PSG INSTITUTE OF TECHNOLOGY AND APPLIED RESEARCH

COIMBATORE – 641 062

(Autonomous Institution Affiliated to Anna University)

2025 Regulations

Scheme of Assessment and Syllabi

For

B.Tech. Artificial Intelligence and Data Science

B.Tech. Artificial Intelligence and Data Science

VISION

To impart quality education and produce socially responsible, creative and ethical engineers in the domain of artificial intelligence and data science with a focus to prepare them for the industry, engage them in potential research areas, to pursue and have continued professional growth to serve the society.

MISSION

- To provide high quality learning infrastructure comparable to global standards
- To provide skill based education to master the students in problem solving and analytical skills to enhance their niche expertise in the field Artificial Intelligence and Data Science.
- To enable students to experience content based learning with premier quality data science education, research and industrial collaboration.
- To create an environment that imparts communication skills, leadership and entrepreneurship skills.
- To produce ethical engineers / researchers by instilling the values of humility, humaneness, honesty and courage to serve the society.

PROGRAMME EDUCATION OBJECTIVES (PEOs)

The Program Educational Objectives specify the professional accomplishments that the students will attain within 3 to 5 years of their graduation. The following are the PEOs for the Programme B.Tech. in Artificial Intelligence and Data Science (AI&DS):

PEO1: Adapt emerging technologies of Artificial Intelligence & Data Science and develop state-of-the-art solutions in the fields of Manufacturing, Agriculture, Health-care, Education, and Cyber Security.

PEO2: Exhibit professional leadership qualities to excel in interdisciplinary domains.

PEO3: Possess human values, professional ethics, application-oriented skills, and engage in lifelong learning.

PROGRAMME OUTCOMES (POs)

PO1: **Engineering Knowledge**: Apply the knowledge of mathematics, natural science, computing, and engineering fundamentals and an engineering specialisation to the solution of complex engineering problems.

PO2: **Problem Analysis**: Identify, formulate, and analyse complex engineering problems, reaching substantiated conclusions with consideration for the holistic nature of the problem.

PO3: **Design/Development of Solutions**: Design creative solutions for complex engineering problems and design systems, components, or processes to meet identified needs - with consideration for public health and safety, and cultural, societal, and environmental factors. Sustainability is now intrinsic to design.

PO4: **Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

PO5: **Engineering Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling - recognizing their limitations - to solve complex engineering problems.

PO6: **The Engineer and the World**: Analyse and evaluate societal and environmental aspects while solving complex engineering problems, considering their impact on sustainability with reference to economy, health, safety, legal frameworks, culture, and the environment.

PO7: **Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity, and inclusion; and adhere to relevant national and international laws.

PO8: **Individual and Collaborative Team Work**: Function effectively as an individual, and as a member or leader in diverse and multi-disciplinary teams.

PO9: **Communication:** Communicate effectively and inclusively within the engineering community and with society at large - comprehending and writing effective reports and design documentation, and making effective presentations - considering cultural, language, and learning differences.

PO10: **Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects in multi-disciplinary environments.

PO11: **Life-Long Learning**: Recognise the need for, and have the preparation and ability for, independent and life-long learning, adaptability to new and emerging technologies, and critical thinking in the broadest context of technological change.

PROGRAMME SPECIFIC OBJECTIVES (PSOs)

After successful completion of the program, students will be able to:

PSO1: Exhibit proficiency in Artificial Intelligence and Data Science by providing sustainable solutions while adapting to societal, environmental, and ethical concerns in solving real-world problems.

PSO2: Develop professional skills in thrust areas such as Artificial Neural Networks (ANN), Deep Learning, Robotics, Internet of Things (IoT), and Big Data Analytics.

PSO3: Pursue higher studies in Artificial Intelligence and Data Science in reputed universities and contribute effectively in research establishments and industries.

B.Tech. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

(Minimum No. of credits to be earned: 168)

S. No.	Course Code	Course Title	Hours / Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER I										
THEORY										
1	25MA101	Calculus and its Applications	3	1	0	4	40	60	100	BS
2	25CS101	C Programming	3	0	0	3	40	60	100	ES
3	25EE101	Basics of Electrical and Electronic Systems	3	0	0	3	40	60	100	ES
4	25HS101	English Language Proficiency	3	1	0	4	40	60	100	HS
5	25HS102	தமிழர் மரபு / Heritage of Tamils	1	0	0	1	40	60	100	HS
PRACTICALS										
6	25CS111	C Programming Laboratory	0	0	4	2	60	40	100	ES
7	25EE112	Engineering Skills Laboratory	0	0	4	2	60	40	100	ES
8	25GE111	Design Thinking for Innovation	0	0	2	1	100	0	100	ES
MANDATORY COURSES										
9	25GEM01	Induction Programme**	-	-	-	Grade	-	-	-	MC
10	25HSO01/ 25HSO02	Physical Education/Yoga and Health	0	0	2	Grade	-	-	-	MC
Total 27 periods			**13**	**2**	**12**	**20**	**420**	**380**	**800**	

S. No.	Course Code	Course Title	Hours / Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER II										
THEORY										
1	25MA202	Transforms and Applications	3	1	0	4	40	60	100	BS
2	25MA203	Discrete Mathematics	3	1	0	4	40	60	100	BS
3	25CY202	Applied Chemistry	3	0	0	3	40	60	100	BS
4	25AD201	Python Programming	3	0	0	3	40	60	100	ES
5	25AD202	Digital Principles and Computer Organization	3	0	0	3	40	60	100	ES
6	25HS201	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	1	0	0	1	40	60	100	HS
PRACTICALS										
7	25AD211	Python Programming Laboratory	0	0	4	2	60	40	100	ES
8	25CY211	Chemistry Laboratory	0	0	4	2	60	40	100	BS
9	25GE211	Engineering Graphics	0	0	4	2	60	40	100	ES
10	25HS21_	Language Elective	0	0	4	2	60	40	100	HS
11	25EEC01	Workplace Communication Skills	0	0	2	Grade	100	0	100	EEC
MANDATORY COURSES										
12	25GEM02	Activity Point Programme I*	-	-	-	Grade	-	-	-	MC
13	25HSO01/ 25HSO02	Physical Education/Yoga and Health	0	0	2	Grade	-	-	-	MC
Total 38 periods			**16**	**2**	**20**	**26**	**580**	**520**	**1100**	

**** As per AICTE Norms,**

*** As per AICTE Norms Total: 60 hours, Grade: Non - Credit Course**

CA - Continuous Assessment; ESE - End-Semester Examination; CAT - Category; BS - Basic Science; HS - Humanities and Social Sciences; ES - Engineering Sciences; PC - Professional Core; PE - Professional Elective; OE - Open Elective; EEC - Employability Enhancement Course; MC - Mandatory Course

L-Lecture; T-Tutorial; P-Practical; C-Credits

S. No.	Course Code	Course Title	Hours / Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER III										
THEORY										
1	25MA301	Linear Algebra and its Applications	3	1	0	4	40	60	100	BS
2	25MA303	Probability, Stochastic Processes and Statistics	3	1	0	4	40	60	100	BS
3	25CS301	Data Structures	3	0	0	3	40	60	100	PC
4	25AD301	Fundamentals of Data Science and Analytics	3	0	0	3	40	60	100	PC
5	25AD302	Data Engineering	3	0	0	3	40	60	100	PC
6	25CS303	Object Oriented Programming	2	0	2	3	50	50	100	PC
PRACTICALS										
7	25CS311	Data Structures Laboratory	0	0	4	2	60	40	100	PC
8	25AD311	Data Analytics and Visualization Laboratory	0	0	4	2	60	40	100	PC
9	25EEC02	Foundations for Problem Solving	0	0	2	1	100	0	100	EEC
MANDATORY COURSES										
10	25MC0_ _	Mandatory Course I	2	0	0	Grade	100	0	100	MC
11	25GEM03	Activity Point Programme II*	-	-	-	Grade	-	-	-	MC
Total 33 periods			**19**	**2**	**12**	**25**	**570**	**430**	**1000**	

S. No.	Course Code	Course Title	Hours / Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER IV										
THEORY										
1	25MA401	Optimization Techniques for Analytics	3	1	0	4	40	60	100	BS
2	25CS401	Database Management Systems	3	0	0	3	40	60	100	PC
3	25CS402	Design and Analysis of Algorithms	3	1	0	4	40	60	100	PC
4	25AD402	Artificial Intelligence Systems	3	1	0	4	40	60	100	PC
5	25AD403	Machine Learning for Data Science	3	0	0	3	40	60	100	PC
PRACTICALS										
6	25CS411	Database Management Systems Laboratory	0	0	4	2	60	40	100	PC
7	25AD412	Artificial Intelligence and Machine Learning Laboratory	0	0	4	2	60	40	100	PC
8	25AD413	Corpus Creation Laboratory	0	0	2	1	60	40	100	ES
9	25ADE01	Mini Project I	0	0	2	1	100	0	100	EEC
10	25EEC03	Problem Solving	0	0	2	1	100	0	100	EEC
MANDATORY COURSES										
11	25MC0_ _	Mandatory Course II	2	0	0	Grade	100	0	100	MC
12	25GEM04	Activity Point Programme III*	-	-	-	Grade	-	-	-	MC
Total 34 periods			**17**	**3**	**14**	**25**	**680**	**420**	**1100**	

*** As per AICTE Norms Total: 60 hours, Grade: Non - Credit Course**

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L-Lecture; T-Tutorial; P-Practical; C-Credits

S. No.	Course Code	Course Title	Hours / Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER V										
THEORY										
1	25HS301	Project and Finance Management	3	0	0	3	40	60	100	HS
2	25AD501	Deep Learning	3	0	0	3	40	60	100	PC
3	25CS501	Operating Systems	3	0	0	3	40	60	100	PC
4	25AD503	Network and Information Security	3	0	2	4	50	50	100	PC
5	25ADP_ _#	Professional Elective I	3#	0	0#	3	40#	60#	100	PE
PRACTICALS										
6	25AD511	Deep Learning Laboratory	0	0	4	2	60	40	100	PC
7	25CS511	Operating Systems Laboratory	0	0	2	1	60	40	100	PC
8	25CSE02/ 25CSE03	Internship I / Community Project	0	0	0	1	100	0	100	EEC
9	25EEC04	Aptitude Skills	0	0	2	1	100	0	100	EEC
MANDATORY COURSES										
10	25GEM05	Activity Point Programme IV*	-	-	-	Grade	-	-	-	MC
Total 25 periods#			**15#**	**0**	**10#**	**21**	**530#**	**370#**	**900**	

