2		2	2

### 7.Prescribed Text Books

1. Michael Miller, Cloud Computing – Web Based Applications That change the way you work and Collaborate Online –Person Education.
2. George Reese Cloud Application Architectures, Ist Edition O'Reilly Media.

### 8.Reference Text Books

1. David S. Linthicum, Cloud Computing and SOA Convergence in your Enterprise : A Step-by-Step Guide- Addison-Wesley Professional.

2. Kai Hwang, GeofferyC.Fox, Jack J, Dongarra, Distributed & Cloud Computing From Parallel Processing to the Internet of Things.

## 9.URLs and Other E-Learning Resources

### URLs:

- <https://www.edureka.co/cloud-computing-certification-courses>
- <https://www.getmeacourse.com/?query=Cloud%20Computing>
- <https://www.coursera.org/courses?query=cloud%20computing>
- [https://onlinecourses.nptel.ac.in/noc17\\_cs23/preview](https://onlinecourses.nptel.ac.in/noc17_cs23/preview)

## 10.Lecture Schedule / Lesson Plan

Topic	No. of Periods	
	Theory	Tutorial
<b>UNIT - I: Cloud computing</b>		
Introduction	1	
what it is and what it isn't		
from collaborations to cloud- a short history of cloud computing	1	
Client/Server, P2P, Distributed computing, Collaborative computing, Cloud computing	1	
the network is the computer- How cloud computing works	1	
Cloud Architecture, Cloud storage, Cloud Services	1	
The pros and cons of cloud computing	1	
Who benefits from cloud computing and who shouldn't	1	
	<b>7</b>	
<b>UNIT - II: Defining clouds for the Enterprise</b>		
Storage-as-a-service	1	
Database-as-a-service	1	
Information-as-a-service	1	
Process-as-a-service	1	
Application-as-a-service	1	
Platform-as-a-service	1	
Security-as-a-service	1	
Infrastructure-as-a-service	1	
	<b>8</b>	

<b>UNIT - III: Virtual Machines and Virtualization</b>		
Implementation levels of virtualization	1	
VMM design requirements and providers	1	
Virtualization support at the OS level	1	
Virtualization structures/tools and mechanisms	2	
Hypervisor and Xen architecture	1	
Binary transition with full virtualization	1	
Para-virtualization with compiler support	1	
	<b>8</b>	
<b>UNIT - IV: Hardware Virtualization</b>		
Virtualization of CPU	1	
Memory and I/O devices	1	
Hardware support for virtualization	1	
CPU virtualization	1	
Memory virtualization	1	
I/O virtualization	1	
	<b>6</b>	
<b>UNIT – V: Ready for the cloud</b>		
Web application design	1	
Machine image design and privacy design	1	
Database management: clustering or replication?	1	
Primary key management	1	
Database backups	1	
	<b>5</b>	
<b>UNIT - VI:</b>		
Data Security	1	
Data Control Encrypt Everything	1	
Regulatory and Standards compliances	1	
Network Security, Firewall rules, Network Intrusion detection	1	
Host Security, System Hardening	1	
Antivirus Protection, Host Intrusion detection	1	
Data segmentation, Credential Management	1	

Compromise response	1	
	8	
<b>Total No .of Periods:</b>	<b>42</b>	

## Assignment-Cum-Tutorial Questions

### Unit- I

#### SECTION-A

#### *Objective Questions*

1. With cloud computing the software programs run on \_\_\_\_\_ accessed via internet.  
[    ]  
a. Servers    b. Private computers    c. Network servers    d. all the above
2. Cloud computing is PC-centric. [TRUE/FALSE]
3. Networking computing and outsourcing are not cloud computing  
[TRUE/FALSE]
4. The cloud is a large group of interconnected computers. These computers are \_\_\_\_\_.  
[    ]  
a. Personal    b. Network Servers    c. Public or Private    d. All the above
5. From Google's perspective the key properties of cloud computing are \_\_\_\_\_.  
[    ]  
i. cloud computing is user-centric.  
ii. cloud computing is task-centric.  
iii. cloud computing is powerful.  
iv. cloud computing is accessible.  
v. cloud computing is intelligent.  
vi. cloud computing is programmable.  
a.    both i & ii    b.    both iii & iv    c. both v & vi    d. all the above
6. The google applications that are popular today are \_\_\_\_\_. [    ]  
a. google docs    b. google calendar    c. gmail    d. All the above
7. In P2P computing each computer has equivalent capabilities and responsibilities  
[TRUE/FALSE]
8. Distributed computing is all about \_\_\_\_\_ between multiple computers  
[    ]  
a. Cycle sharing    b. File sharing    c. Providing internet    d. None
9. Cloud in cloud computing represents \_\_\_\_\_? [    ]  
a) Wireless    b) Hard drives    c) People    d) Internet
10. Which of these is not a cloud computing pricing model. [    ]  
a) Free    b) Pay per use    c) Subscription    d) Ladder
11. What is/are the key characteristics of cloud computing? [    ]

- a) Service offering b) Reliability c) Scalability d) ALL
12. The term \_\_\_\_\_ has been used historically as a Metaphor for the internet?  
[ ]
- a) Cloud b) Intranet c) grid computing d) None of the above
13. Which one is delivering software services to end users and running code?  
[ ]
- a) SOA b) Grid c) Cloud d) None
14. Which of the following is an example of cloud computing application?  
[ ]
- a) Facebook Apps b) Twitter or RSS  
c) Salesforce.com d) Skype
15. What is Grid computing?  
[ ]
- a) It is a network of computers that share resources – the network can be local or distributed across the internet. Hardware as a service  
b) It is a physical arrangement of computer terminals that optimizes computing power – the computers in the center are more powerful.  
c) It is a temporary cloud computer network that only exists as long as single project is active.  
d) All the above.
16. What is an important benefit of cloud.  
[ ]
- a) Highly protected data b) Independent from Internet  
c) Reduced cost d) Small bandwidth
17. What is not a valid reason for customer asking a cloud provider where their servers are located?  
[ ]
- a) Geographical location may tell something about network latency.  
b) Geographical location may tell something about network legislation.  
c) The number of sites tells you something about disaster recovery possibilities.  
d) When a server breaks down, the customer wants to send a technician to fix the problem as soon as possible
18. Which cloud deployment model is operated solely for a single organization and its authorized users.  
[ ]
- a) Community cloud b) Hybrid cloud c) Public cloud d) Private cloud
19. Which cloud deployment model is managed by a cloud provider, has an infrastructure that is offsite, and is accessible to general public  
[ ]
- a) Community cloud b) Hybrid cloud c) Public cloud d) Private cloud

## **SECTION-B**

### ***Descriptive Questions***

1. Define Cloud Computing? Enlist and explain essential characteristics of Cloud Computing?
2. Explain how cloud computing works?

3. Differentiate peer to peer computing and distributed computing?
4. Explain Collaboration to cloud?
5. Explain about cloud application architectures?
5. Enlist various companies in providing cloud computing services.
6. Write a short note on the next step in collaboration?
7. Explain how cloud computing is different from cloud computing?
8. Write a short note on Cloud Storage?
9. Write a short note on cloud services?
10. Explain why cloud computing is important?
11. Explain the architecture behind a cloud computing system?

## Unit- II

### SECTION-A

#### *Objective Questions*

1. \_\_\_\_\_ is the ability to test, bundle, and deliver the platform as a service created applications [ ]  
 (A) design (B) development (C) deployment (D) Storage
2. \_\_\_\_\_ provides self-contained platforms with everything you need for application development and operational hosting. [ ]  
 (A) Paas (B) SaaS (C) Iaas (D) none of the above
3. \_\_\_\_\_ is also known as software as a service [ ]  
 (A) Application as a service (B) Desktop as a service  
 (C) Storage as a service (D) Process as a service
4. \_\_\_\_\_, is the ability to leverage storage that physically exists remotely but Is logically a local storage resource to any application that requires storage [ ]  
 (A) Application as a service (B) Desktop as a service  
 (C) Storage as a service (D) Process as a service
5. What is/are the disadvantages of storage as a service? [ ]  
 (A) is dependent on the internet (B) performance (C) cost (D) All th
6. \_\_\_\_\_provides the ability to leverage the services of remotely hosted database, sharing it with other users and having it logically function as if the database were local. [ ]  
 (A) Database as a service (B) Desktop as a service  
 (C) Storage as a service (D) Process as a service
7. \_\_\_\_\_ refers to the ability to consume any type of remotely hosted information. [ ]



- (A) Database as a service      (B) Information as a service  
 (C) Storage as a service      (D) Process as a service
8. \_\_\_\_\_ allows any application to access any application to access any type of information using API
- (A) Database as a service      (B) Information as a service  
 (C) Storage as a service      (D) Process as a service
9. Cost of downtime is \$100, ongoing maintenance is \$200 and the cost of API service is \$100. What is the ongoing cost per month? [   ]
- (A) \$200      (B) \$100      (C) \$300      (D) \$400
10. \_\_\_\_\_ refers to a remote resource that can bind many resources together, either hosted within the same cloud computing resource or remotely, to create business processes. [   ]
- (A) Database as a service      (B) Information as a service  
 (C) Storage as a service      (D) Process as a service

## SECTION-B

### *Descriptive Questions*

1. What are the components of cloud computing?
2. Explain Storage-as-a-service?
3. Write a short note on Database-as-a-service?
4. Describe Information-as-a-service?
5. Describe Process-as-a-service ?
6. Write a short note on Application-as-a-service.

### *Multiple Choice Questions:*

1. Processes provide \_\_\_\_\_ about how to do something using many resources that can exist on-premise or in the clouds. [   ]  
 (A) transform instructions      (B) control instructions  
 (C) logging instructions      (D) routing instructions
2. \_\_\_\_\_ is a complete platform, including application development, interface development, database development, storage, and testing, delivered through a remotely hosted platform to subscribers. [   ]  
 (A) Database as a service      (B) Information as a service  
 (C) Storage as a service      (D) Platform as a service
3. \_\_\_\_\_ is the ability to run the application over a long period of time, dealing with backup, restore, exception handling, and other things that add value to operations. [   ]  
 (A) design      (B) development      (C) deployment      (D) operations

4. \_\_\_\_\_ is the ability to test local or cloud delivered systems using remotely hosted testing software and services. [ ]

- (A) Testing as a service (B) Information as a service  
(C) Storage as a service (D) Platform as a service

5. \_\_\_\_\_ is any on-demand service that provides the ability to manage one or More cloud services. [ ]

- (A) Database as a service (B) Information as a service  
(C) Management/Governance as a service (D) Platform as a service

6. \_\_\_\_\_ is the ability to deliver core security services remotely over the internet. [ ]

7. A) Database as a service (B) Information as a service (C) Security as a service  
(D) Platform as a service

8. \_\_\_\_\_ is data center as a service, or the ability to access computing resources remotely. [ ]

- (A) Database as a service (B) Information as a service  
(C) Security as a service (D) Infrastructure as a service

9. With \_\_\_\_\_ you can access very expensive data center resources through a rental arrangement and thus preserve capital for the business.

- (A) Database as a service (B) Information as a service  
(C) Security as a service (D) Infrastructure as a service

9. \_\_\_\_\_ technology can be used to deliver integration on demand through browser [ ]

- (A) JAVA (B) AJAX (C) JSP (D) PHP

10. \_\_\_\_\_ is the ability to integrate the applications developed on your platform as a service provider with software as a service applications or applications that may exist within your enterprise [ ]

- (A) design (B) development (C) deployment (D) Integration

## ***II)Problems:***

1. Write a short note on Infrastructure-as-a-service?
2. Explain Platform-as-a-service?
3. Write a short note on Integration-as-a-service?
4. Describe Security-as-a-service?
5. Describe Management-as-a-service ?
6. Write a short note on Testing-as-a-service.

## **UNIT-III SECTION-A**

### **Objective Questions**

1. \_\_\_\_\_ is/are the most important advantages of virtualization. [ ]  
 a. Managed execution    b. isolation    c. Security    d. both a&b
2. The most popular open-source hypervisor available in the market is \_\_\_\_\_. [ ]  
 a. ESX    b. ESXi    c. Hyper-V    d. Xen
3. Process virtual machines are made to run \_\_\_\_\_.  
 a. Operating system  
 b. Operating system and applications  
 c. Some specific application    d. Any application
4. The allocation of resources and their partitioning among different guests is simplified, because, \_\_\_\_\_.  
 a. The virtual host is controlled by program  
 b. host is controlled by administrator  
 c. cycle sharing among user instances  
 d. performance is not a major issue
5. \_\_\_\_\_ simplifies the administration of virtual machine instances. [ ]  
 a. portability    b. self-containment    c. para-virtualization    d. both a&b
6. The causes of performance degradation can be traced back by the overhead introduced by the following activities \_\_\_\_\_. [ ]  
 i. Maintaining status of virtual processor  
 ii. Support of privileged instructions  
 iii. Support of paging within VM  
 iv. console functions.  
 a. only i&ii    b. only i,ii,&iii    c. only ii&iii    d. All the above
7. The major source of performance degradation is \_\_\_\_\_. [ ]  
 a. the VMM is executed scheduled together with other applications  
 b. VMM runs on the user system  
 c. para-virtualization    d. VMware
8. \_\_\_\_\_ and \_\_\_\_\_ can slow down the execution of managed applications .
9. The following is/are the disadvantages of virtualization. [ ]  
 a. performance degradation    b. degraded user experience  
 c. security    d. All the above
10. Combining network resources and network functionality into a single, software- based administrative entity is called as \_\_\_\_\_. [ ]  
 a. virtual network    b. storage virtualization  
 c. Desktop virtualization    d. None of the above
13. A Xen-based system is managed by \_\_\_\_\_.  
 a. University of Cambridge    b. full virtualization  
 c. Xen-hypervisor    d. ALL

14. In a Xen-based system specific control software, which has privileged access to host and controls all the other guest operating systems is executed in special domain called \_\_\_\_\_.
- a. Domain 0    b. Domain X    c. Domain 1    d. None of the above
13. VM ware technology is based on \_\_\_\_\_
- a. Hardware assisted virtualization    b. para virtualization  
c. full virtualization    d. partial virtualization
14. VMware implements full virtualization either in desktop environment by means of \_\_\_\_\_ hypervisors, or in server environment, by means of \_\_\_\_\_ [    ]
- a. type I, type II    b. type II ,type I    c. type I, type 0    d. type 0, type I
15. VMware is well-known for the capability of virtualizing \_\_\_\_\_ architectures.
- a. x86    b. x85    c. 885    d. 8088
16. The following are the components of hypervisor.
- a. Hyper calls Interface    b. MSR    c. APIC    d. All the above
17. Virtualization overhead of hypervisor is maximum in case of \_\_\_\_\_. [    ]
- a. Full virtualization    b. Para-virtualization  
c. Hardware assisted virtualization    d. Equal for all
18. Virtual Machine monitor is the other name of \_\_\_\_\_.
- a. Guest system    b. host system  
c. host operating system    d. Hypervisor
19. The most popular open source hypervisor available in market is\_\_ [    ]
- a. ESX    b. ESXi    c. Hyper-V    d. Xen
20. The single point in the single point of failure problem of virtualization is \_\_\_\_\_.  
a. Virtual machine    b. Guest OS  
c. Host machine    d. VMM

## SECTION-B

### SUBJECTIVE QUESTIONS

1. What is virtualization? What is the need for virtualization?
2. What are the advantages of virtualization?
3. Write a short note on the downsides of virtualization.
4. What are the types of virtualization?
5. Briefly explain the role of virtual machine monitor?
6. Why is hypervisor also called as virtual machine monitor?
7. Write a short note on interpretation and binary translation?
8. Enlist the major server virtualization products and vendors?
9. Write the merits and demerits of Virtual Box?



18. Two servers in two different Amazon EC2 availability zones can operate in the same security group. [TRUE/FALSE]
19. Maintaining off-site backup can help to recover when the cloud provider goes off. [TRUE/FALSE]
10. Network traffic exchanging between instances is visible to other hosts. [TRUE/FALSE]
11. Amazon publishes its security standards and processes at \_\_\_\_\_.  
[ ]
- (A) aws.amazon.com (B) amazoncloud.com  
(C) amazonsecurity.com (D) a2amazon.com
12. Why is it recommended to copy your files in plain text over to a temporary backup server whose job is to perform encryption and then upload backups to the cloud .  
[ ]
- (A) encryption eats up CPU (B) ISP monitors host traffic  
(C) data is stored in plain text (D) None of the above
13. From a security perspective, you'll encounter the following issues in standards and regulation.  
i. How issues ii. Where issues iii. What issues [ ]
- (A) both i & ii (B) both i & iii (C) both ii&iii (D) All i,ii & iii
14. Placing your virtual Linux server in \_\_\_\_\_ mode, the only network traffic you will see is the traffic originating from or destined for your server.  
[ ]
- (A) promiscuous (B) server centric (C) cloud centric (D) kernel
15. Using SCP is more secure than FTP because:  
i. FTP transmits passwords in plain text  
ii. SCP uses SSH protocol for authentication [ ]
- (A) only I (B) only ii (C) both i&ii (D) None of the above
16. The weakness of perimeter security infrastructure is \_\_\_\_\_ [ ]
- (A) A compromise of any individual server inside any given segment provides full access to all servers in that segment  
(B) Interior services tend to be less internet aware  
(C) Outer layer services tend to be more hardened against internet  
(D) DMZ is poorly structured

17. \_\_\_\_\_ is an open source, free and light weight network intrusion detection system .  
 (A) snort (B) snoop (C) DMZ (D) Amazon EC2 [ ]
18. Examples of irregular traffic include  
 i. Port scans  
 ii. Denial-of-service attacks  
 iii. Known vulnerability exploit attempts [ ]  
 (A) both i & ii (B) both i & iii (C) both ii & iii (D) All i, ii & iii
19. \_\_\_\_\_ monitors the state of your server for anything unusual .[ ]  
 (A) HIDS (B) NIDS (C) OSSC (D) snort
20. Each virtual server you manage will mount \_\_\_\_\_ storage devices.[ ]  
 (A) ephemeral (B) long lasting (C) Secondary (D) No specific location

### **SECTION-B**

#### **SUBJECTIVE QUESTIONS**

1. What is the standard operating procedure when you detect a compromise on a physical server?
2. Explain in detail about data segmentation.
3. Briefly describe about Host security.
4. Write a short note on system hardening.
5. Explain the process of starting a virtual server with encrypted file system
6. What is the purpose of a network intrusion detection system?
7. What are the few best practices for network security?
8. Explain firewall rules?
9. Discuss the events that could create trouble for infrastructure?
10. Write a short note on network intrusion detection?
11. Describe how your server is setup for
  - a. presenting attacks
  - b. minimizing the impact of a successful attack on the overall system
  - c. responding to attacks when they occur
12. Write a short note on host intrusion detection.

