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 2025-26)

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

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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 2025-26.

1.0 Program of Study

The following specializations are offered at present for the M.Tech Program of study

1. Structural Engineering (SE)
2. Power Electronics and Electric Drives (PEED)
3. Machine Design (MD)
4. VLSI Design and Embedded Systems (VLSID & ES)
5. CSE (Artificial Intelligence and Machine Learning) (CSE (AI&ML))

2.0 Duration of the Program

A student shall be declared eligible for the award of the M. Tech Degree, if he pursues a course of study in not less than two and not more than four academic years. Under any circumstances, permission shall not be given to complete the course work beyond four years.

3.0 Minimum Instruction Days

The minimum instruction period in each semester are 16 weeks.

4.0 Program Credits

The student shall register for all 80 credits and secure all the 80 credits.

5.0 Attendance Regulations

5.1 Attendance is calculated separately for each course. Attendance in all classes (Lectures / Laboratories) is compulsory. The minimum required attendance in each course is 75%. A student shall not be permitted to appear for the Semester End Examinations (SEE), if his attendance is less than 75%.

5.2 Condoning of shortage of attendance (between 65% and 75%) up to a maximum of 10% (*considering the days of attendance in sports, games, NSS activities and medical exigencies*) in each course (Theory/Lab/Mini Project with Seminar) is condoned on production of valid Certificates/ documents in the stipulated time mentioned here with:

5.2.1 Students who are admitted as in patients for treatment are only eligible to claim condonation of attendance. Such students under medical exigencies need to Produce (a) Doctor Medical Prescription, (ii) Medical bills duly signed by Doctor/Hospital authorities, (c) Diagnosis reports, if any, (d) Discharge summary issued at the time of discharge and any other supporting documents within one/two week(s) from the date of discharge to the respective institution.

5.2.1 Students participation in Sports/Games and NSS activities shall also be permitted for condonation of attendance. In such cases, they need to produce (a) invitation letter from the organising institute/agency, (ii) participation certificate and any supporting documents within one/ two week(s) from the date of participation to the respective departments.

5.3 A prescribed fee per course shall be payable for condoning shortage of attendance after getting the approval of College Academic Committee for the same. The College Academic Committee shall maintain all the relevant documents along with the request from the students, whose attendance is condoned.

5.4 Shortage of Attendance below 65% in any course shall in no case be condoned.

5.5 A Student, whose shortage of attendance is not condoned in any course(s) (Theory / Lab / Seminar) in any Semester, is considered as '**Detained in that course(s)**, and is not eligible to write Semester End Examination(s) of such Course(s), (in case of Seminar, his / her Seminar Report or Presentation are not eligible for evaluation) in that Semester; and he / she has to seek re-registration for those course(s) in subsequent Semesters, and attend the same as and when offered.

5.6 A student shall put in a minimum required attendance in at least FOUR courses in I semester for promotion to II Semester; and at least FOUR courses in II semester for promotion to III Semester.

Re-admission / re-registration

5.7 A student shall not be permitted to appear for the Semester End Examination (SEE) in a course unless they meet the prescribed attendance requirements for that course. Such students may take readmission for the course in the subsequent semester when it is offered by paying the prescribed fee, *at least 30 days before the commencement of classwork*.

5.8 Students who fail due to **less internal marks (less than 50%)** may be extended re-registration and may be permitted during maximum permissible course duration.

5.9 In such a case, the candidate must re-register for the course(s) and secure the required minimum attendance. The candidate's attendance in the re-registered course(s) shall be calculated separately to decide upon eligibility for writing the end examination in those course(s).

5.10 In a semester, students are permitted to re-register maximum of **THREE** courses.

5.11 Upon re-registration, the student's previous performance in the respective course(s) will be nullified. Re-registration must be completed by paying the prescribed fee at least 30 days prior to the commencement of classwork.

6.0 Examinations and Scheme of Evaluation

The performance of the candidate in each semester shall be evaluated course-wise, with a maximum of 100 marks for theory and 100 marks for practical, on the basis of Internal Evaluation and End Semester Examination.

6.1 For the theory courses 60 marks shall be awarded based on the performance in the End Semester Examination and 40 marks shall be awarded based on the Internal Evaluation. The continuous / internal evaluation shall be made based on the average of the marks secured in the two CIE/Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Each CIE/midterm examination shall be conducted for a total duration of 120 minutes with 4 questions (without choice) each question for 10 marks. End semester examination is conducted for 60 marks for all FIVE (5) questions (one question from one unit) to be answered (either or).

6.2 For practical courses, 60 marks shall be awarded based on the performance in the End Semester Examinations and 40 marks shall be awarded based on the day-to-day performance as Internal Marks. The internal evaluation based on the day to day work-10 marks, record- 10 marks and the remaining 20 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the examiners, with breakup marks of Procedure-15, Experimentation- 25, Results- 10, Viva-voce-10.

6.3 For Seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, supervisor/ mentor and two other senior faculty members of the department. For Seminar, there will be only internal evaluation of 100 marks. **A candidate has to secure a minimum of 50% of marks to be declared successful.**

6.4 **A candidate shall be deemed to have secured the minimum academic requirement in a course if he secures a minimum of 40% of marks in the End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.**

6.5 Laboratory examination for M. Tech. courses must be conducted with two Examiners, one of them being the Laboratory Class Teacher or teacher of the respective college and the second examiner shall be appointed by the Head of the Institution from the panel of examiners submitted by the respective department.

7.0 Evaluation of Seminar / Internship / Dissertation Work:

All the students admitted under these regulations have to mandatorily comply the requirements of (i) Seminar-I, (ii) Seminar-II, (iii) Comprehensive Viva, (iv) Disserta

tion Part-A and (v) Dissertation Part-B. Out of these, (i) to (iv) are evaluated by internally by Project Review Committee (PRC) and (v) External Evaluation.

7.1 A Project Review Committee (PRC) shall be constituted with Head of the Department and Two other senior faculty members in the department.

7.2 Students are required to appear for Seminar-I and Seminar-II in First and Second respectively. They shall present before PRC on the topic of their choice / interest preferably on the courses listed in respective semesters. PRC shall advise the students in advance to select topics which strengthen their Dissertation Part-A and Dissertation Part-B.

7.3 Students shall undergo mandatory summer internship / industrial training (2 credits) for a minimum of eight weeks duration at the end of second semester of the Programme / Summer Break. A student will be required to submit a summer internship / industrial training report to the concerned department and appear for an oral presentation before the committee. The Committee comprises of a HoD / Professor of the department and two faculty. The report and the oral presentation shall carry 40% and 60% weightages respectively. For summer internship / industrial training, there will be only internal evaluation of 100 marks. **A candidate has to secure a minimum of 50% of marks to be declared successful.**

7.4 The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering / Specialization in the PG program. Viva will be conducted in 3rd semester. The examination committee will be constituted by the HoD and consist of Professor of the department and two faculty. For comprehensive viva-voce, there will be only internal evaluation of 100 marks. **A candidate has to secure a minimum of 50% of marks to be declared successful.**

7.5 **Registration of Dissertation / Project Work:** A candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses, both theory and practical and duly approved by PRC.

7.6 After satisfying 7.5, student has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work for approval

7.7 If a candidate wishes to change his/her supervisor or topic of the project, he/she can do so with the approval of PRC. However, the PRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

7.8 Continuous assessment of Dissertation-Part A and Dissertation-Part B during the Semester(s) will be monitored by PRC. *Dissertation-Part A* will be only internal evaluation by PRC for 100 marks. **A candidate has to secure a minimum of 50% of marks to be declared successful.**

7.9 The candidate shall submit a status report to the PRC in two stages, each accompanied by an oral presentation, with a minimum interval of three months between the two.

7.10 The work on the project shall be initiated at the beginning of the III Semester and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis (Dissertation – Part A & Part B) only with the approval of PRC not earlier than 40 weeks from the date of registration of the project work.

7.11 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College / School / Institute.

7.12 The thesis shall be adjudicated by one examiner selected by the Principal. For this, the Head of the department shall submit a panel of 5 examiners, eminent in that field, with the help of the guide concerned and head of the department.

7.13 If the report of the examiner is *not favourable*, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is *not favourable* again, the thesis shall be summarily rejected. The candidate has to reregister for the project and complete the project within the stipulated time after taking the approval from the College.

7.14 If the report of the examiner is favourable, Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Head of the Department shall coordinate and make arrangements for the conduct of Viva-Voce examination. The Board shall jointly report the candidate's work for a maximum of 100 marks.

7.15 If the report of the Viva-Voce is unsatisfactory (i.e., < 50 marks), the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at the second Viva-Voce examination, the candidate has to re- register for the project and complete the project within the stipulated time after taking the approval from the College.

