ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

CSE (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Department of
Computer Science and Engineering

M.Tech Two Year Degree Course

(Applicable for the batch admitted from 2021-22)

SESHADRI RAO

GUDLAVALLERU ENGINEERING COLLEGE

(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)

Seshadri Rao Knowledge Village

GUDLAVALLERU - 521 356, Krishna District, Andhra Pradesh

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VISION & MISSION OF THE COLLEGE

Vision

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

- 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 and also to society 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 and 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 instil 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 & MISSION OF THE DEPARTMENT

Vision

To be a leading centre of education and research in Electronics and Communication Engineering, making the students adaptable to changing technological and societal needs in a holistic learning environment.

Articulations

* To be a leading centre of education and research hub in Electronics and Communication Engineering with holistic learning environment.
* Students to be adaptable for the changes in technology and societal needs.
* Students to be recognized and valued for their commitment to excellence and enthusiasm for learning.

Mission:

* To produce knowledgeable and technologically competent engineers for providing services to the society.
* To have a collaboration with leading academic, industrial and research organizations for promoting research activities among faculty and students.
* To create an integrated learning environment for sustained growth in electronics and communication engineering and related areas.

Articulations

* To craft the graduates knowledge and technologically competent engineers for providing services to the society.
* To have alliance with leading academicians, industries and research organizations and encourage the faculty and students for performing research activities.
* To develop a multidiscipline learning environment for continuous growth in electronics and communication engineering and its associated fields.

III. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

To make the graduates of M.Tech Programme in VLSI Design and Embedded Systems

PEO-I : Identify and use appropriate modern tools to solve real world problems in VLSI Design and Embedded Systems domain.

PEO-II : Develop an ability of writing and presenting a substantial technical report/ document and demonstrate degree of mastery over the area of specialization.

PEO-III: Inculcate self learning to pursue research career in relevant areas.

IV. PROGRAM OUTCOMES (POs)

The Post-Graduates will be equipped with an ability to

PO-1 : independently carry out research /investigation and development work to solve practical problems.

PO-2 : write and present a substantial technical report/document.

PO-3 : demonstrate a degree of mastery over the area as per the specialization of the program.

V. ACADEMIC REGULATIONS

Applicable for the students of M.Tech from the Academic Year 2020-21.

1. PG – M.Tech Programs

The following M.Tech Programs are offered at present

i. Structural Engineering (SE)
ii. Power Electronics and Electric Drives (PEED)
iii. Machine Design (MD)
iv. VLSI Design and Embedded Systems (VLSID & ES)
v. Computer Science and Engineering (CSE)

2. Duration of the Program

The duration of the program is two academic years consisting of four semesters. However, a student is permitted to complete the course work of M.Tech program in the stipulated time frame of four academic years from the date of joining.

3. Minimum Instruction Days

Each semester consists of a minimum of ninety instruction days.

4. Program Credits

Each specialization of the M.Tech programs is designed to have a total of 70 credits and the student shall have to complete the two year course work and earn all the 70 credits for the award of M.Tech Degree.

5. Attendance Regulations

5.1 A student shall be eligible to appear for Semester End Examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

5.2 Condoning of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester will be considered for genuine reasons such as medical grounds and participation in co-curricular and extra-curricular activities and shall be granted only after approval by the College Academic Committee. Student should submit application for medical leave along with medical certificate from a registered medical practitioner within three days from reporting to the class work after the expiry of the medical leave. In case of participation in co-curricular and extra-curricular activities, either in the college or other colleges, students must take prior written permission from HoD concerned and should also submit the certificate of participation from the organizer of the event within three days after the completion of the event. Only such cases will be considered for condoning attendance shortage.

5.3 A student shall be eligible to claim for condonation of attendance shortage only once during the two years (four semesters) course work.

5.4 A student will not be promoted to the next semester unless he satisfies the attendance requirement of the current semester. He may seek re-admission for that semester when offered next.

5.5 Shortage of Attendance below 65% in aggregate shall in *NO* case be condoned.

5.6 Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that semester and their registration shall stand cancelled.

5.7 A fee stipulated by the college shall be payable towards condoning attendance shortage.

5.8 A Student is required to put up a minimum of 75% attendance in the Mandatory Non-credit courses for getting the satisfactory grade.

6. Examinations and Scheme of Evaluation

6.1 Theory Courses :

Each theory course shall be evaluated for a total of 100 marks, consisting of 30 marks for internal assessment and 70 marks for semester end examination.

Internal Assessment:

i) Of 30 marks for internal assessment, 10 marks are for continuous assessment in the form of two assignments and 20 marks are based on two mid-term examinations.

ii) Each assignment carries 10 marks and the average of two assignments shall be taken as the marks for continuous assessment.

iii) Each mid-term examination is conducted for 30 marks with one and half hour duration. Each mid-term examination consists of three questions, each for 10 marks. All the questions need to be answered.

iv) Sum of the75% marks of better scored mid-term examination and 25% marks of less scored mid-term examination are scaled down for 20 marks.

v) For the project based theory course, the distribution of 30 marks for internal evaluation shall be 20 marks for theory, based on two mid- term examinations and 10 marks for project. Each mid-term examination is conducted for 30 marks with one and half hour duration. Each mid-term examination consists of two questions, each for 15 marks, with internal choice. All the questions need to be answered. Sum of the 75% marks of better scored mid-term examination and 25% marks of less scored mid-term examination are scaled down for 20 marks.

External Assessment:

i) Semester End Examination will be conducted for 70 marks consisting of five internal choice questions i.e. "either" or choice, carrying 14 marks each. There will be two questions from each unit and the student should answer either of the two questions.

ii) For the project based theory course, the pattern of semester end examination is same as the above. There will be no external assessment for project component.

6.2 Laboratory Courses :

i) For practical subjects the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End Examination. There shall be continuous evaluation by the internal subject teacher during the semester for 30 internal marks. Of the 30 marks for internal, 20 marks shall be for day-to-day performance (15 marks for day-to-day evaluation and 5 marks for Record) and 10 marks shall be evaluated by conducting an internal laboratory test towards the end of semester.

ii) Semester end examination shall be conducted by an internal examiner and an external examiner for 70 marks.

6.3 Mini Project with Seminar:

Mini Project with seminar shall be evaluated for a total of 100 Marks.

i) Of 100 marks, 30 marks shall be awarded by the project supervisor based on student's involvement in carrying out the project and the remaining 70 marks are based on presentation and viva-voce before a committee consisting of supervisor, head of the department and a senior faculty of the department.

ii) There will be no external assessment for mini project.

6.4 Mandatory Non-credit Course:

i) A student is required to take up two Non-Credit course viz. Constitution of India, English for Research Paper writing, one in I semester and the other in II semester. Marks are awarded based on the day-to-day performance in the seminars organized under each course. A student is required to score 40 marks out of 100 marks despite putting up a minimum of 7 5 % attendance to be declared satisfactory in each mandatory non-credit course. The M.Tech degree shall only be awarded if a student gets satisfactory grade in each of the two mandatory non-credit courses and besides acquiring 70 credits of the M.Tech degree course.

ii) A student whose shortage of attendance is condoned in the case of credit courses in that semester shall also be eligible for condoning shortage of attendance up to 10% in the case of mandatory non-credit courses also.

iii) A student has to repeat the course whenever it is offered, if he does not get satisfactory grade or not fulfilling the attendance requirements in each non-credit course for getting the degree awarded.

6.5 MOOCs:

i) A Student shall register for MOOCs offered by NPTEL, CISCO, MICROSOFT and SAYLOR or any other agency with prior approval of departmental committee.

ii) The courses should be other than those offered under regular curriculum and are to be approved by the Departmental Committee consisting of the head of the department, mentor and one/two senior faculty members before the commencement of each semester.

iii) The duration of the course shall be 12 weeks / 50-70 hrs (maximum).

iv) The schedule of the course must be in line with the academic schedule of that semester.

v) The required credits shall be awarded on submission of certificate from the approved agency.

6.6 Project Work:

Every candidate shall be required to submit a dissertation on a topic approved by the Project Review Committee.

i) A Project Review Committee (PRC) shall be constituted for each specialization with Head of the Department / a Senior Faculty as Chairman and two other senior faculty members.

ii) Registration of Project Work: A candidate who has been promoted to 3rd semester shall be eligible to register for the project work.

iii) The eligible candidate can choose his project supervisor and submit the title, objective, abstract and plan of action of the proposed project work to the department for approval by the PRC. The candidate whose proposal is approved by the PRC shall register for the project work. The minimum duration of project work will be 36 weeks from the date of registration.

iv) If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the PRC. In case of such changes, the candidate has to register afresh.

v) There shall be three reviews on the progress of the project work by the PRC with an interval of 12 weeks. The candidate needs to submit a report on the progress of his work and present it before the PRC for assessment. The PRC may suggest for an extension of date of submission of dissertation if the progress of work is not satisfactory or absent himself for the review.

vi) A candidate who has passed all the theory, laboratory and Mini project with seminar examinations and shown satisfactory progress of project work is permitted to submit the dissertation after 36 weeks from the date of registration.

vii) If a candidate fails to submit the dissertation by the end of the 4th semester, he has to take the permission for an extension by paying the semester(s) tuition fee.

viii) Three copies of the Project Thesis certified by the supervisor shall be submitted to the Department.

ix) Project evaluation and Viva-Voce examination is conducted at the end of 4th semester by a committee consisting of Project Supervisor, senior faculty of the department, HoD and an External Examiner nominated by the Chief Controller of Examinations out of a panel of three examiners suggested by the department.

The following grades are awarded for the project work:

i. Excellent
ii. Very Good
iii. Good
iv. Satisfactory
v. Unsatisfactory

The Grade "unsatisfactory" is treated as Fail. Failed Students should take supplementary examination after making required modifications, if any, in the dissertation with a minimum gap of 8 weeks by paying the required examination fee.

7. Criteria for Passing a Course and Award of Grades:

7.1 Criteria for Passing a Course:

i) A candidate shall be declared to have passed in individual theory / laboratory course, if he secures a minimum of 50% aggregate marks (internal & semester end examination marks put together), subject to securing a minimum of 40% marks in the semester end examination.

ii) The candidate shall be declared to have passed in Mini project with seminar if he secures 50% marks.

iii) The candidate shall be declared to have successfully completed the project work if he secures a minimum of 'satisfactory' grade in the project evaluation and viva-voce examination.

iv) On passing a course of a program, the student shall earn assigned credits in that course.