S. No.	Course Code	Course Title	Hours / Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER VI										
THEORY										
1	25MA601	Graph Theory and Mining	3	1	0	4	40	60	100	BS
2	25AD601	Reinforcement Learning	3	0	2	4	50	50	100	PC
3	25AD602	Large Language Model	3	0	0	3	40	60	100	PC
4	25ADP_ _#	Professional Elective II	3#	0	0#	3	40#	60#	100	PE
5	25_ _O_ _	Open Elective I	3	0	0	3	40	60	100	OE
PRACTICALS										
6	25AD611	Large Language Model Laboratory	0	0	4	2	60	40	100	PC
7	25CSE04	Mini Project II	0	0	2	1	100	0	100	EEC
8	25EEC06	Enhancing Arithmetic Problem Solving	0	0	2	1	0	0	100	EEC
MANDATORY COURSES										
9	25GEM06	Activity Point Programme V*	-	-	-	Grade	-	-	-	MC
Total 26 periods#			**15#**	**1**	**10#**	**21**	**370#**	**330#**	**800**	

*** As per AICTE Norms Total: 60 hours, Grade: Non - Credit Course**

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L-Lecture; T-Tutorial; P-Practical; C-Credits

S. No.	Course Code	Course Title	Hours / Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER VII										
THEORY										
1	25AD701	Big Data and Advanced Database Systems	3	0	2	4	50	50	100	PC
2	25AD702	Computer Vision	3	0	2	4	50	50	100	PC
3	25ADP_ _[#]	Professional Elective III	3[#]	0	0[#]	3	40[#]	60[#]	100	PE
4	25ADP_ _[#]	Professional Elective IV	3[#]	0	0[#]	3	40[#]	60[#]	100	PE
5	25_ _O_ _	Open Elective II	3	0	0	3	40	60	100	OE
PRACTICALS										
6	25CSE05	Project Work I	0	0	4	2	100	0	100	EEC
7	25CSE06	Internship II	0	0	0	1	100	0	100	EEC
Total 23 periods[#]			**15[#]**	**0**	**8[#]**	**20**	**420[#]**	**280[#]**	**700**	

S. No.	Course Code	Course Title	Hours / Week			C	Maximum Marks			CAT
			L	T	P		CA	ESE	Total	
SEMESTER VIII										
THEORY										
1	25ADP_ _[#]	Professional Elective V	3[#]	0	0[#]	3	40[#]	60[#]	100	PE
2	25ADP_ _[#]	Professional Elective VI	3[#]	0	0[#]	3	40[#]	60[#]	100	PE
PRACTICALS										
3	25CSE07	Project Work II	0	0	8	4	60	40	100	EEC
Total 14 periods[#]			**6[#]**	**0**	**8[#]**	**10**	**140[#]**	**160[#]**	**300**	

Summary of Credit Distribution

B.Tech. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE										
S. No.	Course Category	Credits Per Semester								Total Credits
		1	2	3	4	5	6	7	8	
1	HS	5	3	0	0	3	0	0	0	**11**
2	BS	4	13	8	4	0	4	0	0	**33**
3	ES	11	10	0	1	0	0	0	0	**22**
4	PC	0	0	16	18	13	9	8	0	**64**
5	PE	0	0	0	0	3	3	6	6	**18**
6	OE	0	0	0	0	0	3	3	0	**6**
7	EEC	0	0	1	2	2	2	3	4	**14**
8	MC	-	-	-	-	-	-	-	-	**-**
TOTAL		**20**	**26**	**25**	**25**	**21**	**21**	**20**	**10**	**168**

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L-Lecture; T-Tutorial; P-Practical; C-Credits

LIST OF PROFESSIONAL ELECTIVE COURSES: VERTICALS

S. No.	VERTICAL I Full Stack Development	VERTICAL II Data Science for Intelligent System	VERTICAL III Computational Intelligence and Machine Learning	VERTICAL IV Cyber Security
1	25CSP01 Micro service Architecture	25ADP01 Recommender Systems	25ADP09 Natural Language Processing	25ADP17 Secure Coding
2	25CSP02 UI/UX Design	25ADP02 Predictive Analytics	25ADP10 MLOps	25CSP14 Cyber Forensics
3	25CSP03 DevOps	25ADP03 Smart Systems	25ADP11 Immersive Technologies	25ADP20 Application Security
4	25CSP04 Software Testing and Automation	25ADP04 Image and Video Analytics	25ADP12 Conversational AI	25ADP15 Responsible AI
5	25CSP05 Full Stack Web Development	25ADP05 Text and Speech Analysis	25ADP13 Gen AI and Small Language Models	25ADP07 Data Privacy and Security
6	25CSP06 MERN Stack	25CSP13 Edge AI	25ADP14 Marketing Analytics	25CSP15 AI in Cyber Security
7	25CSP07 Agile Methodologies	25ADP18 Cloud Services Management	25ADP19 Quantum Machine Learning	25CSP21 Blockchain Technologies
8	25CSP08 Vibe Coding	25ADP08 Stream Processing	25ADP16 Cognitive Science	25CSP12 Ethical Hacking

LIST OF COURSES FOR MINOR DEGREE PROGRAMME IN APPLIED ARTIFICIAL INTELLIGENCE

S. No.	Course Code	Course Title
1	25ADM01	Introduction to Artificial Intelligence
2	25ADM02	Machine Learning Algorithms
3	25ADM03	Deep Learning Essentials
4	25ADM04	Multivariate Data Analytics
5	25ADM05	Big Data & AI Integration
6	25ADM06	Gen AI Tools
7	25ADM07	Prompt Engineering
8	25ADM08	Ethics in AI

LIST OF LANGUAGE ELECTIVE COURSES

S. No.	Course Code	Course Title
1	25HS211	Communication Skills for Engineers
2	25HS212	Basic German
3	25HS213	Basic Japanese

LIST OF MANDATORY COURSES

S. No.	Course Code	Course Title
1	25MC001	Environmental Sciences
2	25MC002	Indian Constitution
3	25MC003	Industrial Safety
4	25MC004	Disaster Risk Reduction and Management
5	25MC005	Indian Knowledge System for Sustainable Human Development
6	25MC006	Strategic Data Management and Governance
7	25MC007	Professional Ethics
8	25HSO01	Physical Education
9	25HSO02	Yoga and Health

SEMESTER I

25MA101 CALCULUS AND ITS APPLICATIONS

(Common to CIVIL, CSE, EEE, ECE, ICE, MECH, AI&DS and EE-VLSI)

3 1 0 4

DIFFERENTIAL CALCULUS: Functions of two variables, Limits and continuity, Partial derivatives, Chain rule, Extreme values and saddle points, Lagrange multipliers, Taylor's formula for two variables. **(9+3)**

INTEGRAL CALCULUS: Double and iterated integrals over rectangles, Double integrals over general regions, Fubini's theorem, Area and volume by double integration, Reversing the order of integration, Double integrals in polar form. **(9+3)**

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS: Basic concepts, Separable differential equations, Exact differential equations, Integrating factors, Linear differential equations, Modeling - Mixing problems, Newton's law of cooling, Decay and growth problems. **(9+3)**

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS: Homogeneous linear equations of second order, Homogeneous linear ODEs with constant coefficients, Euler– Cauchy equations, Solution by variation of parameters, Free oscillations mass spring systems, Electric circuits. **(9+3)**

VECTOR CALCULUS: Gradient and directional derivative of a scalar field, Divergence and curl of a vector field. Integration in vector field – Line integrals, Path independence of line integrals, Green's theorem in the plane, Divergence theorem of Gauss and Stokes' theorem. **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXT BOOKS:

1. J. Hass, C. Heil, and D. W. Maurice, '*Thomas' Calculus*'. Pearson Education, New Delhi, 2018.
2. Erwin Kreyszig, '*Advanced Engineering Mathematics*'. Wiley India, New Delhi, 2018.

REFERENCES:

1. H. Anton, I. Bivens, and S. Davis, '*Calculus*'. John Wiley and Sons, USA, 2016.
2. C. R. Wylie and L. C. Barrett, '*Advanced Engineering Mathematics*'. Tata McGraw-Hill, New Delhi, 2019.
3. D. G. Michael, '*Foundations of Applied Mathematics*'. Dover Publications, New York, 2013.
4. Gilbert Strang, 'Calculus'. Wellesley Cambridge Press, USA, 2017.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the concepts related to Calculus, Differential Equations and Vector Calculus.	**K2**
CO2	Apply the techniques of Calculus, Differential Equations and Vector Calculus to solve engineering problems.	**K3**
CO3	Analyze the solutions of engineering problems employing Calculus, Differential Equations and Vector Calculus.	**K4**
CO4	Use modern tools to solve engineering problems with the help of Calculus, Differential Equations and Vector Calculus.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2	3													
CO3		1												
CO4					1									
	3	**1**			**1**									

1-low, 2-medium, 3-high

25CS101 C PROGRAMMING
(Common to CSE and AI&DS)

3 0 0 3

INTRODUCTION: Evolution of programming languages, Algorithm, Pseudocode and Flowchart, Programming paradigms: Structured programming – Object oriented programming – Functional programming, Static and Dynamic type checking, Strongly and Weakly typed language, Program execution, Embedded C. **(9)**

C PRELIMINARIES AND CONTROL STATEMENTS: Character set – Identifiers and keywords, Data types, Enumeration, Declarations, Expressions, Statements, Preprocessor directives and symbolic constants – Operators and expressions – Input and output Statements, Control constructs: Unconditional statements – Conditional Statements – Branching and Looping Statements. **(9)**

FUNCTIONS AND POINTERS: Library functions and user-defined functions, Call by value, Recursion: Function call – Tail recursion – Tree recursion – Linear recursion, Macros, Storage types, Pointers: Operations on pointers – Pointer arithmetic, Call by reference, Function pointer. **(9)**

ARRAYS: One dimensional and multi-dimensional array, Defining and processing array, Array as function argument, Strings – Pointer to an Array, Array of pointers, Command line arguments, C99-Standards. **(9)**

STRUCTURES, UNION AND DATA FILES: Defining and processing a structure, Nested structures, passing structure to functions – Array of structure, Pointer to structure – Union – Dynamic memory allocation – Files: Streams, Opening and closing a file, Reading and writing a file. **(9)**

Total L: 45 periods

TEXTBOOKS:

1. H. M. Deitel and P. J. Deitel, *'C: How to Program'.* 9th Edition, Pearson, New Delhi, 2022.
2. Herbert Schildt, *'C: The Complete Reference'.* 4th Edition, McGraw Hill, Noida, 2017.