8.0 Cumulative Grade Point Average (CGPA):

Marks Range Theory Laboratory (Max - 100)	Marks Range Mini Project / Project Work for Dissertation (Max - 100)	Letter Grade	Level	Grade Point
≥ 90	≥ 90	S	Outstanding	10
≥ 80 & < 90	≥ 80 & < 90	A	Excellent	9
≥ 70 & < 80	≥ 70 & < 80	B	Very Good	8
≥ 60 & < 70	≥ 60 & < 70	C	Good	7
≥ 50 & < 60	≥ 50 & < 60	D	Fair	6
< 50	< 50	F	Fail	0
			Absent	0

Computation of SGPA:

The following procedure is to be adopted to compute the Semester Grade Point Average(SGPA) and Cumulative Grade Point Average(CGPA):

The **SGPA** is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e:

$$\textbf{SGPA (Si)} = \frac{\sum (Ci \ X \ Si)}{\sum (Ci)} \quad \text{for each semester.}$$

where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Computation of CGPA:

The **CGPA** is also calculated in the same manner taking into account all the courses undergone by a student over all the semester of a Programme, i.e.

$$\textbf{CGPA (Ci)} = \frac{\sum (Ci \ X \ Si)}{\sum (Ci)}$$

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Equivalent Percentage = (CGPA - 0.5) x 10

9.0 Award of Degree and Class:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following classes:

Class Awarded	CGPA to be Secured	
First Division with Distinction	≥ 7.5 (without Supplementary History)	From the CGPA secured from 80 Credits
First Class	≥ 6.5 & < 7.5	
Second Class	≥ 6.0 & < 6.5	

The secured grade, grade points, status and credits obtained will be shown separately in the memorandum of marks.

If a student wants to leave the program / exit after successful completion of first two semesters, he/she will be awarded Post Graduate Diploma in the specialization concerned.

10.0 Supplementary Examinations

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

11.0 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.

12.0 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.

13.0 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.

14.0 General

i) Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

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

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

iv) The institute may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the institution.

COURSE STRUCTURE

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SYLLABUS

COURSE STRUCTURE

I Semester

L : Lecture T : Tutorial P : Practical

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	D251AI01	Mathematics for Machine Learning	3	1	-	4
2	D251AI02	Artificial Intelligence	3	1	-	4
3	D251AI03	Data Science Applications	3	1	-	4
4		Program Elective - I	3	-	-	3
5		Program Elective - II	3	-	-	3
6	D251AI90	Artificial Intelligence Laboratory	-	-	4	2
7	D251AI91	Data Wrangling Laboratory	-	-	4	2
8	D251AI80	Seminar - I	-	-	2	1
		Total	**15**	**3**	**10**	**23**

II Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	D252AI01	Machine Learning	3	1	-	4
2	D252AI02	Deep Learning	3	1	-	4
3	D252AI03	Advanced Data Structures and Algorithms	3	1	-	4
4		Program Elective - III	3	-	-	3
5		Program Elective - IV	3	-	-	3
6	D252AI90	Deep Learning Laboratory	-	-	4	2
7	D252AI91	Machine Learning Laboratory	-	-	4	2
8	D252AI80	Seminar - II	-	-	2	1
		Total	**15**	**3**	**10**	**23**

III Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	D2530001	Research Methodology and IPR /	3	-	-	3
	/M	Swayam 12 Week Mooc Course				
2	D253AI0S	Seminar Internship / Industrial Training**	-	-	6	3
3	D253AICV	Comprehensive Viva ***	-	-	4	2
4	D253AI0P	Dissertation Par - A ****	-	-	20	10
		Total	**3**	**-**	**30**	**18**

* Student Attended Summer/ Year Break and Assessment will be done in Third Semester.
** Comprehensive viva can be conducted courses completing.
*** Dissertation –Part A, Internal Assessment.

IV Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	D254AI0P	Project / Dissertation Part - B ****	-	-	32	16
		Total	**-**	**-**	**32**	**16**

**** External Assessment

Professional Electives:

Program Elective - I

D251AIA0 Advanced Data Mining
D251AIA1 Mining Massive Data Sets
D251AIA2 High Performance Computing
D251AIA3 Natural Language Processing

Program Elective - II

D251AIB2 Augmented Reality and Virtual Reality
D251AIB3 Recommender Systems
D251AIB4 Time Series Analysis
D251AIB5 Robotic Process Automation

Program Elective - III

D252AIA1 Cloud Computing
D252AIA2 Reinforcement Learning
D252AIA3 Generative AI
D252AIA4 Blockchain Technologies

Program Elective - IV

D252AIB1 Computer Vision
D252AIB2 Quantum Computing
D252AIB3 Soft Computing
D252AIB4 Agentic AI

SYLLABUS

MATHEMATICS FOR MACHINE LEARNING

I Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 4		External Marks	: 60

Course Objectives

- To provide a deep understanding of the math that makes machine learning algorithm work.

Course Outcomes

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

- use of matrix algebra techniques that are needed by engineers for practical applications.
- apply advanced matrix decomposition techniques including Cholesky, eigen and singular value decompositions for matrix analysis and approximation.
- understand the structure of vector spaces, linear independence, basis, and orthonormal projections within analytic geometry contexts.
- compute gradients and higher-order derivatives, and apply these concepts in backpropagation and multivariate function analysis.
- construct probability models and apply continuous optimization methods including gradient descent and constrained optimization using Lagrange multipliers.

Course Content

UNIT – I:

Linear Algebra: System of linear equations: Matrices - Solving system of homogeneous equations - Solving system of non-homogeneous equations by Gauss elimination method, Gauss Seidel method and Relaxation method.
Eigen Values and Eigen Vectors: Eigen Values and Eigen Vectors -Properties.

UNIT – II:

Matrix Decompositions: Cholesky Decomposition method - Eigen decomposition and Diagonalization - Singular value decomposition -Matrix Approximation - Matrix Phylogeny.

UNIT – III:

Vector Spaces: Vector Spaces and Subspaces - Linear independence - Basis and Rank - Linear mapping. Analytic Geometry: Norms - Inner Product Spaces - Lengths and Distances - Orthonormal Basis - Orthogonal Complements and Projections.

UNIT – IV:

Partial Derivatives: Differentiation of univariate functions - Partial differentiation and Gradients - Gradients of vector-valued functions - Gradients of matrices - Useful identities for computing gradients -Back propagation and Automatic Differentiation - Higher order derivatives - Linearization and Multivariate Taylor series.

UNIT – V:

Probability and Distributions: Probability: Construction of a probability space - Discrete and Continuous probabilities - Sum rule and Product rule - Baye's theorem - Summary statistics and independence - Gaussian distribution.

Continuous Optimization: Optimization using gradient descent - Constrained optimization and Lagrange's multipliers - Convex optimization: Linear programming and Quadratic programming.

Text Books

1. "Mathematics for Machine Learning", Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, Cambridge University Press.
2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd Edition, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2017.

Reference Books

1. Machine Learning: An Applied Mathematics Introduction, Paul Wilmott, Panda Ohana Publishing 2019**.**

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ARTIFICIAL INTELLIGENCE

I Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 4		External Marks	: 60

Course Objectives

- To gain a historical perspective of Artificial Intelligence (AI) and its foundations.
- To become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- To investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
- To experience AI development tools such as an 'AI language', expert system shell, and/or data mining tool. Experiment with a machine learning model for simulation and analysis.
- To explore the current scope, potential, limitations, and implications of intelligent systems

Course Outcomes

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

- analyse and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them.
- analyze and apply problem reduction techniques and game playing and adversarial search strategies in AI.
- develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.
- apply probabilistic and evidential reasoning techniques to handle uncertainty in intelligent systems.
- apply and analyze fuzzy set operations, fuzzy inference mechanisms, and fuzzy systems to solve real-world problems under uncertainty.

Course Content

UNIT – I:

Introduction to artificial intelligence: Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-tie game playing, development of AI languages, current trends in AI, **Problem solving: state-space search and control strategies:** Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative-deepening a*, constraint satisfaction.

UNIT – II:

Problem reduction and game playing: Introduction, problem reduction, game playing, alpha-beta pruning, two-player perfect information games, **Logic concepts:** Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate Logic

UNIT – III:

Knowledge representation: Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, knowledge representation using frames, **advanced knowledge representation techniques:** Introduction, conceptual dependency theory, script structure, cyc theory, case grammars, semantic web.

UNIT – IV:

Uncertainty measure: probability theory: Introduction, probability theory, Bayesian belief networks, certainty factor theory, dempster-shafer theory.

UNIT – V:

Fuzzy sets and fuzzy logic: Introduction, fuzzy sets, fuzzy set operations, types of membership functions, multi valued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, inference rules for fuzzy propositions, fuzzy systems.

Text Books

1. Artificial intelligence, A modern Approach, 2nd ed, Stuart Russel, Peter Norvig, Prentice Hall.
2. Artificial Intelligence, Saroj Kaushik, 1st Edition, CENGAGE Learning, 2011.