7.2 Method of Awarding Letter Grade and Grade Points for a Course:

A letter grade and grade points will be awarded to a student in each course based on his performance, as per the grading system given below.

Theory /Elective /Laboratory /Seminar / Term Paper /Project Dissertation (%)	Grade Points	Letter Grade
≥ 90	10	O (Outstanding
≥ 80 & < 90	9	A+ (Excellent)
≥ 70 & < 80	8	A (Very Good)
≥ 60 & < 70	7	B+ (Good)
≥ 50 & < 60	6	B (Above Average)
< 50	0	F (Fail)

7.3 Calculation of Semester Grade Point Average (SGPA)* for semester:

The performance of each student at the end of the each semester is indicated in terms of SGPA. The SGPA is calculated as given below:

SGPA = $\frac{\sum(CR \, X \, GP)}{\sum CR}$ for each semester.

where CR = Credits of a course

GP = Grade Points awarded for a course

* SGPA is calculated for a candidate who passed all the courses in that semester.

7.4 Eligibility for Award of M.Tech Degree:

A student will be declared eligible for the award of the M. Tech. Degree if he fulfills the following academic regulations.

(a) Pursued a course of study for not less than two academic years and not more than four academic years.

(b) Registered for prescribed **70** credits and secured **70** credits.

(c) Students, who fail to complete their Two years Course of study within Four years or fail to acquire the prescribed **70** Credits for the award of the degree within four academic years from the year of their admission shall forfeit their seat in M. Tech course and their admission shall stand cancelled.

7.5 Calculation of Cumulative Grade Point Average (CGPA) for Entire Program:

The CGPA is calculated as given below:

CGPA = $\frac{\sum(CR \, X \, GP)}{\sum CR}$ for entire program.

where CR = Credits of a course

GP = Grade points awarded for a course

* CGPA is calculated for a candidate who passed all the prescribed courses excluding project work.

7.6 Award of Division:

After satisfying the requirements prescribed for the completion of the program, the student shall be eligible for the award of B.Tech Degree and shall be placed in one of the following grades:

CGPA	Class
≥ 7.5	First Class with Distinction *
≥ 6.5 & < 7.5	First Class
≥ 6.0 & < 6.5	Second Class

*** CGPA** ≥ 7.5 will be awarded first class with distinction provided the student must have fulfilled all the program requirements in two (2) years duration.

8. Supplementary Examinations

i) Supplementary examinations will be conducted once in a year along with regular examinations.

ii) Semester end supplementary examinations shall be conducted till next regulation comes into force for that semester after the conduct of the last set of regular examinations under the present regulation.

iii) Thereafter supplementary examinations will be conducted in the equivalent courses as decided by the Board of Studies concerned.

9. Challenge Valuation

Challenge valuation of failed or passed subjects shall be performed as per the following norms.

i) Students can submit the application for challenge valuation, along with the prescribed fee receipt for evaluation of his answer script(s) of theory course(s) as per the notification issued by the Controller of Examinations.

The Controller of Examinations shall arrange for challenge valuation of such answer script(s).

ii) The challenge valuation will be carried out by a three member committee comprising an external subject expert nominated by the Chief Controller of Examinations, the internal subject expert and the BoS Chairman.

iii) After the challenge valuation, if the grade is improved or there is a change in the status i.e., fail to pass, the improved grade shall be notified, otherwise, the previous grade will remain.

10. Re-admission Criteria

A candidate, who is detained in a semester due to lack of attendance has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling the required norms stipulated by the college and by paying the required tuition fee and special fee in addition to paying an administrative fee of Rs. 1,000/-

11. Break in Study

Student, who discontinues the studies for what-so-ever reason, can get readmission into appropriate semester of M.Tech program only with the prior permission of the Principal of the College, provided such candidate shall follow the transitory regulations applicable to the batch he joins. An administrative fee of Rs.2,000/- per each year of break in study in addition to the prescribed tuition and special fees shall be paid by the candidate to condone his break in study.

12. Transitory Regulations

When a student is detained due to shortage of attendance, he/she may be readmitted into the same semester in which he/she has been detained. However, the academic regulations under which the detained student was first admitted shall continue to be applicable to him/her. A candidate, who is detained in a semester, on readmission shall be required to do all the courses in the curriculum prescribed for the batch of students in which the student joins subsequently. However, exemption will be given to those candidates who have already passed such courses in the earlier semester(s) he was originally admitted into and he will be offered substitute subjects in place of them as decided by the Board of Studies. However, the decision of the Board of Studies will be final.

13. Withholding of Results

If the student has not paid the dues, if any, to the College or if any case of indiscipline is pending against him, the result of the student will be withheld. His degree will be withheld in such cases.

14. Malpractices

i) The Principal shall refer the cases of malpractices in internal assessment tests and semester end examinations to a malpractice enquiry committee constituted by him for the purpose. Such committee shall follow the approved levels of punishment. The Principal shall take necessary action against the erring students based on the recommendations of the committee.

ii) Any action by the candidate trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder.

iii) Malpractices identified at spot centre during valuation

The following procedure is to be followed in the case of malpractice cases detected during valuation, scrutiny etc. at spot centre.

I. A notice is to be served to the candidate(s) involved **(i)** through the Principal of the college, **(ii)** to the candidate(s) to his college address and **(iii)** to the candidate(s) to his permanent address regarding the malpractice.

DISCIPLINARY ACTION FOR MALPRACTICES/IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices / Improper conduct	Punishment
If the candidate		
1.a	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination.)	Expulsion from the examination hall and cancellation of the performance in that subject only.
b	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through Cell phones with any candidates or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester / year. The hall ticket of the candidate shall be cancelled.

3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for the examinations of the remaining subjects of that semester / year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the impostor is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or takes out or arranges to send out the question paper during the examination or answer book during or after the examination.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester / year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of performance in that subject.

6.	Refuses to obey the orders of the Chief Superintendent/Assistant Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in or around the examination hall or organises a walkout or instigates others to walkout or threatens the officer-in-charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the Officer-in-charge or any person on duty in or outside the examination hall of any of his relations or indulges in any other act of misconduct or mischief which results in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the Officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	Expulsion from the examination hall and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester / year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat.

9	If student of the college who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the college will be handed over to the police and a police case is registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester / year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester / year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be referred to the Chief Superintendent of Examinations for future action towards suitable punishment.	

II. A committee consisting of the following is to be constituted at spot centre to process such malpractice cases and the recommendations of the malpractice committee are to be sent to the Chief Controller of Examinations.

1. Principal — Chairman
2. Vice Principal - Academics — Member
3. Chief examiner of that subject — Member
4. Controller of Examinations — Convener

The involvement of the staff, who are in charge of conducting examinations, valuing examination papers and preparing / keeping records

of documents related to the examinations in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all concerned at the examination shall be viewed seriously and appropriate disciplinary action will be taken after thorough enquiry.

15. Other Matters

i) Deserving physically challenged candidates will be given additional examination time and a scribe based on the certificate issued by the concerned authority. Students who are suffering from contagious diseases are not allowed to appear either for internal or semester end examinations.

ii) The students who participated in coaching / tournaments held at State / National / International levels through University / Indian Olympic Association during semester end external examination period will be promoted to subsequent semesters as per the guidelines of University Grants Commission Letter No. F.1-5/88 (SPE/PES), dated 18-08-1994.

iii) The Principal shall deal in an appropriate manner with any academic problem which is not covered under these rules and regulations, in consultation with the Heads of the Departments and subsequently such actions shall be placed before the Academic Council for ratification. Any emergency modification of regulation, approved in the meetings of the Heads of the Departments shall be reported to the Academic Council for ratification.

16. General

i) The Academic Council may, from time to time, revise, amend or change the regulations, schemes of examination and /or syllabi.

ii) The academic regulations should be read as a whole for the purpose of any interpretation.

iii) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman of the Academic Council is final.

v) Wherever the word he, him or his occurs, it will also include she, her and hers.

VI. CURRICULAR COMPONENT

Sl. No.	Course Work - Subject Areas	Total No.of Credits	% of Total Credits
1	Open Elective (OE)	3	4.29
2	Humanities and Social Sciences (HSS)	3	4.29
3	Professional Core (PC)	20	28.58
4	Professional Electives (PE)	15	21.42
7	Others (Seminar, Term Paper, Dissertation, etc.)	29	41.42

COURSE STRUCTURE

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SYLLABUS

COURSE STRUCTURE

I Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	CS4901	Advanced Data Structures and Algorithm Analysis	3	-	-	3
2	CS4902	Data Science	3	-	-	3
3		Professional Elective - I	3	-	-	3
4		Professional Elective - II	3	-	-	3
5	BA3901	Research Methodology & IPR	3	-	-	3
6	CS4909	Advanced Data Structures and Algorithm Analysis Lab	-	-	4	2
7	CS4910	Data Science Lab	-	-	4	2
		Total	**15**	**-**	**8**	**19**
8	BA3902	Constitution of India (Audit Course)	2	-	-	

II Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	CS4911	MEAN Stack Technologies	3	-	-	3
2	CS4912	Machine Learning	3	-	-	3
3		Professional Elective - III	3	-	-	3
4		Professional Elective - IV	3	-	-	3
5	CS4919	MEAN Stack Technologies Lab	-	-	4	2
6	CS4920	Machine Learning using Python Lab	-	-	4	2
7	CS4921	Mini Project with Seminar	-	-	6	3
		Total	**12**	**-**	**14**	**19**
8	EG3901	English for Research Paper Writing (Audit Course)	2	-	-	-

III Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1		Professional Elective - V	3	-	-	3
2		Open Elective	3	-	-	3
3	CS4926	Dissertation Phase - I	-	-	20	10
		Total	**6**	**-**	**20**	**16**

* Project Based Theory Course

L : Lecture **T : Tutorial** **P : Practical**

IV Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	CS4926	Dissertation Phase - II	-	-	32	16
		Total	**-**	**-**	**32**	**16**

Professional Electives:

Professional Elective - I

CS4903 Digital Image Processing
CS4904 Ad hoc and Sensor Networks
CS4905 Intelligent Systems

Professional Elective - II

CS4906 Internet of Things
CS4907 Principles of Computer Security
CS4908 Distributd Systems

Professional Elective - III

CS4913 Blockchain Technology
CS4914 Data Preparation and Analysis
CS4915 Natural Language Processing

Professional Elective - IV

CS4916 Cloud Computing
CS4917 Quantum Computing
CS4918 Digital Forensics

Professional Elective - V

CS4922 Deep Learning
CS4923 Recommender Systems
CS4925 MOOCs

Open Electives:

CE3924 Sustainable Development
EE3924 Energy Audit, Conservation & Management
ME3924 Rapid Prototyping
EC3924 Automotive Electronics (Other than VLSID&ES)
CS3924 Soft Computing Techniques

SYLLABUS

ADVANCED DATA STRUCTURES AND ALGORITHM ANALYSIS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with various types of data structures.
- To analyze the asymptotic performance of algorithms.