REFERENCES:

1. Pradip Dey and Manas Ghosh, *'Programming in C'*. Oxford University, New Delhi, 2018.
2. Mike McGrath, *'C Programming in Easy Steps Limited'*. 5th Edition, United Kingdom, 2018.
3. Gottfried B, *'Programming with C'*. McGraw Hill, 4th Edition, Noida, 2018.
4. B. W. Kernighan and D. M. Ritchie, *'The C Programming Language'*. 2nd Edition, Pearson, New Delhi, 2015.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the application of C programming in engineering problems.	**K2**
CO2	Apply programming knowledge to solve engineering problems through simple projects.	**K3**
CO3	Analyze data generated through C programs and effectively communicate the results.	**K4**
CO4	Evaluate different problem-solving approaches for effectiveness in given engineering tasks.	**K5**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2									2	2	2
	3	**3**	**2**									**3**	**3**	**3**

1-low, 2-medium, 3-high

25EE101 BASICS OF ELECTRICAL AND ELECTRONIC SYSTEMS
(Common to CSE and AI&DS)

3 0 0 3

DC CIRCUIT: current-voltage –power-energy, electrical circuit elements: resistors-inductor- capacitor, source of electrical energy. Ohm's law-Kirchhoff's laws, series and parallel circuits, Maxwell's loop current method, Network theorems: superposition theorem-Thevenin's theorem-Norton's theorem-maximum power transfer theorem. **(9)**

AC CIRCUITS: Single phase AC circuits: Average and RMS values of sinusoidal wave form- RLC Circuit-Phasor representation-active, reactive apparent power –power factor, analysis of RLC Circuit, three phase circuit: star and delta connection-phase and line quantities-balance and unbalance systems. **(9)**

ELECTROMAGNETISM AND MAGNETIC CIRCUITS: Electromagnetic induction; induced currents, Faraday's law, induction and energy, motional emf and Lenz's law. Magnetic field-magnetic circuit-inductance and mutual inductance-magnetic materials –ideal transformers and real transformers. **(8)**

SEMICONDUCTOR DEVICES: Basic diode concepts-diode circuit: half wave rectifier-full wave rectifier-bridge rectifier-special purpose diodes-Zener diode –transistor fundamentals – transistor biasing-bipolar junction transistors-basis amplifier concept-loading effect-power supplies and efficiency. **(10)**

OPERATIONAL AMPLIFIERS: Op-Amp Basics, Ideal characteristics of Op-Amp, practical Op-Amp circuits, differential and common mode operation, Inverting and non- inverting amplifiers, Op-Amp as Adder, Subtractor, integrator and differentiator. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Edward Hughes, John Hiley and Keith Brown, '*Electrical and Electronic Technology*'. Pearson Education, 2020.
2. K. Murugesh Kumar, '*Basic Electrical Science and Technology*'. Vikas Publishing House, 2016.
3. B. L. Theraja, '*Basic Electronic Solid State*'. S. Chand and Company Ltd., New Delhi, 2010.

REFERENCES:

1. D. P. Leach, '*Digital Principles and Applications*'. Tata McGraw Hill, 2021.
2. R. Hambley, '*Electrical Engineering Principles and Applications*'. Pearson education, 2018.
3. R. L. Boylestad and L. Nashelsky, '*Electronic Devices and Circuit Theory*'. Pearson Education, Noida, 2013.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the basic principles of DC and AC circuits, magnetic circuits, and semiconductor devices.	**K2**
CO2	Apply electrical laws, network theorems, and Electromagnetic principles to analyze electrical circuits, magnetic circuits, and transformers.	**K3**
CO3	Analyze the performance characteristics of electrical and electronic systems using phasors, load analysis, and Op-Amp configurations.	**K4**

COs - POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2	3		2											
CO3		3	3		2									
	3	**3**	**3**		**2**									

1-low, 2-medium, 3-high

25HS101 ENGLISH LANGUAGE PROFICIENCY
(Common to CIVIL, CSE, EEE, ECE, ICE, MECH, AI&DS and EE-VLSI)

3 1 0 4

VOCABULARY: Etymology-Prefixes and suffixes–Synonyms–Antonyms–Guessing meanings from context– Word formation- Single-word substitutes- Different forms of a word– Phrasal verbs–Collocations. **(9+3)**

LISTENING AND SPEAKING: Understanding listening – Listening techniques - Introducing oneself and others –Seeking and sharing information– Description-Conversation skills– Extempore speaking– Speech practice in varied formal contexts. **(9+3)**

GRAMMAR: Wh-questions – Yes/no questions– Parts of speech – Articles– Prepositions– Gerunds– Conjunctions-Degrees of comparison– Tenses– Modal verbs – Adverbs - Direct and indirect questions. **(9+3)**

READING: Reading strategies: Skimming and scanning, predicting– Reading comprehension: techniques Practice reading. **(9+3)**

WRITING: Discourse markers – Dialogue writing - Completing sentences – Jumbled sentences – Paragraph writing –Writing compare & contrast paragraphs – Letter writing. **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXTBOOKS:

1. K. N. Shoba and Lourdes Joavani Rayen, '*Communicative English*'. Cambridge University press, Cambridge, 2021.
2. Raymond Murphy, '*Intermediate English Grammar*'. Cambridge University Press, New Delhi, 2020.
3. Dr M. Sambaiah, '*Technical English an integrated text book*'. Wiley India Pvt. Ltd., 2025.

REFERENCES:

1. Raymond Murphy, '*English Grammar in Use*'. Cambridge University Press, New Delhi 2020.
2. N. P. Sudharshana and C. Savitha, '*English for Engineers*'. Cambridge University Press, New York, 2018.
3. Helen Naylor with Raymond Murphy, '*Essential English Grammar*'. Cambridge University Press, New Delhi, 2019.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Demonstrate the ability to recognize and use a wide range of vocabulary and key grammatical structures accurately, while developing inferential reading skills to comprehend, interpret, and analyze written texts across diverse contexts.	**K2**
CO2	Organize their ideas logically in essay writing, develop paragraphs with clear topic sentences and adapt their letter- writing skills to various real-world scenarios.	**K3**
CO3	Develop and demonstrate clear and confident speaking skills in formal and informal contexts.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1									3		3			
CO2									3		3			
CO3									1		1			
									3		**3**			

1-low, 2-medium, 3-high

25HS102 *தமிழர் மரபு*
(Common to all B.E./B.Tech./B.Des. Degree Programmes)

1 0 0 1

மொழி மற்றும் இலக்கியம்: *இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச்சார் பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க்காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.* **(3)**

மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக்கலை: *நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரி முனையில் திருவள்ளுவர் சிலை – இசைக்கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வியல் கோவில்களின் பங்கு.* **(3)**

நாட்டுப்புறக்கலைகள் மற்றும் வீரவிளையாட்டுகள்: *தெருக்கூத்து, கரகாட்டம், வில்லுப் பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.* **(3)**

தமிழர்களின் திணைக்கோட்பாடுகள்: *தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்க கால நகரங்களும் துறைமுகங்களும் – சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.* **(3)**

இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: *இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப் பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப் படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.* **(3)**

Total L: 15 Periods

25HS102 HERITAGE OF TAMILS
(Common to all B.E./B.Tech./B.Des. Degree Programmes)

1 0 0 1

LANGUAGE AND LITERATURE: Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan. **(3)**

HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE: Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils. **(3)**

FOLK AND MARTIAL ARTS: Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamil. **(3)**

THINAI CONCEPT OF TAMILS: Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Chola. **(3)**

CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE: Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books. **(3)**

Total L: 15 Period

TEXT – CUM – REFERENCE BOOKS:

1. கே. கே. பிள்ளை, 'தமிழக வரலாறு - மக்களும் பண்பாடும்'. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்.
2. முனைவர் இல. சுந்தரம், 'கணினித்தமிழ்'. விகடன் பிரசுரம்
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம், தொல்லியல் துறை வெளியீடு
4. பொருநை - ஆற்றங்கரை நாகரிகம், தொல்லியல் துறை வெளியீடு
5. Dr. K.K. Pillay, '*Social Life of Tamils*'. A joint publication of TNTB, ESC and RMRL
6. Dr. S. Singaravelu, '*Social Life of the Tamils – The Classical Period*'. International Institute of Tamil Studies.
7. Dr. S.V. Subaramanian and Dr. K.D. Thirunavukkarasu, '*Historical Heritage of the Tamils*'. International Institute of Tamil Studies
8. Dr. M. Valarmathi, '*The Contributions of the Tamils to Indian Culture*'. International Institute of Tamil Studies.
9. Keeladi – Sangam '*City Civilization on the banks of river Vaigai*'. Department of Archaeology, Tamilnadu Text Book and Educational Services Corporation, Tamilnadu
10. Dr. K.K. Pillay, Studies in the History of India with Special Reference to Tamilnadu
11. '*Porunai Civilization*'. Department of Archaeology, Tamil Nadu Text Book and Educational Services Corporation, Tamilnadu
12. R. Balakrishnan, '*Journey of Civilization Indus to Vaigai*'. RMRL, Tamilnadu