Reference Books

1. Artificial intelligence, structures and Strategies for Complex problem solving, 5th Edition, George F Lugar, PEA.
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer, 2017.
3. Artificial Intelligence, A new Synthesis, 1st Edition, Nils J Nilsson, Elsevier, 1998.
4. Artificial Intelligence- 3rd Edition, Rich, Kevin Knight, Shiv Shankar B Nair, TMH.
5. Introduction To Artificial Intelligence And Expert Systems, 1st Edition, Patterson, Pearson India, 2015.

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DATA SCIENCE APPLICATIONS

I Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 4		External Marks	: 60

Course Objectives

- To cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short-term memory cells and convolution neural networks.

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.
- understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists.
- implement data collection and management scripts using Python Pandas
- ability to efficiently preprocess, wrangle, and aggregate data from diverse sources for effective analysis and transformation.
- ability to visualize and analyze data using matplotlib and pandas, including time series and financial data applications.

Course Content

UNIT – I:

PYTHON Basics and Programming Concepts: Introducing Python, Types and Operations - Numbers, Strings, Lists, Tuples, Dictionaries, Files, Numeric Types, Dynamic Typing; Statements and Syntax - Assignments, Expressions, Statements, Loops, iterations, comprehensions; Functions - Function Basics, Scopes, Arguments, Advanced Functions; Modules - Module Coding Basics, Module Packages, Advanced Module Topics; Exceptions and Tools - Exception Basics, Exception Coding Details, Exception Objects, Designing With Exceptions, Parallel System Tools.

UNIT – II:

GUI Programming: Graphical User Interface - Python gui development options, Adding Widgets, GUI Coding Techniques, Customizing Widgets; Internet Programming - Network Scripting, Client Side scripting, Pymailgui client, server-side scripting, Pymailcgi server; Tools and Techniques - databases and persistence, data structures, text and language, python/c integration.

UNIT – III:

Pandas and NumPy: Numpy Basics - Fast Element wise array functions, Multidimensional Array, Data Processing using arrays, file i/o with arrays; Pandas - Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics, Handling Missing Data, Hierarchical Indexing.

UNIT – IV:

Data Preprocessing: Data Loading, Storage, and File Formats - Reading and Writing data in text format, binary data formats, interacting with html and web apis, interacting with databases; Data Wrangling: Clean, Transform, Merge, Reshape - Combining and Merging Data Sets, Reshaping and Pivoting, Data Transformation, String Manipulation; Data Aggregation and Group Operations – Group by Mechanics, Data Aggregation, Groupby Operations and Transformations, Pivot Tables and Cross-Tabulation.

UNIT – V:

Data Visualization: A Brief matplotlib API Primer, Plotting Functions in pandas, Time Series, Financial and Economic Data Applications.

Text Books

1. Learning Python , 5th Edition, Mark Lutz, OReilly, 2013.
2. Programming Python, 4th Edition, Mark Lutz, OReilly, 2010.
3. Python For Data Analysis, 2nd Edition, Wes Mckinney, O Reilly, 2017.

Reference Books

1. Python: The Complete Reference,1st Edition, Martin C. Brown, McGraw Hill Education, 2018.
2. Head First Python, 2nd Edition, Paul Barry, O2 Reilly, 2016.

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Program Elective - I

ADVANCED DATA MINING

I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce fundamental and advanced data mining techniques for discovering patterns and building predictive models from real-world data.

Course Outcomes

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

- understand and compare major data mining methodologies such as CRISP-DM and SEMMA
- perform covariance and correlation analysis in the context of association mining.
- make use of association rule mining techniques on categorical and continuous data.
- identify and apply clustering algorithm (with open-source tools), interpret, evaluate and report the result.
- evaluate clustering algorithms based on cluster characteristics, data properties, and cluster quality metrics.

Course Content

UNIT – I:

Data Mining Methodologies: CRISP-DM and SEMMA, Comparison of Data Mining Methodologies. Statistical Limits on Data Mining, Introduction to Predictive Analytics, Classification & Prediction: Predictive Modelling; Concepts, General Approach to solving a classification problem, - ZeroR, OneR, Decision Tree Induction: Attribute Selection Measures, Tree Pruning, Scalability and Decision Tree Induction, Bayesian Classification Methods: Bayes Theorem, Naïve Bayes Classification, Model Evaluation and Selection, Visualization techniques and experiments with weka.

UNIT – II:

Association Analysis: Problem Definition, Frequent Itemset Generation, Rule Generation: Confident Based Pruning, Rule Generation in Apriori Algorithm, Compact Representation of frequent item sets, FP-Growth Algorithm, Generating item sets and rules efficiently, Covariance and Correlation analysis

UNIT – III:

Advanced Concepts on Association Analysis: Handling Categorical and Continuous Attributes, handling a Concept Hierarchy, Sequential Patterns: Preliminaries, Sequential Pattern Discovery, Timing Constraints, Alternative Counting Schemes; Subgraph Patterns: Preliminaries: Frequent Subgraph Mining, Candidate Generation, Candidate Pruning, Support Counting (Tan & Vipin Kumar).

UNIT – IV:

Clustering: Importance of Cluster Analysis, Clustering techniques, Different Types of Clusters; K-means: The Basic K-means Algorithm, K- means Additional Issues, Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses.(Tan & Vipin Kumar).

UNIT – V:

Cluster Analysis: Additional Issues and Algorithms: Cluster Evaluation, Characteristics of Data, Clusters, and Clustering Algorithms. (Tan &Vipin Kumar) Mining rich data types: Mining text data, Spatial-temporal data, Graph and networks (Han 4th ed)

Mining Real Data: Preprocessing data from a real medical domain, data mining techniques to create a comprehensive and accurate model of data.

Text Books

1. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, AnujKarpatne, Vipin Kumar, 2nd edition.
2. Data Mining: Concepts and Techniques, J. Han and M. Kamber, Morgan Kaufmann C.J. Date, Database Systems, Pearson, 4th edition.

Reference Books

1. Fundamentals of Data Warehouses, 2nd edition, Jarke, Lenzerini, Vassiliou, Vassiliadis, Springer.

E-Learning Resources:

1. https://nptel.ac.in/courses/106105174/

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Program Elective - I

MINING MASSIVE DATA SETS

I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To help students learn basic concepts and techniques for handling and analyzing large datasets, including data mining, distributed computing, data stream To s, frequent patterns, clustering, and dimensionality reduction, to solve practical problems.

Course Outcomes

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

- understand the fundamentals of data mining, statistical modeling, and feature extraction for analyzing large datasets.
- apply the MapReduce framework and distributed file systems for efficient processing of massive data.
- analyze data streams using techniques like sampling, filtering, and counting distinct elements in real-time scenarios.
- use frequent itemset mining algorithms to identify patterns in large datasets and optimize their computation
- evaluate clustering techniques and dimensionality reduction methods to group data and reduce complexity in high-dimensional datasets.

Course Content

UNIT – I:

Data Mining: Introduction, Statistical Modeling, Machine Learning, Computational Approaches to Modeling, Feature Extraction, Statistical Limits on Data Mining, Hash Functions, Indexes, Natural Logarithms, Power Laws.

UNIT – II:

Map Reduce and the New Software Stack: Distributed File Systems, Map Reduce, Algorithms Using MapReduce, Extensions to MapReduce, Complexity Theory for MapReduce.

UNIT – III:

Mining Data Streams: The Stream Data Model, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Counting Ones in a Window, Decaying Windows.

UNIT – IV:

Frequent Item sets: The Market-Basket Model, Market Baskets and the A-Priori Algorithm, Handling Larger Datasets in Main Memory, Limited- Pass Algorithms, Counting Frequent Items in a Stream.

UNIT – V:

Clustering: Introduction to Clustering Techniques, Hierarchical Clustering, K-means Algorithms, The CURE Algorithm, Clustering in Non-Euclidean Spaces, and Clustering for Streams and Parallelism. Dimensionality Reduction: Eigen values and Eigenvectors of Symmetric Matrices, Principal-Component, Analysis, Singula -Value, Decomposition, CUR Decomposition.

Text Books

1. Mining of Massive Datasets - Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman.

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Program Elective - I

HIGH PERFORMANCE COMPUTING

I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To study parallel computing hardware and programming models, performance analysis and modeling of parallel programs.

Course Outcomes

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

- understand the need for parallelism and the scope of parallel computing. Explain various parallel programming platforms, architectures, and their limitations.
- develop an efficient parallel algorithm to solve given problem analyze and measure performance of modern parallel computing system.
- understand fundamental communication operations in parallel computing and their performance implications. Explain the basics of shared address space programming using threads, synchronization, and OpenMP.
- evaluate performance metrics, overheads, and scalability factors in parallel systems using analytical models.
- build the logic to parallelize the programming task Develop parallel algorithms for sorting, graph problems, and CUDA-based GPU programming to address computational challenges in modern systems.