Course Outcomes

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

- analyze the performance of algorithms in terms of time and space complexities.
- apply different sorting and searching techniques on the given data and analyze their performance.
- construct binary trees for given data and perform the basic operations such as insertion, deletion and search on them.
- create AVL and B+ trees and perform the basic operations.
- represent graphs using linked lists and adjacency matrices and perform graph traversals.
- apply dynamic-programming paradigm to solve a class of problems.

Course Content

UNIT– I:

Preliminaries of Algorithm Analysis: Time and Space Complexity, Asymptotic Notations.

Searching: Linear and Binary Search Methods.

Sorting: Quick Sort, Merge Sort.

UNIT–II:

Binary Trees: Properties, Representation and Traversals, Expression Trees (Infix, Prefix, Postfix).

Binary Search Trees: ADT, Operations- Searching, Insertion, Deletion, Implementation.

UNIT–III:

AVL Trees: Introduction, Operations- Insertion, Deletion and Searching.

B+ Trees: Introduction, Operations-Insertion, Deletion and Search.

UNIT–IV:

Graphs: Basic Concepts, Representation and Traversals, Minimum Cost Spanning Trees – Prim's, Kruskal's Methods.

Hashing: Hash Table Representation, Hash functions, Collision Resolution- Separate Chaining, Open Addressing-Linear Probing, and Double Hashing.

UNIT–V:

Dynamic Programming: Introduction, Matrix Chain Multiplication, Optimal Binary Search Trees, Travelling Sales Person Problem.

Text Books

1. Data Structures: A Pseudocode Approach with C, Second Edition. Richard F. Gilberg. Behrouz A. Forouzan, Cengage publications.
2. Ellis Horowitz, SatrajSahni and Rajasekharam, "Fundamentals of Computer Algorithms", Galgotia publications pvt. Ltd.

Reference Books

1. Allen Weiss, "Data structures and Algorithm Analysis in C", Second edition, Pearson education.
2. R.C.T.Lee, S.S.Tseng, R.C.Chang and T.Tsai, "Introduction to Design and Analysis of Algorithms A strategic approach", McGraw Hill.

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DATA SCIENCE

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To demonstrate statistics and machine learning concepts that is vital for data science.
- To critically evaluate data visualizations based on their design and use for communicating stories from data.

Course Outcomes

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

- explain how data is collected, managed and stored for data science.
- apply statistical methods on the data to draw the useful inferences
- use machine learning techniques to extract useful patterns from the given data.
- analyze time series data to extract meaningful statistics and other characteristics of the data.
- describe learning and generalization of neural networks.

Course Content

UNIT – I: Introduction to Data Science

Concept of Data Science, Traits of Big data, Web Scraping, Analysis vsReporting.

UNIT – II: Introduction to Programming Tools for Data Science

Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK, Visualizing Data: Bar Charts, Line Charts, Scatterplots, Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction.

UNIT – III: Mathematical Foundations

Linear Algebra: Vectors, Matrices, Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Correlation and Causation, Probability: Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem, Hypothesis and Inference: Statistical Hypothesis Testing, Confidence Intervals, Phacking, Bayesian Inference.

UNIT – IV: Machine Learning

Overview of Machine learning concepts – Over fitting and train/test splits, Types of Machine learning – Supervised, Unsupervised, Reinforced learning, Introduction to Bayes Theorem, Linear Regression- model assumptions, regularization (lasso, ridge, elastic net), Classification and Regression algorithms- Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees, and random forest, Classification Errors.

UNIT – V: Time Series Analysis

Analysis of Time Series- Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural Networks-Learning And Generalization, Overview of Deep Learning.

Text Books

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media.
2. Jeeva Jose, "Machine Learning", Khanna Publishing House, Delhi.

Reference Books

1. AurélienGéron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media.
2. Jain V.K., "Data Sciences", Khanna Publishing House, Delhi.
3. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press http://www.deeplearningbook.org

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Professional Elective - I

DIGITAL IMAGE PROCESSING

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To describe and explain basic principles of digital image processing
- To discuss various image processing techniques.

Course Outcomes

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

- use appropriate image enhancement technique to improve the quality of an image.
- apply suitable image segmentation technique for an application.
- analyze various image compression techniques.
- apply morphological operations to modify the structure of an image.

Course Content

UNIT – I: Introduction

Digital image processing, examples of fields that use digital image processing, fundamental steps in digital image processing.

Digital Image Fundamentals- Image sensing and acquisition, sampling and quantization, basic relationships between pixels.

UNIT – II: Image Enhancement in the Spatial Domain

Introduction, Basic gray-level transformations, histogram processing, enhancement using arithmetic and logic operators. Basics of spatial filtering, smoothing and sharpening spatial filters, combining the spatial enhancement methods.

UNIT – III: Color Image Processing

Introduction, color fundamentals, color models, pseudo color image processing, basics of full–color image processing, color transformations, color image smoothing and sharpening, color segmentation.

UNIT – IV: Image Compression

Fundamentals, image compression models, error-free compression, lossy predictive coding.

UNIT – V: Morphological Image Processing

Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphologic algorithms.

Image Segmentation: Detection of discontinuous, edge linking and boundary detection, thresholding, region–based segmentation.

Text Books

1. Rafeal C.Gonzalez, Richard E.Woods, & quot; Digital Image Processing & quot;, 2nd Edition, Pearson Education/PHI.

Reference Books

1. Milan Sonka, Vaclav Hlavac and Roger Boyle,"Image Processing, Analysis, and Machine Vision & quot;, 2nd Edition, Thomson Learning.
2. Adrian Low, & quot; Computer Vision and Image Processing & quot;, 2nd Edition, B.S.Publications.
3. William K. Prat, & quot; Digital Image Processing & quot;, Wily 3rd Edition.
4. B. Chanda, D. Datta Majumder, & quot; Digital Image Processing and Analysis & quot;, Prentice Hall of India, 2003

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Professional Elective - I

AD HOC AND SENSOR NETWORKS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To teach various techniques in mobile networks/Adhoc networks and sensor based networks.
- To facilitate the understanding of Infrastructure less networks and their importance in the future directions for wireless communications.

Course Outcomes

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

- explain the Fundamental Concepts and applications of ad hoc and wireless sensor networks.
- describe the MAC protocol issues of ad hoc networks.
- describe routing protocols for ad hoc wireless networks with respect to TCP design issues.
- explain the concepts of network architecture and MAC layer protocol for WSN.
- discuss the WSN routing issues by considering QoS measurements

Course Content

UNIT – I: Introduction

Fundamentals of Wireless Communication Technology, The Electromagnetic Spectrum, Radio propagation Mechanisms ,Characteristics of the Wireless channel mobile ad hoc networks (MANETs), Wireless Sensor Networks (WSNs): concepts and architectures, Applications of Ad Hoc and Sensor Networks, Design Challenges in Ad hoc and Sensor Networks.

UNIT – II: MAC Protocols For Ad Hoc Wireless Networks

Issues in designing a MAC Protocol, Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks, Design Goals of a MAC Protocol for Ad Hoc Wireless Networks, Classification of MAC Protocols, Contention based protocols, Contention based protocols with Reservation Mechanisms, Contention based protocols with Scheduling Mechanisms, Multi channel MAC - IEEE802.11.

UNIT – III: Routing Protocols And Transport Layer In Ad Hoc Wireless Networks

Routing Protocol: Issues in designing a routing protocol for Ad hoc networks, Classification, proactive routing, reactive routing (on-demand), hybrid routing, Transport Layer protocol for Ad hoc networks, Design Goals of a Transport Layer Protocol for

Ad Hoc Wireless Networks, Classification of Transport Layer solutions- TCP over Ad hoc wireless, Network Security, Security in Ad Hoc Wireless Networks, Network Security Requirements.

UNIT – IV: Wireless Sensor Networks (WSNS) And Mac Protocols

Single node architecture - hardware and software components of a sensor node, WSN Network architecture: typical network architectures, data relaying and aggregation strategies, MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC -IEEE802.15.4.

UNIT – V: WSN Routing, Localization &QoS

Issues in WSN routing, OLSR, Localization, Indoor and Sensor Network Localization, absolute and relative localization, triangulation, QOS in WSN, Energy Efficient Design, Synchronization.

Text Books

1. "Ad Hoc Wireless Networks: Architectures and Protocols ", C. Siva Ram Murthy, and B. S. Manoj, Pearson Education,2008
2. "Wireless Adhoc and Sensor Networks", Labiod. H, Wiley, 1stedition-2008
3. "Wireless ad -hoc and sensor Networks: theory and applications", Li, X, Cambridge University Press, fifthedition-2008.

Reference Books

1. "Ad Hoc & Sensor Networks: Theory and Applications", 2nd edition, Carlos De Morais Cordeiro, Dharma Prakash Agrawal ,World Scientific Publishing Company,2011
2. "Wireless Sensor Networks", Feng Zhao and Leonides Guibas, Elsevier Publication 2ndedition-2004
3. "Protocols and Architectures for Wireless Sensor Networks", Holger Karl and Andreas Willig, Wiley, 2005 (soft copy available)
4. "Wireless Sensor Networks Technology, Protocols, and Applications", Kazem Sohraby, Daniel Minoli, &TaiebZnati, John Wiley, 2007. (soft copy available)

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Professional Elective - I

INTELLIGENT SYSTEMS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To provide the fine structure or deeper knowledge of intelligent systems.
- To generate intelligent behavior on the basis of statistical evidence.

Course Outcomes

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

- demonstrate data representation and logical operations.
- analyze backward reasoning and solve problems by reduction.
- design and develop rule based system for the given data.
- explain the architecture of real time expert systems.
- demonstrate qualitative simulation on the data.