### **UNIT-V SECTION-A**

#### **Objective Questions**

1. Which of the following are key elements in disaster recovery planning?
  - i. backup & data retention

- ii. geographic redundancy  
 iii. organizational redundancy [ ]
- A) i & ii      B) ii & iii      C) i & iii      D) All the above
2. Ability to recover from a disaster is limited by \_\_\_\_\_ of backups. [ ]
- A) quality      B) frequency C) both A&B      D) none
3. In disaster recovery \_\_\_\_\_ data is generally the data of greatest concern. [ ]
- A) persistent      B) short term      C) meta      (D) none of the above
4. \_\_\_\_\_ of your file system tend to be most efficient. [ ]
- A) snapshots      B) zipped file system C) centralized backup      D) none
5. \_\_\_\_\_ involves setting up a master server that handles your write operations and replicating transactions over to a slave server. [ ]
- A) Master slave replication      B) Multi-master replication  
 C) Clustering      D) Master server
6. A \_\_\_\_\_ database is one in which two master servers execute write transactions independently and replicate the transactions to the other master. [ ]
- A) Master slave replication      B) Multi master replication  
 C) Master server      D) none of the above
7. The correct sequence of steps for creating database dump are \_\_\_\_\_. [ ]
- i. encrypt the dump and break it in to small , manageable chunks  
 ii. execute the database dump  
 iii. move the dump over to S3  
 A) i-ii-iii      B) ii-i-iii C) iii-i-ii D) None of the above
8. Amazon S3 limits your file size to be \_\_\_\_\_ GB. [ ]
- A) 2      B) 5      C) 10      D) 20
9. \_\_\_\_\_ need the ability to manage your EC2 infrastructure from the monitoring site. [ ]
- A) automated disaster recovery      B) disaster management  
 C) database recovery      D) application server recovery
10. \_\_\_\_\_ is the art of being able to resume normal systems operations when faced with a disaster scenario. [ ]
- A) disaster recovery      B) database backup  
 C) accepting disaster      D) None of the above
11. A \_\_\_\_\_ will help your IT systems survive a fire in your data center that destroy all of the servers in the data center and the systems they support. [ ]
- A) Virtualization      B) Data center      C) Cloud computing      D) None
12. \_\_\_\_\_ lets you automate disaster recovery. [ ]
- A) virtualization      B) data center





1. \_\_\_\_\_ is the ability to leverage storage that physically exists remotely but is logically a local storage resource to any application that requires storage. [ ]  
 (a) Storage-as-a-service (b) Database-as-a-service  
 (c) Information-as-a-service (d) Process-as-a-service
2. The most primitive component of cloud computing is \_\_\_\_\_. [ ]  
 (a) Storage-as-a-service (b) Database-as-a-service  
 (c) Information-as-a-service (d) Process-as-a-service
3. \_\_\_\_\_ provides the ability to leverage the services of a remotely hosted database, sharing it with other users and having it logically function as if the database were local. [ ]  
 (a) Storage-as-a-service (b) Database-as-a-service  
 (c) Information-as-a-service (d) Process-as-a-service
4. \_\_\_\_\_ refers to the ability to consume any type of remotely hosted information. [ ]  
 (a) Storage-as-a-service (b) Database-as-a-service  
 (c) Information-as-a-service (d) Process-as-a-service
5. \_\_\_\_\_ refers to a remote resource that can bind many resources together. [ ]  
 (a) Storage-as-a-service (b) Database-as-a-service  
 (c) Information-as-a-service (d) Process-as-a-service
6. \_\_\_\_\_ was really the first drive into modern cloud computing.[ ]  
 (a) Storage-as-a-service (b) Database-as-a-service  
 (c) Information-as-a-service (d) Application-as-a-service
7. \_\_\_\_\_ is any application delivered over the platform of the Web to an end user, typically leveraging the application through a browser. [ ]  
 (a) Storage-as-a-service (b) Database-as-a-service  
 (c) Information-as-a-service (d) Application-as-a-service
8. \_\_\_\_\_ is the ability to test, bundle, and deliver the platform-as-a service–created applications. [ ]  
 (a) Design (b) Development (c) Deployment (d) Integration
9. \_\_\_\_\_ is the ability to run the application over a long period of time, dealing with backup, restore, exception handling. [ ]  
 (a) Design (b) Development (c) Deployment (d) Operations
10. Converting the information semantics from one system to the information semantics of another system, so the target system can receive information in a format it understands. [ ]  
 (a) Transformation (b) Routing (c) Interface (d) Logging

11. SOAP stands for\_\_\_\_\_.
12. \_\_\_\_\_ is the ability to deliver core security services remotely over the Internet. [ ]  
(a) Storage-as-a-service (b) Database-as-a-service  
(c) Security-as-a-service (d) Application-as-a-service
13. \_\_\_\_\_ is any on-demand service that provides the ability to manage one or more cloud services. [ ]  
(a) Management-as-a-service (b) Database-as-a-service  
(c) Security-as-a-service (d) Application-as-a-service
14. Testing-as-a-service is the ability to test local or cloud-delivered systems using remotely hosted testing software and services. [ ]  
(a) Management-as-a-service (b) Testing-as-a-service  
(c) Security-as-a-service (d) Application-as-a-service
15. \_\_\_\_\_ is a data center-as-a-service and the ability to access computing resources remotely. [ ]  
(a) Management-as-a-service (b) Testing-as-a-service  
(c) Security-as-a-service (d) Infrastructure-as-a-service

## **SECTION-B**

### **SUBJECTIVE QUESTIONS**

- 1.List the components of Cloud Computing.
- 2.Explain how Storage-as-a-service allows us to store information on a remote disk drive as if it were local.
- 3.Summarize the benefits and drawbacks of Storage-as-a-service.
- 4.Explain Database-as-a-service providers.
- 5.Justify how Information-as-a-service has the ability to consume any type of remotely hosted information.
- 6.Discuss how Process-as-a-service allows us to bind on-premise or cloud-delivered resources together to form business solutions.
- 7.Explain the following:
  - (i) Application-as-a-service
  - (ii) Security-as-a-service
  - (iii) Infrastructure-as-a-service
- 8.Explain the major components of Platform-as-a-service?
- 9.Explain the major functions of an Integration Engine.

**Signature of the Faculty**

## HANDOUT ON CYBER SECURITY

**Class & Sem:** III B.Tech – II Semester

**Year:** 2020-2021

**Branch** : CSE

**Credits:** 3

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### **1. Brief History and Scope of the Subject**

Cyber Security has become a major concern over the last few years as hackers have penetrated the IT infrastructure of governments and enterprises with increasing frequency and sophistication. The growth of mobile and IoT devices will increase exposure of a cyber-security hack and enterprises, governments are preparing themselves. Computer networks have always been the target of criminals, and it is likely that the danger of cyber security breaches will only increase in the future as these networks expand, but there are sensible precautions that organizations can take to minimize losses from those who seek to do harm. With the right level of preparation and specialist external assistance, it is possible to control damages, and recover from a cyber-breach and its consequences.

Many aspects of our lives rely on the Internet and computers, including communications (e-mail, cell phones, texting), transportation (traffic control signals, car engine systems, airplane navigation), government (birth/death records, social security, licensing, tax records), finance (bank accounts, loans, electronic paychecks), medicine (equipment, medical records), and education (virtual classrooms, online report cards, research). Just consider how much of our personal information is stored either on our own computer or on someone else's system. How is the data and the systems on which the data resides (or is transmitted) kept secure?

Cyber Security involves protecting the information and systems we rely on every day whether at home, work or school. Cyber Security refers to the body of technologies, processes, and practices designed to protect networks, devices, programs, and data from unauthorized access, vulnerabilities and attacks delivered via the Internet by cyber criminals. Cyber Security may also be referred to as Information Technology (IT) Security.

### **2. Pre-Requisites**

- Basic knowledge of Computers, Internet and Networking.

### **3. Course Objectives:**

- To understand security concepts, ethics in network security.
- To familiarize with new algorithms (mathematical formulas) and statistical measures that assesses relationships among members of large data sets.
- To identify the vulnerability of the Internet systems and recognize the mechanisms of the attacks, and apply those to design and evaluate counter measure tools.
- To gain knowledge on security threats, and the security services and mechanisms to counter them.

#### 4. Course Outcomes:

Students will be able to

- outline management framework.
- describe various tools that can be used in cyber security management.
- write a secure access client for access to a server.
- determine firewall requirements, and configure a firewall.
- employ policies and standards to solve security problems.
- use security techniques in an organisational context.

#### 5. Program Outcomes:

**Computer Science and Engineering Graduates will be able to:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### Program Specific Outcomes (PSOs)

**PSO1 :** Design, develop, test and maintain reliable software systems and intelligent systems.

**PSO2 :** Design and develop web sites, web apps and mobile apps.

### 6.Mapping of Course Outcomes with Program Outcomes:

CS2513 : CYBER SECURITY (OPEN ELECTIVE-III)														
Course outcomes	Program Outcomes and Program Specific Outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1:outline management framework.	2													
CO2: describe various tools that can be used in cyber security management.	1				1							1		
CO3:write a secure access client for access to a server.		1	2			2		2					2	2
CO4:determine firewall requirements, and configure a firewall.	2	2				1		2						
CO5:employ policies and standards to solve security problems.	2		1			1		2				2		

CO6:use security techniques in an organisational context.	2					2		1				1	2	2
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## 7.Prescribed Text Books

- Mike Shema, “Anti-Hacker Tool Kit (Indian Edition)”, Publication Mc Graw Hill.
- Computer forensics and cyber crime: an introduction by Marjie T. Britz.

## 8.Reference Text Books:

- James Graham, Ryan Olson, Rick Howard, “Cyber Security essentials”, 1<sup>st</sup> edition.
- Chwan-Hwa (John) Wu, J. David Irwin, “Introduction to Computer Networks and Cybersecurity”.
- Nina Godbole and Sunit Belpure, “Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Publication Wiley.

## 9.URLs and Other E-Learning Resources

[https://swayam.gov.in/nd2\\_nou19\\_cs08](https://swayam.gov.in/nd2_nou19_cs08)

<https://www.cyberdegrees.org/resources/free-online-courses/>

<https://www.coursera.org/specializations/cyber-security>

<https://www.udemy.com/topic/cyber-security/>

## 10.Online Course Certifications

<https://www.cybrary.it/>

<https://www.simplilearn.com/cyber-security/>

<https://www.infosecinstitute.com/>

## 11.Lecture Schedule / Lesson Plan

Topic	No of Periods
<b>UNIT - I: Systems Vulnerability Scanning</b>	
Overview of Vulnerability Scanning, Open Port / Service Identification	2
Banner/Version Check, Traffic Probe, Vulnerability Probe	2
Vulnerability Examples - OpenVAS	2
Metasploit	2
Networks Vulnerability Scanning - Netcat, Understanding Port and Services tools - Datapipe, Fpipe	2
Network Reconnaissance –Nmap, THC-Amap.	2
Network Sniffers and Injection tools – Tcpdump and Windump.	2
<b>UNIT - II: Network Defence Tools</b>	
Firewalls and Packet Filters: Firewall basics	1
Packet Filter vs Firewall, how a firewall protects a network packet characteristic to filter, Stateless vs Stateful Firewalls	2
Network Address Translation (NAT) and Port Forwarding	2

The basics of Virtual Private Networks	1
Snort: Intrusion Detection System	2
<b>UNIT - III: Web Application Tools</b>	
Scanning for web vulnerabilities tools: Nikto, HTTP utilities-Curl, OpenSSL and Stunnel	3
Password Cracking and Brute-Force tools	1
John the Ripper, L0phtCrack	2
pwdump, HTC-Hydra	1
<b>UNIT - IV: Introduction to Cyber Crime and Law</b>	
Cyber crimes, types of cyber crime, hacking	2
Attack vectors, Cyberspace and criminal behavior, clarification of terms,	2
Traditional problems associated with computer crime	2
<b>UNIT - V: Introduction to Incident Response</b>	
Digital forensics, computer language, network language	2
Realms of the cyber world, a brief history of the Internet,	2
Recognizing and defining computer crime, contemporary crimes	1
Computers as targets, contaminants and destruction of data, Indian IT ACT 2000	2
<b>UNIT - VI: Introduction to Cyber Crime Investigation</b>	
Firewalls and Packet Filters, Password Cracking	2
Keyloggers and Spyware	1
Virus and Worms	1
Trojan and Backdoors	1
Steganography	2
Attack on Wireless Networks	1
<b>Total No. of Periods:</b>	<b>50</b>

### Assignment-Cum-Tutorial Questions

#### UNIT-I SECTION-A

#### Objective Type Questions

1. A \_\_\_\_\_ is software application that assesses security vulnerabilities in networks or host systems and produces a set of scan results.
2. \_\_\_\_\_ is a weakness that can be exploited by attackers. [ ]  
A) System with virus                      B) System without firewall  
C) System with vulnerabilities        D) System with strong password
3. Nmap is abbreviated as Network Mapper. [True/False]
4. Which of them is not a powerful vulnerability detecting tool? [ ]  
A) Nessus    B) Nexpose                      C) Metasploit                      D) Nmap
5. Which of the following is an objective of scanning? [ ]



- i) Detection of the live system running on network
- ii) Discovering the IP address of the target system
- iii) Discovering the services running on target system
- iv) Detection of spyware in a system

A) i,ii      B) ii,iii      C) i,ii,iii      D) All of the above

6. \_\_\_\_\_ scanning is done when a series of messages are sent by someone keeping in mind to break into a computer. [      ]

A) Network      B) Port      C) Vulnerability      D) System

7. \_\_\_\_\_ scanning is a procedure to identify active hosts on your network.

8. A zero-day vulnerability is a type of vulnerability unknown to the creator or vendor of the system or software. [      ]

a) True      b) False

9. Which of them is not a vulnerability scanning tool? [      ]

A) Nexpose      B) Nessus Professional      C) Snort      D) Nikto Web scanner

10. Netcat is a Network Scanner. [True/False]

11. \_\_\_ phase in ethical hacking is known as the pre-attack phase. [      ]

A) Reconnaissance      B) Scanning  
C) Gaining access      D) Maintaining access

12. Which of them is not a scanning tool? [      ]

A) NMAP      B) Nexpose      C) Maltego      D) Nessus

13. DoS stands for \_\_\_\_\_

14. Which of the following comes under scanning methodologies? [      ]

- i) Vulnerability scanning
- ii) Sweeping
- iii) Port Scanning
- iv) Google Dorks

A) i,iii      B) i,iv      C) i,ii,iii      D) All of the above

15. \_\_\_\_\_ is a technique of monitoring every packet that crosses the network

16. Packet Sniffer can also be called as [      ]

- i) Network Sniffer      ii) Protocol Analyzer
- iii) Packet Analyzer      iv) Network Analyzer

A) i,ii,iii      B) ii,iii,iv      C) i,iii,iv      D) All of the above

17. tcpdump is a common packet analyzer that runs under the \_\_\_\_\_

## SECTION-B

### Descriptive Questions



6. \_\_\_\_ firewalls are a combination of other three types of firewalls [    ]  
 A) Packet Filtering                      B) Circuit Level Gateway  
 C) Application-level Gateway D) Stateful Multilayer Inspection
7. HTTPS is abbreviated as \_\_\_\_\_ [    ]  
 A)Hypertexts Transfer Protocol Secured  
 B)Secured Hyper Text Transfer Protocol  
 C)Hyperlinked Text Transfer Protocol Secured  
 D) Hyper Text Transfer Protocol Secure
8. Packet filtering firewalls are vulnerable to \_\_\_\_\_ [    ]  
 A) hardware vulnerabilities                      B) MiTM  
 C) phishing                                              D) spoofing
9. VPN is abbreviated as \_\_\_\_\_
10. \_\_\_\_\_ type of VPNs are used for home private and secure connectivity.  
 A) Remote access VPNs [    ]  
 B) Site-to-site VPNs  
 C) Peer-to-Peer VPNs  
 D) Router-to-router VPNs
11. A \_\_\_\_\_ can hide a user’s browsing activity. [    ]  
 A) Firewall      B) Antivirus      C) Incognito mode      D) VPN
12. \_\_\_\_\_ is the port number for SSH (Secure Shell).
13. IDS stands for \_\_\_\_\_

## SECTION-B

### Descriptive Questions

1. Explain,how a firewall protects a network.
2. Outline the basics of virtual private networks.
3. Distinguish packet filter and firewall.
4. Explain the characteristics of firewalls.
5. What are the advantages and disadvantages of firewalls?
6. Define IDS and explain its functioning.
7. Differentiate stateful and stateless firewalls.
8. Describe the working of NAT.
9. Discuss about packet filter.
10. Write a short note on port forwarding in networks and explain its relation with NAT.

## UNIT-III

### Assignment-Cum-Tutorial Questions

#### SECTION-A

1. A \_\_\_\_\_ is used to test the basic security of a web application.
2. \_\_\_\_\_ is an open source web server scanner [    ]  
 A) Aircrack-ng      B) Nikto      C) Cain and Abel      D) Pwdump

3. \_\_\_\_\_ is a command-line tool for getting or sending data including files using URL syntax. [     ]
- A)Nikto  
B)Stunnel  
C)Curl  
D)OpenSSL
4. \_\_\_\_\_ is an open-source application used to provide a universal TLS/SSL tunneling service.
5. Brute force attack is \_\_\_\_\_ [     ]
- A)fast  
B)inefficient  
C)slow  
D)complex to understand
6. \_\_\_\_\_ is a general purpose cryptographic library that provides open-source implementation of the SSL and TLS protocols.
7. Passwords need to be kept encrypted to protect from such offline attacks. (True/False)
8. Which of the following is not an example of offline password attack? [     ]
- A) Dictionary attack                      B) Rainbow attack  
C) Brute force attack                      D) Spamming attack
9. \_\_\_\_\_ is the art of decrypting the passwords in order to recover them.
10. A \_\_\_\_\_ is a process of breaking a password protected system or server by simply & automatically entering every word in a dictionary as a password. [     ]
- A) Dictionary attack                      B) Phishing attack  
C) Social engineering attack              D) MiTM attack
11. L0phtCrack is formerly known as LC3. [     ]
- A) True  
B) False
12. \_\_\_\_\_ is a password recovery and auditing tool. [     ]
- A) Stunnel                      B) LC4  
C) Nikto                      D) Curl
13. \_\_\_\_\_ is known for its ability to crack passwords of network authentications by performing brute-force attacks against more than 50 protocols.
14. Hydra also includes a GUI based on the open source GTK library called \_\_\_\_\_

## SECTION-B

### Descriptive Questions

11. Explain about Nikto web vulnerability scanner. (L2) (CO:2)
12. Explain about the following HTTP Utility tools. (L2) (CO:2)
- a. OpenSSL
  - b. Stunnel
  - c. Curl
13. Outline the working of the following password cracking and brute-force tools. (L2) (CO:2)
- a. John the Ripper
  - b. L0phtcrack

- c. Pwdump
- d. THC-Hydra

## UNIT-IV

### SECTION-A

#### Objective Questions

1. \_\_\_\_\_ is the action of pretending to be a licensed venture and sending fake e-mails to users.
2. Launching cyber-attacks is very difficult and expensive. (True/False)
3. Which of the following is not a type of cybercrime?  
(a) Data theft      (b) Damage to data and systems  
(c) Forgery      (d) Installing antivirus for protection
4. Which of the following is not done by cyber criminals?  
(a) Unauthorized account access      (b) Trojan horse attacks  
(c) Email spoofing & spamming      (d) Reporting vulnerability
5. The computers can be misused or hacked only when the sensitive data are stored. (True/False)
6. \_\_\_\_\_ is the forgery of an e-mail header so that the message appears to have originated from someone or somewhere other than the actual source.
7. \_\_\_\_\_ is the criminal practice of using social engineering over the telephone system, most often using features facilitated by VoIP  
(a) Phishing   (b) Spear phishing      (c) Vishing      (d) Smishing
8. Involving deliberate attacks intended to disable computers or networks is \_\_\_\_\_.
9. Fraud involving another person's identity for an illicit purpose is \_\_\_\_\_  
(a) Identity theft      (b) Forgery      (c) Spoofing      (d) Counterfeiting
10. Unauthorized access of internet hours paid by another person is called \_\_\_\_\_.
11. Which of the following is an example of Intellectual property?

- (a) Patent    (b) Trademarks    (c) Copyright    (d) All of the above
12. Sending large number of email to a specific email address is known as \_\_\_\_\_
- (a) Spamming    (b) Hacking    (c) E-mail bombing    (d) Spoofing
13. When a person uses a computer to commit an unethical act, it is known as computer crime. (True/False)
14. Programs created to do something only when a trigger event occurs is \_\_\_\_\_
- (a) Virus    (b) Trojan horse    (c) Salami attack    (d) Logic bomb
15. \_\_\_\_\_ is also called as false data entry.
16. Worms are sometimes disguised as a useful program. (True/False)
17. DoS stand for \_\_\_\_\_.
18. Theft of software through the illegal copying of genuine programs is \_\_\_\_\_
- (a) Software piracy    (b) Forgery    (c) Hacking    (d) Salami technique
19. Gaining access and control over the website is known as \_\_\_\_\_.
20. \_\_\_\_\_ is the convergence of cyberspace and terrorism.
21. Every act committed toward breaking into a computer and/or network is \_\_\_\_\_.
22. \_\_\_\_\_ are the lowest form of cyber-criminal without programming knowledge
- (a) Cyberpunks    (b) Hackers    (c) Skiddie    (d) Crackers
23. \_\_\_\_\_ is a path or means by which a hacker can gain access to a computer or network server in order to deliver a malicious payload or malware.
24. Sneakware is the software that adds hidden components to the system. (True/False)
25. \_\_\_\_\_ is a criminal act which has been facilitated by computer use.
26. Advantages of cyberspace include
- (i) Entertainment    (ii) Social Networking
- (iii) Informational resources    (iv) Great medium of connectivity
- (a) i,ii    (b) iii,iv    (c) i,ii,iii    (d) All of the above
27. Prosecutorial Reluctance is a traditional problem associated with cybercrime. (True/False)
28. Lack of resources includes cost of training and cost of laboratory. (True/False)

29. Cyberspace is derived from the word \_\_\_\_\_

## SECTION-B

### Descriptive Questions

14. Define the following (L1) (CO:5)
- a) Cybercrime
  - b) Hacking
  - c) Computer crime
15. Classify the different types of cybercrimes. (L4) (CO:5,6)
16. Interpret the following (L2) (CO:6)
- a) Cybercrimes against individual.
  - b) Cybercrimes against property.
  - c) Cybercrimes against organization.
  - d) Cybercrimes against society.
17. What is an attack vector? List out the different ways to launch attack vectors. (L4) (CO:1)
18. Explain the Hierarchy of Contemporary Cyber-Criminals. (L2) (CO:5)
19. Summarize about Cyberspace and Criminal behavior. (L2) (CO:5)
20. Outline the traditional problems associated with computer crime. (L2) (CO:5)

## UNIT-V

### Assignment-Cum-Tutorial Questions

#### SECTION-A

#### Objective Questions

1. The smallest piece of data is called a \_\_\_\_\_
2. 4 bits = \_\_\_\_\_
3. The communication protocol used by internet is \_\_\_\_\_ [       ]  
(a) HTTP       (b) WWW       (c) TCP/IP       (d) FTP
4. DNS stands for \_\_\_\_\_
5. \_\_\_\_\_ is a branch of forensic science which includes the recovery and investigation of material found in digital devices.
6. \_\_\_\_\_ are central switching devices for communications lines in a star topology.