Course Content

UNIT – I: Introduction

Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, multi-core architecture.

UNIT – II: Parallel Programming: Principles of Parallel Algorithm Design

Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.

UNIT – III: Basic Communication

Operations- One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix- Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

Programming shared address space platforms: threads- basics, synchronization, OpenMP programming.

UNIT – IV: Dynamic Programming

Analytical Models: Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and the effect of Granularity on Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost, optimal execution time. Dense Matrix Algorithms: Matrix Vector Multiplication, Matrix-Matrix Multiplication.

UNIT – V: Parallel Algorithms

Sorting and Graph: Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quick sort, All- Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel Best First Search.CUDA Architecture: CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C-Write and launch CUDA C kernels, Manage GPU memory, Manage communication and synchronization, Parallel programming in CUDA- C.

Text Books

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2.
2. Jason sanders, Edward Kandrot, "CUDA by Example", Addison-Wesley, ISBN-13: 978- 0-13-138768-3.

Reference Books

1. Kai Hwang," Scalable Parallel Computing", McGraw Hill 1998, ISBN:0070317984.
2. Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013 ISBN: 9780124159884.
3. David Culler Jaswinder Pal Singh," Parallel Computer Architecture: A Hardware/ Software Approach", Morgan Kaufmann,1999, ISBN 978-1-55860-343-1.
4. Rod Stephens, "Essential Algorithms", Wiley, ISBN: ISBN: 978-1-118-61210-

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Program Elective - I

NATURAL LANGUAGE PROCESSING

I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- To examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- To enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

Course Outcomes

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

- summarize on the term 'internet of things' in different contexts.
- demonstrate a given text with basic Language features.
- design an innovative application using NLP components.
- explain a rule based system to tackle morphology/syntax of a language.
- design a tag set to be used for statistical processing for real-time 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, 2nd Edition, 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 Ling Pipe Cookbook, 1 st Edition, Breck Baldwin, Atlantic Publisher, 2015.
2. Natural Language Processing with Java, 2 nd Edition, Richard M Reese, OReilly Media,2015.
3. Handbook of Natural Language Processing, Second, Nitin Indurkhya and Fred J. Damerau, Chapman and Hall/CRC Press, 2010.Edition Natural Language Processing and Information Retrieval, 3 rd Edition, Tanveer Siddiqui, U.S. Tiwary, Oxford University Press,2008.

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Program Elective - II

AUGMENTED REALITY AND VIRTUAL REALITY

I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To acquire the knowledge on augmented reality.
- To demonstrate the augmented reality devices.
- To acquire the knowledge on virtual reality.
- To illustrate the VR devices.
- To explain how to apply VR/AR for various applications.

Course Outcomes

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

- explain the origin and fundamental concepts of Augmented Reality.
- explain the working of Augmented Reality and identify its key ingredients
- understand the relationship between Augmented Reality and other related technologies
- understand the fundamental concepts, historical development, and key components of virtual reality systems and input interfaces.
- apply knowledge of VR output devices and human factors to analyze user interaction, performance, and safety in virtual environments.

Course Content

UNIT – I:

Augmented Reality, origin of Augmented Reality, The Relationship Between Augmented Reality and Other Technologies, Augmented Reality Concepts, working of Augmented Reality, Ingredients of an Augmented Reality Experience.

UNIT – II:

Augmented Reality Hardware, Major Hardware Components for Augmented Reality Systems, Augmented Reality Software, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.

UNIT – III:

Virtual Reality: The Three I's of Virtual Reality, A Short History of Early Virtual Reality, Early Commercial VR Technology, VR Becomes an Industry, The Five Classic Components of a VR System. Input Devices: Trackers, Navigation, and Gesture Interfaces: Three-Dimensional Position Trackers, Navigation and Manipulation Interfaces.

UNIT – IV:

Output Devices: Graphics, Three-Dimensional Sound, and Haptic Displays: Graphics Displays, Sound Displays, Haptic Feedback.Human Factors in VR: Methodology and Terminology, User Performance Studies,VR Health and Safety Issues, VR and Society.

UNIT – V:

Augmented Reality Applications, characteristics of a Good Augmented Reality Application, Application Areas, Magic Books, Magic Windows and Doors, Applying Augmented Reality to a Problem, Evaluating Augmented Reality Applications, VR Applications in Manufacturing, Applications of VR in Robotics.

Text Books

1. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
2. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.

Reference Books

1. LaValle, “Virtual Reality”, Cambridge University Press, 2016.
2. Alan B Craig, William R Sherman and Jeffrey D Will, “Developing Virtual Reality Applications: Foundations of Effective Design”, Morgan Kaufmann, 2009.
3. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.
4. Anand R., “Augmented and Virtual Reality”, Khanna Publishing House, Delhi.

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Program Elective - II

RECOMMENDER SYSTEMS

I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To covers the basic concepts of recommender systems, including personalization algorithms, evaluation tools, and user experiences.

Course Outcomes

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

- understand the fundamentals, mathematical notations, and applications of recommender systems along with associated challenges.
- evaluate different collaborative filtering approaches and assess the impact of attacks on recommender systems to improve their robustness and performance.
- develop content-based and knowledge-based recommendation models using item profiles, feature extraction, and classification algorithms.
- design and implement hybrid recommender systems by exploring various hybridization strategies.
- evaluate recommender systems, and explore the integration of social tagging, trust, and community-driven recommendations for personalized web search.

Course Content

UNIT – I:

Introduction: Recommender system functions, Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

UNIT – II:

Collaborative Filtering: User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, Model based and pre- processing based approaches, Attacks on collaborative recommender systems.

UNIT – III:

Content-based Recommendation: High level architecture of content-based systems, Advantages and drawbacks of content-based filtering, Item profiles, discovering features of documents, obtaining item features from tags, representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classifica-

tion algorithms. Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.

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, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centered metrics. Recommender Systems and communities: Communities, collaboration and recommender systems in personalized web search, social tagging recommender systems, Trust and recommendations.

Text Books

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
2. RicciF., Rokach L.,Shapira D., Kantor B.P., Recommender Systems Handbook, Springer (2011), 1st ed.

Reference Books

1. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems for Learning, Springer (2013), 1st ed.

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Program Elective - II

TIME SERIES ANALYSIS

I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce a variety of statistical models for time series and cover the main methods for analyzing these models.

Course Outcomes

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

- develop and design forecasting models using time series data by analyzing its structure, autocorrelation patterns, and applying appropriate techniques for accurate predictions.
- use statistical software to estimate the models from real data, and draw conclusions and develop solutions from the estimated models.
- evaluate and apply advanced regression techniques and time series models to analyze data, make predictions, and assess model adequacy.
- communicate the statistical analyses of substantial data sets through explanatory text, tables and graphs. Apply ARIMA and Seasonal ARIMA models to analyze time series data, assess stationarity.
- combine and adapt different statistical models to analyze larger and more complex data.

Course Content

UNIT – I:

Introduction of Time Series Analysis: Introduction to Time Series and Forecasting, Different types of data, Internal structures of time series. Models for time series analysis, Autocorrelation and Partial autocorrelation. Examples of Time series Nature and uses of forecasting, Forecasting Process, Data for forecasting, Resources for forecasting.

UNIT – II:

Statistics Background for Forecasting: Graphical Displays, Time Series Plots, Plotting Smoothed Data, Numerical Description of Time Series Data, Use of Data Transformations and Adjustments, General Approach to Time Series Modeling and Forecasting, Evaluating and Monitoring Forecasting Model Performance.

UNIT – III:

Time Series Regression Model: Introduction Least Squares Estimation in Linear Regression Models, Statistical Inference in Linear Regression, Prediction of New

Observations, Model Adequacy Checking, Variable Selection Methods in Regression, Generalized and Weighted Least Squares, Regression Models for General Time Series Data, Exponential Smoothing, First order and Second order.

UNIT – IV:

Autoregressive Integrated Moving Average (ARIMA)Models: Autoregressive Moving Average (ARMA) Models, Stationarity and Invertibility of ARMA Models, Checking for Stationarity using Variogram, Detecting Non stationarity, Autoregressive Integrated Moving Average (ARIMA) Models, Forecasting using ARIMA, Seasonal Data, Seasonal ARIMA Models Forecasting using Seasonal ARIMA Models Introduction, Finding the "BEST" Model.

Example: Internet Users Data Model Selection Criteria, Impulse Response Function to Study the Differences in Models Comparing Impulse Response Functions for Competing Models.

UNIT – V:

Multivariate Time Series Models and Forecasting: Multivariate Time Series Models and Forecasting, Multivariate Stationary Process, Vector ARIMA Models, Vector AR (VAR) Models, Neural Networks and Forecasting Spectral Analysis, Bayesian Methods in Forecasting.