Course Content

UNIT – I: Knowledge Representation

Data and knowledge: Data representation and data items in traditional databases, Data representation and data items in relational databases. Rules: Logical operations, Syntax and semantics of rules, Data log rule sets, the dependence graph of data log rule sets, objects.

UNIT – II: Rule Based Systems

Solving problems by reasoning: The structure of the knowledge base, the reasoning algorithm, Conflict resolution, Explanation of the reasoning.

Forward reasoning: The method of forward reasoning, a simple case study of forward reasoning, backward reasoning: Solving problems by reduction, the method of backward reasoning, a simple case study of backward reasoning, Bidirectional reasoning.

UNIT – III: Verification and Validation of Rule Bases

Contradiction freeness: The notion of contradiction freeness, Testing contradiction freeness, The search problem of contradiction freeness .Completeness: The notion of completeness, Testing Completeness, The search problem of completeness. Decomposition of knowledge bases: Strict decomposition, Heuristic decomposition.

UNIT – IV: Real-Time Expert Systems

The architecture of real-time expert systems: The real-time subsystem, The intelligent subsystem Synchronization and communication between real-time and intelligent subsystems: Synchronization and communication primitives, Priority

handling and time-out. Data exchange between the real-time and the intelligent subsystems: Loose data exchange, the blackboard architecture. Software engineering of real- time expert systems: The software lifecycle of real time expert systems, Special steps and tool, An Example of A Real-Time expert System.

UNIT – V: Qualitative Reasoning

Sign and interval calculus, Qualitative simulation: Constraint type qualitative differential equations, The solution of QDEs: the qualitative simulation algorithm: Initial data for the simulation, Steps of the simulation algorithm, Simulation results. Qualitative physics, Signed directed graph (SDG) models.

Text Books

1. Intelligent Control Systems-An Introduction with Examples by Katalin M. Hangos, Rozália Lakner, Miklós Gerzson, Kluwer Academic Publishers.
2. Intelligent Systems and Control: Principles and Applications Paperback – 12 Nov 2009 by Laxmidhar Behera, IndraniKar by OXFORD.

Reference Books

1. Intelligent Systems and Technologies Methods and Applications by Springer publications.
2. Intelligent Systems - Modeling, Optimization and Control, by Yung C. Shin and ChengyingXu, CRC Press, Taylor & Francis Group, 2009.

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Professional Elective - II

INTERNET OF THINGS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiar with smart objects and IoT Architectures.
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and RaspberryPi.

Course Outcomes

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

- summarize on the term 'internet of things' in differentcontexts.
- analyze various protocols forIoT.
- design a PoC of an IoT system using Rasperry Pi/Arduino
- apply data analytics and use cloud offerings related to IoT.
- analyze applications of IoT in real time scenario

Course Content

UNIT – I: Fundamentals of IoT

Evolution of Internet of Things, Enabling Technologies, IoT Architectures, oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT – II: IoT Protocols: IT Access Technologies

Physical and MAC layers, topology of IEEE 802.15.4, Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAPandMQTT.

UNIT – III: Design and Development

Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino. Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.

UNIT – IV: Data Analytics and Supporting Services

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning – No SQL Databases, Xively Cloud for IoT, Python Web Application Framework, Django.

UNIT – V: Case Studies

Cisco IoT system, IBM Watson IoT platform, Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

Text Books

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017

Reference Books

1. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press,2015
2. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit2).
3. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", JanHo¨ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. Davidoyle and Elsevier, 2014.
4. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.
5. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O'Reilly Media, 2011.

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Professional Elective - II

PRINCIPLES OF COMPUTER SECURITY

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To impart knowledge on modern cryptographic theories and techniques, mainly focusing on their application into real systems.
- To provide basic terms and concepts in Database and Cloud Security, Denial-of-Service Attacks and Operating System Security.

Course Outcomes

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

- analyze and evaluate the computer security needs of an organization.
- determine and analyze user authentication principles and security techniques to reduce the risk of exploitation.
- implement database and cloud security solutions for recent developments.
- describes issues concerning software development and implementation, including operating systems, utilities, and applications
- describes the application security requirements in operating systems.

Course Content

UNIT–I: Introduction

Computer Security Concepts, Threats, Attacks, and Assets, Security Functional Requirements, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, Computer Security Strategy. Cryptographic Tools: Confidentiality with Symmetric Encryption, Message Authentication and Hash Functions, Public-Key Encryption.

UNIT–II: User Authentication

Electronic User Authentication Principles, Password-Based Authentication, Token-Based Authentication, Biometric Authentication, Remote User Authentication, Security Issues for User Authentication.

UNIT–III: Database and Cloud Security

The Need For Database Security, Database Management Systems, Relational Databases, Sql Injection Attacks, Database Access Control, Database Encryption, Cloud Computing, Cloud Security Risks And Countermeasures, Data Protection In The Cloud, Cloud Security As A Service.

UNIT–IV: Denial-of-Service Attacks

Denial-of-Service Attacks, Flooding Attacks, Distributed Denial- of-Service Attacks, Application-Based Bandwidth Attacks, Reflector and Amplifier Attacks, Defenses Against Denial-of-Service Attacks, Responding to a Denial-of-Service Attack. Software Security: Software Security Issues, Handling Program Input, Writing Safe Program Code.

UNIT–V: Operating System Security

Introduction to Operating System Security, System Security Planning, Operating Systems Hardening, Application Security, Security Maintenance, Linux/Unix Security, Windows Security, Virtualization Security.

Text Books

1. Computer 7Security: Principles and Practices, 3e, William Stallings, Lawrie Brown, Pearson.

Reference Books

1. Network Security Essentials, Principles and Practices, William Stallings, Pearson

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Professional Elective - II

DISTRIBUTED SYSTEMS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with different distributed systems and their architectures.
- To explain different communication mechanisms and their advantages and disadvantages.

Course Outcomes

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

- explain resource sharing in distributed systems and different system models used to construct distributed system network between systems.
- illustrate distributed objects and remote invocation.
- explore functional distributed file systems.
- explain distributed transaction management, coordination and agreement between distributed processes.
- design a distributed system that fulfills the requirements.

Course Content

UNIT–I: Characterization of Distributed Systems

Introduction, Examples of Distributed Systems, Resource Sharing and the Web, Challenges. (6 hours) System Models: Introduction, Architectural Models- Software Layers, System Architecture, Variations, Interface and Objects, Design Requirements for Distributed Architectures, Fundamental Models- Interaction Model, Failure Model, Security Model.

UNIT–II: Distributed Objects and Remote Invocation

Introduction, Communication between Distributed Objects- Object Model, Distributed Object Model, Design Issues for RMI, Implementation of RMI, Distributed Garbage Collection; Remote Procedure Call, Events and Notifications.

UNIT–III: Distributed File Systems

Introduction, File Service Architecture; Peer-to-Peer Systems: Introduction, Napster and its Legacy, Peer-to-Peer Middleware.

UNIT–IV: Coordination and Agreement

Introduction, Distributed Mutual Exclusion, Elections, Multi-cast Communication.

UNIT–V: Transactions & Replications

Introduction, System Model and Group Communication, Concurrency Control in Distributed Transactions, Distributed Dead Locks, Transaction Recovery; Replication-Introduction, Passive (Primary) Replication, Active Replication.

Text Books

1. George Coulouris, Jean Dollimore, Tim Kindberg, “Distributed Systems-Concepts and Design”, Fourth Edition, Pearson Publication
2. Ajay D Kshemkalyani, Mukesh Sighal, “Distributed Computing, Principles, Algorithms and Systems”, Cambridge.

Reference Books

1. Andrew S. Tanenbaum, Maarten Van Steen - Distributed Systems principlesand paradigms.

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RESEARCH METHODOLOGY & IPR

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To impart the importance of research & IPR in professional growth.

Course Outcomes

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

- analyze various research methodologies
- perform research design
- collect and analyze the data required for research
- able to write research reports
- apply for Patents, Designs, Trade and Copyright.

Course Content

UNIT–I: Introduction

Research Methodology: Meaning of Research – Objectives – Types – Research Approaches – Significance of Research - Research Methods versus Methodology – Research and Scientific Method – Research Process – Criteria of Good Research – Research Ethics – Problems Encountered by Researchers in India.

Defining the Research Problem: What is a Research Problem? – Selecting the Problem – Necessity of Defining the problem – Technique Involved in Defining a Problem – An Illustration – Conclusion.

UNIT–II: Research Design

Meaning of Research Design – Need for Research Design – Features of a Good Design – Important Concepts Relating to Research Design – Different Research Designs – Basic Principles of Experimental Designs – Important Experimental Designs – Conclusion.

UNIT–III: Data Collection & Preparation, Report Writing

Data Collection: Introduction – Experiments and Surveys – Collection of Primary Data – Collection of Secondary Data – Selection of Appropriate Method for Data Collection – Case Study Method

Data Preparation: Data Preparation Process – Some Problems in Preparation Process – Missing Values and Outliers – Types of Analysis – Statistics in Research

Report Writing: Significance of Report Writing – Difference Steps in Writing Report – Layout of the Research Report – Types of Reports – Oral Presentation – Mechanics of Writing a Research Report – Precautions for Writing Research Reports - Conclusion.

UNIT–IV: Nature of Intellectual Property

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT–V: Patent Rights & Developments

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Text Books

1. Kothari C.R "Research Methodology-Methods and Techniques",New age international Publishers, New Delhi.
2. T. Ramappa, "Intellectual Property Rights in India"

Reference Books

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students".
2. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.

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ADVANCED DATA STRUCTURES AND ALGORITHM ANALYSIS LAB

I Semester

Practical	: 4	Internal Marks	: 30
Credits	: 2	External Marks	: 70

Course Objectives

- To implement different sorting techniques.
- To impart knowledge on the implementation of various data structures in Java.

Course Outcomes

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

- develop code in Java for different sorting and searching techniques.
- experiment with basic data structures such as linked list, stacks and queues.
- implement advanced data structures in Java
- perform graph traversals on the given data.