7. Units of data exchanged between host computers are called \_\_\_\_\_.
8. Routers are defined as special-purpose computers (or software packages) that handle the connection between two or more networks. (True/False)
9. \_\_\_\_\_ are small pieces of information that an HTTP server sends to the individual browser upon the initial connection.
10. \_\_\_\_\_ is a small local network connecting computers which are within one organization and which are controlled by a common system administrator. [            ]  
(a) Internet      (b) Routers      (c) Hub      (d) Intranet
11. Collection of hyperlinked pages of information distributed over the internet via a network protocol is called \_\_\_\_\_.
12. Which of the following protocols is used for WWW? [            ]  
(a) FTP   (b) HTTP   (c) W3      (d) All of the above
13. Information Technology (IT) Act 2000 came into force on \_\_ [            ]  
(a) 17 October 2000      (b) 9 June 2000  
(c) 1 June 2000      (d) 1 October 2000

## SECTION-B

### Descriptive Questions

1. Define Digital forensics. **(L1) (CO:5)**
2. Write short note about computer language. **(L1) (CO:1)**
3. List and explain commonly used terms in network language. **(L4)(CO:1)**
4. Explain the realms of the cyber world. **(L4) (CO:1)**
5. Discuss about brief history of the Internet. **(L4) (CO:1)**
6. Explain about computers as a target in the commission of cybercrimes. **(L4) (CO:1)**
7. Give an overview of Indian IT ACT 2000. **(L2) (CO:1)**



## UNIT-VI

### SECTION-A

#### Objective Questions

- \_\_\_\_\_ are the special type of programs used for recording and tracking user's keystroke. [ ]  
(a) Key logger (b) Trojans (c) Virus (d) Worms
- \_\_\_\_\_ is a small malicious program that works in background and steals sensitive data. [ ]  
(a) Virus (b) Trojan (c) Shareware (d) Adware
- Some Trojans carry ransom ware with them to encrypt the data and ask for ransom. (True/False)
- Trojans cannot \_\_\_\_\_. [ ]  
(a) Steal data (b) Self-replicate  
(c) Steal financial info (d) Steal login credentials
- A computer \_\_\_\_\_ is a malicious code which self-replicates by copying itself to other programs. [ ]  
(a) Program (b) Virus (c) Application (d) Worm
- \_\_\_\_\_ are difficult to identify as they keep on changing their type and signature. [ ]  
(a) Program Virus (b) Boot Sector Virus  
(c) Polymorphic Virus (d) Multipartite Virus
- Viruses, Worms and Spyware are the different types of Malware. (True/False)
- Trojans are not a type of virus. (True/False)
- A \_\_\_\_\_ travels from computer to computer in a network, but it does not usually erase data.
- \_\_\_\_\_ is the art of covered or hidden writing.
- What is a key logger? [ ]  
(a) Software that records keys you set when encrypting files  
(b) Software that records keystrokes made on a keyboard  
(c) Software used to log all attempts to access a certain file  
(d) Software that steals passwords or "keys" that you have saved on your computer.
- What is the software called which when get downloaded on computer scans your hard drive for personal information and your internet browsing habits?  
[ ]  
(a) Backdoors (b) Key logger (c) Virus (d) Spyware
- The virus that spread in application software is called as \_\_\_\_\_.
- \_\_\_\_\_ is hiding of data within data, where we can hide images, text, and other messages within images, videos, music or recording files. [ ]  
a)Cryptography b) Tomography c) Steganography d) Chorography
- Which malicious program cannot do anything until actions are taken to activate the file attached by the malware? [ ]  
a) Trojan Horse b) Worm c) Virus d) Bots
- Sniffing is traditional attack technique on wireless networks. (True/False)
- MITM stands for \_\_\_\_\_

### SECTION-B

#### Descriptive Questions

- Define firewall. (L1) (CO:4)
- State the purpose of packet filter. (L1) (CO:4)
- What is password cracking and explain the types of password cracking. (L4) (CO:6)

4. What is a key logger? Explain its various types. **(L4) (CO:6)**
5. Mention the use of antikeylogger. **(L1) (CO:6)**
6. What is a spyware? Explain the types of spywares. **(L4) (CO:6)**
7. What is a virus? Mention the typical actions of virus. **(L2) (CO:6)**
8. Categorize different types of viruses. **(L4) (CO:6)**
9. What is a worm? Why are worms dangerous? Explain it with an example (Morris Worm). **(L1) (CO:6)**
10. Differentiate Virus and Worms. **(L4) (CO:6)**
11. What is a Trojan/Trojan horse? What are the threats caused by Trojans? **(L1) (CO:6)**
12. What is a backdoor? Outline the functions of backdoor. **(L1) (CO:6)**
13. How to protect our system from Trojan horses and backdoors?  
**(L1) (CO:6)**
14. Discuss the concept of steganography. **(L4) (CO:5)**
15. What is steganalysis? **(L1) (CO:5)**
16. Difference between Steganography and Cryptography. **(L4) (CO:5)**
17. What is a wireless network? Describe the important components of wireless network.  
**(L4) (CO:6)**
18. Explain the traditional techniques of attacks on wireless networks.  
**(L4) (CO:6)**
19. How to secure the wireless networks? **(L1) (CO:6)**

**Signature of the Faculty**

## HANDOUT ON NODE AND ANGULAR JS

Class & Sem. : III B.Tech – II Semester

Year : 2020-21

Branch : CSE

Credits:3

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### 1. Brief History and Scope of the Subject

**NodeJS:** Node.js is an open-source, cross-platform, JavaScript runtime environment that executes JavaScript code outside of a browser. Node.js lets developers use JavaScript to write command line tools and for server-side scripting—running scripts server-side to produce dynamic web page content before the page is sent to the user's web browser. Node.js is a platform built on Chrome's JavaScript runtime for easily building fast, scalable network applications. Node.js uses an event-driven, non-blocking I/O model that makes it lightweight and efficient, perfect for data-intensive real-time applications that run across distributed devices. MERN has four components that breaths it into life; MongoDB, Express, React, and Node.js.

**AngularJS:** AngularJS is a JavaScript-based open-source front-end web framework mainly maintained by Google and by a community of individuals and corporations to address many of the challenges encountered in developing single-page applications. It aims to simplify both the development and the testing of such applications by providing a framework for client-side model–view–controller (MVC) and model–view–viewmodel (MVVM) architectures, along with components commonly used in rich Internet applications. AngularJS is the frontend part of the MEAN stack, consisting of MongoDB database, Express.js web application server framework, Angular.js itself, and Node.js server runtime environment.

### 2. Pre-Requisites:

- Should have knowledge on HTML, CSS, JavaScript, DOM and XML.
- Need to be aware of various programming language constructs.

### 3. Course Objectives:

1. To familiarize with defining own custom AngularJS directives that extend the HTML language.

2. To introduce the concepts of client-side services that can interact with the Node.js web server.
3. To understand the best practices for server side JavaScript.

#### 4. Course Outcomes:

Upon successful completion of the course, the students will be able to

- develop single page applications that reduces app's time to market without plugins.
- identify the services, modules and directives to subdivide application logic into modules and share code across apps
- explain the routing process in angular for managing URL's.
- interpret command line applications in Node.js that allows developers a more maintainable code
- develop code with use of Node.js and JSON services for web applications.
- examine how error events affect piped streams and handling events in Node.js

#### 5. Program Outcomes:

**Computer Science and Engineering Graduates will be able to:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### Program Specific Outcomes (PSOs)

**PSO1 :** Design, develop, test and maintain reliable software systems and intelligent systems.

**PSO2 :** Design and develop web sites, web apps and mobile apps.

### 6. Mapping of Course Outcomes with Program Outcomes:

CS2512: NODE AND ANGULAR JS (OPEN ELECTIVE-III)														
Course outcomes	Program Outcomes and Program Specific Outcome													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1: Develop single page applications that reduces app's time to market without plugins.	1		2	2	3							2	2	2
CO2: Identify the services, modules and directives to subdivide application logic into modules and share code across apps	2			2	1									
CO3: Explain the routing process in angular for managing URL's	1							1						
CO4: Interpret command line applications in Node.js that allows developers a more maintainable code	1			1	2							1	1	
CO5: Develop code with use of Node.js and JSON services for	2	1	2	1	3							2	2	2

web applications.																
CO6: Examine how error events affect piped streams and handling events in Node.js	1	2	2	2	3								2		2	2

### 7. Prescribed Text Books

- a. Agus Kurniawan, “Nodejs Programming By Example”, PE Press.
- b. Andrew Grant, “Beginning AngularJS”, Apress Publishers.

### 8. Reference Text Books

- a. David Herron, “Node.js Web Development”, 4th edition, Packt Publishing Ltd.
- b. Marc Wandschneider, “Learning Node.js: A Hands-On Guide to Building Web Applications in JavaScript”, Addison Wesley.
- c. Ken Williamson, “Learning AngularJS: A Guide to AngularJS Development”, O’Relly Media.
- d. Matt Frisbie, “AngularJS Web Application Development Cookbook”, Packt Publishing Ltd.

### 9. URLs and Other E-Learning Resources

- a. <https://www.techiedelight.com/json-introduction/>
- b. <https://docs.angularjs.org/tutorial>
- c. <https://docs.angularjs.org/tutorial>
- d. <https://www.tutorialspoint.com/angularjs/index.htm>

### 10. Digital Learning Materials

- e. <https://freevideolectures.com/course/3982/udemy-understand-nodejs>

### 11. Lecture Schedule / Lesson Plan

TOPIC	No. of Periods	
	Theory	Tutorial
<b>UNIT - I: Introduction to Node.js and JSON</b>		
Introduction	1	0
Operators	1	
Decision statements	1	
Iterative statements	1	
Node.js collections: create array object	1	
Insert, access, update and remove data	2	
JSON : Create JSON object	1	
JSON : Display, access and edit data	1	
JSON Array : Creation	1	
JSON Array : Display, access and edit data	1	

JSON Array: Check JSON attribute	1	
	<b>12</b>	
<b>UNIT - II: Node.js Files, Functions and Strings</b>		
File modules	1	0
Reading text	1	
Creating file	1	
Functions: creating function	1	
Types of functions	1	
Callback function	1	
Strings: operations	2	
String to numeric and vice-versa	1	
String parser	1	
	<b>10</b>	
<b>UNIT - III: Node.js Modules, Error Handling &amp; Logging and Events</b>		
Create simple module	1	0
module class	1	
Error handling and logging	2	
Events: Events module	2	
once event listener	2	
Remove events.	1	
	<b>9</b>	
<b>UNIT - IV: Introduction to Angular</b>		
Introduction to TypeScript (TS)	2	0
Node Package Manager	1	
Introduction to Angular	1	
Create angular application using TS and angular CLI	1	
Web pack	1	
Gulp introduction	1	
	<b>7</b>	
<b>UNIT - V: Elements in Angular</b>		
Angular components	1	0
Controllers	1	
Modules	2	
Dependency injection	1	
Angular service	1	
providers and directives	2	
Pipes and filters	2	
Angular forms-Reactive	1	
Lifecycle hooks	1	
	<b>12</b>	
<b>UNIT - VI: Routing in Angular</b>		
Routing-module	1	0

Component	1	
lazy loading of components	1	
apply route guards security	2	
Angular material design.	1	
	<b>6</b>	
<b>Total No. of Periods:</b>	<b>56</b>	<b>0</b>

**12. Seminar Topics:**

- f. Differences between NodeJS and Javascript
- g. Overview of AngularJS

**UNIT-I**

**Assignment-Cum-Tutorial Questions**

**A. Objective Questions:**

1. To make sure Node.js was installed, type \_\_\_\_\_ in the command window. [    ]
  - a) http://localhost:8080
  - b) http://127.0.0.1:8080/
  - c) eval
  - d) node -version
  
2. The way you run Node.js is the shell is called *REPL*. *REPL* stands for [    ]
  - a) Read-Eval-Print-Loop
  - b) Respond- Encode -Pool-Layout
  - c) Request- encode - Port- loop
  - d) Read- Edge -Print-Layout
  
3. How Node.js based web servers do differ from traditional web servers? [    ]
  - a) A. Node based server uses a single threaded model and can serve much larger number of requests compared to any traditional server like Apache HTTP Server.
  - b) B. Node based server process request much faster than traditional server.
  - c) C. There is no much difference between the two.
  - d) D. All of the above
  
4. Which of the following are True? [    ]
  - i. If you ever see three dots (...) in the Node REPL, that means it is expecting more input from you to complete the current expression, statement, or function.



- ii. If you do not understand why REPL is giving you the ellipsis i.e (...), you can just type `.break` to get out of it.
- iii. One or more servers on your machine listens on a *port* 80 for HTTP.
- iv. When a request is received, web server forks a new process or a thread to begin processing and responding to the query.
- a) i,ii,iii                      b) i,ii ,iv                      c) ii,iii,iv                      d) i, ii,iii,iv,
5. Which of the following are True? [    ]
- i. Web server work involves communicating with external services, such as a database, memory cache, external computing server, or even just the file system.
- ii. When all Web server work is finally finished, the thread or process is returned to the pool of “available” servers, and more requests can be handled.
- iii. To help with debug issue, Node.js you just add the debug flag before the name of your program: `node debug debugging.js`
- iv. The types null and undefined are special kinds of objects and are treated specially in JavaScript.
- a) i,ii,iii                      b) i,iii,iv                      c) ii,iii,iv                      d) i, ii,iii, iv
6. The push and pop functions help us add and remove items to the end of an array, respectively in Node.JS. [ True/False]
7. All numbers in JavaScript are 64-bit IEEE 754 double-precision floating-point numbers. [ True/False]
8. A JavaScript Engine is a program that converts code written in JavaScript to something that computer processor understands. [ True/False]
9. What operation is used to insert data into array in Node.js. [    ]
- a) insert()                      b) push()                      c)place()                      d) put()
10. Which of the following is the valid command to execute nodejs file using command prompt? [    ]
- a) `node filename`                      c) `node filename.js`  
b) `nodejs filename`                      d) `nodejs filename.js`
11. Match the following.
- |                  |                                    |
|------------------|------------------------------------|
| I. JSON          | P) collection manipulation         |
| II. NodeJS Array | Q) to combine JSON and collection  |
| III. JSON Array  | R) an open-source, cross-platform, |

## JavaScript runtime environment

- IV. NodeJS                      S) is an open-standard file format
12. Which of the following function is used to check for the existence of attribute name a JSON object? [   ]
- a) isOwnProperty( )
  - b) findOwnProperty( )
  - c) hasOwnProperty( )
  - d) ownProperty( )
13. Identify the features of nodejs from the following options. [   ]
- I. Everything is asynchronous
  - II. It yields great concurrency
  - III. single-threaded
  - IV. multi-threaded
- a) I, II only      b) I, II, IV only    c) II, III, IV only    d) I, II, III only
14. What is the expected output of the following code when executed on nodejs environment? [   ]
- ```
var a= '2019';
var b=2019;
console.log(a+b);
console.log(a==b);
console.log(a===b);
console.log(a-b);
console.log(a/b);
```
- a) 4038 true false 0 undefined
 - b) 4038 true false 0 1
 - c) '20192019' false false 0 1
 - d) '20192019' true false 0 undefined
 - e) '20192019' true false 0 1
15. What is the output of the following code in nodejs? []
- ```
var year = "2019";
console.log((year++)== 2020);
console.log((year++)== 2020);
```
- a) true true
  - b) true false
  - c) false true

- d) false false
16. Node uses \_\_\_\_\_ engine in core. [ ]
- a) Microsoft Spartan
  - b) SpiderMonkey
  - c) Chrome V8
  - d) Node En 12
17. Which of the following line numbers display true? [ ]
- Line 1: `console.log("222" === 222+ "");`
  - Line 2: `console.log("222" === 221+"1");`
  - Line 3: `console.log("222" !== 220+2);`
  - Line 4: `console.log("222" === 222+null);`
- a) Line 1, Line 2
  - b) Line 2, Line 3
  - c) Line 1, Line 3
  - d) Line 3, Line 4
18. What is the output of the following nodejs code?
- ```
var cars = ["Swift", "Grand i10", "Brezza", "Honda Jazz", "Honda City", "Kia Seltos"];
console.log(cars.splice(1,4).sort());
console.log(cars);
console.log(cars.splice(1,4).sort());
console.log(cars);
```
- a) ['Brezza', 'Grand i10', 'Honda City', 'Honda Jazz']
['Swift', 'Kia Seltos']
['Kia Seltos']
['Swift']
 - b) ['Brezza', 'Grand i10', 'Honda City', 'Honda Jazz']
["Swift", "Grand i10", "Brezza", "Honda Jazz", "Honda City", "Kia Seltos"]
['Brezza', 'Grand i10', 'Honda City', 'Honda Jazz']
["Swift", "Grand i10", "Brezza", "Honda Jazz", "Honda City", "Kia Seltos"]
 - c) ["Grand i10", "Honda City", "Honda Jazz", "Kia Seltos"]
['Brezza', 'Swift']
["Grand i10", "Honda City", "Honda Jazz", "Kia Seltos"]
['Brezza', 'Swift']
 - d) ["Grand i10", "Honda City", "Honda Jazz", "Kia Seltos"]
['Brezza', 'Swift']
["Grand i10", "Honda City", "Honda Jazz", "Kia Seltos"]
['Brezza']

19. Consider the following JSON and choose the correct option to display NAJS and DAA from the given options.

```
var subjects = {
  branch : 'CSE',
  year : ' Third Year',
  regulation : 'R17',
  electives : {
    e_subject1 : 'NAJS',
    e_subject2 : 'Cyber Security',
  },
  non_electives : {
    sub_1 : 'DAA',
    sub_2 : 'DWDM',
  }
}
```

- a) console.log(subjects.e_subject1);
console.log(subjects.e_subject1);
- b) console.log(subjects.electives.e_subject1);
console.log(subjects.non_electives.e_subject1);
- c) console.log(subjects.electives[0].e_subject1);
console.log(subjects.non_electives[0].e_subject1);
- d) console.log(subjects.electives[0]);
console.log(subjects.non_electives[0]);

SECTION-B

Descriptive Questions:

1. Discuss main features of Nodejs?
2. Discuss different operators, decision and iterative statements in Nodejs.
3. Identify the differences between JavaScript and Node JS.
4. Develop a program to create an array object, insert, access and update and remove data from it in Nodejs.
5. Develop a program to create JSON object, display, access and edit data from JSON object.
6. Develop a program for Creation, display, access and edit data from JSON Array.
7. Develop a program to differentiate slice and splice functions of array object in Nodejs.
8. Explain How Do We Decide, When To Use Node.Js And When Not To Use It?
9. Explain How Does Node.Js Work.

UNIT-II

SECTION-A

Objective Questions:

1. All file system operations have synchronous and asynchronous forms. The asynchronous form takes a _____ as its last argument. []
a) callback b) node c) process d) thread
2. The arguments passed to the completion callback depend on the method, but the first argument is always reserved for _____. []
a) error b) node c) process d) node --version
3. If file system operation was completed successfully, then the first argument will be null or undefined. [True/ False]
4. In the Node.js module system, each file is treated as a separate module. [True/ False]
5. Which is needed to import node fs module into our code and start writing IO operations code? []
a) request('fs') b) require('fs') c) require('files') d) request('files')
6. Which method takes the last parameter as the completion function callback and the first parameter of the callback function as error.
a) callback b) asynchronous c) synchronous d) module
7. Asynchronous method blocks a program during its execution, whereas synchronous method does not. [True/False]
8. How does the following nodejs code work? []

```
var fs = require("fs");  
function readData(err, data) {  
    console.log(data);  
}  
  
fs.readFile('ExistingFile.txt', 'utf8', readData);
```

 - a) Reads the data from ExistingFile.txt and ready to print on the console.
 - b) Reads the data from ExistingFile.txt and prints on the console.
 - c) Reads the data from ExistingFile.txt and prints on the browser.
 - d) Generates compile time error.
9. Which of the following options shows correct display output to the below NodeJs code? []

```
var myData = 123.45;  
if (true) {  
    (function () {  
        var myData = 'strange';  
        console.log(myData);
```

```

    })();
  }
  console.log(myData);

```

- a) strange b) 123.45 c) strange 123.45 d) compile time error

10. Which of the following options shows correct display output to the below NodeJs code?

[]

```

var status = 'normal';
if (true) {
  (function () {
    status = 'strange';
    console.log(status);
  })();
}
console.log(status);

```

- a) normal strange
 b) strange strange
 c) normal normal
 d) strange normal

11. Which of the following is FALSE about callback function?

[]

- a) a function that is to be executed after another function has finished executing
 b) The function which stores its previous state and called by itself.
 c) Any function that is passed as an argument is called a callback function.
 d) A callback function is a function that is called through a function pointer.
 e) Callbacks are a way to make sure certain code doesn't execute until other code has already finished execution.