Text Books

1. Introduction To Time Series Analysis and Forecasting, 2nd Edition, Wiley Series in Probability and Statistics, By Douglas C. Montgomery, Cheryl L. Jen (2015).
2. Master Time Series Data Processing, Visualization, And Modeling Using Python Dr. Avishek Pallor. PksPrakash (2017)

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Program Elective - II

ROBOTIC PROCESS AUTOMATION

I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To understand the basics of Robotic Process Automation.
- To demonstrate the use of sequence and control flow for a task.
- To understand different mouse and keyboard activities
- To design an Assistant bot on a keyboard event
- To understand deploying and managing the bot.

Course Outcomes

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

- enumerate the benefits of Robotic Process Automation.
- make use of sequence and control flow for a task.
- apply different mouse and keyboard activities.
- design an Assistant bot on a keyboard event.
- create the bot for a workflow.

Course Content

UNIT – I:

Introduction To Robotic Process Automation: Scope and technique of automation, Robotic process automation, Benefits of RPA, Components of RPA, RPA platforms, UiPath studio, UiPath Robot, UiPath orchestrator, the future of automation.

UNIT – II:

Record And Play: UiPath Stack, Types of Robots, the user interface, Quick Access Toolbar, Different panels, Task recorder, Step by step examples using recorder. Sequence, Activities, Control flow, various types of loops, decision making, step by step example using sequence and flow chart, step by step example using sequence and control flow.

UNIT – III:

Data Manipulation And Controls: Variables and Scope, Collections, Arguments, Data table usage, clipboard management, File operations, CSV/Excel to data table and vice versa. Finding and attaching windows, finding the control, techniques

for a waiting for a control, act on controls, mouse and keyboard activities, working with UiExplorer, Handling events, Screen scraping, OCR.

UNIT – IV:

Assistant Bots, Exception Handling: Assistant bots, Monitoring system event triggers, Hotkey trigger, Mouse trigger, System trigger Monitoring image and element triggers, Example of monitoring email, Example of monitoring a copying event and blocking it – Launching an assistant bot on a keyboard event. Exception Handling, common exceptions, logging and taking screenshots, Debugging techniques, collecting crash dumps, error reporting.

UNIT – V:

Deploying And Maintaining The Bot: Publishing using publish utility, publish a workflow in Uipath, Overview of Orchestartion server, using orchestration server to control bots, using orchestration server to deploy bots, license management, publishing and managing updates.

Text Books

1. Alok Mani Tripathi, “Learning Robotic Process Automation”, Packt Publishing, 2018.

Reference Books

1. Frank Casale , Rebecca Dilla, Heidi Jaynes , Lauren Livingston, “Introduction to Robotic Process Automation: a Primer”, Institute of Robotic Process Automation,1st Edition 2015.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant”, Independently Published, 1st Edition 2018.
3. Srikanth Merianda,”Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation”, Consulting Opportunity Holdings LLC, 1st Edition 2018.
4. Lim Mei Ying, “Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes”, Packt Publishing, 1st Edition 2018.

E-Learning Resources

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

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ARTIFICIAL INTELLIGENCE LAB

I Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To equip students with hands-on experience in implementing fundamental and advanced artificial intelligence algorithms using Python. Students will learn to solve real-world problems using search strategies, heuristic techniques, game-playing algorithms, optimization methods, and expert systems, fostering their ability to design intelligent systems for various applications.

Course Outcomes

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

- implement and analyse classic AI search techniques, such as DFS and BFS, for solving structured problems using Python.
- apply heuristic-based approaches, including TSP and simulated annealing, to optimize complex problem-solving scenarios.
- develop and implement advanced AI algorithms like A*, AO*, and hill-climbing to address puzzles and decision-making tasks effectively.
- design game-playing strategies using Min-Max algorithms and evaluate their performance in adversarial settings.
- build and test expert systems utilizing forward and backward chaining methods to automate reasoning processes in Python.

List of Experiments:

1. Implementation of DFS for water jug problem using PYTHON.
2. Implementation of BFS for tic-tac-toe problem using PYTHON.
3. Implementation of TSP using heuristic approach using PYTHON.
4. Implementation of Hill-climbing to solve 8- Puzzle Problem using PYTHON.
5. Implementation of Monkey Banana Problem using PYTHON.
6. Implementation of A* Algorithm using PYTHON.
7. Implementation of AO* Algorithm using PYTHON.
8. Implementation of Min-Max Game playing algorithm using PYTHON.
9. Implementation Expert System with forward chaining using PYTHON.
10. Implementation Expert System with backward chaining using PYTHON.

Text Books

1. Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, Prentice Hall.
2. Artificial Intelligence, SarojKaushik, 1stEdition, CENGAGE Learning, 2011.

Reference Books

1. Artificial intelligence, structures and Strategies for Complex problem solving, 5th Edition, George F Lugar, PEA.
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer, 2017.
3. Artificial Intelligence, A new Synthesis, 1st Edition, Nils J Nilsson, Elsevier, 1998.
4. Artificial Intelligence- 3rd Edition, Rich, Kevin Knight, Shiv Shankar B Nair, TMH.
5. IntroductionToArtificialIntelligenceandExpertSystems,1st Edition, Patterson, Pearson India, 2015.

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DATA WRANGLING LAB

I Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To demonstrate concepts of machine learning, data handling and visualizations that is vital for data science.
- To familiarize with Suitability and limitations of tools and techniques related to data science process.

Course Outcomes

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

- perform Read and write operations on CSV, JSON and XML files.
- process the Excel file using Pandas.
- parse and Extract the Tables using Python library.
- apply the basis of Data cleanup operation on the given dataset.
- explore the web scraping in Python.

List of Experiments:

1. Write a Python script to read each row from a given csv file and print a list of strings.
2. Write a Python program to read a given CSV file as a dictionary.
3. Write a Python program to convert Python dictionary object (sort by key) to JSON data. Print the object members with indent level 4.
4. Write the python script to Read the XML file.
5. Write a Pandas program to import excel data (child labour and child marriage data.xlsx) into a Pandas data frame and process the following.
6. Get the data types of the given excel data.
7. Display the last ten rows.
8. Insert a column in the sixth position of the said excel sheet and fill it with NaN values.
9. Develop the python script to parse the pdf files using pdf miner.
10. Extract the Table from the child labour and child marriage data.xlsx using pdfables library.
11. Write a Python data wrangling scripts to insert the data into SQLite database.
12. Develop the Python Shell Script to do the basic data cleanup on child labour and child marriagedata.xlsx.
13. Check duplicates and missing data.

14. Eliminate Mismatches.
15. Cleans line breaks, spaces, and special characters.
16. Import the data into ‘agate‘ then explores the table using agate methods and perform statistical correlations.
17. Draw the chart between perceived corruption scores compared to the child labour percentages using matplotlib.
18. Write the python script to Map the Child Labour Worldwide using pygal.

Text Books

1. Jacqueline Kazil& Katharine Jarmul,” Data Wrangling with Python”, O’Reilly Media, Inc,2016.
2. Dr.TirthajyotiSarkar, Shubhadeep,” Data Wrangling with Python: Creating actionable data from raw sources”, Packt Publishing Ltd, 2019.

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MACHINE LEARNING

II Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 4		External Marks	: 60

Course Objectives

- To develop an appreciation for what is involved in learning from data.
- To demonstrate a wide variety of learning algorithms.
- To demonstrate how to apply a variety of learning algorithms to data.
- To demonstrate how to perform evaluation of learning algorithms and model selection.

Course Outcomes

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

- 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 Overfitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, Metrics for assessing regression, Metris 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, Logis-

tic Regression for Classification Tasks, Fisher's Linear Discriminant and Thresholding for Classification, Minimum Description Length Principle.

UNIT – IV:

Support Vector Machines (SVM): Introduction, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for linearly separable data, Linear Soft Margin Classifier for Overlapping Classes, Kernel Induced Feature Spaces, Nonlinear Classifier, Regression by Support vector Machines. 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:

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, M. Gopal, McGraw Hill Education, 2019.
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
3. Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis (CRC) 1st Edition-2014.

Reference Books

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009. (freely available online)
2. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
3. Machine Learning Methods in the Environmental Sciences, Neural Networks, William WHsieh, Cambridge Univ Press. 1 edition (August 31,2009).
4. Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc., 2nd Edition-2001.

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DEEP LEARNING

II Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 4		External Marks	: 60

Course Objectives

- To cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short-term memory cells and convolution neural networks.

Course Outcomes

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

- understand the structure of biological and computational neurons, perceptron models, and the fundamentals of perceptron learning and linear separability.
- understand and explore feedforward networks Gain a mathematical understanding of deep learning approaches, algorithms, and paradigms.
- apply deep learning techniques, including neural networks and advanced models, to real-world applications in various domains like computer vision, natural language processing, and speech recognition.
- apply concepts of RNNs, LSTMs, CNNs, and generative models like RBMs to design and analyze deep learning architectures for sequential andimage data.
- analyze and implement advanced deep learning models such as recurrent neural networks, convolutional neural networks, and generative models for complex data processing.