List of Experiments:

1. Write a java program to perform various operations on single linked list.
2. Write a java program for the following
   a) Reverse a linked list b) Sort the data in a linked list
   c) Remove duplicates d) Merge two linked lists
3. Write a java program to perform various operations on doubly linked list.
4. Write a java program to perform various operations on circular linked list.
5. Write a java program for performing various operations on stack using linked list.
6. Write a java program for performing various operations on queue using linked list.
7. Write a java program for the following using stack
   a) Infix to postfix conversion. b) Expression evaluation.
   c) Obtain the binary number for a given decimal number.
8. Write a java program to implement various operations on Binary Search Tree Using Recursive and Non-Recursive methods.
9. Write a java program to implement the following for a graph.
   a) BFS b) DFS
10. Write a java program to implement Merge & Heap Sort of given elements.
11. Write a java program to implement Quick Sort of given elements.
12. Write a java program to implement various operations on AVL trees.
13. Write a java program to perform the following operations:
    a) Insertion into a B-tree b) Searching in aB-tree
14. Write a java program to implementation of recursive and non-recursive functions to Binary tree Traversals.
15. Write a java program to implement all the functions of Dictionary (ADT) using Hashing.

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DATA SCIENCE LAB

I Semester

Practical	: 4	Internal Marks	: 30
Credits	: 2	External Marks	: 70

Course Objectives

- To implement statistics and machine learning concepts that is vital for data science.

Course Outcomes

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

- implement data science operations like data collection, management and storing.
- apply Python programming concepts in data science, including their real-world applications.
- implement data collection and management scripts using Python Pandas.

List of Experiments:

1. Write a programme in Python to predict the class of the flower based on available attributes.
2. Write a programme in Python to predict if a loan will get approved or not.
3. Write a programme in Python to predict the traffic on a new mode of transport.
4. Write a programme in Python to predict the class of user.
5. Write a programme in Python to indentify the tweets which are hate tweets and which are not.
6. Write a programme in Python to predict the age of the actors.
7. Mini project to predict the time taken to solve a problem given the current status of the user.

Reference Books

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media.
2. AurélienGéron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media.
3. Jain V.K., "Data Sciences", Khanna Publishing House, Delhi.
4. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press http://www.deeplearningbook.org

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Audit Course - I

CONSTITUTION OF INDIA

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand the structure of Executive, Legislature and Judiciary.
- To understand the autonomous nature of Constitutional bodies like Supreme Court and High court controller and Auditor general of India and Election Commission of India.
- To understand the Central and State relation financial and administrative.

Course Outcomes

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

- apply the knowledge on Fundamental Rights and Duties and Directive principles of state policy.
- explain the role of President and Prime Minister and also know the Structure of Supreme court and High court.
- understand the Structure of State Government and also analyze the role of Governor and Chief Minister.
- compare and Contrast District administration role and importance.
- evaluate the various commissions of viz., SC/ST/OBC and Women.

Course Content

UNIT–I:

History of Making of the Indian Constitution: Sources. Features – Citizenship, Preamble, Fundamental Rights and Duties, Directive principles of State Policy.

UNIT–II:

Union Government and its administration Structure of the Indian Union: Federalism – Centre – state relationship. President: Role, power and position. Prime Minister and Council of ministers. Loksabha, Rajyasabha The Supreme Court and High Court: Powers and Functions.

UNIT–III:

State Government and its Administration Governor – Role and Position – Chief Minister and Council of ministers.

UNIT–IV:

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Functions, PRI: ZilaPachayat. Elected offi-

cials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT–V:

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books

1. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Subash Kashyap, Indian Constitution, National Book Trust.
3. J.C.Johari, Indian Government and Politics Hans.
4. H.M.Sreevani, Constitutional Law of India, 4th edition in 3 Volumes (Universal Law of Publication).

Reference Books

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

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MEAN STACK TECHNOLOGIES

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To translate user requirements into the overall architecture and implementation of new systems and Manage Project and coordinate with the Client.
- To write optimized front end code HTML and JavaScript.
- To design and implementation of robust and scalable front end applications.

Course Outcomes

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

- identify the Basic Concepts of Web & Markup Languages.
- develop web Applications using Scripting Languages &Frameworks.
- make use of Express JS and Node JS frame works
- illustrate the uses of web services concepts like restful, react js.
- adapt to Deployment Techniques & Working with cloud platform.

Course Content

UNIT–I: Introduction to Web

Internet and World Wide Web, Domain name service, Protocols: HTTP, FTP, SMTP. Html5 concepts, CSS3, Anatomy of a web page. XML: Document type Definition, XML schemas, Document object model, XSLT, DOM and SAX Approaches.

UNIT–II: JavaScript

The Basic of JavaScript: Objects, Primitives Operations and Expressions, Control Statements, Arrays, Functions, Constructors, Pattern Matching using Regular Expressions. Angular Java Script Angular JS Expressions: ARRAY, Objects, $eval, Strings, Angular JS Form Validation & Form Submission, Single Page Application development using Angular JS.

UNIT–III: Node.js

Introduction, Advantages, Node.js Process Model, Node JS Modules. Express.js: Introduction to Express Framework, Introduction to Nodejs , What is Nodejs, Getting Started with Express, Your first Express App, Express Routing, Implementing MVC in Express, Middleware, Using Template Engines, Error Handling , API Handling , Debugging, Developing Template Engines, Using Process Managers, Security & Deployment.

UNIT–IV: Restful Web Services

Using the Uniform Interface, Designing URIs, Web Linking, Conditional Requests. React Js: Welcome to React, Obstacles and Road blocks, React's Future, Keeping Up with the Changes, Working with the Files, Pure React, Page Setup, The Virtual DOM, React Elements, React DOM, Children, Constructing Elements with Data, React Components, DOM Rendering, Factories.

UNIT–V: Mongo DB

Introduction, Architecture, Features, Examples, Database Creation & Collection in Mongo DB. Deploying Applications: Web hosting & Domains, Deployment Using Cloud Platforms.

Text Books

1. Programming the World Wide Web, Robet W Sebesta, 7ed,Pearson.
2. Web Technologies, Uttam K Roy,Oxford
3. Pro Mean Stack Development, ELadElrom,Apress
4. Restful Web Services Cookbook, SubbuAllamraju,O'Reilly
5. JavaScript &jQuery the missing manual, David sawyer mcfarland,O'Reilly
6. Web Hosting for Dummies, Peter Pollock, John WileyBrand

Reference Books

1. Ruby on Rails up and Running, Lightning fast Web development, Bruce Tate, Curt Hibbs, Oreilly (2006).
2. Programming Perl, 4ed, Tom Christiansen, Jonathan Orwant, Oreilly(2012).
3. Web Technologies, HTML< JavaScript, PHP, Java, JSP, XML and AJAX, Black book, DreamTech.
4. An Introduction to Web Design, Programming, Paul S Wang, Sanda S Katila, Cengage Learning.
5. Express.JS Guide, The Comprehensive Book on Express.js, Azat Mardan, Lean Publishing.

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MACHINE LEARNING

II Semester

Lecture	: 3	nternal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with a wide variety of machine learning algorithms.
- To explain how to evaluate learning algorithms.

Course Outcomes

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

- acquire domain Knowledge for Productive use of Machine Learning and Diversity of Data.
- demonstrate on Supervised and Computational Learning
- analyze on Statistics in learning techniques and Logistic Regression Illustrate on Support Vector Machines and Perceptron Algorithm
- design a Multilayer Perceptron Networks and classification of decision tree

Course Content

UNIT–I: Introduction

Towards Intelligent Machines Well posed Problems, Example of Applications in diverse fields, Data Representation, Domain Knowledge for Productive use of Machine Learning, Diversity of Data: Structured / Unstructured, Forms of Learning, Machine Learning and Data Mining, Basic Linear Algebra in Machine Learning Techniques.

UNIT–II: Supervised Learning

Rationale and Basics: Learning from Observations, Bias and Why Learning Works: Computational Learning Theory, Occam's Razor Principle and Over fitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, and Metrics for assessing regression, Metrics for assessing classification.

UNIT–III: Statistical Learning

Machine Learning and Inferential Statistical Analysis, Descriptive Statistics in learning techniques, Bayesian Reasoning: A probabilistic approach to inference, K-Nearest Neighbor Classifier. Discriminant functions and regression functions, Linear Regression with Least Square Error Criterion, Logistic Regression for Classification Tasks, Fisher's Linear Discriminant and Thresholding for Classification, Minimum Description Length Principle.

UNIT–IV: Learning with Support Vector Machines (SVM)

Introduction, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for linearly seperable data, Linear Soft Margin Classifier for Overlapping Classes.

Learning with Neural Networks: Towards Cognitive Machine, Neuron Models, Network Architectures, Perceptrons, Linear neuron and the Widrow-Hoff Learning Rule, The error correction delta rule.

UNIT–V: Neural Networks and Decision Trees

Multilayer Perceptron Networks and error back propagation algorithm, Radial Basis Functions Networks. Decision Tree Learning: Introduction, Example of classification decision tree, measures of impurity for evaluating splits in decision trees, ID3, C4.5, and CART decision trees, pruning the tree, strengths and weakness of decision tree approach.

Text Books

1. Applied Machine Learning,1stedition, M.Gopal, McGraw HillEducation,2018
2. Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis (CRC) 1stEdition-2014

Reference Books

1. Machine Learning Methods in the Environmental Sciences, Neural Networks, William WHsieh, Cambridge Univ Press. *1* edition (August 31,2009)
2. Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & SonsInc., 2nd Edition 2001.
3. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995.
4. Machine Learning by Peter Flach , Cambridge-1st Edition 2012.

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Professional Elective - III

BLOCKCHAIN TECHNOLOGY

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with block chain systems (mainly Bit coin and Ethereum).
- To securely interact with them.
- To design, build, and deploy smart contracts and distributed applications,

Course Outcomes

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

- demonstrate the foundation of the Block chain technology and understand the processes in payment and funding.
- identify the risks involved in building Block chain applications.
- review of legal implications using smart contracts.
- choose the present landscape of Blockchain implementations and Understand crypto currency markets.
- examine how to profit from trading crypto currencies.

Course Content

UNIT – I:

The consensus problem, Asynchronous Byzantine Agreement ,AAP protocol and its analysis, Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model ,RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS).

UNIT – II:

Cryptographic basics for crypto currency - a short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography.

UNIT – III:

Bitcoin, Wallet, Blocks, Merkley Tree, hardness of mining,transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin.

UNIT – IV:

Ethereum - Ethereum Virtual Machine (EVM) ,Wallets for Ethereum - Solidity , Smart Contracts , some attacks on smart contracts.

UNIT – V:

(Trends and Topics) - Zero Knowledge proofs and protocols in Blockchain, Succinct non interactive argument for Knowledge (SNARK), pairing on Elliptic curves, Zcash.