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the Dravidian language family, outline the features of Tamil classical literature, and explain the development of Tamil art, sculpture, and temple-related traditions in a historical context.	**K2**
CO2	Demonstrate the cultural relevance of Tamil folk and martial arts, apply the concepts of Sangam landscape classification to social contexts, and relate Tamil contributions to India's freedom struggle, cultural legacy, and Siddha medicine.	**K3**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1							3				3		
CO2							3				3		
							3				**3**		

1-Low, 2-Medium, 3-High

25CS111 C PROGRAMMING LABORATORY
(Common to CSE and AI&DS)

0 0 4 2

1. Formatted I/O statements.
2. Decision Making statements: Simple If, If – else, Switch- case.
3. Looping Statements: For, While, Do – while.
4. Single dimensional arrays and multi-dimensional arrays.
5. Operations on Strings.
6. Pass by value and pass by address, Recursion using functions.
7. Structures and nested structures.
8. String handling operations using pointers.
9. Operations on arrays using pointers.
10. File operations using command line arguments

Total P: 60 periods

REFERENCES:

1. Byron S. Gottfried and Jitendar Kumar Chhabra, '*Programming with C'*. Tata McGraw Hill Publishing Company, New Delhi, 2018.
2. Herbert Schildt, '*C-The Complete Reference*'. Tata McGraw Hill Publishing Company, New Delhi, 2010.
3. Pradip Dey and Manas Ghosh, '*Programming in C'*. Oxford University Press, New Delhi, 2018.
4. Yashavant P. Kanetkar, '*Let Us C'*. BPB Publications, 2017.
5. H. M. Deitel and P. J. Deitel, '*C How to Program'*. Pearson Education, New Delhi, 2013.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain how programs use logical flow and data organization to produce correct and meaningful results.	**K2**
CO2	Apply structured problem-solving approaches to develop programs that handle data efficiently.	**K3**
CO3	Analyze program behavior and outputs to manage data effectively and identify possible improvements.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												3	3	3
CO2	3											3	3	3
CO3		2										2	2	2
	3	**2**										**3**	**3**	**3**

1-low, 2-medium, 3-high

25EE112 ENGINEERING SKILLS LABORATORY
(Common to CSE and AI&DS)

0 0 4 2

1. Residential house wiring.
2. Stair case wiring.
3. Measurement of electrical quantities Voltage, Current, Power and Power factor.
4. Measurement of energy using single-phase energy meter.
5. Study of iron Box/heater and fan regulator.
6. Verification of Ohms law and Kirchhoff's law.
7. Construction of half-wave and full wave rectifier.
8. Verification of logic gates.
9. Fabrication of electronic circuit using general purpose PCB.
10. Measurement of signal parameters using oscilloscope.
11. Construct amplifier circuit using Op. Amp.

Total P: 60 periods

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, '*Basic Electrical Engineering'.* New Delhi, India: Tata McGraw-Hill, 2010.
2. S. K. Bhattacharya, '*Basic Electrical and Electronics Engineering'*. New Delhi, India: Pearson Education, 2011.
3. R. A. Gayakwad, '*Op-Amps and Linear Integrated Circuits*'. 4th Editon. Delhi, India: Pearson, 2015.
4. R. L. Boylestad and L. Nashelsky, '*Electronic Devices and Circuit Theory*'. 11th Edition, Upper Saddle River, NJ, USA: Pearson, 2013.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the basics of electrical wiring, measurement of electrical and electronic circuits.	**K2**
CO2	Construct and verify basic circuits using electrical and electronics components.	**K3**
CO3	Collaborate in teams to conduct experiments, and present findings through reports.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1														
CO2	3													
CO3		3			2									
	3	**3**			**2**									

1-low, 2-medium, 3-high

25GE111 DESIGN THINKING FOR INNOVATION
(Common to CIVIL, CSE, EEE, ECE, ICE, MECH, AI&DS and EE-VLSI)

0 0 2 1

Foundations of Design Thinking History & Origins: Roots in Creative Problem Solving: Traces back to mid-20th century practices in architecture, engineering, and psychology. Herbert Simon's "Sciences of the Artificial" (1969): Introduced design as a way of thinking distinct from scientific inquiry. IDEO and the Rise of Human-Centered Design: Popularized design thinking as a repeatable, user-focused innovation process. Stanford school's Influence: Helped institutionalize design thinking in education and entrepreneurship.

Variations of Design Thinking Phases: IDEO's 3-Phase Model: Inspiration, Ideation, Implementation A flexible, non-linear approach emphasizing creativity and action. Stanford school's 5-Phase Model: Empathize, Define, Ideate, Prototype, Test A structured yet iterative framework centered on user empathy. Double Diamond Model (Design Council UK): Divides the process into Discover, Define, Develop, and Deliver—highlighting divergent and convergent thinking.

Related Concepts & Frameworks: Human-Centered Design (HCD): Focuses on designing solutions that deeply resonate with users' needs and contexts. Systems Thinking: Encourages understanding the broader ecosystem and interdependencies within a problem space. Agile & Lean UX: Integrates design thinking with iterative development and minimal viable experimentation. Service Design: Applies design thinking to orchestrate holistic user experiences across touchpoints. Participatory Design: Involves stakeholders directly in the design process to ensure relevance and inclusivity.

EMPATHIZE: Apply Human-Centric Design Principles: Focus on designing solutions that prioritize user needs, experiences, and values throughout the process. Consult Experts: Engage with subject matter experts to gain foundational knowledge about the problem space. Competitive Analysis: Identify & studying similar products or services to identify gaps and opportunities. Stakeholder Interviews: Engaging with people who influence or are affected by the product or service. Conduct Observations: Observe users in their natural environment to understand behaviors, challenges, and interactions. Engage with Users: Use interviews, conversations, and other methods to connect with users and hear their stories. Immerse Yourself: Step into the users' context to experience their environment and challenges firsthand. Create Empathy Maps: Visualize what users say, think, feel, and do to synthesize insights. Identify User Needs and Pain Points: Extract meaningful patterns and needs from user interactions and observations. Set Aside Assumptions: Approach the research with an open mind, suspending personal biases and preconceptions. Document Insights: Capture quotes, observations, and emotional cues to inform the next stage (Define). **(6)**

DEFINE: Organize Research Findings: Review and structure the data collected during the Empathize stage. Analyze Observations: Identify patterns, themes, and insights from user interactions and behaviors. Craft a Human-Centered Problem Statement: Frame the problem from the user's perspective, focusing on their needs—not business goals. Avoid Business- Centric Framing: Refrain from defining problems based on company objectives alone (e.g., market share). Persona Development: Synthesizing research into user personas to guide design decisions. Use Empathy to Guide Definition: Ensure the problem statement reflects real user challenges and motivations. Develop Point-of-View Statements: Create concise summaries that capture who the user is, what they need, and why. Prepare for Ideation: Formulate "How Might We" questions to spark creative thinking in the next phase. **(6)**

IDEATE: Review the Problem Statement: Revisit the user-centric problem defined in the previous stage to guide ideation. Explore Multiple Perspectives: Encourage diverse viewpoints to broaden the range of potential solutions. Use Ideation Techniques: Apply methods like Brainstorming, Brain writing, SCAMPER, and Worst Possible Idea to spark creativity. Encourage Free Thinking: Create a judgment-free space to generate as many ideas as possible without filtering. Expand the Problem Space Push boundaries and explore unconventional or extreme ideas to uncover hidden opportunities. Refine and Select Ideas: Use evaluation techniques to identify promising concepts that address user needs effectively. Prepare for Prototyping: Choose ideas that are feasible and impactful to develop into tangible prototypes in the next stage. **(6)**

PROTOTYPE: Build Low-Cost Prototypes: Create simple, scaled-down versions of the product or its features to explore ideas. Experiment with Solutions: Implement different solutions from the Ideate stage into prototypes for testing. Test Internally and Externally: Share prototypes with team members, other departments, or a small group of users. Observe User Interactions: Watch how users engage with the prototypes to uncover usability issues and insights. Evaluate and Iterate: Accept, refine, or discard prototypes based on user feedback and performance. Identify Limitations: Discover constraints and challenges in the proposed solutions through hands-on testing. Gain Deeper User Understanding: Learn how users think, feel, and behave when interacting with the product. **(6)**

TEST: Conduct Rigorous Testing: Evaluate the complete product using the most promising prototypes. Observe Real User Interactions: Study how users behave, think, and feel while using the product. Gather Feedback and Insights: Collect qualitative and quantitative data to assess usability and effectiveness. Identify Remaining Issues: Detect limitations, pain points, and areas for improvement. Refine and Iterate: Use test results to improve the product and revisit earlier stages if needed. Redefine Problems if Necessary: Reframe or adjust problem statements based on new insights. Enhance Understanding of Users: Deepen empathy and knowledge of user needs through real-world testing. **(6)**

Design Thinking & Customer Centricity: A human-centered approach that blends empathy and innovation to create solutions that truly resonate with customer needs. Practical Examples of Customer Challenges: Real-world scenarios where customers face friction, unmet needs, or emotional disconnects in their product or service journey. Use of Design Thinking to Enhance Customer Experience: Applying iterative problem-solving and user insights to craft experiences that are intuitive, delightful, and deeply relevant. Parameters of Product Experience: Key dimensions like usability, accessibility, emotional impact, and consistency that shape how customers perceive and interact with a product. Alignment of Customer Expectations with Product Design: Ensuring that every design decision reflects what customers value, expect, and aspire to achieve through the product. **(6)**

Total P: 30 periods

TEXT BOOKS:

1. T. Brown, '*Change by Design*'. Harper Business, 2009.
2. J. Liedtka and T. Ogilvie, '*Designing for Growth*'. Columbia Business School Publishing, 2011.