12. What is the output of the following code?

```

console.log("first");
setTimeout(function() {
  console.log("second");
}, 0);
console.log("third");

```

- a) first second
 b) first second third
 c) first third second
 d) first third

13. Which of the following is/are optional in writing functions in nodejs?

[]

- e) Function name, parameters, function keyword
 f) Function name, return statement, function keyword
 g) Return statement, parameters, function keyword
 h) Function name, parameters, return statement

14. What is the output of the following nodejs code? []

```
function calculate(a,b,callback){
    var c = a/b + a;
    callback(c); }
calculate(111,3,function(result){
    console.log(result);
})
```

e) Compile time error

f) 138

g) 148

h) 111

i) What is the output of the following nodejs code? []

15. Which of the following options is correct output for the following nodejs code?

[]

```
function perform(a,b,callback)
{
    var errorCode = 102;

    callback(errorCode,'Internal error');
}
perform(33,11,function(errCode,msg)
{
    if(errCode){
        console.log(msg);
    }
})
```

a) errorCode

b) Internal error

c) Compile time Error

d) 102

16. Which of the following lines print 125 as output? []

Line1: console.log(parseInt('125'));

Line2: console.log(parseInt('125.34'));

Line3: console.log(parseInt('-125'));

Line4: console.log(parseInt('0.125'));

Line5: console.log(parseInt('125abc'));

Line6: console.log(parseInt('1'+25));

Line7: console.log(parseInt('abc125'));

a) Line 1, Line 2, Line 5, Line 6 Only

b) Line 1, Line 2 Only

- c) Line 1, Line 5, Line 6 Only
- d) Line 1, Line 2, Line 5, Line 7 Only

17. What is the output of the following nodejs code?

```
var msg = "Today is a nice day";  
var token = msg.split(' ');  
for(var i in token)  
    console.log(i);
```

Space for output:

18. Consider the following code and choose the correct option as output of the code.

```
var msg = "Today is a nice day";  
var token = msg.split(' ');  
for(var i in token)  
{  
    if(token[i++].length < token[1].length)  
        console.log(token[i]);  
}
```

- a) is
- b) a
- c) nice
- d) day
- e) nothing is displayed

19. What is the output of the following nodejs code?

```
var msg = "Today is a nice day";  
var token = msg.split(' ');  
for(var i in token)  
{  
    if(token[i].length > token[i].length)  
        console.log(token[i]);  
}
```

- a) Compile time error
- b) nothing will be displayed
- c) Today is a nice day
- d) Today nice

20. Write the correct output for the given nodejs code when split() method is used to parse a string.

```
var msg = "NodeJs-works-for:server-side--also";  
var token = msg.split('-');  
for(var i in token)  
{  
    if(token[i].length)
```



```
        console.log(token[i]);
    }
}
```

Space for output:

SECTION-B

Descriptive Questions:

1. Discuss file modules required for reading text in NodeJS.
2. Develop a program for reading text in NodeJS.
3. Develop a program for create file with the message “Today is a nice day” in NodeJS.
4. Discuss different arguments in the following function:

```
fs.read(fd, buffer, offset, length, position, callback)
```
5. Discuss different types of functions in NodeJS.
6. Illustrate the different string operations, string to numeric and vice-versa in NodeJS.
7. Create a function with parameters and a returning value in NodeJS.
8. Design a callback function in NodeJS.
9. Discuss string parser in NodeJS.

UNIT-IV

SECTION-A

Objective Questions

1. Which of the following are True? []
i) app-root is a component that is defined by our Angular application.
ii) In Angular we define our own HTML tags and give them custom functionality.
iii) The app-root tag will be the “entry point” for our application on the page.
iv) HTML <link> element refers to an external CSS file
A. i and ii B. i, iii and iv C. i and iv D. I, ii, iii and iv
2. Which of the following are TRUE? []
i) AngularJS is the most popular JavaScript MVC.
ii) Angular is essentially an HTML5 compiler.
iii) The [] parameter in the module definition can be used to define dependent modules.
iv) Without the [] parameter, you are not *creating* a new module, but *retrieving* an existing one.
A. i and ii B. i, iii and iv C. i and iv D. I, ii, iii and iv
3. Which of the following are True?

SECTION-B

SUBJECTIVE QUESTIONS

1. Illustrate TypeScript configuration and the TypeScript environment that are important to Angular developers including details about the [tsconfig.json](#) configuration.
2. Create angular application using TS and angular CLI. (5M)
3. Discuss two groups of packages, organized in package.json in Angular.
- 4) Illustrate defining the variables in Typescript using let, var and const.
- 5) Discuss 4 pillars of Angular 4.
6. Discuss Variable Scope in TypeScript : Global, Local & function scope.
- 7) Develop Angular JS program using angular CLI.
- 8) Develop Angular JS program using angular webpack.
- 9) Summarize 5 types of binding Angular 4.
- 10) Develop Angular JS program using gulp.

UNIT-V

SECTION-A

Objective Questions

1. Import **ReactiveFormsModule** for reactive forms, and **FormsModule** for template-driven forms.
A. <http://localhost:8080> B. `var clc = require('cli-color');`
C. <http://127.0.0.1:9000/> D. `node --version`
2. Instead of using **FormControl** directly, we can use a API underneath that does it all for us with **FormBuilder**. [T/F]
3. Match the Following life cycle hooks :
a) `ngAfterViewInit` i) Invoked when the component's view has been fully initialized.
b) `constructor` ii) This is invoked when Angular creates a component or directive by calling `new` on the class.
c) `ngAfterViewInit` iii) Invoked when the component's view has been fully initialized.
d) `ngOnDestroy` iv) This method will be invoked before Angular destroys component.
A. a-i, b-ii, c-iii, d-iv B. a-ii, b-i, c-iii d-iv
C. a-ii, b-iii, c-i, d-iv D. a-iii, b-i,c-ii, d-iv

UNIT-VI

SECTION-A

Objective Questions

1. we can add to our application is a _____ guard which is usually used to warn people if they are navigating away from a page where they have some unsaved changes.
A. CanDeactivate B. `var clr = require('cli-color');`
C. CanActivateChild D. `node --version`

2. 403 is a HTTP code, this one means _____. []
A. Accepted C. *Permission Denied*
B. The client request has succeeded. D. Created

3. The ngRoute module []

5. The most typical use case for the _____ guard is some form of checking to see if the user has permissions to view a page. []
C. CanActivate B. regression C. Selection D. Analysis

6. To add validation, we need to import the lovely **Validators** from **@angular/forms** and pass them in as a second argument to our **FormControl** instances.
[]

7. lazy-loading syntax uses [loadChildren](#) followed by a function that uses the browser's built-in `import(...)` syntax for dynamic imports. [T/F]

8. The import path is the relative path to the module. [T/F]

9. Guards are implemented as services that need to be provided so we typically create them as `@Injectable` classes. [T/F]

10. The Angular [Router](#) enables navigation from one [view](#) to the next as users perform application tasks. [T/F]

11. Match the following life cycle hooks: []
a) **ngDoCheck** i) Invoked when the change detector of the given component is invoked. It allows us to implement our own change detection algorithm for the given component.
b) [RouterOutlet](#) ii) is a directive from the router library that is used like a component
c) [RouterModule.forRoot\(\)](#) iii) is a method in module imports to configure the router.
d) `appRoutes` array of *routes* iv) describes how to navigate.
A. a-i, b-ii,c-iii, d-iv B. a-ii,b-i, c-iii, d-iv C. a-ii, b-iii,c-i, d-iv D. a-iii, b-i,c-ii, d-iv

SECTION-B

SUBJECTIVE QUESTIONS

1. Describe the steps involved in Routing.
2. Summarize route guards security.
3. Discuss the architecture of Angular material design.
4. Identify lazy loading of components in Angular.
5. Analyze various kinds of Angular material design.
6. Apply route guards security in Angular.

Signature of the Faculty

HANDOUT ON SCRIPTING LANGUAGES

Class & Sem. : III B.Tech – II Semester

Year : 2020-21

Branch : CSE

Credits : 3

1. Brief History and Scope of the Subject

- **jQuery:** jQuery is a fast, small, and feature-rich JavaScript library. It makes things like HTML document traversal and manipulation, event handling, animation, and Ajax much simpler with an easy-to-use API that works across a multitude of browsers. With a combination of versatility and extensibility, jQuery has changed the way that millions of people write JavaScript.
- **JSON:** JSON grew out of a need for stateless, real-time server-to-browser communication protocol without using browser plugins such as Flash or Java applets, the dominant methods used in the early 2000s. JSON was based on a subset of the JavaScript scripting language and is commonly used with Javascript, but it is a language-independent data format.
- **PERL:** Perl is a family of two high-level, general-purpose, interpreted, dynamic programming languages. "Perl" refers to Perl 5, but from 2000 to 2019 it also referred to its redesigned "sister language", Perl 6, before the latter's name was officially changed to Raku in October 2019. In addition to CGI, Perl 5 is used for system administration, network programming, finance, bioinformatics, and other applications, such as for GUIs
- **RUBY:** Ruby is an interpreted, high-level, general-purpose programming language. It was designed and developed in the mid-1990s by Yukihiro "Matz" Matsumoto in Japan. It supports multiple programming paradigms, including procedural, object-oriented, and functional programming. According to the creator, Ruby was influenced by Perl, Smalltalk, Eiffel, Ada, Basic, and Lisp. Ruby is dynamically typed and uses garbage collection
- **AJAX:** Ajax (Asynchronous JavaScript and XML) is a set of web development techniques using many web technologies on the client side to create asynchronous web applications. Ajax is not a single technology, but rather a group of technologies. With Ajax, web applications can send and retrieve data from a server asynchronously

(in the background) without interfering with the display and behaviour of the existing page.

2. Pre-Requisites:

- Should have knowledge on HTML, CSS, JavaScript, DOM and XML.
- Need to be aware of various programming language constructs.
- Should be able to write regular expressions.

3. Course Objectives:

- To familiarize with jQuery, JSON, PERL, Ruby, AJAX to develop client-side and server-side web applications.

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

- use jQuery with DOM to manipulate HTML elements, attributes and CSS.
- store and exchange data between server and browser using JSON.
- develop PERL scripts using arrays, hashes, control structures and subroutines.
- write Ruby scripts using data types, arrays, hashes, control structures and classes.
- retrieve data from a database using PHP and AJAX

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|---|---|
| and subroutines | | | | | | | | | | | | | | | | | | | |
| CO4: write Ruby scripts using data types, arrays, hashes, control structures and classes. | 2 | 2 | 2 | 1 | 2 | | | | | | | | | | | | | 2 | 2 |
| CO5: retrieve data from a database using PHP and AJAX | 2 | 2 | 2 | 1 | 2 | | | | | | | | | | | | | 2 | 2 |

7. Prescribed Text Books:

- Kogent, “HTML 5 Black Book”, 2nd Edition, Dreamtech Press.
- Dave Thomas, “Programming Ruby 1.9 & 2.0: The Pragmatic Programmers’ Guide”, 4th Edition, Pragmatic Bookshelf.
- Randal L. Schwartz, ý Brian D. Foy,ý Tom Phoenix, “Learning Perl”, 6th edition, O’REILLY Publications.

8. Reference Text Books:

- Uttam K Roy, “Web Technologies”, Oxford
- Chris Bates, WILEY, “Web Programming: building internet applications”, Dreamtech, 2nd edition.
- Robert W Sebesta, “Programming the World Wide Web”, Pearson publications, 4th edition

9. URLs and Other E-Learning Resources

- jQuery - <https://www.geeksforgeeks.org/jquery-tutorials/>
- JSON - https://www.tutorialspoint.com/json/json_overview.htm
- Ruby - <https://drive.google.com/file/d/0B8XIBGIjyFjmQVRDeTl6RE9sbU0/view>
- AJAX – https://www.w3schools.com/xml/ajax_intro.asp

10. Digital Learning Materials:

- PERL - <https://slideplayer.com/slide/11207876>
- AJAX - <https://freevideolectures.com/course/3195/ajax/3>

11. Lecture Schedule / Lesson Plan (4)

| Topics | No. of Periods |
|---|----------------|
| UNIT - I: jQuery | |
| Introduction | 1 |
| Selectors - element, id, class | 2 |
| Events | 1 |
| Effects – hide/show, fade, slide, animate, callback, chaining | 3 |

| | |
|---|-----------|
| Manipulating HTML using jQuery | 2 |
| Manipulating CSS using jQuery | 1 |
| | 10 |
| UNIT - II: JSON | |
| Introduction, Syntax rules | 2 |
| JSON vs XML, Data types | 1 |
| Objects | 1 |
| Arrays | 1 |
| Parsing JSON | 1 |
| using stringify() function | 1 |
| | 07 |
| UNIT - III: Introduction to PERL | |
| Basic syntax | 1 |
| Variables, operators | 2 |
| Control flow statements | 2 |
| Arrays | 1 |
| Hashes | 1 |
| File handling – open, close | 1 |
| Regular expressions | 2 |
| Subroutines | 1 |
| | 11 |
| UNIT - IV: Working with PERL | |
| Packages | 1 |
| Modules | 1 |
| Working with files - read, copy, move, rename, delete | 3 |
| Retrieving documents from the web with Perl – HTML pages | 2 |
| | 07 |
| UNIT - V: Ruby | |
| Introduction to Ruby | 1 |
| Types – Numeric and string literals, Variables and assignment statements, Numeric Operators, String Methods | 2 |
| Simple I/O – Screen output, keyboard input | 1 |
| Control Statements - Selection Statements, Looping Statements | 2 |
| Arrays , Hashes | 1 |

| | |
|--|-----------|
| Methods , Classes | 1 |
| Iterators | 1 |
| Pattern Matching | 2 |
| Overview of rails | 1 |
| | 12 |
| UNIT - VI: AJAX a New Approach | |
| Introduction, creating XMLHttpRequest object | 1 |
| Integrating AJAX with PHP | 2 |
| Retrieving data from a database using PHP and AJAX | 2 |
| Handling XML data using PHP and AJAX | 2 |
| | 07 |
| Total | 54 |

12. Seminar Topics:

- Overview of Javascript
- Overview of PHP

UNIT - I

Assignment-Cum-Tutorial Questions

A. Objective Questions:

1. jQuery is a []

- a) JavaScript Library
- b) JavaScript Language
- c) JavaScript Method
- d) PHP Method

2. What scripting language is jQuery written in? []

- a) C++
- b) JavaScript
- c) VBScript
- d) C#

3. `$(document).ready(function(){});`

Why do we place all jQuery methods inside this code?

[
]

- a) Because jQuery is never compiled
- b) It shows where jQuery starts and ends
- c) To enable the DOM to load jQuery
- d) To prevent jQuery code from running before the document is fully loaded

4. `$(selector).action()` – What does this jquery syntax format do? []

- a) Select an HTML element and then use HTML to act on it
- b) Select an HTML element and perform some action on it
- c) Perform an action on an element and then select it
- d) Perform selection and ignore the action

5. When referencing an HTML element preceded by a # (pound or hash), what javascript function is this equivalent to? []

- a) `getElementById`
- b) `getElementByClassName`
- c) `getElementByTagName`
- d) None of the above

6. Which of the following jQuery syntax uses the class selector []

- a) `$('#temp')`
- b) `$('.temp')`
- c) `$('.class')`
- d) `$('#temp').class`

7. `$('#temp').action()`

What type of selector is used in the above jQuery syntax? []

- a) id selector
- b) class selector
- c) name selector
- d) value selector

8. Look at the following jQuery selector: `$("div#intro .head")`. What does it select? []

- a) The first element with `id="head"` inside any `div` element with `class="intro"`

b) All elements with class="head" inside the first div element with id="intro"

c) All div elements with id="intro" or class="head"

d) None of the above

9. Which of the following jQuery selector selects elements with the given element

tag-name? []

a) \$('tag-name')

b) \$('#tag-name')

c) \$('.tag-name')

d) None of the above.

10. Which of the following jQuery selector selects element with the given element

id some-id? []

a) \$('some-id')

b) \$('#some-id')

c) \$('.some-id')

d) \$('@some-id')

11. Which of the following jQuery selector select elements whose css class is some class? []

a) \$('some-class')

b) \$('#some-class')

c) \$('.some-class')

d) None of the above.

12. Which of the following jQuery selector selects all elements available in a DOM? []

a) \$('*')

b) \$('?')

c) \$('#')

d) None of the above.

13. Which jQuery method is used to hide selected elements? []

a) hidden()

b) hide()

c) visible(false)

d) display(none)

14. Which of the following is correct about callbacks? []

- a) A callback is a plain JavaScript function passed to some method as an argument or option.
- b) Some callbacks are just events, called to give the user a chance to react when a certain state is triggered.
- c) Both of the above.
- d) None of the above.

15. Which jQuery method is used to switch between adding/removing one or more classes (for CSS) from selected elements? []

- a) toggleClass()
- b) switch()
- c) altClass()
- d)switchClass()

16. The speed options can be applied to which jQuery functions? []

- a) css and ajax
- b) show and fadeIn
- c) toggleCss
- d) All of the above

17. Which function do you reference in HTML form data? []

- a) value()
- b) formData()
- c) val()
- d) None of the above

18. Which function do you reference in content of selected elements? []

- a) html()
- b) text()
- c) val()d) None of the above

19. When do you use the \$(this) code? []

- a) When an HTML element will reference its own action.
- b) When an HTML element will reference its parent element's action c) When an HTML element will reference the entire document

d) none of the above.

20. What is the correct jQuery code to set the background color of all “p” elements to red? []

- a) `$("#p").layout("background-color","red");`
- b) `$("#p").manipulate("background-color","red");`
- c) `$("#p").style("background-color","red");`
- d) `$("#p").css("background-color","red");`

B. Descriptive Questions:

1. Define jQuery? List all the advantages of jQuery.
2. Differentiate between JavaScript and jQuery?
3. List and explain in detail different types of selectors available in jQuery with examples.
4. Define Event. Explain with an example how Click event is handled in jQuery.
5. Write a jQuery program to handle various mouse events.
6. Write a jQuery program to handle various key board events.
7. Explain with an example the following jQuery event methods:
 - (i) `dblclick`
 - (ii) `hover`
 - (iii) `focus`
 - (iv) `submit`
8. Explain with an example the following jQuery effect methods:
 - (i) `hide`
 - (ii) `show`
 - (iii) `delay`
 - (iv) `animate`
9. List and explain in detail various jQuery Fading Methods with an example.
10. List and explain in detail various jQuery Sliding Methods with an example.

11. What is method chaining in jQuery? Give an example.
12. Explain with an example the use of html() method in jQuery?
13. What is the purpose of jQuery css() Method? Give examples.

UNIT - II

Assignment-Cum-Tutorial Questions

A.Objective Questions:

1. JSON stands for
 - a) Java Standard Output Network
 - b) JavaScript Object Notation
 - c) JavaScript Output Name
 - d) Java Source Open Network
2. _____ is the file extension of JSON.
3. Which of the following is not true for JSON ?
 - a) JSON object is an unordered set of name/value pairs.
 - b) JSON object begins with { (left brace) and ends with }
 - c) JSON objects are typeless while XML data is typed
 - d) JSON objects are typed while XML data is typeless
4. Which of these is a benefit JSON has over XML?
 - a) JSON is more forgiving of poor formatting
 - b) JSON has less markup requirements and therefore is lighter than XML
 - c) JSON can be written poorly and still be parsed
 - d) JSON does not need to be stored in a file to be sent remotely
5. Which is correct format of writing JSON name/value pair
 - a) 'name : value'
 - b) name = 'value'
 - c) name = "value"
 - d) "name" : "value"
6. In the below notation, Employee is of type
{ "Employee": ["Amy", "Bob", "John"] }
 - a) Not a valid JSON string

b) Array

b) Class

d) Object

7. Which answer represents the following order of TYPES?

Object, String, Boolean, Number

a) “{ }”, “a string”, “false”, “0”

b) [], 0, “true”, “0”

c) { }, “0”, false, 0

d) { }, hello, “false”, “0”

8. Which of these is proper a JSON array?

a) { “letters” : [“a”, “b”, “c”;] }

b) { ‘letters’ : {“a”, “b”, “c” } }

c) { “letters” : [a, b, c] }

d) { “letters” : [“a”, “b”, “c”] }

9. Which of the following is NOT a valid JSON object?

a) { "name": "Smiley", "age": 20, "phone": "888-123-4567", "email": "smiley@xyz.com", "happy": true } b) { "name": "Smiley", "age": 20, "phone": null, "email": null, "happy": true }

c) { name: "Smiley", age: 20, phone: "888-123-4567", email: "smiley@xyz.com", happy: true }

d) { "name": "Smiley", "age": 20, "phone": { }, "email": "smiley@xyz.com", "happy": true }

10. Which of the following code will return a valid JSON object?

a) `JSON.parse(("{“FirstName”: “John”, “LastName”:”Doe”}));`

b) `JSON.parse(("{‘FirstName’: ‘John’, ‘LastName’:’Doe’}));`

c) `JSON.parse(("{{‘FirstName’: ‘John’, ‘LastName’:’Doe’}}));`

d) `JSON.parse(("{“FirstName”: “John”, “LastName”:”Doe”}’));`

11. Which of the following code will throw an error?

a) `JSON.parse(null);`

b) `JSON.parse(‘{ }’);`

c) `JSON.parse(undefined);`

d) `JSON.parse('[]');`

12. Which function will convert a JavaScript object to a JSON string?

a) `JSON.text()`

b) `JSON.serialize()`

b) `JSON.toString()`

d) `JSON.stringify()`

B.Descriptive Questions:

1. List out the advantages of JSON.

2. Explain with an example how to send, receive and store data using JSON.

3. Write the object notation syntax used in JSON. Give an example of JSON object.

4. Differentiate between JSON and XML

5. List and explain in detail various data types that are supported by JSON. Give examples for each.

6. Explain with an example how to create, store and access elements in an Array using JSON.

7. Does JSON support Nested arrays? Justify

8. Explain with an example various operations performed on an Object using JSON.

9. Create a JSON object that represents a Student with properties “Roll number”, “name”, “branch”, “year”, “mobile number”. The values of each field can be arbitrary.