Text Books

1. Aravind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016. (Free download available)

Reference Books

1. Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and crypto currency, IEEE Symposium on security and Privacy, 2015 (article available for free download) { curtain raiser kind of generic article, written by seasoned experts and pioneers}.
2. J. A. Garay et al, The bitcoin backbone protocol - analysis and applications EUROCRYPT 2015 LNCS VOl 9057, (VOLII), pp 281-310. (Also available at eprint.iacr.org/2016/1048). (serious beginning of discussions related to formal models for bitcoinprotocols).
3. R. Pass et al, Analysis of Blockchain protocol in Asynchronous networks, EUROCRYPT 2017, (eprint.iacr.org/2016/454). A significant progress and consolidation of several principles).

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Professional Elective - III

DATA PREPARATION AND ANALYSIS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To prepare the data for analysis and develop meaningful Data Visualizations

Course Outcomes

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

- extract the data for performing the analysis
- handle missing data by choosing appropriate technique
- apply the concept of clustering and association to analyze this statistical data
- apply techniques reallocated/ geolocated data
- summarize the data using basic statistics and visualize the data using basic graphs and plots.

Course Content

UNIT–I: Data Gathering and Preparation

Data formats, parsing and transformation, Scalability and real-time issues.

UNIT–II: Data Cleaning

Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation.

UNIT–III: Exploratory Analysis

Descriptive and comparative statistics, Clustering and association, Hypothesis generation.

UNIT–IV: Visualization

Designing visualizations, Time series, Reallocated data, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity.

UNIT–V:

Visualizations using R:- Exporting data, importance of box plots, plotting bar charts, plotting multiple variables_scatter plots, dealing with time-series plots.

Text Books

1. Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 2007.

Refernce Books

1. Exploratory Data mining and Data Cleaning, by Tamraparni DSU, Theodore Jhonson.
2. Visualizing Data: Exploring and Explaining Data with the Processing Environment by Ben Fry.

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Professional Elective - III

NATURAL LANGUAGE PROCESSING

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize the fundamental concepts and techniques of natural language processing (NLP).
- To impart knowledge on NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.

Course Outcomes

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

- demonstrate PoS tagging on a given text with basic Languagefeatures
- to design an innovative application using NLP components
- explain a rulebased system to tackle morphology/syntax of alanguage
- to design a tag set to be used for statistical processing for real-timeapplications.
- to compare and contrast the use of different statistical approaches for different types of NLP applications.

Course Content

UNIT–I: Introduction

Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT–II: Word Level Analysis

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT–III: Syntactic Analysis

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing, Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures

UNIT–IV: Semantics and Pragmatics

Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT–V: Discourse Analysis and Lexical Resources

Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2ndEdition, Daniel Jurafsky, James H. Martin¯Pearson Publication, 2014.
2. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, OReilly Media, 2009.

Reference Books

1. Language Processing with Java and LingPipe Cookbook, 1stEdition, Breck Baldwin, Atlantic Publisher,2015.
2. Natural Language Processing with Java, 2ndEdition, Richard M Reese, OReilly Media,2015.
3. Handbook of Natural Language Processing, Second, NitinIndurkhya and Fred J. Damerau, Chapman and Hall/CRC Press, 2010.Edition
4. Natural Language Processing and Information Retrieval, 3rdEdition, anveerSiddiqui, U.S. Tiwary, Oxford University Press, 2008.

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Professional Elective - IV

CLOUD COMPUTING

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To provide the architectural concepts of cloud computing.
- To familiarize with cloud service models and cloud based applications.

Course Outcomes

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

- differentiate the stages in historical evolution of cloud computing.
- use suitable cloud services to define cloud for the enterprise.
- demonstrate OS level virtualization to implement virtual machines.
- design machine images, web applications and databases for virtual machines.
- apply data, network and host security for the cloud**.**

Course Content

UNIT–I: Cloud Computing

Introduction, cloud computing: What it is and what it isn't, from collaboration to the cloud : A short history of cloud computing, the network is the computer: How cloud computing works, understanding cloud architecture , storage, services; The pros and cons of cloud computing. Who benefits from cloud computing? who shouldn't be using cloud computing.

UNIT–II: Defining Clouds for the Enterprise

Capacitive Parasitics: Capacitance and Reliability, Capacitance and Performance in CMOS; Resistive Parasitics: Resistance and Reliability— Ohmic Voltage Drop, Electromigration, Resistance and Performance.

Storage-as-a-Service, Database-as-a-Service, Information-as-a-Service, Process-as- a-Service, Application-as-a-Service, Platform-as-a-Service, Security-as-a-service, Infrastructure-as-a-Service.

UNIT–III: Virtual Machines and Virtualization

Implementation levels of virtualization: levels of virtualization implementation, VMM design requirements and providers, virtualization support at the OS level, virtualization structures/tools and mechanisms: Hypervisor and Xen architecture, binary transition with full virtualization, para-virtualization with compiler support.

UNIT–IV: Data Center to Cloud

Move into the cloud, know your software licenses, the shift to a cloud cost model, service levels for cloud applications.

UNIT–V: Security

Data Security: data control, encrypt everything, regulatory and standards compliance; Network Security: firewall rules, network intrusion detection; Host Security: system hardening, antivirus protection, host intrusion detection, data segmentation, credential management; Compromise response.

Text Books

1. Kai Hwang, Jack Dongarra and Geoffrey C.Fox, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things", 1st edition, Morgan Kaufman Publications.
2. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud", 1st edition, O'Reilly.

References Books

1. Michael Miller, "Cloud Computing- Web Based Applications That Change the Way You Work and Collaborate Online", 1st edition, Que publications.
2. David S. Linthicum, "Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide" Addison Wesley.

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Professional Elective - IV

QUANTUM COMPUTING

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To impart necessary knowledge to the learner for developing and implementing algorithms and write programs using these algorithms.

Course Outcomes

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

- explain the working of a quantum computing program, its architecture and program.
- model develop quantum logic gate circuits.
- develop quantum algorithm.
- program quantum algorithm on major toolkits.

Course Content

UNIT – I: Introduction to Quantum Computing

Motivation for studying Quantum Computing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.), Origin of Quantum Computing, Overview of major concepts in Quantum Computing Qubits and multi-qubits states, Bra-ket notation; Bloch Sphere representation; Quantum Superposition; Quantum Entanglement.

UNIT – II: Math Foundation for Quantum Computing

Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.

UNIT – III: Building Blocks for Quantum Program

Architecture of a Quantum Computing platform.

Details of q-bit system of information representation: Block Sphere, Multi-qubits States, Quantum superposition of qubits (valid and invalid superposition), Quantum Entanglement, Useful states from quantum algorithmic perceptive e.g. Bell State, Operation on qubits: Measuring and transforming using gates, Quantum Logic gates and Circuit: Pauli, Hadamard, phase shift, controlled gates, Ising, Deutsch, swap etc.

Programming model for a Quantum Computing Program Steps performed on classical.

Computer: Steps performed on Quantum Computer, Moving data between bits and qubits.

UNIT – IV: Quantum Algorithms

Basic techniques exploited by quantum algorithms- Amplitude amplification, Quantum Fourier Transform, Phase Kick-back, Quantum Phase estimation, Quantum Walks.

Major Algorithms- Shor's Algorithm; Grover's Algorithm; Deutsch's Algorithm;Deutsch -Jozsa Algorithm.

UNIT – V: Tools

OSS Toolkits for implementing Quantum program IBM quantum experience-Microsoft Q, RigettiPyQuil (QPU/QVM

Text Books

1. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.
2. David McMahon, "Quantum Computing Explained", Wiley
3. IBM Experience: https://quantumexperience,ng,bluemix.net

References Books

1. Microsoft Quantum Development Kit https://www.microsoft.com/en-us/quantum/development-kit
2. Forest SDK PyQuil: https://pyquil.readthedocs.io/en/stable/

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Professional Elective - IV

DIGITAL FORENSICS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To provide an in-depth study of the rapidly changing and fascinating field of computer
- To impart the knowledge required to investigate, detect and prevent digital crimes by combining both the technical expertise.
- To impart knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools.

Course Outcomes

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

- describe relevant legislation and codes of ethics
- analyze cyber crimes
- infer cause of crime from the gathered evidence.
- explain computer forensics and mobile forensics.

Course Content

UNIT–I: Digital Forensics

Forensic science, computer forensics, and digital forensics,
Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics.

UNIT–II: Cyber Crime Scene Analysis

Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

UNIT–III: Evidence Management and Presentation

Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

UNIT–IV: Computer Forensics

Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, and complete a case, Critique a case, Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

UNIT – V: Mobile Forensics

Mobile forensics techniques, mobile forensics tools.

Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008, Recent trends in mobile forensic technique and methods to search and seizure, electronic evidence.

Text Books

1. The Basics of Digital Forensics, John Sammons, 2nd edition, Elsevier, 2014.

Reference Books

1. Digital Forensic: The Fascinating world of digital evidences, 1st Edition, Nilakshi Jain, Dhananjay R.kalbande, wiley-2016

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MEAN STACK TECHNOLOGIES LAB

II Semester

Practical	: 4	Internal Marks	: 30
Credits	: 2	External Marks	: 70

Course Objectives

- To explain the core concepts of both the frontend and backend programming course.
- To familiarize with the latest web development technologies.
- To impart knowledge on SQL and Mongo databases.

Course Outcomes

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

- identify the basic concepts of web and markup languages.
- develop web applications using scripting languages and frameworks.
- create and run applications using jsp libraries.
- create our first controller working with and displaying in angular js and nested forms with ng- form.
- work with the files in React JS and constructing elements with data.

List of Experiments:

1. Develop static pages (using only HTML) of an online Book store. The pages should resemble: www.amazon.com. The website should consist of the following pages. Home page
   a) Registration and user Login b) User profilepage
   c) Bookscatalog d) Shoppingcart
   e) Payment by credit card OrderConformation
2. Write an HTML page including any required JavaScript that takes a number from text field in the range of 0 to 999 and shows it in words. It should not accept four and above digits, alphabets and special characters.
3. Develop and demonstrate JavaScript with POP-UP boxes and functions for the following problems:
   a) Input: Click on Display Date button using on click ( ) function Output: Display date in the text box
   b) Input: A number n obtained using prompt Output: Factorial of n number using alert
   c) Input: A number n obtained using prompt Output: A multiplication table of numbers from 1 to 10 of n using alert

d) Input: A number n obtained using prompt and add another number using confirm Output: Sum of the entire n numbers using alert

4. Create a simple visual bean with a area filled with a color. The shape of the area depends on the property shape. If it is set to true then the shape of the area is Square and it is Circle, if it is false. The color of the area should be changed dynamically for every mouse click.