REFERENCES:

1. T. Kelley and D. Kelley, '*Creative Confidence*'. Crown Business, 2013.
2. Stanford d. School resources: https://dschool.stanford.edu/
3. https://apphaus.sap.com/toolkit/methods#design-thinking

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply empathy-driven research to understand user needs.	**K3**
CO2	Develop and test prototypes to refine innovative solutions to the real-world problems.	**K4**
CO3	Frame actionable problem statements and generate creative ideas.	**K5**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3					3	3	3	3		3	1	1	1
CO2		2				2	2	2	2		2	1	1	1
CO3			1			1	1	1	1		1	1	1	1
	3	**2**	**1**			**3**	**3**	**3**	**3**		**3**	**1**	**1**	**1**

1-low, 2-medium, 3-high

25GEM01 INDUCTION PROGRAMME
(Common to CIVIL, CSE, EEE, ECE, ICE, MECH, AI&DS and EE-VLSI)

All students shall undergo an induction programme at the beginning of the first semester for a duration of three weeks as per the guidelines of All India Council for Technical Education (AICTE). A student completing the induction programme will be awarded a completed grade in the grade sheet, and only the students who complete the induction programme shall be considered as eligible for award of degree subject to satisfying other conditions. A student who does not complete the induction programme in the first semester shall redo the same in the subsequent semester.

SEMESTER II
25MA202 TRANSFORMS AND APPLICATIONS
(Common to AI&DS and CSE)

3 1 0 4

LAPLACE TRANSFORMS: Laplace transform, inverse transform, linearity, s-shifting, transforms of derivatives and integrals, unit step function, t – shifting, Dirac's delta function, periodic functions, differentiation and integration of transforms. **(9+3)**

APPLICATION OF LAPLACE TRANSFORMS: Convolution, solving differential equations with constant coefficients and variable coefficients, integral equations, systems of ODEs by using Laplace transform technique. **(9+3)**

Z TRANSFORM: Z-transform, the relationship of the Z-transforms to the Laplace transform, some useful properties, inverse Z-transforms, solution of difference equations. **(6+2)**

FOURIER SERIES: Fourier series – even and odd functions, half range expansion, convergence of Fourier series, basic concepts of PDE's, wave equation, solution of one- dimensional heat equation and steady state two-dimensional heat equation. **(12+4)**

FOURIER TRANSFORMS: Fourier integral, Fourier cosine and sine integrals, Fourier transform, Discrete Fourier transform, Fast Fourier transform – DIT algorithm. **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXT BOOKS:

1. Erwin Kreyszig, '*Advanced Engineering Mathematics*'. Wiley India, New Delhi, 2018.
2. G. D. Dean, '*Advanced Engineering Mathematics with MATLAB*'. CRC Press, USA, 2017.

REFERENCES:

1. Peter V. O. Neil, '*Advanced Engineering Mathematics*'. Cengage, New Delhi, 2018.
2. C. R. Wylie and L. C. Barrett, '*Advanced Engineering Mathematics*'. Tata McGraw-Hill, New Delhi, 2019.
3. R. K. Jain and S. R. K. Iyengar, '*Advanced Engineering Mathematics*'. Narosa Publishing House, New Delhi, 2018.
4. Alexander D Poularikas, '*Transforms and Applications Primer for Engineers with Examples and MATLAB*'. CRC press, USA, 2010.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the concepts related to Laplace, Fourier and Z- Transforms and its Applications.	**K2**
CO2	Apply the techniques of Laplace, Fourier and Z- Transforms to solve engineering problems.	**K3**
CO3	Analyze the solutions of engineering problems employing Laplace, Fourier and Z-Transforms.	**K4**
CO4	Use modern tools to solve engineering problems with the help of Laplace, Fourier and Z- Transforms.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1														
CO2	3													
CO3		1												
	3	**1**												

1-low, 2-medium, 3-high

25MA203 DISCRETE MATHEMATICS

3 1 0 4

SETS, RELATIONS AND FUNCTIONS: Introduction to Sets - Set Operations – Computer representation of Sets - Sequences and Summations - Cardinality of Sets - Relations and Their Properties - Closures of Relations - Equivalence Relations - Partial Orderings – Functions: Injective, Surjective, Bijective, and Composition. **(9+3)**

MATHEMATICAL LOGIC AND PROOFS: Propositional Logic - Applications of Propositional Logic - Propositional Equivalences - Predicates and Quantifiers - Nested Quantifiers - Rules of Inference - Introduction to Proofs: Proof by contraposition, Proof by contradiction. **(9+3)**

COUNTING AND COMBINATORICS: The Basics of Counting - The Pigeonhole Principle - Permutations and Combinations - Generalized Permutations and Combinations - Generating Permutations and Combinations. **(9+3)**

RECURRENCE RELATIONS: Recursion – Recurrence relations: Linear First-order recurrence relations – Linear Second order recurrence relations – Divide and conquer recurrence relations. **(9+3)**

ALGEBRAIC STRUCTURES: Algebraic Systems: properties – Groups, Semi groups, Monoids: Homomorphism of Semi groups and monoids – Sub semi groups and sub monoids – Rings: Structure and Properties. **(9+3)**

Total L: 45 +T: 15 = 60 periods

TEXT BOOKS:

1. Kenneth H. Rosen, '*Discrete Mathematics and its Applications*'. 7th Edition, Tata McGraw Hill, 2007.
2. Tremblay J. P. and Manohar R, '*Discrete Mathematical structures with application to Computer Science*'. Tata McGraw Hill, 2011.

REFERENCES:

1. Ralph. P. Grimaldi, '*Discrete and Combinatorial Mathematics: An Applied Introduction*'. 5th Edition, Pearson Education, New Delhi, 2014.
2. Seymour Lipschutz and Mark Lipson, '*Discrete Mathematics*'. 3rd Edition, Schaum's Outlines McGraw Hill Pub. Co. Ltd., New Delhi, 2013.
3. Thomas Koshy, '*Discrete Mathematics with Applications*'. Elsevier Publications, Boston, 2004.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the concepts related to Functions, Mathematical logic, Combinatorics, Recurrence Relations and Algebraic Structures.	**K2**
CO2	Apply the techniques of Functions, Mathematical logic, Combinatorics, Recurrence Relations and Algebraic Structures.	**K3**
CO3	Analyze the solutions of engineering problems employing Functions, Mathematical logic, Combinatorics, Recurrence Relations and Algebraic Structures.	**K4**
CO4	Use modern tools to solve engineering problems with the help of Functions, Mathematical logic, Combinatorics, Recurrence Relations and Algebraic Structures.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2	3													
CO3		1												
CO4					1									
	3	**1**			**1**									

1-low, 2-medium, 3-high

25CY202 APPLIED CHEMISTRY
(Common to CSE and AI&DS)

3 0 0 3

ELECTRONIC MATERIALS: Inorganic semiconductors – Elemental – Si and Ge - band theory, doping, compound semiconductors – band gap engineering – applications. Organic semiconductors – conjugated polymers – mechanism of charge transport, doping, states of aggregation, material properties – thermal, mechanical, electrical, chemical, electrochemical. Applications – OLED, OPV – working principle. Liquid crystalline materials – display application. **(9)**

PROCESSES IN ELECTRONICS MANUFACTURE: Microchip fabrication – overview, photoresists – chemistry, types. Fabrication facilities – clean rooms - maintenance, ultrapure water– specification, production processes – ion exchange, reverse osmosis, continuous electrode ionisation. PCB fabrication – electroless and electroplating of copper – principle, bath chemistries and process parameters, formation of copper track on plastic board. **(9)**

ELECTRONICS PACKAGING AND PROTECTION: Packaging materials-encapsulants and underfills - adhesives – chemical types, application methods, factors influencing adhesion, soldering alloys – phase diagrams, lead free alloys, phase change materials for cooling. Conducting inks for printed electronics - metal and carbon based – graphene, CNT– synthesis, structure, electrical properties. Corrosion in electronics – types, protection – vapour phase inhibitors. **(9)**

ELECTROCHEMICAL POWER SOURCES: Electrochemical cells – emf, electrode potential, dependence of emf on electrolyte concentration – Nernst equation. Batteries– performance characteristics. Materials, construction, reactions, characteristics of Leclanche cell, primary lithium batteries, lead - acid battery and lithium-ion batteries. Supercapacitors – EDLC – fundamentals, electrode materials, electrolytes, pseudo capacitors – materials. **(9)**

CHEMICAL SENSORS: Sensors – basic components. Electrochemical sensors- potentiometric transducers – principle, ion-selective electrodes – configurations, response functions and selectivity, applications – potentiometric titrations, water quality monitoring - pH, Hardness, fluoride ion sensors Amperometric transducers – principle, application - glucose biosensors, conductivity sensors – principle – application in conductometric titrations. Colorimetric sensors - Beer-Lambert's law, components, application - determination of ferric ion in water sample. Chemi-resistive sensors - principle, application – environmental monitoring – CO_2 sensor. Microelectrodes for sensors – fabrication. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Shashi Chawla, '*A Textbook of Engineering Chemistry*'. 6th Edition, Dhanpat Rai and Co, New Delhi2022.
2. J. M. G. Cowie and Valeria Arrighi, '*Polymers: Chemistry and Physics of Modern Materials*'. 3rd Edition, CRC Press, London, 2016.