10. Illustrate with an example the purpose of following methods in JSON

(i) `parse()`

(ii) `stringify()`

UNIT - III

Assignment-Cum-Tutorial Questions

A. Objective Questions:

1. What is Perl?

- a) Practical Extraction and Report Language
- b) Practice for Exclusive and Report Language
- c) Practical Extraction and Report Learning
- d) Practical Exclusive and Report Language

2. Which of the following variable context doesn't care what the return value is?

- a) Scalar

- b) List
 - c) Boolean
 - d) Void.
3. Which of the following symbol is used to denote Scalar in Perl?
 - a) \$
 - b) #
 - c) %
 - d) ^
 4. Which of the following symbol is used to denote Arrays?
 - a) #
 - b) \$
 - c) @
 - d) %
 5. Perl is?
 - a) An application program
 - b) A relation database
 - c) A type of interat
 - d) A programming language
 6. Scalar are used to store
 - a) Arrays
 - b) Single Value
 - c) Float Values
 - d) Hashes
 7. Which of the following data type stores associative arrays?
 - a) Scalar
 - b) Hash
 - c) Resource
 - d) Array

B. Subjective Questions:

1. How can a PERL variable act as a string and a number?
2. Write a “if...elsif.....else” structure which chooses between four alternatives in PERL.
3. Differentiate between arrays and hashes in PERL.
4. Write a subroutine to sort a list of numbers in increasing order and calculate their sum in PERL.
5. Can you list five reasons for using subroutines in our programs in PERL?
6. Explain about add and remove elements in Hashes with example.
7. Write a PERL program that implements “Quotelike Operators”.
8. Demonstrate PERL control flow statements with an example.
9. Write a Perl program that demonstrates Relational and Assignment operators.
10. Write a Perl program to Count the no of Palindrome numbers in a given set of numbers.
11. Write a Perl program that implements File handling concepts of STDIN, STDOUT and STDERR.

UNIT - IV

Assignment-Cum-Tutorial Questions

A. Objective Questions:

- a. What is the syntax for creating a package? []
A) package package_name (b) pkg package_name
(c) package statemet (d) None of the above
- b. Which keyword is used to load a module []
(a) use (c) import
(b) require (d) Both (a) and (b)
- c. Default package in Perl is _____ []
(a) default (c) system
(b) main (d) root
- d. What is the extension to save a module in perl []
(a) .pl (c) .pmod
(b) .pm (d) .perl
- e. Which operator is used to refer the variables within a package explicitly?
[]
(a) Package qualifier (c) :: ::
(b) -> (d) Dot operator
- f. What is the syntax to access the variables explicitly in another package?
[]
(a) PACKAGE_NAME::\$VARIABLE_NAME
(b) \$PACKAGE_NAME::\$VARIABLE_NAME
(c) PACKAGE_NAME::VARIABLE_NAME
(d) \$PACKAGE_NAME::VARIABLE_NAME
- g. What is the syntax to access the subroutines explicitly in another package?
[]
(a) PACKAGE_NAME::\$METHOD_NAME()
(b) \$PACKAGE_NAME::\$METHOD_NAME()
(c) PACKAGE_NAME::METHOD_NAME()
(d) \$PACKAGE_NAME::METHOD_NAME()
- h. Which environment variable is used for setting the path []
(a) @INC (c) TEMP
(b) PATH (d) ROOT
- i. BEGIN { } block acts as []
(a) Constructor (c) Heap
(b) Destructor (d) None of the above
- j. END { } block acts as []
(a) Constructor (c) Destructor
(b) Heap (d) None of the above
- k. What is the order of execution of BEGIN { ... } block []
(a) Top - Down
(b) Bottom - Up
(c) Neither (a) nor (b)
(d) None of the above
- l. What is the output of the following code: []
package Sample;
print "I am the First Line in the program\n";
BEGIN {

```

    print "This is BEGIN Block1\n"
  }
BEGIN {
  print "This is BEGIN Block2\n"
}
BEGIN {
  print "This is BEGIN Block3\n"
}
END {
  print "This is END Block1\n"
}
END {
  print "This is END Block2\n"
}
END {
  print "This is END Block3\n"
}
1;

```

- (a) This is BEGIN Block1
This is BEGIN Block2
This is BEGIN Block3
I am the First Line in the program
This is END Block3
This is END Block2
This is END Block1
- (b) I am the First Line in the program
This is BEGIN Block1
This is BEGIN Block2
This is BEGIN Block3
This is END Block3
This is END Block2
This is END Block1
- (c) This is BEGIN Block3
This is BEGIN Block2
This is BEGIN Block1
I am the First Line in the program
This is END Block1
This is END Block2
This is END Block3
- (d) This is BEGIN Block1
This is BEGIN Block2
This is BEGIN Block3
I am the First Line in the program
This is END Block1
This is END Block2
This is END Block3

- m. Syntax for Reading data from a FileHandle using print function. []
- (a) print(<FILE HANDLE>)
 - (b) print <FILE HANDLE>
 - (c) print "FILEHANDLE"
 - (d) print "<FILE HANDLE>"

14. Syntax for writing data to a file through a FileHandle using print function. []
- (a) print FileHandle String
 - (b) print <FileHandle> String
 - (c) print "FileHandle" String
 - (d) print "<FileHandle>" String

15. Which function is used to close a file in perl. []
- (a) close()
 - (b) pclose()
 - (c) fclose()
 - (d) Both (a) and (c)

16. LWP in perl means []
- (a) Library for WWW in Perl
 - (b) Leave Without Pay
 - (c) Least Working Package
 - (d) Library With Packages

C. Descriptive Questions:

- a. Define package? Write syntax for creating and accessing the package?
- b. Define module? Write syntax for creating and accessing of modules.
- c. Write a program which demonstrates the BEGIN and END blocks in modules.
- d. What is file handle? List and explain different file handles in perl.
- e. List and explain different operation on files.
- f. Explain different modes of file handling.
- g. Write a perl program to open a file in following modes:
 - (a)Read Only mode
 - (b)Write Only mode
 - (c)Append mode
- h. Write a perl program to count number of lines in a file.
- i. Write a perl program to find size of the file.

UNIT - V

A. Objective Questions:

1. Which of the following is supported by Ruby? []
 - a) Multiple Programming Paradigms
 - b) Dynamic Type System
 - c) Automatic Memory Management
 - d) All of the Mentioned
2. What is the extension used for saving the ruby file? []
 - a) .ruby extension
 - b) .rb extension
 - c) .rrb extension
 - d) None of the mentioned
3. Which of the following datatypes are valid in Ruby? []
 - a) Numbers
 - b) Boolean
 - c) String
 - d) All of the mentioned
4. What is the output of the following? []

"Iam learning ruby language".length

 - a) 26
 - b) 23
 - c) 20
 - d) 18
5. Which sequence can be used to substitute the value of any expression in a string?
 - a) #(expr)
 - b) #{expr}
 - c) #expr
 - d) None of the mentioned
6. The following syntax is correct for if conditional statement.

```
if condition code
end
```

 - a) True
 - b) False

What is the output of the given code?
- 7.


```

x=1
  if x > 2
    puts "x is greater than 2" elsif x
  <= 2 and x!=0
    puts "x is 1"
  else
    puts "I can't guess the number"
  end

```

a) x is greater than 2

b) x is 1

c) I can't guess the number

d) None of the mentioned

8. What is the use of else statement? []

a) When the if condition is false then the next else condition will get executed

b) When the if condition is false then the elsif condition will get executed

c) When the if condition is false and if else condition is true then only it will get executed

d) None of the mentioned

9. What is the output of given code? []

```

counter=1
  if counter<=5
    puts (counter)
    counter=counter+1
  else
    puts(counter)
    counter=counter-1
  end

```

a) 1, 2 end

b) 1,2,3,4,5

c) 1 2 1

d) 1

2

10. What is the output of the given code? []

```

x=3
  unless x>2
    puts "x is less than 2"
  end

```

else

end

puts "x is greater than 2"

a) x is greater than 2

b) x is less than 2

c) 3

d) None of the mentioned

11. What is the output of the given code? []

age = 5

```
case age when
  0 .. 2
```

```
  puts "baby"
when 3 .. 6
```

```
  puts "little child"
when 7 .. 12
```

```
  puts "child"
when 13 .. 18
```

```
  puts "youth"
else
```

```
  puts "adult"
end
```

a) baby

b) adult

c) little child

d) youth

12. What is the output of the given code? []

i = 0

```
while i < 5
```

```
  puts i
  i=(i+1)**2
```

```
end
```

a) 1 2 3 4 5

b) 0 1 4

c) 0 1

d) 1 4

13. What will be the output of the following? []

array = [100, 200, 300, 400, 500]

print array[4]

- a) 400
- b) 500
- c) Nil
- d) None of the mentioned

B. Descriptive Questions:

1. List and different features in ruby.
2. List and explain different types of variables in ruby with syntax.
3. Explain different types of data types supported by ruby.
4. Differentiate between Arrays and hashes in ruby.
5. Write the syntax for creating, accessing and looping through arrays.
6. Write a program to perform various operations on arrays.
7. Write the syntax for creating, accessing and deleting elements from associative arrays.
8. Define Method and outline with an example.
9. Write a program to create a Ruby Class called Student consisting of variables: name, rollnumber, branch, percentage and a method: display_details() which displays the details of the Student. Create atleast 2 objects for the class Student and display Student details.
10. Define iterator. List and explain types of iterators.
11. Define Pattern Matching. Give an example.
12. Draw the MVC architecture of ruby in rails.

UNIT - VI

A. Objective Questions:

1. Which JavaScript object is used by AJAX to exchange data between server and client.
 - a) XMLHttpRequest Object
 - b) ActiveX Object
 - c) XMLHttpRequest
 - d) ResponseText Object
2. What combination of technologies gives AJAX its name?
 - a) ASP and XAML
 - b) Asynchronous JavaScript and XML
 - c) Autonomic Computing and DHTML
 - d) Atlas and XML
3. What are the server response properties in AJAX?
 - a) responsetext
 - b) responseXML
 - c) responseText, responseXML
 - d) responsetext, responseXml
4. Which property holds the status of XMLHttpRequest object

- a) Onreadystatechange
 - b) readyState
 - c) status
 - d) readystate
5. In case of AJAX, what does the status-number 200 means?
- a) OK
 - b) Forbidden error
 - c) Not found error
 - d) Server is busy
6. Which type of communication does AJAX Engine supports?
- a) Synchronous
 - b) Asynchronous
 - c) One-way
 - d) Two-way
7. _____ function is called every time when the readyState changes in AJAX.
- a) status
 - b) onreadystatechange
 - c) responseXML
 - d) statusText
8. Difference between send() and send(string) method in AJAX?
- a) both used for sending data, where send() is used for GET request and send(string) is used for POST request.
 - b) "both used for sending data, where send() is used for POST request and send(string) is used for GET request."
 - c) send() is used for sending data where send(string) is used for sending request.
 - d) send(string) is used for sending data where send() is used for sending request.
9. PHP is a _____ Language
- a) Server side scripting
 - b) Client side scripting
 - c) Browser side scripting
 - d) Server side programming
10. PHP files have a default file extension of _____
- a) .html
 - b) .xml
 - c) .php
 - d) .ph
11. What is the Syntax of open method in AJAX?
- a) open(method, url, async)
 - b) open(url,method,async)
 - c) open(async,method,url)
 - d) open(method,async,url)
12. In Asynchronous communication model which type of communication was ELIMINATED?
- a) Asynchronous
 - b) stop- start- stop –start
 - c) Synchronous

- d) start-stop-start-stop
- 13. Which is the appropriate code to begin a HTTP GET request in AJAX?
 - a) request.open("GET","data");
 - b) request.open(POST,"data.csv");
 - c) request.open(GET,"data.csv");
 - d) request.open("GET");
- 14. What is the return type of async flag in AJAX?
 - a) T: Asynchronous, F: synchronous
 - b) T: accept, F: reject
 - c) T: synchronous, F: Asynchronous
 - d) T: reject, F: accept

B. Descriptive Questions:

1. Outline the features of AJAX.
2. Describe with an example how XMLHttpRequest object can be used to exchange data with a web server.
3. Outline the properties of XMLHttpRequest object.
4. With an example demonstrate how a web page can retrieve data from a database using PHP and AJAX.
5. Compare and contrast traditional web application with AJAX based web application.
6. With an example program explain how to access data from database using PHP and AJAX.
7. Differentiate between JavaScript and AJAX.
8. Create a simple XMLHttpRequest and retrieve data from a text file using AJAX.
9. Draw the architecture of AJAX.
10. Write a program that uses XMLHttpRequest Object.
11. Write program to access and display data stored in a MySQL database table using PHP and AJAX.
12. Differentiate between Synchronous and Asynchronous Ajax requests.

Signature of the Faculty

HANDOUT ON WEB MINING

Class & Sem. : III B.Tech–II Semester

Year : 2020-21

Branch : CSE

Credits: 3

1. **Brief History and Scope of the Subject**

The rapid growth of the Web in the last decade makes it the largest publicly accessible data source in the world. Web mining aims to discover useful information or knowledge from the **Web hyperlink structure**, **page content**, and **usage data**. Although Web mining uses many data mining techniques, it is not purely an application of traditional data mining techniques due to the heterogeneity and semi-structured or unstructured nature of the Web data. Yet the **Web mining process** is similar to the data mining process. The difference is usually in the data collection. In traditional data mining, the data is often already collected and stored in a data warehouse. For Web mining, data collection can be a substantial task, especially for Web structure and content mining, which involves crawling a large number of target Web pages. With the growth of the web and text documents, Web Mining and Text Mining are becoming increasingly important and popular.

2. **Pre-Requisites**

Basic knowledge of Data Mining Algorithms

3. **Course Objectives:**

- To impart machine learning techniques to mine the web and other information networks like social networks and social media.
- To introduce search, retrieval, classification and recommendation methods.

4. Course Outcomes:

Upon successful completion of the course, the students will be able to

CO1: describe classic and recent developments in information retrieval, web search and web mining

CO2: apply Page Rank and HITS algorithm for social network data analysis

CO3: differentiate Universal, Focused and Topical crawlers in internet

CO4: analyze complex information and social networks using Information

CO5: discover sentiment from social media data using opinion mining and web usage mining.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

| | |
|--|-----------|
| Web Search | 1 |
| Meta-Search | 2 |
| | 10 |
| Unit – II : Link Analysis | |
| Social Network Analysis | 3 |
| Page Rank Algorithm | 2 |
| HITS Algorithm | 2 |
| Community Discovery | 2 |
| | 9 |
| Unit – III : Web Crawling | |
| Crawler Algorithm | 2 |
| Implementation Issues | 2 |
| Universal Crawlers | 2 |
| Focused Crawlers | 2 |
| Topical Crawlers | 3 |
| | 11 |
| Unit – IV : Information Integration | |
| Schema Matching | 1 |
| Pre-Processing | 1 |
| Schema Level Match | 1 |
| Domain and Instance Level Match | 2 |
| 1: M Match | 1 |

| | |
|--|----------|
| Integration Of Web Query Interfaces | 3 |
| | 9 |
| Unit – V : Opining Mining | |
| Sentiment Classification | 2 |
| Feature Based Opinion Mining | 3 |
| Comparative Sentence and Relation Mining | 2 |

| | |
|-------------------------------------|-----------|
| Opinion Search | 2 |
| | 9 |
| Unit – VI : Web Usage Mining | |
| Data Collection | 3 |
| Data Modelling for Web Usage Mining | 2 |
| Discovery and Analysis | 3 |
| | 8 |
| Total No.of Periods: | 56 |

12. Seminar Topics

- Google Page Rank
- Link Prediction
- Web Structure Mining
- Web Content Mining
- Web Usage Mining

UNIT-I

Assignment-Cum-Tutorial Questions

SECTION-A

Objective Questions

1. A model of information retrieval in which we can pose any query in which search terms are combined with the operators AND, OR, and NOT:
 - a) Ad Hoc Retrieval
 - b) Ranked Retrieval Model
 - c) Boolean Information Model
 - d) Proximity Query Model
2. A data structure that maps terms back to the parts of a document in which they occur is called an
 - a) Postings list
 - b) Incidence Matrix
 - c) Dictionary
 - d) Inverted Index
3. A process to efficiently intersect lists to be able to quickly find documents that contain both terms is referred to as merging postings lists. [True/False]
4. The number of times that a word or term occurs in a document is called the
 - a) Proximity Operator
 - b) Vocabulary Lexicon
 - c) Term Frequency
 - d) Indexing Granularity
5. Stemming increases the size of the vocabulary. [True/False]

6. In information retrieval, extremely common words which would appear to be of little value in helping select documents that are excluded from the index vocabulary are called
- a) Stop words b) Tokens c) Lemmatized words d) Stemmed terms
7. A crude heuristic process that chops off the ends of the words to reduce inflectional forms of words and reduce the size of the vocabulary is called
- a) Lemmatization b) Case Folding c) True casing d) Stemming
8. Which of the following is NOT a benefit of index compression?
- a) Simplified algorithm design
b) Reduction of disk space
c) Faster transfer of data from disk to memory
d) Increased Use of caching
9. The tf-idf weight is _____ when a term t occurs many times within a small number of documents.
- a) Lowest b) highest c) 0 d) 1
10. A measure of similarity between two vectors which is determined by measuring the angle between them is called
- a) Cosine similarity b) Sine similarity c) vector similarity d) vector scoring
11. A web link within a web page that references another part of the same page is called a
- a) In link b) Vector c) Out link d) Tendril
- The search system that combines the results of other search engines is
- a) Fusion Search b) Meta Search
c) Combination Search d)
13. Copying a page is _____ and copying an entire site is _____
- a) Duplication, Mirroring b) Mirroring, Duplication
c) Duplication, Replication d) Replication, Duplication
14. The reputation score of a web page indicates its
- a) Weight b) Complexity c) Quality d) Content
15. In the context of web search engines the manipulation of web page content for the purpose of appearing high up in search results for selected query terms is called
- a) Paid inclusion b) Spam c) SEO d) Link Analysis

SECTION-B

Subjective Questions

1. Illustrate general IR architecture and the modules involved.

2. Discuss different types of Queries.
3. Explain briefly about the available IT models.
4. What is a Similarity Measure? Discuss such different measures.
5. What is Text Pre-Processing? Explain different tasks involved.
6. Is it necessary to pre-process web pages? Discuss different Web Pre-Processing techniques.
7. Explain how Duplicate Detection is done.
8. Explain the necessity of compressing the document inverted index.
9. Illustrate the procedure of constructing Inverted Index.
10. Explain how search is done using Inverted Index.
11. List and explain different coding schemes used to compress Inverted Index.
12. Briefly explain the operations of a Search Engine.
13. Illustrate the Meta-Search Engine and its architecture.
14. Explain the meta-search combination (or fusion) algorithm that uses Similarity scores.
15. Explain the fusion algorithm that uses Ranked Positions.

UNIT-II

SECTION-A

Objective Questions

1. During the process of integration, individual database schema or query interfaces are integrated into a _____.
2. Mapping is represented with _____ relation. []
 - a) Similarity
 - b) Aggregation
 - c) Union
 - d) None of the above
3. The process of breaking an attribute value into atomic words is []
 - a) Stemming
 - b) Standardization
 - c) Tokenization
 - d) Atomicalization
4. 1:m and m:1 matches are equivalent to each other. [True/False]
5. A is a _____ of B if B is a kind of A. []
 - a) Synonym
 - b) Hypernym
 - c) Homonym
 - d) Acronym
6. The approaches to schema-level only match are []
 - I. Linguistic
 - II. Constraint based
 - III. Clustering based
 - IV. Correlation based
 - V. Instance based

- a) I, II, III, IV, V b) I, II c) I, II, V d) III, IV, V
7. _____ is a popular similarity measure used in information retrieval. []
- a) Tangent b) Co-tangent c) Sine d) Cosine
8. The sub-domains derived from a composite domain are _____. []
- a) Simple b) Composite c) n-ary d) can't determine
9. When each relevant schema element on the many side is a specialization of the schema element on the one side, it is _____ type 1:m match. []
- a) Specialized b) Generalized c) Part-of d) Is-a
10. _____ is a set of databases that can only be accessed through parameterized query interfaces. []
- a) Surface Web b) Deep Web c) Spider Web d) DBGroup
11. Match the related words: positively correlated, negatively correlated, group, match, co-occur, rarely co-occur []
- a) positively correlated, group, match
- b) negatively correlated, co-occur, match
- c) positively correlated, co-occur, group
- d) negatively correlated, rarely co-occur, match
12. Occurrence Matrix is a 3-dimensional matrix built on []
- a) IS, GS and RS b) GS, IS and RS c) RS, IS and GS d) RS, GS and IS

SECTION-B

Subjective Questions

1. Write a short note on Schema Matching.
2. List the types of Schema Matching based on the input information.
3. Discuss different Pre-Processing techniques used for Schema Matching.
4. Write a short note on the notion of match cardinality.
5. Explain the linguistic approaches to Schema-level Matching.
6. Define the following:
 - a. Hypernym
 - b. Homonym
7. Explain briefly about the Domain and Instance-level Matching.
8. Discuss different approaches to domain identification of attributes.
9. Demonstrate how finding a 1:m Match is different from 1:1 match.
10. Compare and contrast Web Query Interface and traditional database schema.
11. Illustrate the Schema Model of Query Interfaces.
12. List and explain the steps in clustering based technique of query interface integration.
13. Explain briefly about the correlation based query interface integration.
14. Illustrate the Instance based approach to query interface integration.

Signature of the Faculty

GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, Gudlavalleru – 521 356.

Department of Computer Science and Engineering



2020-21 SEM -II

IV-B.Tech Handout

HANDOUT ON SOCIAL NETWORKS

Class & Sem. : IV B.Tech – I Semester

Year : 2020-21

Branch : CSE

Credits : 3

1. Brief History and Scope of the Subject

Social networks have been at the core of human society since we were hunters and gatherers. People were tied together through their relations with one another and their dependence on one another. Kinship and family relations are social networks. Neighbourhoods, villages, and cities are crisscrossed with networks of obligations and relationships. Beyond kinship relations, people in modern societies are dependent upon one another for many things. It is well known that World Wide Web is the main driving force behind making new connections. Internet itself is an example of a huge network and changed the rules of social networks.