5. Create an XML document that contains 10 users information. Write a Java Program, which takes User Id as input and returns the user details by taking the user information from XML document using DOM parser or SAX parser.
6. Develop and demonstrate PHP Script for the following problems:
   a) Write a PHP Script to find out the Sum of the IndividualDigits.
   b) Write a PHP Script to check whether the given number is Palindrome ornot
7. Implement the following in CSS
   a) Implementation of 'get' and 'post' methods.
   b) Implementation in colors, boarder padding.
   c) Implementation button frames tables, navigation bars.
8. Implement the web applications with Database using
   a) PHP, b) Servletsand c) JSP
9. Write a program to design a simple calculator using
   a) JavaScript b) PHP c) Servletand d) JSP
10. Create registration and login forms with validations using Jscript query.
11. Jscript to retrieve student information from student database using database connectivity.
12. Implement the following in React JS
    a) Using React Js creating constructs data elements.
    b) Using React Js implementations DoM.
13. Implement the following in Angular JS
    a) Angular Js databinding.
    b) Angular JS directives andEvents.
    c) Using angular Js fetching data fromMySQL.
14. Develop and demonstrate Invoking data using Jscript from Mongo DB.
15. Create an Online fee payment form using JScript and MangoDB.

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MACHINELEARNING USING PYTHON LAB

II Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 2	External Marks	: 70

Course Objectives

- To explain different Data sets in implementing the machine learning algorithms.
- To implement machine learning concepts and algorithms in any suitable language of choice.

Course Outcomes

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

- implement procedures for the machine learning algorithms
- apply appropriate data sets to the Machine Learning algorithms
- identify and apply Machine Learning algorithms to solve real world problems Design Python programs for various Learning algorithms

List of Experiments:

Note: Implement using R and Python.

1. Write a program to apply the following machine learning methods on any chosen dataset:
   a) Linear Regression b) Logistic Regression.
2. Write a program to implement Support Vector Machines.
3. Perform Exploratory Data Analysis for Classification using Pandas and Matplotlib.
4. Write a program to implement to analyze Bias, Variance, and Cross Validation.
5. Write a program to simulate a perception network for pattern classification and function approximation.
6. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
7. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
8. Write a program to implement the naïve Bayesian classifier for Iris data set. Compute the accuracy of the classifier, considering few test data sets.

9. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your dataset.
10. Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
11. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.
12. Implementing data visualization using R
    a) Find the data distributions using box and scatter plot.
    b) Find the outliers using plot.
    c) Plot the histogram, bar chart and pie chart on sample data.

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Audit Course - II

ENGLISH FOR RESEARCH PAPER WRITING

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To equip the trainees with the critical thinking skills required for crafting research issues into researchable questions.
- To develop in them research paper writing skills in three areas – vocabulary, discourse, and style;
- To enhance their awareness of the referencing conventions vis-à-vis scholarly communication;
- To develop in them an understanding of the knowledge-constructing practices of their disciplines (under the guidance of a research mentor on an apprenticeship programme) and sharpen that understanding so as to enable them to identify research issues, investigate them, and then present and publish papers on them.

Course Outcomes

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

- craft research issues into researchable questions;
- write appropriate introductions and conclusions to academic / research texts;
- review research literature using the skills of analysis, synthesis, critical evaluation, paraphrasing, and summarising and avoiding the risk of plagiarism;
- use the right vocabulary for different research communication purposes, such as stating study aims, reviewing sources, describing research designs, presenting arguments, evaluating and emphasizing, and analysing and discussing results.
- organise texts following the discourse rules of coherence and cohesion;
- write research paper abstracts; and
- communicate their research in academic style with grammatical accuracy.

Course Content

UNIT–I:

Understanding Researchability: Evaluating research questions in order to gain awareness of researchability - Identifying research issues, developing research questions from them, and crafting them into researchable questions

Academic Vocabulary: Neutral, and formal vocabulary - Nominalisation - Phrases commonly used in research communication

UNIT–II:

Writing and Rhetorical Conventions: Writing introductions - Writing conclusions - Discourse organization

Academic Vocabulary: Research and Study aims.

UNIT–III:

Writing and Rhetorical Conventions: Summarising - Paraphrasing -

Academic Vocabulary: Evaluating and critiquing

UNIT–IV:

Writing and Ahetorical Conventions: Writing abstracts - Varying sentence length and structure

Remedial Grammar

UNIT–V:

Writing and Rhetorical Conventions: Avoiding repetition and redundancy - Style of academic / scholarly communication - Referencing

Academic Vocabulary: Analysing and discussing results

Apprenticeship

The apprenticeship will involve each individual trainee, under the guidance of a research mentor in his/her department, developing and crafting research questions on issues of his/her concern, investigating at least one of those issues during the course of the internship, and writing a paper on it which, before its presentation or publication, will be reviewed or assessed, as part of the internal assessment, by a panel of experts in the trainees' own departments. The entire process could be broken down into the following skills:

a. Identifying research issues
b. Framing the issues – developing research questions from them, refining them, and crafting them
c. Addressing literature
d. Investigating one of those issues by selecting an appropriate research design and data collection procedures and arriving at conclusions
e. Gaining competence in disciplinary specialized discourse conventions
f. Presenting arguments which scholars anticipate
g. Writing a paper on the study, presenting it before a panel of experts, and revising the paper on the basis of feedback from the panel
h. Determining the prestige of journals
i. Establishing a paper-journal fit and submitting the revised paper for publication
j. Learning to negotiate two principal audiences in one's scholarly communication – the community of scholars and journal gate-keepers
k. Negotiating peer review and editorial commentary

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Professional Elective - V

DEEP LEARNAING

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To design and analyze various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- To explore supervised and unsupervised learning paradigms of machine learning.

Course Outcomes

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

- explore Deep learning techniques and various feature extraction strategies.
- mathematically understand the deep learning approaches and paradigms.
- apply the deep learning techniques for various applications.

Course Content

UNIT–I: Basics

Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

UNIT–II: Feedforward Networks

Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training.

UNIT–III: Better Training of Neural Networks

Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

UNIT–IV: Recurrent Neural Networks

Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.

Convolutional Neural Networks: LeNet, AlexNet.

Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

UNIT – V: Recent trends

Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning

Applications: Vision, NLP, Speech (just an overview of different applications in 2-3 lectures)

Text Books

1. Deep Learning, Ian Goodfellow and YoshuaBengio and Aaron Courville, MIT Press, 2016.

Reference Books

1. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996.
2. Pattern Recognition and Machine Learning, Christopher Bishop, 2007.

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Professional Elective - V

RECOMMENDER SYSTEMS

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To learn techniques for making recommendations, including non-personalized, content-based, and collaborative filtering.
- To automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations.

Course Outcomes

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

- design recommendation system for a particular application domain.
- evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy, diversity, product coverage, and serendipity.
- explain User-based recommendation, knowledge-based recommender system.
- define Opportunities for hybridization, Monolithic hybridization.
- identify hybridization design, Weighted, Switching, Mixed, Pipelined hybridization.

Course Content

UNIT–I: Introduction

Overview of Information Retrieval, Retrieval Models, Search and Filtering Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

UNIT–II: Content-based Filtering

High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, preprocessing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

UNIT–III: Collaborative Filtering

User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems. Types of Recommender Systems: Recommender systems in personalized web

search, knowledge-based recommender system, Social tagging recommender systems, Trust-centric recommendations, Group recommender systems.

UNIT–IV: Hybrid Approaches

Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade, Meta-level, Limitations of hybridization strategies.

UNIT–V: Evaluating Recommender System

Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations.

Text Books

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1sted.
2. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer (2016), 1sted.

Reference Books

1. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1sted.
2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1sted.

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Open Elective

SUSTAINABLE DEVELOPMENT

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To help the students understand the fundamental key concepts on Sustainable Development (SD),suchasintra-andinter-generational equity, economic, social and environmental,sustainability, strong and weak sustainability, natural capitalism, steady state and green economy.
- To enable students to identify and discuss in detail the key empiricalissues on sustainable development, such as renewable energy transitions, urban agriculture and green architecture.
- To empower students with the expertise to distinguish between "greeneconomy" and "sustainability" and various efforts at multiple levels ofgovernance:from individual to governments.
- To exposestudents to awide varietyof research areas to apply and therefore appropriate the oretical knowledge on public policy and international relations to the issue area of sustainable development, insuch aspects as international aid, global climate change negotiations, the importance of international regimes as opposed to voluntary private governance.
- To empower Students to make their own lives more sustainable and join social movements to bring about more of sustainable development.

Course Outcomes

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

- gainknowledgeofsustainabilityandbiodiversity
- studyaboutgreenhousegases
- learndynamicsofsustainability
- gainKnowledgeonsocio-economicsystems
- studyabouttheconventionsonsustainabledevelopment
- learnconceptofSustainableDevelopmentanditsrolein buildingofenvironment

Course Content

UNIT–I: Concept of Sustainable Development

Definition of sustainability - History and emergence of the concept of Sustainable development – Our Common Future - Objectives of Sustainable Development - Millennium Development Goals - Environment and Development linkages – Globalization and environment - Population, Poverty and Pollution –Global, Regional

and Local environmental issues–Resource Degradation–Greenhouse gases and climate Change – Desertification – Industrialization –Socialinsecurity.

UNIT–II: Sustainability and thetriple bottom line

Components of sustainability–Complexity of growth and equity-Social, economic and environmental dimensions of sustainable development–Environment–Biodiversity–Natural Resources–Ecosystem integrity–Clean air and water–Carrying capacity–Equity, Quality of Life, Prevention, Precaution, Preservation and Public participation. - Structural and functional linking of developmental dimensions – Sustainability in national and regional context..

UNIT–III: Sustainable Development and International Response

Role of developed countries in the development of developing countries–International summits–Stock holm to Johannes burg–Rio Principles–Agenda 21-Conventions–Agreements–Tokyo Declaration-Doubling Statement - Trans boundary issues – Integrated approach for resource protection and management.