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:

Feed Forward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders. Deep Neural Networks: Difficulty of training deep neural networks, Greedy layer wise 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 (drop-out, 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, Transformers, GPT Applications: Vision, NLP, Speech.

Text Books

1. Deep Learning, Ian Good fellow and Yoshua Bengio 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.
3. Deep Learning with Python, François Chollet, Manning Publications, 2017.

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ADVANCED DATA STRUCTURES AND ALGORITHMS

II Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 4		External Marks	: 60

Course Objectives

- To concepts of Algorithms, Searching and Sorting techniques, Trees, Binary trees, representation, traversal.
- To dictionaries, ADT for List, Stack, Queue, Hash table representation, Hash functions, Priority queues, Priority queues using heaps, search trees.
- To AVL trees, operations of AVL trees, Red- Black trees, Splay trees, comparison of search trees.

Course Outcomes

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

- understand, design, and analyze algorithms for efficient problem-solving in computing.
- understand and apply fundamental algorithms and data structures, including searching, sorting, trees, and graphs, to organize and process data efficiently.
- understand and apply Abstract Data Types (ADTs) and hashing techniques for efficient data storage and retrieval.
- design and implement variety of data structures including linked lists, binary trees, heaps, graphs and search trees
- compare various search trees (AVL, Red-Black, Splay, B-Trees) based on performance and applications.

Course Content

UNIT – I:

The Role of Algorithms in Computing, Algorithms, Algorithms as technology, Insertion sort, Analyzing algorithms, Designing algorithms, Growth of Functions, Asymptotic notation, Standard notations and common functions.

UNIT – II:

Searching-Linear and Binary, Search Methods, Sorting-Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort. Trees- Binary trees, Properties, Representation and Traversals (DFT, BFT), Expression Trees (Infix, prefix, postfix). Graphs-Basic Concepts, Storage structures and Traversals.

UNIT – III:

Dictionaries, ADT, The List ADT, Stack ADT, Queue ADT, Hash Table Representation, Hash Functions, Collision Resolution-Separate Chaining, Open Addressing-Linear Probing, Double Hashing.

UNIT – IV:

Priority Queues- Definition, ADT, Realizing a Priority Queue Using Heaps, Definition, Insertion, Deletion, Search Trees- Binary Search Trees, Definition, ADT, Implementation, Operations Searching, Insertion, Deletion.

UNIT – V:

Search Trees- AVL Trees, Definition, Height of AVL Tree, Operations-, Insertion, Deletion and Searching, Introduction to Red-Black and Splay Trees, B-Trees, Height of B-Tree, Insertion, Deletion and Searching, Comparison of Search Trees.

Text Books

1. Introduction to Algorithms, 3rd Edition, Thomas H Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, The MIT Press.
2. Data Structures: A Pseudo Code Approach, 2nd Edition, Richard F.Gilberg, BehrouzA. Forouzon and Cengage

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Program Elective - III

CLOUD COMPUTING

II Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To implement Virtualization.
- To implement Task Scheduling algorithms.
- Apply Map-Reduce concept to applications.
- To build Private Cloud.
- To broadly educate to know the impact of engineering on legal and societal issues involved.

Course Outcomes

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

- understand the fundamentals of network-centric computing, cloud models, ethical concerns, and challenges in distributed systems.
- analyze cloud infrastructure, platforms, applications, and paradigms to identify opportunities and challenges in various domains.
- apply virtualization techniques and cloud scheduling policies to manage and allocate cloud resources effectively.
- evaluate cloud storage systems and assess cloud security risks, privacy concerns, and protective mechanisms.
- evaluate own organizations' needs for capacity building and training in cloud computing-related IT areas.

Course Content

UNIT – I:

Introduction: Network centric computing, Network centric content, peer-to–peer systems, cloud computing delivery models and services, Ethical issues, Vulnerabilities, Major challenges for cloud computing.

Parallel and Distributed Systems: Introduction, architecture, distributed systems, communication protocols, logical clocks, message delivery rules, concurrency, model concurrency with Petri Nets.

UNIT – II:

Cloud Infrastructure: At Amazon, The Google Perspective, Microsoft Windows Azure, Open Source Software Platforms, Cloud storage diversity, Inter cloud, energy use and ecological impact, responsibility sharing, user experience, Software licensing.

Cloud Computing: Applications and Paradigms: Challenges for cloud, existing cloud applications and new opportunities, architectural styles, workflows, The Zookeeper, The Map Reduce Program model, HPC on cloud, biological research.

UNIT – III:

Cloud Resource virtualization: Virtualization, layering and virtualization, virtual machine monitors, virtual machines, virtualization- full and para, performance and security isolation, hardware support for virtualization,

Case Study: Xen, Blades.

Cloud Resource Management and Scheduling: Policies and Mechanisms, Applications of control theory to task scheduling, Stability of a two-level resource allocation architecture, feedback control based on dynamic thresholds, coordination, resource bundling, scheduling algorithms, fair queuing, start time fair queuing, cloud scheduling subject to deadlines, Scheduling Map Reduce applications, Resource management and dynamic application scaling.

UNIT – IV:

Storage Systems: of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system. Apache Hadoop, Big Table, Megastore (text book 1), Amazon Simple Storage Service(S3) (Text book 2).

Cloud Security: Cloud security risks, security – a top concern for cloud users, privacy and privacy impact assessment, trust, OS security, Virtual machine security, Security risks.

UNIT – V:

Cloud Application Development: Amazon Web Services : EC2 – instances, connecting clients, security rules, launching, usage of S3 in Java, Installing Simple Notification Service on Ubuntu 10.04, Installing Hadoop on Eclipse, Cloud based simulation of a Distributed trust algorithm, Cloud service for adaptive data streaming (Text Book 1).

Google: Google App Engine, Google Web Toolkit (Text Book 2).

Microsoft: Azure Services Platform, Windows live, Exchange Online, Share Point Services, Microsoft Dynamics CRM (Text Book 2).

Text Books

1. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.
2. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH.

Reference Books

1. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH.

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Program Elective - III

REINFORCEMENT LEARNING

II Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To provide the fundamentals of Reinforcement learning.

Course Outcomes

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

- recall and define the key concepts, elements, and historical background of reinforcement learning and its foundational problems.
- develop and implement strategies for solving n-armed bandit problems using advanced methods like UCB, gradient bandits, and contextual bandits.
- understand the structure and components of finite Markov Decision Processes and explain the role of value functions and optimal policies.
- design and evaluate Monte Carlo-based reinforcement learning algorithms for both on-policy and off-policy control scenarios.
- analyze and interpret real-world reinforcement learning applications and case studies to assess algorithm effectiveness and performance.

Course Content

UNIT – I:

Reinforcement Learning Problem: The Reinforcement Learning, Examples, Elements of Reinforcement Learning, Limitations and Scope, An Extended Example: Tic-Tac-Toe, Summary, History of Reinforcement Learning.

UNIT – II:

Multi-arm Bandits: An n-Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandits, Associative Search (Contextual Bandits).

UNIT – III:

Finite Markov Decision Processes: The Agent–Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation.

UNIT – IV:

Monte Carlo Methods: Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off- policy Prediction via Importance Sampling, Incremental Implementation, Off-Policy Monte Carlo Control, Importance Sampling on Truncated Returns.

UNIT – V:

Applications and Case Studies: TD-Gammon, Samuel's Checkers Player, The Acrobot, Elevator Dispatching, Dynamic Channel Allocation, Job- Shop Scheduling.

Text Books

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning-An Introduction", 2nd Edition, The MIT Press, 2018.
2. Marco Wiering, Martijn van Otterlo Reinforcement Learning: State-of-the-Art (Adaptation, Learning, and Optimization (12)) 2012th Edition.

References Books

1. Vincent François-Lavet, Peter Henderson, Riashat Islam, An Introduction to Deep Reinforcement Learning (Foundations and Trends(r) in Machine Learning), 2019.

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Program Elective - III

GENERATIVE AI

II Semester

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

Course Objectives

- To understand the principles and concepts underlying Generative AI.
- To explore various types of generative models and their applications.
- To develop practical skills in implementing and training generative models.
- To evaluate the performance and limitations of different generative AI techniques.
- To analyze ethical considerations and emerging trends in Generative AI.

Course Outcomes

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

- understand the basics of generative AI, its applications, and the role of probability in data generation and style transformation.
- apply the building blocks of deep neural networks, including CNNs and RNNs, to handle vision and sequence-based data
- evaluate and implement generative adversarial networks (GANs) for image generation using various advanced GAN architectures.
- apply generative models such as GANs and autoencoders to create deepfakes and understand their operational workflows and features.
- understand generative models used in music composition, including LSTMs and MuseGAN, and explore emerging applications in generative AI.

Course Content

UNIT – I:

Introduction to Generative AI: "Drawing" Data from Models Applications of AI, the rules of probability, why use generative models, Style transfer and image transformation.