Social networks and their analysis is an inherently interdisciplinary academic field which emerged from social psychology, sociology, statistics and graph theory. Social network analysis can be applied to many substantive areas. Social network analysis is now one of the major paradigms in contemporary sociology, and is also employed in a no. of other social and formal sciences. Together with other complex networks, it forms part of the nascent field of network science. This course covers introduction to social concepts and social network analysis.

2. Pre-Requisites

- Familiar with the fundamental concepts of Graph Theory.

3. Course Objectives:

- To familiarize with the technological concepts of Social networks.
- To provide a comprehensive overview of Social Network Systems.

4. Course Outcomes:

Upon successful completion of this course, students should be able to:

- CO1:** outline social concepts.
- CO2:** categorize network segments and their Characteristics.
- CO3:** analyze psychological foundations of Social networks.
- CO4:** evaluate network structure of organizations.
- CO5:** examine Network Influence and diffusion of ideas.
- CO6:** evaluate network as social capital

5. Program Outcomes:

Graduates of the Computer Science and Engineering Program will have

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Design, develop, test and maintain reliable software systems and intelligent systems.

PSO2 : Design and develop web sites, web apps and mobile apps.

6. Mapping of Course Outcomes with Program Outcomes:

| CT2539 : SOCIAL NETWORKS (Professional Elective-VI) | | | | | | | | | | | | | | | |
|--|--|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|---------------|---------------|---------------|---------------|---------------|--|
| Course outcomes | Program Outcomes and Program Specific Outcome | | | | | | | | | | | | | | |
| | P O 1 | P O 2 | P O 3 | P O 4 | P O 5 | P O 6 | P O 7 | P O 8 | P O 9 | P O 10 | P O 11 | P O 12 | PS O 1 | PS O 2 | |
| CO1:outline social network concepts | 2 | | | | | | | | | | | | | | |
| CO2:categorize network segments and their characteristics. | 2 | 2 | | | | | | | | | | 1 | | | |
| CO3:analyze psychological foundations of social networks. | 2 | 2 | | | | 2 | | | | | | 1 | | | |
| CO4:evaluate network structure of organizations. | 2 | 1 | 2 | 1 | | | | | | | | 1 | | | |
| CO5:examine network influence and diffusion of ideas. | | 3 | | | | | | | | | | 1 | | | |
| CO6:evaluate network as social capital. | 2 | 1 | | | | 1 | | | | | | 1 | | | |
| SOCIAL NETWORKS | 2 | 2 | | | | 1 | | | | | | 1 | | | |

7. Prescribed Text Books

1. Understanding Social Networks: Theories, Concepts, and Findings By Charles Kadushin.

8. Reference Text Books

1. Social Networks and the Semantic Web By Peter Mika.
2. Social Network Analysis: Methods and Applications By Stanley Wasserman, Katherine Faust.

9. URLs and Other E-Learning Resources

- a. www.ischool.utexas.edu/~i385q/archive/sharma_social_networks.ppt
- b. <http://www.pr.com/press-release/214190cs.nyu.edu/~jchen/socialnetworks.ppt>
- c. http://en.wikipedia.org/wiki/Social_network

10. Lecture Schedule / Lesson Plan

| Topic | No. of Theory |
|--------------|----------------------|
|--------------|----------------------|

| | Periods |
|---|----------------|
| UNIT – 1: Basic social network concepts | |
| Basic social network concepts | 4 |
| Distributions | 3 |
| Multiplexity | 2 |
| Roles and positions | 1 |
| Embedded of the informal within instituted or named networks | 2 |
| | 12 |
| UNIT – 2: Network segmentation | |
| Network segmentation | 2 |
| Named and Unnamed Network segments | 2 |
| Segmenting groups on the basis of cohesion | 2 |
| structural similarity and structural equivalence | 2 |
| | 8 |
| UNIT – 3: Psychological foundations of social networks | |
| Psychological foundations of social networks | 2 |
| Safety | 2 |
| Effectiveness | 2 |
| Status | 2 |
| Limits on individual networks | 2 |
| | 10 |
| UNIT – 4: Organizations and networks Information | |
| Organizations and networks Information | 2 |
| Driven organizations | 2 |
| Bridging the gaps: Network size | 2 |
| diversion and social cohesion | 2 |
| | 8 |
| UNIT – 5: Networks, Influence and diffusion | |
| Networks and diffusion | 3 |
| Influence and decision making | 4 |
| Epidemiology and network diffusion | 4 |
| | 11 |
| UNIT – 6: Network as social capital | |
| Network as social capital | 3 |
| Individual level social capital | 3 |
| social capital as an attribute of social systems | 3 |
| | 9 |
| Total No. of Periods: | 58 |

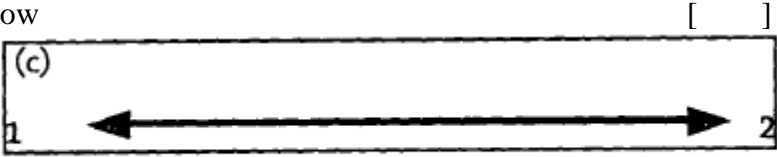
11. Seminar Topics

- Social Networking
- The Small World Phenomenon
- Semantic Web

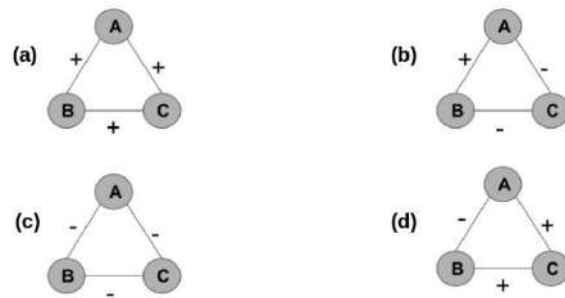
- Social Network Clusters
- Privacy and Security in Social Networks

UNIT-I
Assignment- Cum- Tutorial Questions

Objective Questions

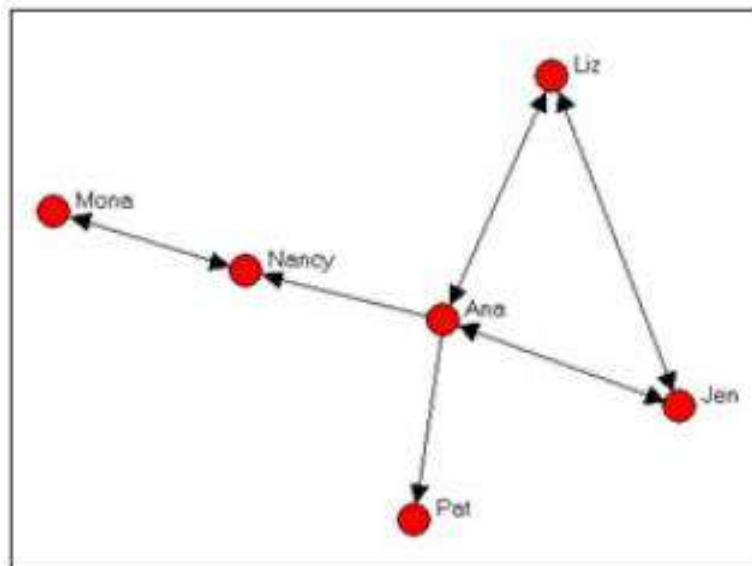
- The term Sociogram is invented by _____.
- _____ is used to represent the network mathematically.
- _____ The phrase “A Friend of my friend is a friend of mine” is example of _____
- As per the well-known history of Karate club, in the end, the club got divided into how many communities
a) 1 b) 2 c) 3 d) 4
- A Person with higher degree than others has
a) high centrality b) low Centrality
c) small distance d) None of these
- _____ Networks in which boundaries are not clear
a) Ego-Centric Network b) Socio-Centric Network
c) Open System Network d) None of these.
- When nodes are more likely to be connected based on geographical proximity, it is called as
a) Propinquity b) Homophily
c) Mutuality d) Balanced
- _____ Homophily refers to the friendship between people
a) Who are similar to each other
b) Who are dissimilar to each other
c) Who are introduced to each other because of a common friend
d) Who have different ethnicity but live at the same place
- _____ Identify the type of dyad in the figure below
[]

- a) Null b) Asymmetric c) Mutual d) None
- In social networks, friends and acquaintances respectively lead to:
a) Strong Ties, Weak Ties b) Weak Ties, Strong Ties
c) Both lead to Strong Ties d) Both lead to Weak Ties
- Identify the network group in which a person receives support for job search
a) Ego-Centric Network b) Socio-Centric Network
c) Open System Network d) None of these.
- Diameter of a network is defined as?

- a) The number of nodes on the longest path between the two most distant nodes in the network.
 - b) The number of nodes on the shortest path between the two most distant nodes in the network.
 - c) The number of edges on the longest path between the two most distant nodes in the network.
 - d) The number of edges on the shortest path between the two most distant nodes in the network.
12. The Famous allegation “six degrees of separation” demonstrates
- a) The Theoretical no. of steps between any two persons in India.
 - b) The original no. of steps between any two persons in India.
 - c) The Theoretical no. of steps between any two persons in US.
 - d) The original no. of steps between any two persons in US.
13. Citation Network is which type of network?
- a) Directed b) Undirected c) Weighted d) None of the above
14. Co-authorship Network is which type of network?
- a) Role Multiplicity b) Position Multiplicity
 - c) Content Multiplicity d) None
15. _____ were first identified as loyalties for accomplishment of tasks
- a) Formal relations b) Informal Relations
 - c) Complex Relations d) Multiple Relations
16. Dynamics of friendships formation and behavior of people in a network is
- a) Impacted by neither - selection and social influence.
 - b) Impacted by both, selection as well as social influence.
 - c) Impacted by selection but not social influence.
 - d) Impacted by social influence but not selection.
17. Weak ties are important because:
- a) They might later become strong ties.
 - b) They provide connections across communities.
 - c) They connect nodes with difficult-to-reach parts of the network.
 - d) both b and c
18. Triadic closure implies that:
- a) Two people having a common enemy have more probability of becoming friends with each other.
 - b) Three people having a common enemy have more probability of becoming friends with each other.
 - c) Two people having a common friend have more probability of becoming friends with each other.
 - d) Two people having a common person as a distant acquaintance have more probability of becoming friends with each other.
19. Which of the following triangles follows the social belief that ‘Enemy of my enemy is my friend’?



Descriptive Questions

1. Define Network. What are different relationships between nodes of a network?
2. Mention different kinds of networks investigated by social scientists?
3. What is Propinquity Effect?
4. What is Density? What does Density facilitates?
5. Define Geodesic Distance. How a set of nodes can be grouped into different zones based on distance?
6. What is Sociogram? Write the concept of mutuality
7. Briefly discuss about Individual-Level Homophily.
8. Point out the importance of Centrality in a Network
9. Discuss in detail about size of Interpersonal Environment.
10. Explain about Multiplexity in Social Networks.
11. Identify Dyad based Reciprocity in the network below:



12. Compare and Contrast Formal and Informal relations in a network .

Unit-II

Assignment- Cum- Tutorial Questions

Objective Questions

1. Identify which type of elite core suggest type of cluster can be applied to the community power literature
 - a) Groucho Marx Core
 - b) Caucus
 - c) Deference
 - d) Meek
2. Separating the whole network into smaller meaningful parts known as
 - a) Groups
 - b) Cliques
 - c) Clusters
 - d) Segments
3. Networks that correspond to names given by the participants in the network []
 - a) emic Networks
 - b) etic Networks
 - c) Local Networks
 - d) None
4. A small social group whose members share close personal enduring relationships
 - a) Clusters
 - b) Cliques
 - c) Primary Groups
 - d) Segments
5. A maximal complete sub graph of three or more nodes
 - a) dyad
 - b) triad
 - c) Clique
 - d) None of the above
6. Group of thing or persons close together is known as
 - a) Clusters
 - b) Cliques
 - c) Primary Groups
 - d) Segments
7. Higher density of node in a network can be identified by
 - a) A Node has more Likes
 - b) A Node has less likes
 - b) A Node has no likes
 - d) None of the above
8. Nodes that have similar patterns of relationships with other nodes are grouped together
 - a) Structural Equivalence
 - b) Structural Similarity
 - c) clusters
 - d) Cliques
9. Identify which of the following block model is suitable for "Block A relates to block A and block B, B relates to A but not to itself".

a)

| | A | B |
|---|---|---|
| A | 1 | 1 |
| B | 1 | 0 |

b)

| | A | B |
|---|---|---|
| A | 1 | 0 |
| B | 1 | 0 |

c)

| | A | B |
|---|---|---|
| A | 1 | 1 |
| B | 1 | 0 |

d)

| | A | B |
|---|---|---|
| A | 1 | 0 |
| B | 1 | 1 |

10. Identify which adjacency matrix represents symmetric relation []

a)

| A | B |
|---|---|
| 0 | 1 |
| 1 | 0 |

b)

| A | B |
|---|---|
| 1 | 0 |
| 0 | 1 |

c)

| A | B |
|---|---|
| 0 | 1 |
| 0 | 0 |

d)

| A | B |
|---|---|
| 0 | 0 |
| 1 | 0 |

11. There can be a situation in which A remains the elite in that relates only to other A's, but B also has some density of relating to other B's, and also to A. Breiger calls this situation.

- a) The Meek Deference
- c) Polarization Caucus

- b)
- d)

12. Which of the following block model comes under polarization

- a)

| A | B |
|---|---|
| 1 | 0 |
| 0 | 1 |
- b)

| A | B |
|---|---|
| 0 | 0 |
| 0 | 0 |
- c)

| A | B |
|---|---|
| 0 | 1 |
| 1 | 0 |
- d)

| A | B |
|---|---|
| 0 | 0 |
| 1 | 0 |

13. Identify the two master ideas about social relations in network

- a) Cohesiveness, Structural Similarity
- B) Structural Similarity, Structural Equivalence
- C) Cohesiveness, Structural Equivalence
- D) None of these.

14. Nodes can be removed or added to the network the former and latter is called

- a) adhesion, cohesion
- b) cohesion, adhesion
- c) adhesion, disruption
- d) None of these

8. For the following Karate club member networks which pairs of nodes has highest Density

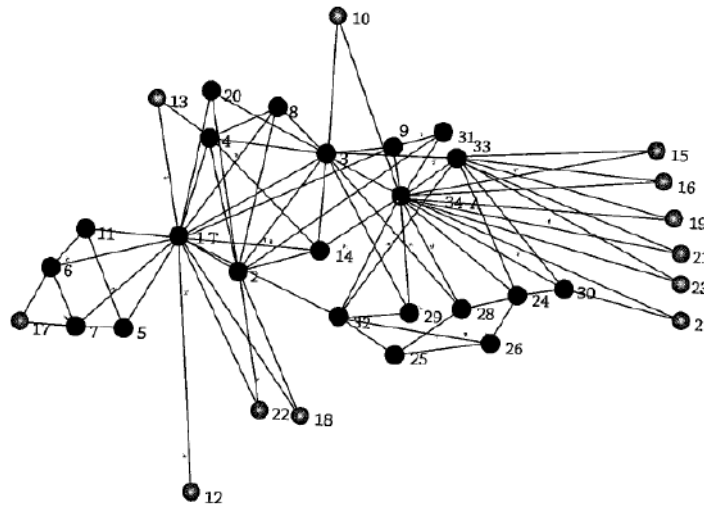
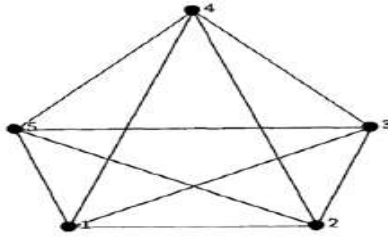


FIGURE 3.1 Friendship Network among Karate Club Members

- a) 1,34
- 10,22
- b) 4,33
- 25,31

- b)
- d)

9. Name the following network



- a) Dyad b)
- Triad
- b) Clique d)
- Primary Group

10. In a core-periphery structure

- a) Low status people are linked in densely connected core while the high status people atomize around this core as periphery of the network.
- b) Core and the periphery occupy interchangeable positions in the network.
- c) The notion of a node being in a core or in a periphery does not depend on the social status or the wealth of a node.
- d) High status people are linked in densely connected core while the low status people atomize around this core as periphery of the network.

Descriptive Questions

1. Define Network Segmentation. What are its advantages.
2. Discuss in detail about Structural Similarity.
3. State the Mathematical definition of Cliques.
4. Differentiate between Structural Similarity and Structural Equivalence.
5. Explain Named and Unnamed Network Segments. Segments.
- (February 2019)
6. Explain the concept of Resistance to Disruption.
7. Illustrate Core-Periphery Structures. Structures.
- (February 2019)

(or)

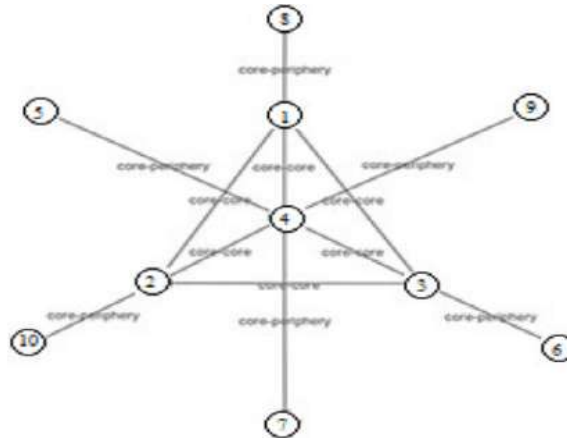
Illustrate various block models involved for the symmetric network.

Write a short note on

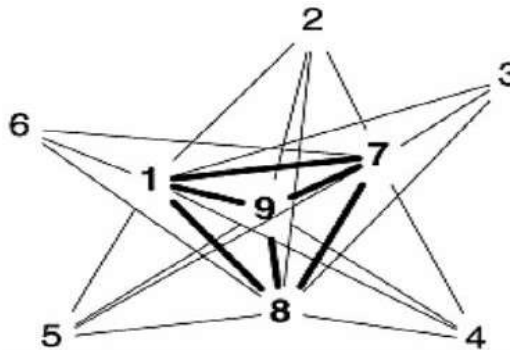
Clusters

Primary Groups.

8. Assume that there are two blocks in a network: block A having nodes 1,2,3,4 and block B having the nodes 5,6,7,8,9,10. Compute the Adjacency Matrix and various core/periphery structures of the following graph.

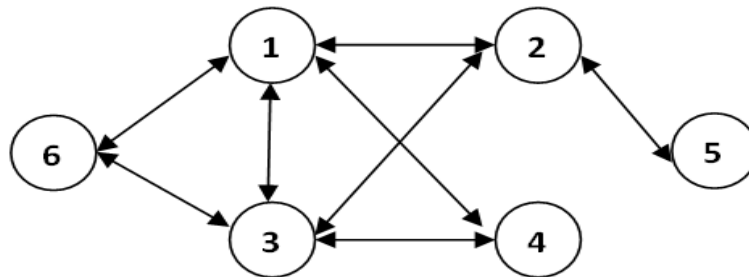


9. Assume that there are two blocks in a network: In block A having nodes 1,7,8,9 and block B having the nodes 2,3,4,5,6. Compute the Adjacency Matrix and various core/periphery structures of the following graph.



10. For the given network, assume there are two blocks – block A having nodes <1,2,3> and block B having nodes <4,5,6>. Write Blocked Adjacency Matrix and various Core/Periphery Structures.

(November 2018)



Unit III

Assignment- Cum- Tutorial Questions

Objective Questions

Two kinds of basic human motivations respond to primary needs are

- a) feel safe, individual
- b) reach out, integrity
- c) feel safe, reach out
- d) none

A professional manipulator of people and information who brings communication for profit is known as

a)broker b)neighbour c)manager d) None of the above
When examining community and support, one first checks for the presence of **ties** embedded in the social system.

Cohesion and support became more important in

- a) traditional systems b)modern society c)social cocoon d) none

The main difference between effectiveness networks and safety networks as ideal types is

- a) Location of Fraud b)Location of deceit c) Location of Trust d) None

A sense of self-sufficiency, autonomy and individuation is called as

- a) safety b)effectiveness c)cohesion d)support

Dense social networks are characterized by the sense of

- a) Fraud b) Trust c) individuality d) none

By focusing on which, we concern ourselves more with efficacy than safety

- a) Connections b) Holes c) mutual relationships d) none

Identify the concept to which the following statement belongs to "Stay within one's social cocoon, for the connections between people".

- A)Safety b) communication c) effectiveness d) None of the above

1. In case of exchange situations of nodes in a network, relate which of the following are altered.

- A) Safety & effectiveness b)Cohesion& Support c)Cohesion d)Support

2. "Density depends on Structural holes rather than cohesion" correlate the statement to appropriate one.

- A)Effectiveness b)Proximity c) Safety d)None of these

3. Identify the group for which network of infant and her mother, father or household members belongs to

- a) modern society group b) Human Group
c) social cocoon group d) traditional systems group.

4. Connect the group affiliation-trust-density with the related aspect

- a) Status b)Effectiveness c)Safety d)None

5. "People follow their own goals, and independent of others" associate this statement to related property.

- a) Co-joint b)Dis-joint c)Joint d)None

6. The mean size of one's circle of acquaintances per men and women

- a) 650,590 b) 590,650 c) 600,500 d) 500,600

Descriptive Questions

Write briefly about psychological foundations of Social networks.

Write a short note on community and support.