UNIT–IV: Sustainable Development of Socio-Economic Systems

Demographic dynamics of sustainability – Policies for socio-economic development –Strategies for implementing eco-development programmes – Sustainable development through trade – Economic growth – Action plan forimplementing sustainable development – Urbanization and Sustainable Cities –Sustainable Energy and Agriculture –Sustainable Livelihoods – Ecotourism.

UNIT–V: Framework for Achieving Sustainability

Sustainability indicators - Hurdles to Sustainability - Operational guidelines – Inter connected pre-requisites for sustainable development – Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry-Science and Technology for sustainable development – Performance indicators of sustainability and Assessment mechanism – Constraints and barriers for sustainable development.

Text Books

1. Austin, James and Tomas Kohn. 1990. Strategic Management in DevelopingCountries.TheFreePress.
2. Berger. 1994. “The Environment and the Economy.” In Smelser and Swedberg(eds.)
3. TheHandbookofEconomicSociology.RusselSageFoundation.D’Arcy,David. Transcript of broadcast, Dec. 5, 2002, “In Houston, a Treasure of ExiledAfghanArt,”National PublicRadio,

Reference Books

1. Elkington, John. Cannibals with Forks:TheTriple Bottom Line for 21stCenturyBusiness Oxford:Capstone Publishing,October 1997.
2. Guillen, Mauro and Sandra L. Suarez. 2002. “The Institutional Context of Multinational Activity.”In Organization Theory and the Multinational Corporation” .2ndedition. New York: St.Martin’s Press.

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Open Elective

ENERGY AUDIT, CONSERVATION & MANAGEMENT

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To learn principle of energy audit as well as management for industries and utilities and buildings.
- To study the energy efficient motors and lighting.
- To learn power factor improvement methods and operation of different energy instruments.
- To compute depreciation methods of equipment for energy saving.

Course Outcomes

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

- understand the principle of energy audit and their economic aspects.
- recommend energy efficient motors and design good lighting system.
- understand advantages to improve the power factor.
- evaluate the depreciation of equipment.

Course Content

UNIT–I: Basic Principles of Energy Audit

Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams and load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT–II: Energy Management

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting. Energy manager, qualities and functions, language,Questionnaire – check list for top management.

UNIT–III: Energy Efficient Motors and Lighting

Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed , variable duty cycle systems, RMS - voltage variation-voltage unbalanceover motoring-motor energy audit. lighting system design and practice, lighting control, lighting energy audit.

UNIT–IV: Power Factor Improvement and Energy Instruments

Power factor – methods of improvement, location of capacitors, Power factor with non-linear loads, effect of harmonics on p.f, p.f motor controllers – Energy

Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers,application of PLC s.

UNIT–V: Economic Aspects and their Computation

Economics Analysis depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method, net present value method-Power factor correction, lighting – Applications of life cycle costing analysis, return on investment.

Text Books

1. Energy management by W.R.Murphy&G.Mckay Butter worth, Heinemann publications, 1982.
2. Energy management hand book by W.CTurner, John Wiley and sons, 1982.

Reference Books

1. Energy efficient electric motors by John.C.Andreas, Marcel Dekker Inc Ltd-2nd edition,1995
2. Energy management by Paul o Callaghan, Mc-graw Hill Book company-1st edition, 1998
3. Energy management and good lighting practice : fuel efficiency- booklet12-EEO.

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Open Elective

RAPID PROTOTYPING

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with Rapid Prototype tools and techniques for design and Manufacturing.

Course Outcomes

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

- assess the need of RPT in Product development.
- use appropriate RT Software for development of Prototype model.
- judge the correct RP Process for Product/Prototype development.
- predict the technical challenges in 3D printing.
- list the applications of RPT.

Course Content

UNIT–I: Introduction to Rapid Prototyping

Introduction to prototyping, traditional prototyping Vs. rapid prototyping (RP), need for time compression in product development, usage of RP parts, generic RP process, distinction between RP and CNC, other related technologies, classification of RP.

UNIT–II: RP Software and Software Issues of RP

RP Software: Need for RP software, MIMICS, magics, surgiGuide, 3D-doctor, simplant, velocity2, voxim, solidView, 3Dview, etc., software.

Software Issues of RP: Preparation of CAD models, problems with STI, files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

UNIT–III: Photopolymerization RP Processes, Powder Bed Fusion RP Processes and Extrusion-Based RP Systems

Photopolymerization RP Processes: Sterolighography (SL), SL resin curing process, SL scan patterns, microstereolithography, applications of photopolymerization processes.

Powder Bed Fusion RP Processes: Selective laser sintering (SLS), powder fusion mechanism and powder handling, SLS metal and ceramic part creation, electron beam melting (EBM), applications of powder bed fusion processes.

Extrusion-Based RP Systems: Fused deposition modelling (FDM), principles, plotting and path control, applications of extrusion-based processes..

UNIT–IV: Printing RP Processes, Sheet Lamination RP Processes and Beam Deposition RP Processes

Printing RP Processes: 3D printing (3DP), research achievements in printing deposition, technical challenges in printing, printing process modeling, applications of printing processes.

Sheet Lamination RP Processes: Laminated Object Manufacturing (LOM), ultrasonic consolidation (UC), gluing, thermal bonding, LOM and UC applications.

Beam Deposition RP Processes: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), processing – structure - properties, relationships, benefits and drawbacks.

UNIT–V: Rapid Tooling, Errors in RP Processes and RP Applications

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, classification of rapid tooling, direct and indirect tooling methods, soft and hard tooling methods.

Errors in RP Processes: Pre-processing, processing, post-processing errors, part building errors in SLA, SLS, etc.,

RP Applications: Design, engineering analysis and planning applications, rapid tooling, reverse engineering, medical applications of RP.

Text Books

1. Chua Chee Kai., Leong KahFai., Chu Sing Lim, “Rapid Prototyping: Principles and Applications in Manufacturing”, World Scientific

Reference Books

1. Ian Gibsn., David W Rosen., Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010
2. Pham, D.T, Dimov, S.S, Rapid Manufacturing, Springer, 2001.

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Open Elective

AUTOMOTIVE ELECTRONICS

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the electronic systems inside automotive vehicle.
- To introduce with the concepts of advanced safety systems

Course Outcomes

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

- learn the fundamentals of automotive technology.
- describe the operation of microcomputer systems.
- acquire knowledge in automotive sensors and control systems.
- develop communications & navigation/routing in automotive vehicles.

Course Content

UNIT–I: Automotive Fundamentals

Use of electronics in the automobile, evolution of automotive electronics, the automobile physical configuration, evolution of electronics in the automobile, survey of major automotive systems, engine control or electronic control unit, ignition system.

UNIT–II: Automotive Micro-Computer System

Binary number system, binary counters, Microcomputer fundamentals-digital versus analog computers, basic computer block diagram, microcomputer operations, CPU registers, accumulator registers, condition code register-branching; microprocessor architecture, memory-ROM, RAM; I/O parallel interface, digital to analog converter and analog to digital converters with block diagram.

UNIT–III: Basics of Electronics Engine Control

Motivation for electronic engine control, exhaust emissions, fuel economy, concept of an electronic engine control system, engine functions and control, electronic fuel control configuration, electronic ignition with sensors.

UNIT–IV: Sensors and Actuators

Introduction; basic sensor arrangement; types of sensors such as oxygen sensors, crank angle position sensors, fuel metering/vehicle speed sensors and detonation sensors, altitude sensors, flow sensors, throttle position sensors, solenoids, stepper motors, actuators – fuel metering actuator, fuel injector, and ignition actuator.

UNIT–V: Electronic Vehicle Management System and Automotive Instrumentation System

Cruise control system, antilock braking system, electronic suspension system, electronic steering control, and transmission control, safety: air bags, collision avoidance radar warning system with block diagram, low tire pressure warning system, advanced cruise control system.

Speech synthesis, sensor multiplexing, control signal multiplexing with block diagram, fibre optics inside the car, automotive internal navigation system, GPS navigation system, voice recognition cell phone dialling.

Text Books

1. William B. Ribbens, "Understanding Automotive Electronics", SAMS/Elsevier Publishing, 6th Edition. (UNITS I -V).
2. Robert Bosch Gambh, "Automotive Electrics Automotive Electronics Systems and Components", John Wiley& Sons Ltd., 5th edition, 2007.

Reference Books

1. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999.
2. G. Meyer, J. Valldorf and W. Gessner, "Advanced Microsystems for Automotive Applications", Springer, 2009.
3. Robert Bosch, "Automotive Hand Book" SAE, 5th Edition, 2000.

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Open Elective

SOFT COMPUTING TECHNIQUES

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
- To introduce students to artificial neural networks and fuzzy theory from an engineering perspective

Course Outcomes

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

- comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
- understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
- understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
- understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
- reveal different applications of these models to solve engineering and other problems.

Course Content

UNIT–I: Fuzzy Set Theory

Introduction to Neuro – Fuzzy and Soft Computing, Fuzzy Sets, Basic Definition and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, Fuzzy Rules and Fuzzy Reasoning, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models, Surgeon Fuzzy Models, Tsukamoto Fuzzy Models, Input Space Partitioning and Fuzzy Modeling.

UNIT–II: Optimization

Derivative based Optimization, Descent Methods, The Method of Steepest Descent, Classical Newton's Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing and Random Search – Downhill Simplex Search..

UNIT–III: Artificial Intelligence

Introduction, Knowledge Representation, Reasoning, Issues and Acquisition: Prepositional and Predicate Calculus Rule Based knowledge Representation Symbolic Reasoning under Uncertainty Basic knowledge Representation Issues Knowledge acquisition, Heuristic Search: Techniques for Heuristic search Heuristic Classification State Space Search: Strategies Implementation of Graph Search based on Recursion Patent directed Search Production System and Learning.

UNIT–IV: Neuro Fuzzy Modeling

Adaptive Neuro-Fuzzy Inference Systems, Architecture – Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling, Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

UNIT–V: Applications of Computational Intelligence

Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Soft Computing for Color Recipe Prediction.

Text Books

1. J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI, 2004, Pearson Education 2004.
2. N.P.Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2006.

Reference Books

1. Elaine Rich & Kevin Knight, Artificial Intelligence, Second Edition, Tata Mcgraw Hill Publishing Comp., 2006, New Delhi.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill, 1997.
3. Davis E.Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, N.Y., 1989.

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