UNIT – II:

Building Blocks of Deep Neural Networks Perceptrons — a brain in a function, multi-layer perceptrons and back propagation, Varieties of networks: Convolution and recursive, Networks for seeing: Convolution architectures, Networks for sequence data RNNs and LSTMs.

UNIT – III:

Image Generation with GANs, The taxonomy of generative models Generative adversarial networks, Vanilla GAN, Improved GANs, Progressive GAN.

UNIT – IV:

Deepfakes with GANs, Deepfakes overview, Modes of operation, Key feature set, High-level workflow, Replacement using autoencoders, Re- enactment using pix2pix.

UNIT – V:

Composing Music with Generative Models Getting started with music generation, Music generation using LSTMs, Music generation using GANs, MuseGAN — polyphonic music generation, Emerging applications in generative AI.

Text Books

1. Generative AI with Python and TensorFlow 2, Joseph Babcock, Raghav Bali.
2. Hands-On Generative Adversarial Networks with Keras, Rafael Valle, Packt Publishing.

References Books

1. S.Rajasekaran , G.A.Vijayalakshmi Pai, Neural Networks, Fuzzy Systems and Evolutionary Algorithms : Synthesis And Applications, 2nd edition, PHI Publications, 2017.
2. George J. Klir, Ute St. Clair, Bo Yuan, Fuzzy Set Theory: Foundations and Applications 1st edition Prentice Hall, 1997.

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Program Elective - IV

BLOCKCHAIN TECHNOLOGIES

II Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To learn the fundamentals of Block Chain and various types of block chain and consensus mechanism.
- To understand public block chain system, Private block chain system and consortium block chain.
- To able to know the security issues of blockchain technology.

Course Outcomes

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

- understand the fundamentals of blockchain technology, types of blockchains, consensus mechanisms, and cryptocurrencies.
- analyze public blockchain systems and smart contracts with use cases in Ethereum and industry.
- compare private and consortium blockchains and apply key concepts in platforms like hyperledger and Corda.
- examine security, privacy, performance, and compliance issues in blockchain networks.
- develop and test blockchain applications using Python and Hyperledger Fabric through case studies.

Course Content

UNIT – I:

Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future. Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol. Cryptocurrency: Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

UNIT – II:

Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain. Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart

Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

UNIT – III:

Private Blockchain System: Introduction, Key Characteristics of Private Blockchain, Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E- commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain. Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda.

UNIT – IV:

Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

UNIT – V:

Blockchain Case Studies: Case Study 1 – Retail, Case Study 2 – Banking and Financial Services, Case Study 3 – Healthcare, Case Study 4 – Energy and Utilities. Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain. Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

Text Books

1. “Block chain Technology”, Chandramouli Subramanian, Asha A.George, Abhilasj K A and Meena Karthikeyan , Universities Press.

Reference Books

1. Blockchain Blue print for Economy, Melanie Swan, SPD Oreilly.
2. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gauar, Pearson Addition Wesley.

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Program Elective - IV

COMPUTER VISION

II Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To understand the Fundamental Concepts related to sources, shadows and shading.
- To understand the Geometry of Multiple Views.

Course Outcomes

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

- recall and understand the fundamental principles of radiometry, shading, and color in image formation using pinhole camera models.
- apply concepts of lighting, shading, and color perception to analyze how light interacts with surfaces in computer vision applications.
- apply stereo vision and clustering techniques for image segmentation and multi-view geometry in computer vision.
- apply probabilistic models such as the Hough Transform, EM algorithm, and Kalman filtering for segmentation, fitting, and tracking in dynamic scenes.
- apply geometric camera models and calibration techniques, including model-based vision methods, for applications like mobile robotics and medical image registration.

Course Content

UNIT – I:

CAMERAS: Pinhole Cameras Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

UNIT – II:

CAMERAS: Pinhole Cameras Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

UNIT – III:

The Geometry of Multiple Views: Two Views Stereopsis: Reconstruction, Human Stereopsis, Binocular Fusion, Using More Cameras Segmentation by Clustering: What Is Segmentation? Human Vision: Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering.

UNIT – IV:

Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, fitting as a Probabilistic Inference Problem, Robustness Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, Tracking with Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples.

UNIT – V:

Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, Case study: Mobile Robot Localization Model- Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Case study: Registration in Medical Imaging Systems, Curved Surfaces and Alignment.

Text Books

1. David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2009.

Reference Books

1. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013.
2. R. C. Gonzalez and R. E. Woods "Digital Image Processing" Addison Wesley 2008. 3. Richard Szeliski "Computer Vision: Algorithms and Applications" Springer-Verlag London Limited 2011.

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Program Elective - IV

QUANTUM COMPUTING

II Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To covers the basic concepts of quantum computing and problem-solving approach using finite dimensional mathematics.

Course Outcomes

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

- understand the foundational concepts of linear algebra, complex numbers, and set theory relevant to quantum computing.
- understand basic principles of quantum physics, quantum theory, and entanglement essential for quantum computation.
- understand the architecture and hardware components of quantum computers, including qubits, gates, and decoherence challenges.
- understand the structure and logic behind key quantum algorithms such as Deutsch-Jozsa, Shor's, and Grover's algorithms..
- understand the implications of quantum computing on classical asymmetric cryptographic algorithms and their security.

Course Content

UNIT – I:

Introduction to Essential Linear Algebra: Some Basic Algebra, Matrix Math, Vectors and Vector Spaces, Set Theory. Complex Numbers: Definition of Complex Numbers, Algebra of Complex Numbers, Complex Numbers Graphically, Vector Representations of Complex Numbers, Pauli Matrice, Transcendental Numbers.

UNIT – II:

Basic Physics for Quantum Computing: The Journey to Quantum, Quantum Physics Essentials, Basic Atomic Structure, Hilbert Spaces, Uncertainty, Quantum States, Entanglement. Basic Quantum Theory: Further with Quantum Mechanics, Quantum Decoherence, Quantum Electrodynamics, Quantum Chromodynamics, Feynman Diagram Quantum Entanglement and QKD, Quantum Entanglement, Interpretation, QKE.

UNIT – III:

Quantum Architecture: Further with Qubits, Quantum Gates, More with Gates,

Quantum Circuits, The D-Wave Quantum Architecture. Quantum Hardware: Qubits, number of Qubits Needed, Addressing Decoherence, Topological Quantum Computing, Quantum Essentials.

UNIT – IV:

Quantum Algorithms: Algorithm, Deutsch's Algorithm, Deutsch-Jozsa Algorithm, Bernstein-Vazirani Algorithm, Simon's Algorithm, Shor's Algorithm, Grover's Algorithm.

UNIT – V:

Impact of Quantum Computing on Cryptography: Asymmetric Cryptography, Specific Algorithms, Specific Applications.

Text Books

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.
2. Dr. Chuck Easttom, Quantum Computing Fundamentals, Pearson.

Reference Books

1. Quantum Computing for Computer Scientists, Noson S. Yanofsky and Mirco A. Mannucci.
2. Principles of Quantum Computation and Information, Benenti G., Casati G. and Strini G.,
3. An Introduction to Quantum Computing Algorithms, Pittenger A. O.,

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Program Elective - IV

SOFT COMPUTING

II Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts in Soft Computing such as Artificial Neural Networks, Fuzzy logic- based systems, genetic algorithm-based systems and their hybrids.

Course Outcomes

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

- understand the fundamentals of soft computing, artificial neural networks, neuron models, and basic learning mechanisms.
- analyze and compare different perceptron architectures and training algorithms including Adaptive Linear Neuron and Backpropagation Network.
- recall basic concepts of fuzzy logic including fuzzy sets, relations, membership functions, and fuzzification methods.
- understand fuzzy inference systems, rule formation, and hybrid neuro- fuzzy systems such as Mamdani and Sugeno models.
- apply genetic algorithms and hybrid systems to optimization problems, including genetic-neuro and genetic-fuzzy rule-based systems.

Course Content

UNIT – I:

Introduction to Soft Computing, Artificial neural networks, biological neurons, Basic models of artificial neural networks, Connections, Learning, Activation Functions, McCulloch and Pitts Neuron, Hebb Network.

UNIT – II:

Perceptron networks, Learning rule, Training and testing algorithm, Adaptive Linear Neuron, Back propagation Network, Architecture, Training algorithm.

UNIT – III:

Fuzzy logic, fuzzy sets, properties, operations on fuzzy sets, fuzzy relations, operations on fuzzy relations, Fuzzy membership functions, fuzzification, Methods of membership, value assignments, intuition, inference, rank ordering, Lambda – cuts for fuzzy sets, Defuzzification methods.

UNIT – IV:

Truth values and Tables in Fuzzy Logic, Fuzzy propositions, Formation of fuzzy rules, Decomposition of rules, Aggregation of rules, Fuzzy Inference Systems, Mamdani and Sugeno types, Neuro-fuzzy hybrid systems, characteristics, classification.