REFERENCES:

1. Bansi D. Malhotra, '*Handbook of Polymers in Electronics*'. 1st Edition, Rapra Technology Ltd., UK, 2002.
2. Peter Van Zant, '*Microchip Fabrication: A Practical Guide to Semiconductor Processing*'. 6th Edition, McGraw Hill, 2014.
3. Derek Pletcher and Frank C. Walsh. '*Industrial Electrochemistry*'. 2nd Edition, Chapman and Hall, London, 1993.
4. Florinel-Gabriel Banica '*Chemical Sensors and Biosensors – Fundamentals and Applications'*. 1st Edition, John Wiley and Sons Ltd, 2012.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Learn the chemistry of engineering materials and analytical devices.	**K2**
CO2	Utilize the suitable materials for electronics engineering applications.	**K3**
CO3	Analyze the properties of electronics materials for the fabrication of electronic devices.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												2		
CO2	3										3	3		
CO3								1	1					
	3							**1**	**1**		**3**	**3**		

1-low, 2-medium, 3-high

25AD201 PYTHON PROGRAMMING
(Common to CSE and AI&DS)

3 0 0 3

INTRODUCTION TO PYTHON PROGRAMMING: Introduction to Python, Demo of Interactive and script mode, Tokens in Python – Variables, Keywords, Comments, Literals, Data types, Indentation, Operators and its precedence, Expressions, Input and Print functions. Selective statements – if, if-else, nested if, if –elseif ladder statements. Iterative statements - while, for, Nested loops, else in loops, break, continue, and pass statements. **(10)**

FUNCTIONS AND STRINGS: Functions: Types, parameters, arguments: positional arguments, keyword arguments, parameters with default values, functions with arbitrary arguments, Scope of variables: Local and global scope, Recursion and Lambda functions. Strings: Formatting, Comparison, Slicing, Splitting, Stripping, Pattern matching. **(8)**

COLLECTIONS: List: Create, Access, Slicing, Negative Indices, List Methods, and comprehensions Tuples: Create, Indexing and Slicing, Operations on tuples. Dictionary: Create, add, and replace values, and operations on dictionaries. Sets: Create and operations on set. **(9)**

FILES, EXCEPTIONS, AND PACKAGES: Files: text files, file handling modes, reading, writing, and appending to files, handling file exceptions, with statement; command line arguments, errors, exception handling with try, handling multiple exceptions; Modules and Packages, Python's Standard Library. **(9)**

OBJECT-ORIENTED PROGRAMMING USING PYTHON: Classes and Objects in Python, properties and methods, Instantiation, __init() function, self-parameter, pass statement, inheritance in Python, __init() function in inheritance, super() method, types of inheritance, function overriding, Polymorphism. **(9)**

Total L: 45 periods

TEXTBOOKS:

1. Eric Matthes, '*Python Crash Course A Hands-On, Project - Based Introduction to Programming'.* 3rd Edition, No Starch Press, 2024.
2. Mark Summerfield, '*Programming in Python 3: A Complete Introduction to the Python Language'.*
3. 2nd Edition, Pearson Education, 2018.

REFERENCES:

1. Paul Deitel and Harvey Deitel, *'Python for Programmers'*. 1st Edition, Pearson Education, 2021.
2. John V Guttag, *'Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data.*'. 3rd Edition, MIT Press, 2021.
3. Allen B. Downey, '*Think Python: How to Think like a Computer Scientist'*. 2nd Edition. O'Reilly Publishers, 2016.
4. Martin C. Brown, *'Python: The Complete Reference'*. 4th Edition, Mc-Graw Hill, 2018.
5. Karl Beecher, *'Computational Thinking: A Beginner's Guide to Problem Solving and Programming'*. 1st Edition. BCS Learning and Development Limited, 2017.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain basic Python concepts used in programming and object-oriented development.	**K2**
CO2	Apply Python programming using control structures, functions, collections, files, and classes to solve simple and complex problems.	**K3**
CO3	Analyze problems and use cases using Python programs and present the results through team activities.	**K4**
CO4	Use Python libraries and tools to explore problems, practice modern programming techniques and work in teams.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												2	2	2
CO2	3											3	3	3
CO3		3										3	3	3
CO4					2				2			2	2	2
	3	**3**			**2**				**2**			**3**	**3**	**3**

1-low, 2-medium, 3-high

25AD202 DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION

3 0 0 3

DIGITAL CIRCUITS: Binary Arithmetic - Boolean Algebra - Basic Theorems and Properties of Boolean Algebra - Simplification of Boolean Functions - Digital Logic Gates - Karnaugh Map Method - Design of Combinational Circuits - Flip-Flops - Design of Sequential Circuits. **(9)**

COMPUTER ORGANIZATION & PROCESSOR DESIGN: Stored program organization (Von Neumann architecture) - Computer Registers -Stack organization - Instruction Formats - Addressing modes - RISC Vs CISC - Quantitative Principles of computer design. **(9)**

MEMORY AND I/O SYSTEMS: Memory Hierarchy - Associative Memory - Cache Memory - Mapping policies – Cache optimization; I/O Systems: Introduction - Interrupts - Modes of Transfer - DMA. **(8)**

PARALLELISM: Pipelining - Pipelining Hazards - Overcoming Hazards - Instruction Level Parallelism – Dependencies. **(8)**

MULTIPROCESSOR SYSTEMS: Symmetric and Distributed shared memory architectures - Challenges – Cache Coherence Snooping protocol - Introduction to GPU Architecture: Streaming Multiprocessors (SMs), CUDA cores - SIMT Model vs. MIMD - GPU Memory Hierarchy: Shared, Global, Constant, and Texture Memory - Parallel Programming Models: Introduction to CUDA / OpenCL Concepts. **(11)**

Total L: 45 periods

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, '*Digital Design: With an Introduction to the Verilog HDL, VHDL and System Verilog'.* 6th Edition, Pearson Education, 2018.
2. John L. Hennessey and David A. Patterson, '*Computer Architecture: A Quantitative Approach*'. Elsevier India Pvt. Ltd, New Delhi, 2015.

REFERENCES:

1. Morris Mano, '*Computer System Architecture*'. Prentice Hall of India, Prentice Hall of India, 2007.
2. Hennessy, John and Patterson, David, '*Computer Organization and Design MIPS Edition: The Hardware/Software Interface*'. Netherlands, Elsevier Science, 2020
3. David B. Kirk and Wen-Mei W. Hwu, '*Programming Massively Parallel Processors: A Hands-on Approach*'. Morgan Kaufmann, 2016.
4. Carl Hamacher, '*Computer Organization*'. Tata McGraw Hill Publishing, New Delhi, 2002.
5. William Stallings, '*Computer Organization and Architecture*'. Pearson Education / Prentice Hall of India, New Delhi, 2006.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain processor organization, instruction formats, addressing modes, and RISC–CISC differences.	**K2**
CO2	Apply Boolean algebra, K-map, and binary arithmetic to design combinational and sequential circuits.	**K3**
CO3	Analyze memory hierarchy, cache, and I/O systems for performance optimization.	**K4**
CO4	Evaluate pipelining, hazards, and instruction-level parallelism.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												2	2	2
CO2	3											3	2	2
CO3		2										3	2	2
CO4			2									2	2	2
	3	**2**	**2**									**3**	**2**	**2**

1-low, 2-medium, 3-high

25HS201 தமிழரும் தொழில்நுட்பமும்

1 0 0 1

நெசவு மற்றும் பானைத் தொழில்நுட்பம்: *சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.* **(3)**

வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: *சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள், சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.* **(3)**

உற்பத்தித் தொழில் நுட்பம்: *கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணங்கள் – நாணயங்கள் அச்சடித்தல்- மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத் துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.* **(3)**

வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: *அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.* **(3)**

அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்: *அறிவியல் தமிழின் வளர்ச்சி – கணினித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.* **(3)**

Total L: 15 periods

25HS201 TAMILS AND TECHNOLOGY

1 0 0 1

WEAVING AND CERAMIC TECHNOLOGY: Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries. **(3)**

DESIGN AND CONSTRUCTION TECHNOLOGY: Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age–Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)-Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period. **(3)**

MANUFACTURING TECHNOLOGY: Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram. **(3)**

AGRICULTURE AND IRRIGATION TECHNOLOGY: Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conch diving - Ancient Knowledge of Ocean - Knowledge Specific Societ. **(3)**

SCIENTIFIC TAMIL & TAMIL COMPUTING: Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project. **(3)**

Total L: 15 Periods

TEXT – CUM – REFERENCE BOOKS

1. கே. கே. பிள்ளை, தமிழக வரலாறு - மக்களும் பண்பாடும், தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்.
2. முனைவர் இல. சுந்தரம், கணினித்தமிழ், விகடன் பிரசுரம்
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம், தொல்லியல் துறை வெளியீடு
4. பொருநை - ஆற்றங்கரை நாகரிகம், தொல்லியல் துறை வெளியீடு
5. Dr. K.K. Pillay, '*Social Life of Tamils*'. A joint publication of TNTB, ESC and RMRL
6. Dr. S. Singaravelu, '*Social Life of the Tamils – The Classical Period*'. International Institute of Tamil Studies.
7. Dr. S.V. Subaramanian and Dr. K.D. Thirunavukkarasu, '*Historical Heritage of the Tamils*'. International Institute of Tamil Studies
8. Dr. M. Valarmathi, '*The Contributions of the Tamils to Indian Culture*'. International Institute of Tamil Studies.
9. Keeladi – '*Sangam City Civilization on the banks of river Vaigai*'. Department of Archaeology, Tamilnadu Text Book and Educational Services Corporation, Tamilnadu
10. Dr. K.K. Pillay, Studies in the History of India with Special Reference to Tamilnadu
11. '*Porunai Civilization*'. Department of Archaeology, Tamil Nadu Text Book and Educational Services Corporation, Tamilnadu
12. R. Balakrishnan, '*Journey of Civilization Indus to Vaigai*'. RMRL, Tamilnadu

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Identify the significance of ancient Tamil technologies in weaving, pottery, metallurgy, and architecture, with emphasis on traditional design and construction methods across historical periods.	**K2**
CO2	Use insights from traditional Tamil knowledge systems in agriculture, irrigation, and marine sciences, and connect the development of Tamil language to its applications in digital platforms and computing.	**K3**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1						1			1		1		
CO2						1			1		1		
						1			**1**		**1**		

1-Low, 2-Medium, 3-High

25AD211 PYTHON PROGRAMMING LABORATORY
(Common to CSE and AI&DS)

0 0 4 2

1. Algorithm and Flowchart for Real World Problems
2. Programs using Decision Making statements and Looping Statements
3. Applications using Set, Lists, Tuples, Dictionary
4. Applications using Functions
5. Python Libraries
6. Text processing
7. Searching & sorting algorithms
8. Application Debugging
9. Build a Simple Python Application

Total P: 60 periods

REFERENCES:

1. Romano, Fabrizio, '*Learn Python Programming: A Beginners Guide to Learning the Fundamentals of Python Language to Write Efficient, High-Quality Code'.* 2nd Edition, India, Packt Publishing, 2018.
2. R. Nageswara Rao, *'Core Python Programming'.* 2nd Edition, Dreamtech Press, 2019.
3. Vijay Kumar Sharma, Vimal Kumar, Swati Sharma and Shashwat Pathak, '*Python Programming: A Practical Approach*'. CRC Press, 2021.
4. Meenu Kohli, '*Basic Core Python Programming: A Complete Reference Book to Master Python with Practical Applications'.* 1st Edition, BPB Publications, 2021.
5. J. Cogliati, '*Non-Programmers Tutorial for Python 3'*. Platypus Global Media, 2019.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Implement python programs using control structures, collections, functions and libraries for simple and complex problems.	**K3**
CO2	Analyze, debug, and improve Python programs involving searching and sorting techniques and application development to build simple Python applications.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3											3	3	3
CO2		2										2	2	2
	3	**2**										**3**	**3**	**3**

1-low, 2-medium, 3-high

25CY211 CHEMISTRY LABORATORY

0 0 4 2

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of strength of acids in a mixture of acid using conductivity meter.
3. Determination of strength of strong acid using conductivity meter.
4. Determination of alkalinity of a given water sample.
5. Determination of DO content of water sample by Winkler's method
6. Determination of strength of given hydrochloric acid using pH meter.
7. Estimation of iron content of the given solution using potentiometer.
8. Corrosion experiment-weight loss method.
9. Electroplating of copper and Nickel and determination of coulombic efficiency.
10. Construction of phase diagram for a simple eutectic system.
11. Designing a battery and determination of its characteristics.
12. Photo-colorimetric estimation of Ferric ion in a water sample.
13. Anodizing of aluminum and determination of thickness of anodised film.
14. Determination of kinematic viscosity of lubricating oil using Redwood viscometer.
15. Proximate analysis of coal.

Total: 60 periods

REFERENCE:

1. J Mendham, '*Vogel's Textbook of Quantitative Chemical Analysis'.* 6th Edition, Pearson Education 2009.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Demonstrate the measurement of water quality parameters in the given water sample	**K3**
CO2	Analyze the properties of materials for Engineering applications	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3								3		3			
CO2				3				3						
	3			**3**				**3**	**3**		**3**			

1-low, 2-medium, 3-high

25GE211 ENGINEERING GRAPHICS
(Common to AI&DS and CSE)

0 0 4 2

INTRODUCTION TO ENGINEERING GRAPHICS **(4)**

1. Introduction to Engineering Graphics.
2. Lettering practice as per BIS.
3. Principles of Dimensioning.

ORTHOGRAPHIC PROJECTIONS **(40)**

1. Introduction to Orthographic Projections.
2. Drawing multiple views from pictorial views of objects.
3. Projection of points.
4. Projection of straight lines (only First angle projections) inclined to both the principal planes.
5. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.
6. Projection of simple solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method.

SECTION OF SOLIDS **(8)**

1. Section of simple solids in simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other and obtaining true shape of section.

ISOMETRIC PROJECTIONS **(8)**

1. Isometric projection of simple solids in simple vertical positions.

Total P: 60 periods

TEXT BOOKS:

1. N. D. Bhatt, '*Engineering Drawing*'. 55th Edition, Charotar Publishing House Pvt. Ltd., 2025.
2. K. C. John, '*Engineering Graphics for Degree*'. Prentice Hall India Publishers, 2009.
3. K. V. Natarajan, '*A Text book of Engineering Graphics*'. 34th Refined Edition, Dhanalakshmi Publications, 2021.

REFERENCES:

1. K. Venugopal and V. Prabhu Raja, '*Engineering Graphics'.* 17th Edition, New Age International Publishers, 2024.
2. Bureau of Indian Standards '*Engineering Drawing Practices for Schools and Colleges SP 46-2003*'. BIS, New Delhi, 2003.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Use the BIS standards and specifications for drawing the engineering components and structures.	**K2**
CO2	Apply orthographic projection principles to draw projection of points, lines, planes, solids, and sectioned solids, isometric and perspective projection of regular solids.	**K3**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1														
CO2	3													
	3													

1-low, 2-medium, 3-high

25EEC01 WORKPLACE COMMUNICATION SKILLS
(Common to CIVIL, CSE, EEE, ECE, ICE, MECH, AI&DS and EE-VLSI)

0 0 2 0

BUILDING COMMUNICATION SKILLS:

1. Introduction to Workplace Communication
2. Profile Building for Internships
3. English in the Workplace (Grammar & Vocabulary)
4. Professional Communication (Speaking & Writing)
5. Workplace Communication Tools
6. Career Exploration
7. Resume Update

Total P: 30 periods

REFERENCES:

1. P. C. Wren and H. Martin, '*High school English Grammar and Composition'.* S Chand Publishing, New Delhi, 2017.
2. Norman Lewis, '*Word Power Made Easy*'. Goyal Publisher, New Delhi, 2011.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the importance of soft skills for employability and fine tune their writing skills – Resume writing	**K2**
CO2	Present with clarity and coherence while speaking in formal contexts.	**K3**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1														
CO2									3					
									3					

1-low, 2-medium, 3-high

SEMESTER III
25MA301 LINEAR ALGEBRA AND ITS APPLICATION

3 1 0 4

LINEAR EQUATIONS: Introduction to systems of linear equations - gauss elimination - linear systems and invertible matrices. **(9+3)**

VECTOR SPACES: General vector spaces- real vector spaces - Euclidean n-space - subspaces - basis and dimension - row space, column space and null space - rank and nullity. **(9+3)**

LINEAR TRANSFORMATIONS: General linear transformation - kernel and range - matrices of linear transformations - change of basis - geometry of linear operators on R^2. **(9+3)**

INNER PRODUCT SPACES: Inner products- angle and orthogonality in inner product spaces, orthonormal bases, Gram Schmidt process, QR decomposition, best approximation- least squares. **(9+3)**

EIGENVALUES AND EIGENVECTORS: Eigen values and eigen vectors, diagonalization- orthogonal diagonalization - spectral decomposition- singular value decomposition- principal component analysis - discrete dynamical systems. **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXT BOOKS:

1. Howard Anton and Chris Rorres, '*Elementary Linear Algebra*'. Wiley India, New Delhi, 2018.
2. Gilbert Strang, '*Linear Algebra and its Applications'*. Cengage, New Delhi, 2012.

REFERENCES:

1. Gareth Williams, '*Linear Algebra with Applications'*. Narosa Publishing House, New Delhi, 2012.
2. David C Lay, '*Linear Algebra and its Applications'*. Pearson, New Delhi, 2016.
3. Friedberg, Insel and Spence, '*Linear Algebra'*. Pearson Education, USA, 2015.
4. Kenneth Hoffman and Ray Kunze, '*Linear Algebra'*. Prentice Hall, New Jersey, 2015.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the concepts related to Linear Equations, Vector spaces, Linear transformations, Inner product spaces, Eigenvalues and Eigenvectors.	**K2**
CO2	Apply the techniques of Linear Equations, Vector spaces, Linear transformations, Inner product spaces, Eigenvalues and Eigenvectors to solve engineering problems.	**K3**
CO3	Analyse the solutions of engineering problems employing Linear Equations, Vector spaces, Linear transformations, Inner product spaces, Eigenvalues and Eigenvectors.	**K4**
CO4	Use modern tools to solve engineering problems with the help of Linear Equations, Vector spaces, Linear transformations, Inner product spaces, Eigenvalues and Eigenvectors.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												2	2	2
CO2	2											2	2	2
CO3		1										2	2	2
CO4					1							2	2	2
	2	**1**			**1**							**2**	**2**	**2**

1-low, 2-medium, 3-high

25MA303 PROBABILITY, STOCHASTIC PROCESSES AND STATISTICS

3 1 0 4

PROBABILITY AND DISCRETE RANDOM VARIABLES: Probability, axioms, Conditional Probability, Partitions and the Law of TOTAL Probability, Baye's theorem, Independence, discrete random variables-definitions, probability mass function, families of discrete random variables - binomial, Poisson and geometric random variables, cumulative distribution functions, expectations. **(9+3)**

CONTINUOUS RANDOM VARIABLES: Continuous Sample Space, cumulative distribution functions, probability density function, families of continuous random variables - uniform, exponential, Erlang and Gaussian random variables, expectations. **(9+3)**

MULTIPLE RANDOM VARIABLES: Joint cumulative distribution function – joint probability mass function – marginal probability mass function - joint probability density function - marginal probability density function - independent random variables- expected values– Covariance, Correlation and Independence. **(9+3)**

STOCHASTIC PROCESSES: Definitions and Examples - Random Variables from Random Processes - Independent, Identically Distributed Random Sequences - The Poisson Process-Properties of the Poisson Process - Markov Process - Discrete-Time Markov Chains - Higher Transition Probabilities: Chapman–Kolmogorov Equations - Long-Run Behavior of Markov Chains. **(9+3)**

STATISTICAL INFERENCE: Foundations for inference - Variability in estimates - Confidence intervals - Hypothesis testing - Central Limit Theorem - Inference for numerical data - t-distribution - ANOVA and the F Test - Inference for categorical data - Inference for a single proportion - Difference of two proportions - Testing for goodness of fit using chi-square - Testing for independence in two-way tables. **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXT BOOKS:

1. Roy D Yates and David J Goodman, '*Elementary Linear Algebra*'. 3rd Edition, Wiley India, New Delhi, 2019.
2. David M Diez, Christopher D Barr, Mine Cetinkaya - Rundel. '*Open Intro Statistics'*. Creative Commons license, 2017.