Explain briefly about Effectiveness and Structural Holes

Discuss in detail about Safety and Social Networks

Explain about Cultural Differences in Safety, Effectance, and Rank

Explain in detail about Cognitive Limits on Individual Networks

Differentiate the following.

A) Safety

B) Effectiveness

Discuss in detail about Status.

Illustrate that the feelings of safety and reach out aspects are needs for human motivation.

Categorise affiliation, competition, location of trust, structural holes, density in to two drives.

UNIT-IV

Objective Questions

Modern organizations are *rational-legal systems*, based on *universalistic principles* and are supposed to be

- A) Fair b) unfair c) None of the above d) Both a & b

Workers also brought their own cultural values and attitudes into the situation. Among those values, as we will see, was the working-class fear of

- A) Employment b) Un-Employment c) profession d) hiring

The Network “Bank Wiring Room” is an example of

- a) Helping Network b) Organizational Network c) Both a&b
d) None of the above

Organizations are social structures designed to get things done through the cooperation of

- A) Individuals b) Groups c) Clusters d) None of these

The organization systems like “The Law offices, health delivery systems, R&D and many nonprofit organizations” comes under

- A) In-Organic Systems b) Organic Systems

- c) Both a&b d) None of the above

The situation in which “Requests are accepted as fitting and legitimate but outside of which they are not” is characterized by

- a) zone of indifference b) Area of acceptance
c) both a & b d) None of these.

In Multilevel organization there is a situation in which if one individual of one group can collaboratively work with other individual of another group.

- a) Re-legislate b) Both a&c c) Silo Problem d) None of the above

In Multilevel organization there is a situation in which if a position does not like a particular decision made in the unit and bypasses her boss to directly approach the CEO

- A) Re-legislate b) Silo Problem c) Both a & b d) None of the above

Identify the statement “Lies with persons to whom it [an order] is addressed, and does not reside in persons of authority” is an example of

- A) Informal Organization b) Formal Organization

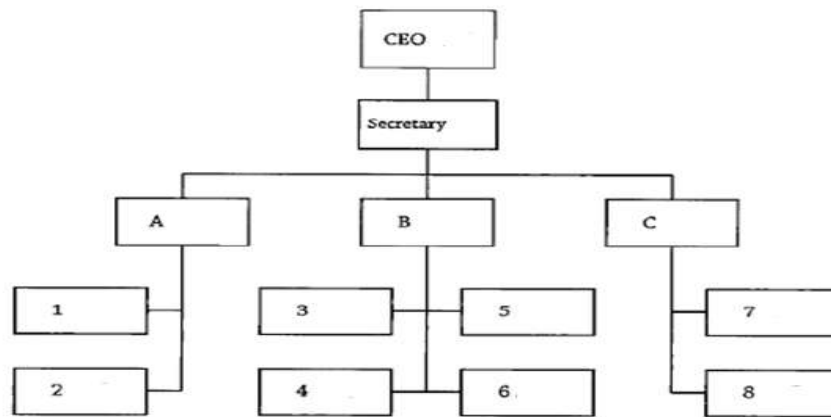
- c) Both a&b d) None of the above.

9. The extent that the friendship, homophily, and propinquity play roles, these networks are fundamentally “**unfair**”

- a) Because these networks are based on Universalistic principles.
b) Because these networks are based on rational legal systems.
c) Because these networks are based on particularistic principles.
d) All the above.

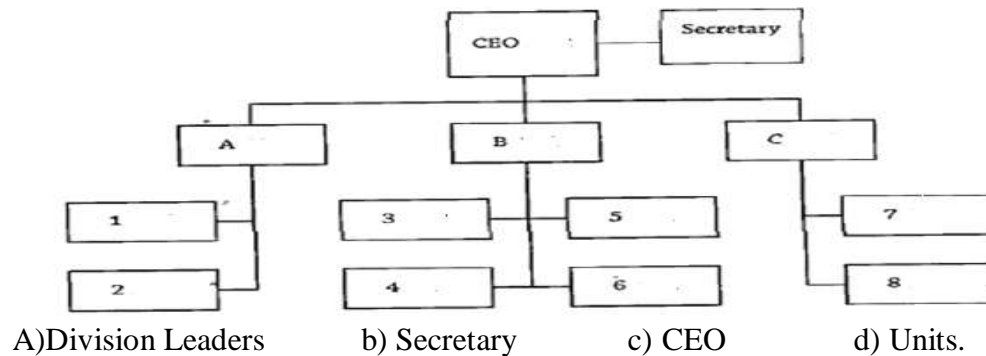
10. The Networks like factory floor, assembly line, and repetitive forms of production are designed

- a) To maximize control of the workers and minimize their opportunities for informal interaction.
 - b) To minimize control of the workers and minimize their opportunities for informal interaction.
 - c) To maximize control of the workers and maximize their opportunities for informal interaction.
 - d) To minimize control of the workers and minimize their opportunities for informal interaction.
11. Consider the given Multi-level Organization chart, Identify which position has highest Krebs power score



- A) Division Leaders b) Secretary c) CEO d) Units.
13. Choose the best possible answer for the given statement “People have to be motivated to share, and this motivation is increased in socially cohesive situations”. This is because
- a) Social Cohesion increases bandwidth whereas Weak Ties decreases it
 - b) Social Cohesion decreases bandwidth whereas Weak Ties decreases it
 - c) Social Cohesion increases bandwidth whereas Weak Ties increases it
 - d) Social Cohesion decreases bandwidth whereas Weak Ties increases it
14. Consider the network situation in which “Players with relationships free of structural holes at their own end and rich in structural holes at the other end” is
- a) Structurally Equivalent
 - b) Structurally Autonomous
 - c) Both a & b
 - d) None of the above
15. Identify the type of networks used by organizations “To develop ideas that help them decide what to make and/or what services to provide and how to do it”.
- a) Internal Networks
 - b) External Networks
 - c) Both a & b
 - d) Eitic networks
16. All formal or external systems breed informal networks that are grafted onto them. By way of the motivations of
- a) Safety
 - b) Effectance
 - c) Safety and Reflectance
 - d) Safety, effectance, and status achievement.
17. Identify the system in which subordinate believes the system is legitimate, consent is given by the subordinate rather than enforced by the leader.
- a) Traditional systems
 - b) Rational-Legal Systems
 - c) Both a & b
 - d) None of the above

18. Consider the given Multi-level Organization chart, Identify which position has highest Krebs power score



Descriptive Questions

Define the term organization in social network and explain about formal organization.

Write briefly about Contradictions of Authority.

List various challenges faced by organizations.

Outline “Bank Wiring Room” helping network and list various constraints involved

(Or)

Discuss briefly about Emergent Networks in organizations

1. Illustrate Barnard’s Zone of Indifference about formal organizations.
2. What organization chart? Explain with suitable example.
3. Compare traditional system with rational-legal systems related to organizations.

Describe briefly about continuous production system in an organization.

4. Explain about Information-Driven Organizations.
5. Discover a silo problem in Multi level organization..
6. Relate chimney problem in Multi-Level organization with Re-legislating.
7. Discuss about Network diversity.
8. Write short notes on trade-offs between Network Size, Diversity and Social Cohesion
9. Determine various bridging gaps between different units of organizations.

UNIT-V

Objective Questions

1. The process through which elements are transferred, borrowed, or adopted into a social system is referred as _____.
2. Diffusion occurs through
 - a) Contact that involves some form of influence, persuasion, or coercion
 - b) Contact that involves some kind of emulation
 - c) Adoption or emulation without direct social contact
 - d) All of the above
3. Diffusion through presumed imitation or adoption of what must have been considered a superior system is termed as
 - a) Cultural Diffusion b) Demic Diffusion c) Biological Diffusion d) None
4. Epidemiology is the study of Biological Diffusion. [True/False] The Contagion Model of diffusion produces _____ shaped curve
 - a) S-shaped b) U-shaped c) V-shaped d) Z-shaped

5. Decision making process is generally influenced by
 - a) Mass Advertisements
 - b) Researchers
 - c) Friends
 - d) All of them
6. Potential factors for diffusion of diseases are
 - a) close person-to-person proximity
 - b) repetitive exposure
 - c) poor ventilation
 - d) All of the above
7. Vaccinating people who are tightly knit with one another is
 - a) Assortative Mixing
 - b) Concurrency
 - c) Both a & b
 - d) None
8. Probit Regression Model which explains the differences in
 - a) time of adoption
 - b) time of imitation
 - c) time of influence
 - d) None
9. Later adopters who are more sensitive to price or the cost will adopt only if
 - a) Prices are lowered
 - b) Prices are hiked
 - c) Prices are stable
 - d) no price
10. The process of Qualitative Assessment includes
 - a) Evaluating the impact of the different sources of influence
 - b) Evaluating the relative impact of the perceived attributes
 - c) Evaluating the influence of media messages
 - d) All of the above
11. Those whose lower threshold has been exceeded are called _____ and those whose upper threshold has been exceeded are called _____
 - a) Adopters, Snobs
 - b) Influentials, Imitators
 - c) Snobs, Adopters
 - d) Imitators, Influentials
12. "Bandwagon effect produces S-shaped diffusion curve". In this process, people involved are
 - a) Early adopters who evaluate the utility of an innovation
 - b) Later adopters who imitate the successful adoption by the initial users
 - c) The population ecology model driven by density and competition between firms
 - d) All of the above
13. Which of the following phenomenon results in Diffusion
 - a) Diversity
 - b) Balance
 - c) Both a & b
 - d) None
14. Low Network Threshold adopters are early adopters relative to _____ and High Network Threshold adopters are early adopters relative to _____
 - a) Social System, Personal Network
 - b) Personal Network, Social System
 - c) Personal Network, Personal Network
 - d) Social System, Social System
15. Potential factors for diffusion of diseases are
 - a) close person-to-person proximity
 - b) repetitive exposure
 - c) poor ventilation
 - d) All of the above
16. The concept of "Keep up with the Joneses" is related to
 - a) Effectiveness by adoption
 - b) Effectiveness by imitation
 - c) Effectiveness by influence
 - d) not related to any
17. Adoption is maximized when agents' neighbors include
 - a) agents with similar thresholds and a core group of similar others
 - b) agents with different thresholds and a core group of dissimilar others
 - c) agents with different thresholds and a core group of similar others

- d) agents with similar thresholds and a core group of dissimilar others
18. The concept that ties individual decision-making and action
 a) Peak b) Threshold c) Tipping Point d) None
19. The speed of transmission of a highly contagious disease can be controlled by restricting
 a) Travel b) Class size c) both a&b d)none

B.Descriptive Questions

10. Discuss briefly about Network Influence and Network Diffusion.
11. Discuss different types of diffusion.
12. Explain different models of diffusion.
13. What is Personal Influence?
14. Define Group Influence.
15. Write in detail about Influence and Decision Making.
16. Mention the characteristics of Opinion leaders and Influentials.
17. Explain briefly about Social Networks and Epidemiology
18. Differentiate between Tipping Point and Threshold.
19. Illustrate how people learn or decide to do something.
20. Demonstrate how Air-Transportation-Network properties results in global pattern of emerging diseases.

Unit - VI

Objective Questions

The trade off between the comfort and support of individuals derive from which networks

- A) Sparse networks b) Dense networks
 c) None of the above d) Both a &b

High community-level social capital can lead to individual well-being
 [True/False]

Anomie at the societal level can be_____

- a)Structural holes b) Lack of moral standards c) Strong ties d) None

Social Capital does not have to be accessible solely through which of these

- A) Weak ties b) Structural holes c) Geographic propinquity d) None

1. The price of the product extracted by misuse of workers, the cost necessary to keep them alive is known as

- a) Dissipate value b) Surplus value c) both a & b d)

None of these.

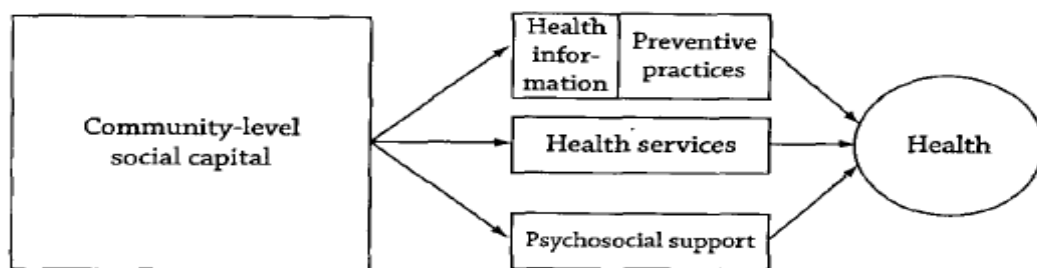
Which of the following will increase the stock of the capitals?

- a) Un productive labor b) Management
 c) Productive labor d) None of the above

2. Personal state of isolation and anxiety resulting from a lack of social control and regulation. Relate the above statement to suitable one

- a) Individual level social capital b) Individual level anomie
 c) only b d) Both a & b

3. The statement “High voluntary organization participation increases community voter turnout.” is an example of
 - a) Individual level social capital
 - b) Social capital investment
 - c) Both a & b
 - d) None of the above
4. “Financial meltdown of 2008 and quick turnaround”. The crisis related to which of the following social system aspect
 - a) Network resources
 - b) Social attributes
 - c) Social capital as an investment.
 - d) None of the above.
5. Identify which of the following people will try to estimate what they can earn if they suspend current resources and invest them in long term resources
 - a) Team leaders
 - b) Entrepreneurs
 - c) Project leaders
 - d) None of the above
6. “The aggregate of the actual resources which are linked to control of a durable network”. In the above statement durable network consists of
 - a) Social relationships of individual recognition
 - b) Institutionalized relationships of mutual recognition
 - c) Both a & b
 - d) None of the above.
7. In the emerging software industry to engage similar strategies identify which of the following are related.
 - a) Network diffusion and Effectance
 - b) Network centrality and geographic propinquity
 - c) Both a & b
 - d) None of the above
8. Choose the incorrect statement in the following.
 - a) Indirect networks reduce the flow of information
 - b) Cohesive networks having greater trust
 - c) Sparse networks give optimal outcomes than dense networks
 - d) Dense networks give optimal outcomes than sparse networks.
9. A firm that gave bonuses to existing workers for referring potential employees: "The firm's \$250 investment yields a return of \$416 in reduced recruiting costs". Correlate the above statement to suitable social aspect
 - A) Social system
 - b) Legal system
 - c) Social investment
 - d) None of the above
10. Choose the incorrect statement related to community level social capital from the following figure



- a) decreases the level of available information on treatment and preventive measures

- b) lowers the effort required to organize politically and therefore *bring* more health facilities
- c) makes social support more accessible.
- d) increases the level of available information on treatment and preventive measures

Descriptive Questions

1. Define the term Social Capital.
2. Explain in detail about Individual-Level Social Capital.
Discuss about Position and Resources Generators.
3. Write the ecological fallacy attributes correlations.
4. What is Social Support? Why social support called fuzzy? Explain it.
5. Explain different situations in which social capital be as an investment.
6. State about the theorists of Social System Social Capital.
7. Discuss about social capital and its consequences
8. Write the general idea of Name Generators.
9. What is community - level social support system? Sketch flow diagram pathways.

Signature of the Faculty

HANDOUT ON CLOUD COMPUTING

Class & Sem. :III B.Tech – II Semester
Branch : CSE

Year:2020-21
Credits:3

1. Brief History and Scope of the Subject

Cloud computing is an information technology (IT) paradigm that enables ubiquitous access to shared pools of configurable system resources and higher-level services that can be rapidly provisioned with minimal management effort, often over the Internet. Cloud computing relies on sharing of resources to achieve coherence and economy of scale, similar to a utility.

Third-party clouds enable organizations to focus on their core businesses instead of expending resources on computer infrastructure and maintenance. Advocates note that cloud computing allows companies to avoid or minimize up-front IT infrastructure costs. Proponents also claim that cloud computing allows enterprises to get their applications up and running faster, with improved manageability and less maintenance, and that it enables IT teams to more rapidly adjust resources to meet fluctuating and unpredictable business demand. Cloud providers typically use a "pay-as-you-go" model, which can lead to unexpected operating expenses if administrators are not familiarized with cloud-pricing models

Since the launch of Amazon EC2 in 2006, the availability of high-capacity networks, low-cost computers and storage devices as well as the widespread adoption of hardware virtualization, service-oriented architecture, and autonomic and utility computing has led to growth in cloud computing.

2. Pre-Requisites

- ☐ Computer Networks
- ☐ Network Security
- ☐ Distributed Computing

3. Course Objectives:

- To understand Virtualization, Virtual Machine and different models of VM.
- To familiarize Cloud computing architecture and its security aspects.

4. Course Outcomes:

At the end of the course, students will be able to

CO1: Differentiate the stages in historical evolution of cloud computing. CO2: Use suitable cloud services to define the cloud for the enterprise.

CO3: Demonstrate hardware level and OS level virtualization to implement virtual machines.

CO4: Design machine images, web applications and databases for virtual machines.

CO5: Apply data, network and host security for the cloud.

5. Program Outcomes:

Computer Science and Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

6. Mapping of Course Outcomes with Program Outcomes:

| CT2540 : CLOUD COMPUTING (PROFESSIONAL ELECTIVE – V) | | | | | | | | | | | | | | | | |
|--|---|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|
| Course outcomes | Program Outcomes and Program Specific Outcome | | | | | | | | | | | | | | | PS O2 |
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PO 13 | PO 14 | PO 15 | |
| CO1:differentiate the stages in historical evolution of cloud computing. | 2 | 1 | | | | | | | | | | | | | | |
| CO2:use suitable cloud services to define cloud for the enterprise. | 2 | 2 | 1 | | | | | | | | | 2 | | | 1 | |
| CO3:demonstrate hardware level and OS level virtualization to implement virtual machines | 3 | | | | | | | | | | | 2 | | | 1 | 2 |
| CO4:design machine images, web applications and databases for virtual machines. | 2 | 1 | 3 | | | | | 1 | | | | 2 | | | 2 | 2 |
| CO5:apply data, network and host security for the cloud. | 1 | | 2 | | | | | 1 | | | | 2 | | | 2 | 2 |
| CLOUD COMPUTING | 2 | 1 | 2 | | | | | | | | | 2 | | | 2 | 2 |

7.Prescribed Text Books

1. Michael Miller, Cloud Computing – Web Based Applications That change the way you work and Collaborate Online –Person Education.
2. George Reese Cloud Application Architectures, 1st Edition O’Reilly Media.

8. Reference Text Books

1. David S. Linthicum, Cloud Computing and SOA Convergence in your Enterprise : A Step-by-Step Guide- Addison-Wesley Professional.
2. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Distributed & Cloud Computing From Parallel Processing to the Internet of Things.

9. URLs and Other E-Learning Resources URLs:

- <https://www.edureka.co/cloud-computing-certification-courses>
- <https://www.getmeacourse.com/?query=Cloud%20Computing>
- <https://www.coursera.org/courses?query=cloud%20computing>
- https://onlinecourses.nptel.ac.in/noc17_cs23/preview
-

10. Lecture Schedule / Lesson Plan

| Topic | No. of Periods | |
|---|----------------|----------|
| | Theory | Tutorial |
| UNIT - I: Cloud computing | | |
| Introduction | 1 | |
| what it is and what it isn't | | |
| from collaborations to cloud- a short history of cloud computing | 1 | |
| Client/Server, P2P, Distributed computing, Collaborative computing, Cloud computing | 1 | |

| | | |
|--|----------|--|
| the network is the computer- How cloud computing works | 1 | |
| Cloud Architecture, Cloud storage, Cloud Services | 1 | |
| The pros and cons of cloud computing | 1 | |
| Who benefits from cloud computing and who shouldn't | 1 | |
| | 7 | |
| UNIT - II: Defining clouds for the Enterprise | | |
| Storage-as-a-service | 1 | |
| Database-as-a-service | 1 | |
| Information-as-a-service | 1 | |
| Process-as-a-service | 1 | |
| Application-as-a-service | 1 | |
| Platform-as-a-service | 1 | |
| Security-as-a-service | 1 | |
| Infrastructure-as-a-service | 1 | |
| | 8 | |
| UNIT - III: Virtual Machines and Virtualization | | |
| Implementation levels of virtualization | 1 | |
| VMM design requirements and providers | 1 | |
| | | |
| Virtualization support at the OS level | 1 | |
| Virtualization structures/tools and mechanisms | 2 | |
| Hypervisor and Xen architecture | 1 | |
| Binary transition with full virtualization | 1 | |
| Para-virtualization with compiler support | 1 | |
| | 8 | |
| UNIT - IV: Hardware Virtualization | | |
| Virtualization of CPU | 1 | |
| Memory and I/O devices | 1 | |
| Hardware support for virtualization | 1 | |
| CPU virtualization | 1 | |

| | | |
|---|-----------|--|
| Memory virtualization | 1 | |
| I/O virtualization | 1 | |
| | 6 | |
| UNIT – V: Ready for the cloud | | |
| Web application design | 1 | |
| Machine image design and privacy design | 1 | |
| Database management: clustering or replication? | 1 | |
| Primary key management | 1 | |
| Database backups | 1 | |
| | 5 | |
| UNIT - VI: | | |
| Data Security | 1 | |
| Data Control Encrypt Everything | 1 | |
| Regulatory and Standards compliances | 1 | |
| Network Security, Firewall rules, Network Intrusion detection | 1 | |
| Host Security, System Hardening | 1 | |
| Antivirus Protection, Host Intrusion detection | 1 | |
| Data segmentation, Credential Management | 1 | |
| Compromise response | 1 | |
| | 8 | |
| Total No.of Periods: | 42 | |

Assignment Cum Tutorial Questions

UNIT- I

Section-A

Objective Questions

1. With cloud computing the software programs run on _____ accessed via internet.
 - a. Servers
 - b. Private computers
 - c. Network servers
 - d. all the above

2. Cloud computing is PC-centric.
[TRUE/FALSE]
3. Networking computing and outsourcing are not cloud computing
[TRUE/FALSE]
4. The cloud is a large group of interconnected computers. These computers are _____.
- a. Personal b. Network Servers c. Public or Private d. All the above
5. From Google's perspective the key properties of cloud computing are _____
- i. cloud computing is user-centric.
- ii. cloud computing is task-centric.
- iii. cloud computing is powerful.
- iv. cloud computing is accessible.
- v. cloud computing is intelligent.
- vi. cloud computing is programmable.
- a. both i & ii b. both iii & iv c. both v & vi d. all the above
6. The google applications that are popular today are _____.
- a. google docs b. google calendar c. gmail d. All the above
7. In P2P computing each computer has equivalent capabilities and responsibilities [TRUE/FALSE]
8. Distributed computing is all about _____ between multiple computers
- a. Cycle sharing b. File sharing c. Providing internet d. None
9. Cloud in cloud computing represents _____?
- a) Wireless b) Hard drives c) People d) Internet
10. Which of these is not a cloud computing pricing model. a) Free b) Pay p
11. What is/are the key characteristics of cloud computing?
- a) Service offering b) Reliability c) Scalability d) ALL
12. The term _____ has been used historically as a Metaphor for the internet?
- a) Cloud b) Intranet c) grid computing d) None of the above
13. Which one is delivering software services to end users and running code?
- a) SOA b) Grid c) Cloud d) None
14. Which of the following is an example of cloud computing application?