UNIT – V:

Introduction to genetic algorithm, operators in genetic algorithm, coding, selection, cross over, mutation, stopping condition for genetic algorithm flow, Genetic-neuro hybrid systems, GeneticFuzzy rule-based system.

Text Books

1. S. N. Sivanandam and S. N.Deepa, Principles of soft computing – John Wiley & Sons,2007.
2. Timothy J. Ross, Fuzzy Logic with engineering applications, John Wiley & Sons, 2016.

Reference Books

1. N. K. Sinha and M. M. Gupta, Soft Computing & Intelligent Systems: Theory & Applications-Academic Press /Elsevier. 2009.
2. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc.1998.
3. R. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/Elsevier, 2007.
4. Driankov D., Hellendoorn H. and Reinfrank M., An Introduction to Fuzzy ControlNarosa Pub., 2001.
5. Bart Kosko, Neural Network and Fuzzy Systems- Prentice Hall Inc., Englewood Cliffs, 1992.
6. Goldberg D.E.,Genetic Algorithms in Search, Optimization, an Machine Learning Addison Wesley, 1989.

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Program Elective - IV

AGENTIC AI

III Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To equip students with the ability to develop and deploy intelligent AI agent solutions while considering coordination, scalability, and ethical issues.

Course Outcomes

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

- understand the genesis, evolution, and classifications of AI agents, and analyze the role of technological advancements in shaping intelligent agent systems.
- evaluate AI agent architectures and frameworks, and identify the challenges in developing scalable, secure, and efficient AI agent-based solutions.
- demonstrate knowledge of multi-agent systems (MAS), including coordination techniques, communication strategies, conflict resolution, and their applications in realworld scenarios.
- analyze the economic implications of AI agents, including the agentic economy, blockchain integration, and token-based incentive mechanisms in autonomous systems.
- examine the role of AI agents in automating business workflows, fostering human-AI collaboration, and identify tasks where AI agents augment or cannot fully replace human intervention.

Course Content

UNIT – I:

Genesis and Evolution of AI Agents: Definition of AI, Historical Trajectory of AI Agents, Reactive Agents, Hybrid Agents, Learning Agents, Cognitive Agents, Collaborative Agents, Domain Specific Agents, Technological Drivers of the AI Agent Renaissance, Examples.

UNIT – II:

AI Agent Tools and Frameworks: Seven-Layer AI Agent Architecture, Features and Comparison of AI Agent Framework, Challenges: Framework and Tooling, Integration, Scalability, Security, Higher-Quality Data source, Skilled workforce Availability.

UNIT – III:

Multi-Agent Coordination: Introduction to MASs, Coordination Techniques in MASs, Communication in MASs, Conflict Resolution in Multi-Agent Environment, Designing Multi-Agent Environments, System Maintenance and Evolution, Real-

Word Application of MASs, AI Agent to Multi-Agent Systems, Build API for AI Agents in Multi-Agent Systems, Future Directions in MAS.

UNIT – IV:

AI Agent Economy: AI Agent Impact on Economy Theory, Agentic Economy on Blockchain, Role of Tokens in the Agentic Economy, Designing Token Incentives for AI Agent, Case Study: Incentives in an Autonomous Investment Ecosystem. AI Agents and Business Workflow: Business Workflows with AI Agents, AI Agent Enabled Full Automation, Human-AI Collaboration, What AI Agent Cannot Replace, Real-World Case Study of AI Agents in Business Workflows.

UNIT – V:

AI Agents in Robotics: Agentic Framework for Robotics, Advanced Modules for Humanoid Robots, Applications of AI Agents in Robotics, NVIDIA's Robotics strategies, platforms and technology, Google DeepMind's Robotics Strategies, platforms and technology, Unitree Robotics, Governances and Ethical Considerations.

Text Books

1. "Agentic AI: Theories and Practice", Foreword by Mathew R. Versaggi and Yang Wang ,Springer Publications, 2025.

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DEEP LEARNING LAB

II Semester

Practical : 4	Internal Marks : 40
Credits : 2	External Marks : 60

Course Objectives

- To enable students to design, implement, and evaluate deep learning models for diverse real- world applications using state-of-the-art techniques and tools.

Course Outcomes

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

- implement deep neural networks to solve real world problems.
- utilize pre-trained models like VGG16 for efficient image recognition.
- apply embedding techniques to represent textual data for natural language processing tasks.
- interpret the results of two different deep learning models.
- choose appropriate pre-trained model to solve real time problem.

Software Package Required

- Keras
- TensorFlow
- PyTorch

List of Experiments:

1. Implement multilayer perceptron algorithm for MNIST Hand written Digit Classification.
2. Design a neural network for classifying movie reviews (Binary Classification) using IMDB dataset.
3. Design a neural Network for classifying news wires (Multi class classification) using Reuters dataset.
4. Design a neural network for predicting house prices using Boston Housing Price dataset.
5. Build a Convolution Neural Network for MNIST Hand written Digit Classification.
6. Build a Convolution Neural Network for simple image (dogs and Cats) Classification.
7. Use a pre-trained convolution neural network (VGG16) for image classification.
8. Implement one hot encoding of words or characters.
9. Implement word embeddings for IMDB dataset.
10. Implement a Recurrent Neural Network for IMDB movie review classification problem.

Text Books

1. Reza Zadeh and Bharath Ramsundar, “Tensorflow for Deep Learning”, O’Reilly publishers, 2018.

e- Learning Resources

1. https://github.com/fchollet/deep-learning-with-python-notebooks

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MACHINE LEARNING LAB

II Semester

Practical : 4	Internal Marks : 40
Credits : 2	External Marks : 60

Course Objectives

- To equip students with practical knowledge of machine learning techniques for data preprocessing, classification, clustering, and visualization using Python.

Course Outcomes

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

- implement dimensionality reduction techniques like PCA and SVD to preprocess and analyse data.
- apply FIND-S and Candidate-Elimination algorithms to derive specific and consistent hypotheses from training data in .CSV files
- build classification models using decision trees (ID3), k-NN, and Bayesian classifiers, and evaluate their performance on various datasets.
- explore clustering techniques, including k-Means and the EM algorithm, to analyse data quality and patterns.
- visualize and interpret data insights using regression models, scatter plots, line charts, and histograms with Python libraries like Matplotlib, Seaborn, and Pandas.

List of Experiments:

1. Implement Principal Component Analysis (PCA) and Singular Value Decomposition (SVD) using NumPy.
2. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
3. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
4. 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.
5. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

6. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
7. 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 data set.
8. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
9. Apply EM algorithm to cluster a set of data stored in a .CSV file. 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.
10. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
11. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
12. Create the following plots using Matplotlib, Pandas Visualization, Seaborn on iris dataset, wine reviews datasets.

    a) Scatter Plot b) Line chart c) Histogram

Text Books

1. Applied Machine Learning, M. Gopal, McGraw Hill Education, 2019.
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.

e- Learning Resources

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman. The Elements of Statistical Learning, Springer 2009. (freely available online)
2. Christopher Bishop, Pattern Recognition and Machine Learning, Springer,2007

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RESEARCH METHODOLOGY AND IPR

III Semester

Lecture : 3	Internal Marks : 40
Credits : 3	External Marks : 60

Course objectives

- To familiarize with the overview of the research methodology and the technique of defining a research problem.
- To impart knowledge of various forms of the intellectual property, its relevance and principles such as patents, copyrights, and trademarks.

Course Outcomes

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

- formulate and define a clear research problem through systematic identification, analysis, and investigation methods.
- conduct effective literature reviews, adhere to research ethics, and prepare well-structured technical reports and research proposals.
- explain the fundamental concepts, types, and processes involved in protecting intellectual property at national and international levels.
- interpret the scope of patent rights and apply knowledge of licensing, technology transfer, and patent databases for innovation management.
- analyze the recent developments and case studies in IPR to understand their role in fostering innovation and socio-economic growth.

Course Content

UNIT – I: Research Problem: Identification, Scope, and Investigation

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT – II: Literature Review, Research Ethics, and Proposal Writing

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT – III: Fundamentals and Processes of Intellectual Property Rights

Nature of Intellectual Property: Patents, Designs, Trademarks 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 – IV: Patent Rights, Licensing, and Technology Transfer

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

UNIT – V: Emerging Trends and Case Studies in IPR

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc, Traditional knowledge Case Studies, IPR and IITs.

Text Books:

1. Stuart Melville, Wayne Goddard, "Research methodology: An Introduction for Science and Engineering Students", Juta & Co Ltd., 1996.
2. Wayne Goddard, Stuart Melville, "Research Methodology: An Introduction", Juta Academic, 2nd Edition, 2014.

Reference Books:

1. Ranjit Kumar, "Research Methodology: A Step-by-Step Guide for Beginners", SAGE Publications Pvt. Ltd., 5th Edition, 2019.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd., 2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.

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