- a) Facebook Apps
 - b) Twitter or RSS
 - c) Salesforce.com
 - d) Skype
15. What is Grid computing?
- a) It is a network of computers that share resources – the network can be local or distributed across the internet. Hardware as a service
 - b) It is a physical arrangement of computer terminals that optimizes computing power – the computers in the center are more powerful.
 - c) It is a temporary cloud computer network that only exists as long as single project is active.
 - d) All the above.
16. What is an important benefit of cloud.
- a) Highly protected data
 - b) Independent from Internet
 - c) Reduced cost
 - d) Small bandwidth
17. What is not a valid reason for customer asking a cloud provider where servers are located?
- a) Geographical location may tell something about network latency.
 - b) Geographical location may tell something about network legislation.
 - c) The number of sites tells you something about disaster recovery possibilities.
 - d) When a server breaks down, the customer wants to send a technician to fix the problem as soon as possible
18. Which cloud deployment model is operated solely for a single organization and its authorized users.
- a) Community cloud
 - b) Hybrid cloud
 - c) Public cloud
 - d) Private cloud
19. Which cloud deployment model is managed by a cloud provider, has an infrastructure that is offsite, and is accessible to general public
- a) Community cloud
 - b) Hybrid cloud
 - c) Public cloud
 - d) Private cloud

1. SECTION-B

Descriptive Questions

1. Define Cloud Computing? Enlist and explain essential characteristics of Cloud Computing?
2. Explain how cloud computing works?
3. Differentiate peer to peer computing and distributed computing?
4. Explain Collaboration to cloud?

5. Explain about cloud application architectures?
5. Enlist various companies in providing cloud computing services.
6. Write a short note on the next step in collaboration?
7. Explain how cloud computing is different from cloud computing?
8. Write a short note on Cloud Storage?
9. Write a short note on cloud services?
10. Explain why cloud computing is important?
11. Explain the architecture behind a cloud computing system?

UNIT-II
SECTION-A

Objective Questions

1. _____ is the ability to leverage storage that physically exists remotely but is logically a local storage resource to any application that requires storage
 - (a) Storage-as-a-service
 - (b) Database-as-a-service
 - (c) Information-as-a-service
 - (d) Process-as-a-service
2. The most primitive component of cloud computing is _____.
 - (a) Storage-as-a-service
 - (b) Database-as-a-service
 - (c) Information-as-a-service
 - (d) Process-as-a-service
3. _____ provides the ability to leverage the services of a remotely hosted database, sharing it with other users and having it logically function as if the database were local.
 - (a) Storage-as-a-service
 - (b) Database-as-a-service
 - (c) Information-as-a-service
 - (d) Process-as-a-service
4. _____ refers to the ability to consume any type of remotely hosted information.
 - (a) Storage-as-a-service
 - (b) Database-as-a-service
 - (c) Information-as-a-service
 - (d) Process-as-a-service
5. _____ refers to a remote resource that can bind many resources together.
 - (a) Storage-as-a-service
 - (b) Database-as-a-service
 - (c) Information-as-a-service
 - (d) Process-as-a-service
6. _____ was really the first drive into modern cloud computing .
 - (a) Storage-as-a-service
 - (b) Database-as-a-service

- (c) Information-as-a-service (d) Application-as-a-service
7. _____ is any application delivered over the platform of the Web to an end user, typically leveraging the application through a browser.
- (a) Storage-as-a-service (b) Database-as-a-service
(c) Information-as-a-service (d) Application-as-a-service
8. _____ is the ability to test, bundle, and deliver the platform-as-a service–created applications.
- (a) Design (b) Development (c) Deployment (d) Integration
9. _____ is the ability to run the application over a long period of time, dealing with backup, restore, exception handling.
- (a) Design (b) Development (c) Deployment (d) Operations
10. Converting the information semantics from one system to the information semantics of another system, so the target system can receive information in a format it understands.
- (a) Transformation (b) Routing (c) Interface (d) Logging
11. SOAP stands for_____.
12. _____ is the ability to deliver core security services remotely over the Internet.
- (a) Storage-as-a-service (b) Database-as-a-service
(c) Security-as-a-service (d) Application-as-a-service
13. _____ is any on-demand service that provides the ability to manage one or more cloud services.
- (a) Management-as-a-service (b) Database-as-a-service
(c) Security-as-a-service (d) Application-as-a-service
14. Testing-as-a-service is the ability to test local or cloud-delivered systems using remotely hosted testing software and services.
- (a) Management-as-a-service (b) Testing-as-a-service
(c) Security-as-a-service (d) Application-as-a-service
15. _____ is a data center-as-a-service and the ability to access computing resources remotely.
- (a) Management-as-a-service (b) Testing-as-a-service
(c) Security-as-a-service (d) Infrastructure-as-a-service

SECTION-B

SUBJECTIVE QUESTIONS

1. List the components of Cloud Computing.
2. Explain how Storage-as-a-service allows us to store information on a remote disk drive as if it were local.
3. Summarize the benefits and drawbacks of Storage-as-a-service.
4. Explain Database-as-a-service providers.
5. Justify how Information-as-a-service has the ability to consume any type of remotely hosted information.
6. Discuss how Process-as-a-service allows us to bind on-premise or cloud-delivered resources together to form business solutions.
7. Explain the following:
 - (i) Application-as-a-service
 - (ii) Security-as-a-service
 - (iii) Infrastructure-as-a-service
8. Explain the major components of Platform-as-a-service?
9. Explain the major functions of an Integration Engine.

UNIT-III

SECTION-A

Objective Questions

1. _____ is/are the most important advantages of virtualization.
 - a. Managed execution
 - b. isolation
 - c. Security
 - d. both a&b
2. The most popular open-source hypervisor available in the market is _____.
 - a. ESX
 - b. ESXi
 - c. Hyper-V
 - d. Xen
3. Process virtual machines are made to run _____.
 - a. Operating system
 - b. Operating system and applications
 - c. Some specific application
 - d. Any application
4. The allocation of resources and their partitioning among different guests is simplified, because, _____.

- a. The virtual host is controlled by program
 - b. host is controlled by administrator
 - c. cycle sharing among user instances
 - d. performance is not a major issue
5. _____ simplifies the administration of virtual machine instances.
- a. portability
 - b. self-containment
 - c. para-virtualization
 - d. both a&b
6. The causes of performance degradation can be traced back by the overhead introduced by the following activities _____.
- i. Maintaining status of virtual processor
 - ii. Support of privileged instructions
 - iii. Support of paging within VM
 - iv. console functions.
- a. only i&ii
 - b. only i,ii,&iii
 - c. only ii&iii
 - d. All the above
7. The major source of performance degradation is _____.
- a. the VMM is executed scheduled together with other applications
 - b. VMM runs on the user system
 - c. para-virtualization
 - d. VMware
8. _____ and _____ can slow down the execution of managed applications .
9. The following is/are the disadvantages of virtualization.
- a. performance degradation
 - b. degraded user experience
 - c. security
 - d. All the above
10. Combining network resources and network functionality into a single, software-based administrative entity is called as _____.
- a. virtual network
 - b. storage virtualization
 - c. Desktop virtualization
 - d. None of the above
11. A Xen-based system is managed by _____.
- a. University of Cambridge
 - b. full virtualization
 - c. Xen-hypervisor
 - d. ALL
12. In a Xen-based system specific control software, which has privileged access to host and controls all the other guest operating systems is executed in special domain called _____ .
- a. Domain 0
 - b. Domain X
 - c. Domain 1
 - d. None of the above

13. VM ware technology is based on _____
- a. Hardware assisted virtualization b. para virtualization
c. full virtualization d. partial virtualization
14. VMware implements full virtualization either in desktop environment by means of _____ hypervisors, or in server environment, by means of _____
- a. type I, type II b. type II ,type I c. type I, type 0 d. type 0, type I
15. VMware is well-known for the capability of virtualizing _____ architectures
- a. x86 b. x85 c. 885 d. 8088
16. The following are the components of hypervisor.
- a. Hyper calls Interface b. MSR c. APIC d. All the above
17. Virtualization overhead of hypervisor is maximum in case of ____.
- a. Full virtualization b. Para-virtualization
c. Hardware assisted virtualization d. Equal for all
18. Virtual Machine monitor is the other name of _____.
- a. Guest system b. host system
c. host operating system d. Hypervisor
19. The most popular open source hypervisor available in market is ____
- a. ESX b. ESXi c. Hyper-V d. Xen
20. The single point in the single point of failure problem of virtualization is ____
- a. Virtual machine b. Guest OS
c. Host machine d. VMM

SECTION-B

SUBJECTIVE QUESTIONS

1. What is virtualization? What is the need for virtualization?
2. What are the advantages of virtualization?
3. Write a short note on the downsides of virtualization.
4. What are the types of virtualization?
5. Briefly explain the role of virtual machine monitor?

6. Why is hypervisor also called as virtual machine monitor?
7. Write a short note on interpretation and binary translation?
8. Enlist the major server virtualization products and vendors?
9. Write the merits and demerits of Virtual Box?
10. Briefly explain the properties of virtual machine?
11. What is the difference between system VM and process VM?

Write a short note on Citrix XenServer?

UNIT-IV

SECTION-A

Objective Questions

1. The big chasm between traditional data centers and the cloud is _____.
 - (A) location of data on someone else's computer
 - (B) locations of data on personal computer
 - (C) encrypted data on servers
 - (D) None of the above
2. The following events could create trouble for your infrastructure.
 - (A) The cloud provider declares bankruptcy
 - (B) Third party sues your cloud provider
 - (C) Failure of cloud provider to secure portions of its infrastructure
 - (D) All the above.
3. Which of the following is/are the solutions to tackle practical problems that arise for a cloud user?

| | |
|------------------------|-------------------------|
| (A) Encrypt everything | (B) keep offsite backup |
| (C) Both A & B | (D) None of the Above |
4. _____ is a feature of Amazon cloud.
 - (A) virtual servers cannot sniff the traffic of other virtual servers.
 - (B) data centers are known to the user
 - (C) virtual servers can sniff the traffic of other virtual servers
 - (D) users need not worry about the network
5. When you bundle your data for backups, you should be encrypting it using some kind of strong cryptography, such as _____.

- (A) EC2 (B) Amazon S3 (C) PGP(D) None
6. Amazon's cloud has no perimeter. Instead,_____ provides security groups that define traffic rules.
- (A) Amazon S3 (B) EC2 (C) PGP(D) None of the above
7. Servers in EC2 can see the network traffic bound for other servers in EC2. [TRUE/FALSE]
7. Two servers in two different Amazon EC2 availability zones can operate in the same security group. [TRUE/FALSE]
8. Maintaining off-site backup can help to recover when the cloud provider goes off. [TRUE/FALSE]
10. Network traffic exchanging between instances is visible to other hosts. [TRUE/FALSE]
11. Amazon publishes its security standards and processes at_____.
- (A) aws.amazon.com (B) amazoncloud.com
(C) amazonsecuiry.com (D) a2amazon.com
12. Why is it recommended to copy your files in plain text over to a temporary backup server whose job is to perform encryption and then upload backups to the cloud
- (A) encryption eats up CPU (B) ISP monitors host traffic
(C) data is stored in plain text (D) None of the above
13. From a security perspective, you'll encounter the following issues in standards and regulation.
- i. How issues ii. Where issues iii. What issues
- (A) both i & ii (B) both i & iii (C) both ii&iii (D) All i,ii & iii
14. Placing your virtual Linux server in _____ mode, the only network traffic you will see is the traffic originating from or destined for your server.
- (A) promiscuous (B) server centric(C) cloud centric (D) kernel
15. Using SCP is more secure than FTP because:
- i. FTP transmits passwords in plain text
ii. SCP uses SSH protocol for authentication
- (A) only I (B) only ii (C) both i&ii(D) None of the above
16. The weakness of perimeter security infrastructure is_____

- (A) A compromise of any individual server inside any given segment provides full access to all servers in that segment
- (B) Interior services tend to be less internet aware
- (C) Outer layer services tend to be more hardened against internet
- (D) DMZ is poorly structured
17. _____ is an open source, free and light weight network intrusion detection sys .
- (A) snort (B) snoop (C) DMZ (D) Amazon EC2
18. Examples of irregular traffic include
- i. Port scans
 - ii. Denial-of-service attacks
 - iii. Known vulnerability exploit attempts
- (A) both i & ii (B) both i & iii (C) both ii & iii (D) All i, ii & iii
19. _____ monitors the state of your server for anything unusual .
- (A) HIDS (B) NIDS (C) OSSC (D) snort
20. Each virtual server you manage will mount _____ storage devices
- (A) ephemeral (B) long lasting (C) Secondary (D) No specific location

SECTION-B

SUBJECTIVE QUESTIONS

1. What is the standard operating procedure when you detect a compromise on a physical server?
2. Explain in detail about data segmentation.
3. Briefly describe about Host security.
4. Write a short note on system hardening.
5. Explain the process of starting a virtual server with encrypted file system
6. What is the purpose of a network intrusion detection system?
7. What are the few best practices for network security?
8. Explain firewall rules?
9. Discuss the events that could create trouble for infrastructure?
10. Write a short note on network intrusion detection?
11. Describe how your server is setup for
 - a. presenting attacks

- b. minimizing the impact of a successful attack on the overall system
- c. responding to attacks when they occur

12. Write a short note on host intrusion detection.

UNIT-V SECTION-A

Objective Questions

1. Which of the following are key elements in disaster recovery planning?
 - i. backup & data retention
 - ii. geographic redundancy
 - iii. organizational redundancy

A) i & ii B) ii & iii C) i & iii D) All the above
2. Ability to recover from a disaster is limited by _____ of backups .

A) quality B) frequency C) both A&B D) none
3. In disaster recovery _____ data is generally the data of greatest concern.

A) persistent B) short term C) meta (D) none of the above
4. _____ of your file system tend to be most efficient.

A) snapshots B) zipped file system C) centralized backup D) none
5. _____ involves setting up a master server that handles your write operations and replicating transactions over to a slave server.

A) Master slave replication B) Multi-master replication
C) Clustering D) Master server
6. A _____ database is one in which two master servers execute write transactions independently and replicate the transactions to the other master.

A) Master slave replication B) Multi master replication
C) Master server D) none of the above
7. The correct sequence of steps for creating database dump are ____
 - i. encrypt the dump and break it in to small , manageable chunks
 - ii. execute the database dump
 - iii. move the dump over to S3

A) i-ii-iii B) ii-i-iii C) iii-i-ii D) None of the above
8. Amazon S3 limits your file size to be _____ GB.

A) 2 B) 5 C) 10 D) 20
9. _____ need the ability to manage your EC2 infrastructure from the monitoring site.

A) automated disaster recovery B) disaster management

- C) database recovery D) application server recovery
10. _____ is the art of being able to resume normal systems operations when faced with a disaster scenario.
- A) disaster recovery B) database backup
C) accepting disaster D) None of the above
11. A _____ will help your IT systems survive a fire in your data center that destroy all of the servers in the data center and the systems they support.
- A) Virtualization B)Data center C) Cloud computing D)None
12. _____ lets you automate disaster recovery.
- A) virtualization B) data center
C) cloud computing D)cloud infrastructure
13. Disaster recovery plan involves two key metrics_____ and _____ .
- A) Recovery point objective & Recovery time objective
B) disaster point objective & disaster time objective
C) Disaster plan virtualization & data center
D) None of the above
14. _____ objective identifies how much data you are willing to loose in the event of a disaster.
- A) Recovery point B) Recovery time C) disaster point D) disaster time
15. _____ objective identifies how much down time is acceptable in the event of disaster.
- A) Recovery point B) Recovery time C) disaster point D) disaster time
16. An ideal disaster recovery scenario is which has_____.
- A) no down time B) no loss of data
C) both A&B D) depends on nature of disaster
17. A _____ will survive the loss of any individual data storage or database node with no data loss.
- A) Clustered database B) Distributed database C) Both A&B D) None
18. In traditional infrastructure, a rapid RTO is very expensive. [TRUE/FALSE]
19. A _____ will survive the loss of any individual server, except for instances data corruption with no data loss.
- A) NAS B) SAN C) both A&B D) None

SECTION-B

SUBJECTIVE QUESTIONS

1. Explain Disaster Recovery Planning.

2. Illustrate how RPO is typically governed by the way in which you save and back up data.
3. Explain the metrics of Disaster Recovery Plan.
4. Explain about the key disasters in cloud.
5. Explain different kinds of data that web applications typically manage?
6. Explain about Amazon's Elastic Block Storage.
7. Explain the process will typically cover all levels of database failure.

UNIT-VI SECTION-A

Objective Questions

1. _____ is the ability to leverage storage that physically exists remotely but is logically a local storage resource to any application that requires storage.
 - (a) Storage-as-a-service
 - (b) Database-as-a-service
 - (c) Information-as-a-service
 - (d) Process-as-a-service
2. The most primitive component of cloud computing is _____.
 - (a) Storage-as-a-service
 - (b) Database-as-a-service
 - (c) Information-as-a-service
 - (d) Process-as-a-service
3. _____ provides the ability to leverage the services of a remotely hosted database, sharing it with other users and having it logically function as if the database were local.
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 - (b) Database-as-a-service
 - (c) Information-as-a-service
 - (d) Process-as-a-service
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 - (c) Information-as-a-service
 - (d) Process-as-a-service
5. _____ refers to a remote resource that can bind many resources together.
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 - (c) Information-as-a-service
 - (d) Process-as-a-service
10. _____ was really the first drive into modern cloud computing.
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 - (b) Database-as-a-service
 - (c) Information-as-a-service
 - (d) Application-as-a-service
11. _____ is any application delivered over the platform of the Web to an end user, typically leveraging the application through a browser.
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 - (b) Database-as-a-service

- (c) Information-as-a-service (d) Application-as-a-service
12. _____ is the ability to test, bundle, and deliver the platform-as-a service–created applications.
- (a) Design (b) Development (c) Deployment (d) Integration
13. _____ is the ability to run the application over a long period of time, dealing with backup, restore, exception handling.
- (a) Design (b) Development (c) Deployment (d) Operations
10. Converting the information semantics from one system to the information semantics of another system, so the target system can receive information in a format it understands.
- (a) Transformation (b) Routing (c) Interface (d) Logging
11. SOAP stands for _____.
12. _____ is the ability to deliver core security services remotely over the Internet.
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(c) Security-as-a-service (d) Application-as-a-service
13. _____ is any on-demand service that provides the ability to manage one or more cloud services.
- (a) Management-as-a-service (b) Database-as-a-service
(c) Security-as-a-service (d) Application-as-a-service
14. Testing-as-a-service is the ability to test local or cloud-delivered systems using remotely hosted testing software and services.
- (a) Management-as-a-service (b) Testing-as-a-service
(c) Security-as-a-service (d) Application-as-a-service
15. _____ is a data center-as-a-service and the ability to access computing resources remotely.
- (a) Management-as-a-service (b) Testing-as-a-service
(c) Security-as-a-service (d) Infrastructure-as-a-service

SECTION-B

SUBJECTIVE QUESTIONS

1. List the components of Cloud Computing.
2. Explain how Storage-as-a-service allows us to store information on a remote disk drive as if it were local.
3. Summarize the benefits and drawbacks of Storage-as-a-service.
4. Explain Database-as-a-service providers.
5. Justify how Information-as-a-service has the ability to consume any type of remotely hosted information.

6. Discuss how Process-as-a-service allows us to bind on-premise or cloud-delivered resources together to form business solutions.

7. Explain the following:

(i) Application-as-a-service

(ii) Security-as-a-service

(iii) Infrastructure-as-a-service

8. Explain the major components of Platform-as-a-service?

9. Explain the major functions of an Integration Engine.

Signature of the Faculty