REFERENCES:

1. Saeed Ghahramani, '*Fundamentals of Probability with Stochastic Processes'*. CRC Press, Taylor & Francis Group, USA, 2018.
2. Douglas C Montgomery and George C Runger, '*Applied Statistics and Probability for Engineers'*. Wiley India, New Delhi, 2018.
3. Ronald E. Walpole, Raymond H Myers, Sharon L Myers and Keying Ye, '*Probability and Statistics for Engineers and Scientists*'. Pearson, New Delhi, 2016.
4. David Spiegelhalter, '*The Art of Statistics: How to Learn from Data'*. Pelican Books, 2020.
5. Michael J. Evans, Jeffrey S. Rosenthal, '*Probability and Statistics: The Science of Uncertainty*'. 2nd Edition, WH Freeman, 2010.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the concepts related to Probability, Random variables, Stochastic processes and Statistical inference.	**K2**
CO2	Apply the techniques of Probability, Random variables, Stochastic processes and Statistical inference to solve engineering problems.	**K3**
CO3	Analyze the solutions of engineering problems employing Probability, Random variables, Stochastic processes and Statistical inference.	**K4**
CO4	Use modern tools to solve engineering problems with the help of Probability, Random variables, Stochastic processes and Statistical inference.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												2	2	2
CO2	3											2	2	2
CO3		2										2	2	2
CO4					1				1			2	2	2
	3	**2**			**1**				**1**			2	2	2

1-low, 2-medium, 3-high

25CS301 DATA STRUCTURES

3 0 0 3

INTRODUCTION: Need for data structures – Types of data structures – Abstract Data Type – Algorithm complexity analysis of linear and non-linear data structures – Best case and worst-case complexities – Asymptotic notations. **(9)**

ARRAYS AND LISTS: Array representation and operations – Matrix representation using multi-dimensional arrays – Linked list representation – Operations on singly linked list – Types of linked list – Polynomial addition – Sparse matrices. **(9)**

STACKS AND QUEUES: Stack ADT – Representation and operations – Expressing handling – Role of stack in implementing recursive algorithms – Queue ADT – Representation and operations – Types of queues – Circular queue – Dequeue – Priority queue. **(9)**

TREES: Terminologies – Binary Tree – Traversal – Expression trees – Binary Heap – Priority queue implementation using Binary Heap – Binary Search Tree – AVL Tree – m-way search trees – B Tree – B+ Tree – Application – Tree structure. **(9)**

HASHING AND GRAPHS: Hash table – Hash functions – Resolving collisions – Rehashing. GRAPHS: Graph terminologies – Types of graphs – Representation – Breadth First Search – Depth First Search – Topological sort. **(9)**

Total L: 45 periods

TEXTBOOKS:

1. Mark Allen Weiss, '*Data Structures and Algorithm Analysis in C*'. 2nd Edition, Pearson Education, 2019.
2. Jean Paul Tremblay, Sorenson, '*An Introduction to Data Structures with Applications*'. 2nd Edition, McGraw Hill Publishing Company, New Delhi, 2017.

REFERENCES:

1. Ellis Horowitz, SartaiShani, Sanguthevar Rajasekaran, '*Fundamentals of Computer Algorithms*'. 2nd edition, Universities Press, 2019.
2. Salaria R S, '*Data Structures and Algorithms using C*'. 5th Edition, Khanna Book Publishing, New Delhi, 2017.
3. Amol M. Jagtap, Ajit S. Mali, '*Data Structures Using C – A Practical Approach for Beginners*'. 1st Edition, Chapman and Hall/CRC, 2021.
4. Aaron M Tanenbaum, Moshe J Augenstein and Yedidyah Langsam, '*Data Structures Using C and C++*'. 2nd Edition, Prentice Hall, 2021.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts, classifications, and principles of data structures and algorithm complexity.	**K2**
CO2	Apply appropriate data structures and their operations to solve computational problems.	**K3**
CO3	Analyze the complexity of data structures and associated algorithms.	**K4**
CO4	Design and develop efficient solutions using appropriate linear and non-linear data structures.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2					2				2	2	2
	3	**3**	**2**					**2**				**3**	**3**	**3**

1-low, 2-medium, 3-high

25AD301 FUNDAMENTALS OF DATA SCIENCE AND ANALYTICS

3 0 0 3

INTRODUCTION: Need for data science – Benefits and uses – Facts of data – Data science process – Setting the research goal – Retrieving data – cleansing, integrating, and transforming data – Exploratory data analysis – Build the models – Presenting and building applications. **(9)**

DESCRIPTIVE ANALYTICS: Frequency distributions – Outliers – Interpreting distributions – Graphs – Averages – Describing variability – Interquartile range – variability for qualitative and ranked data - Normal distributions – z scores – Correlation – Scatter plots – Regression – Regression line – Least squares regression line – Standard error of estimate – Interpretation of r^2 – Multiple regression equations – Regression towards the mean. **(9)**

INFERENTIAL STATISTICS: Populations – Samples – Random sampling – Sampling Distribution-Standard error of the mean - Hypothesis testing – z-test – z-test procedure – Decision rule – Calculations – Decisions – Interpretations - One-tailed and two-tailed tests – Estimation – Point estimate – Confidence interval–Level of confidence – Effect of sample size. **(9)**

ANALYSIS OF VARIANCE: t-test for one sample – Sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – Statistical significance – t-test for two related samples. F-test – ANOVA – Two-factor experiments – three f-tests – two-factor ANOVA – chi-square tests. **(9)**

PREDICTIVE ANALYTICS: Linear models - goodness of fit - weighted resampling - regression with Stats Models - multiple and non-linear regression - logistic regression - time series basics - moving averages - handling missing data - autocorrelation - survival analysis. **(9)**

Total L:45 Periods

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, '*Introducing Data Science'*. Manning Publications, 2016.
2. Robert S. Witte and John S. Witte, '*Statistics*'. 11th Edition, Wiley Publications, 2017.
3. Jake VanderPlas, '*Python Data Science Handbook'*. O'Reilly, 2016.

REFERENCE:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, '*Deep Learning'*. MIT Press, 2016
2. Allen B. Downey, '*Think Stats: Exploratory Data Analysis in Python'*. Green Tea Press, 2014.
3. Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, '*Fundamentals of Data Science*'. CRC Press, 2022.
4. Chirag Shah, '*A Hands-On Introduction to Data Science*'. Cambridge University Press, 2020.
5. Vineet Raina, Srinath Krishnamurthy, '*Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice*'. Apress, 2021.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the principles of data preparation, statistical measures, probability distributions, hypothesis testing, variance analysis, and predictive modelling.	**K2**
CO2	Apply appropriate statistical techniques such as regression, hypothesis testing, and t-tests to complex datasets for data interpretation and decision-making.	**K3**
CO3	Analyze datasets using ANOVA, correlation, multiple regression, and time series methods to identify patterns, trends, and relationships among variables.	**K4**
CO4	Construct analytical models using statistical and predictive techniques and generate structured interpretations of the results.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												2	2	2
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2		2			2				2	2	2
	3	**3**	**2**		**2**			**2**				3	3	3

1-low, 2-medium, 3-high

25AD302 DATA ENGINEERING

3 0 0 3

INTRODUCTION TO EXPLORATORY DATA ANALYSIS (EDA) - Steps in EDA, Data Types: Numerical Data - Discrete data, continuous data - Categorical data -Measurement Scales: Nominal, Ordinal, Interval, Ratio - Comparing EDA with classical and Bayesian Analysis - Software tools for EDA. **(9)**

TRANSFORMATION TECHNIQUES: Performing data deduplication - Replacing values - Discretization and binning. Introduction to Missing data, Handling missing data: Traditional methods - Maximum Likelihood Estimation. **(9)**

DESCRIPTIVE STATISTICS: Understanding statistics, Measures of central tendency, Measures of dispersion, Grouping Datasets Understanding group by(), Group by mechanics, Data aggregation, Pivot tables and cross-tabulations, Correlation: Introducing correlation, Types of analysis. **(9)**

PLOTTING AND VISUALIZATION: A Brief matplotlib API Primer- Plotting with pandas and seaborn, Time Series Analysis (TSA): Fundamentals of TSA - characteristics of TSA – Time based indexing - visualizing time series – grouping time series data- resampling time series data. **(9)**

PANDAS: Introduction to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics. Data Loading, Storage and File Formats. Reading and Writing Data in Text Format, Web Scraping, Binary Data Formats, Data Cleaning and Preparation. Handling Missing Data, Data Transformation, String Manipulation. Data Wrangling: Hierarchical Indexing, Combining and Merging Data Sets Reshaping and Pivoting. **(9)**

Total L: 45 Periods

TEXT BOOKS:

1. Suresh Kumar Mukhiya and Usman Ahmed, '*Hands-On Exploratory Data Analysis with Python'*. 1st Edition,
2. Packt Publisher, 2020.
3. McKinney. W, '*Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython'*. 2nd Edition, O'ReillyMedia, 2017.

REFERENCES:

1. Ayodele Oluleye, '*Exploratory Data Analysis with Python*'. 1st Edition, Packt Publisher, 2023.
2. Anamitra Dehmukh,Nimbalkar, '*Data Exploration and Visualization'.* 1st Edition, Technical Publications, 2022.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the fundamental concepts of Exploratory Data Analysis (EDA), transformation techniques, and descriptive statistics used to summarize datasets.	**K2**
CO2	Apply appropriate techniques for data preprocessing and transformation, visualizing Time Series data, and pandas for data manipulation and statistical computations.	**K3**
CO3	Analyze datasets using grouping, aggregation, correlation methods, and visualization tools, including time series analysis, to identify patterns, trends, and relationships in data.	**K4**
CO4	Evaluate data analysis workflows by integrating EDA techniques, visualization methods, and data wrangling tools to generate meaningful insights from structured and unstructured data.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												2	2	2
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2		2							2	2	2
	3	**3**	**2**		**2**							3	3	3

1-low, 2-medium, 3-high

25CS303 OBJECT ORIENTED PROGRAMMING

2 0 2 3

CLASSES AND OBJECT-ORIENTED CONCEPTS: Object oriented programming paradigms – Java buzzwords – Data types, variables and arrays – Operators – Control statements – Programming structures in Java – Classes – Constructors – Methods – Access specifiers – Static members –- Overloading methods - Objects as parameters - Returning objects. **(6)**

INHERITANCE, PACKAGES AND INTERFACES: Inheritance Basics – Types of inheritance – Super keyword - Method overriding - Dynamic method dispatch - Abstract classes - Final keyword with inheritance – Packages - Packages and member access - Importing packages – Interfaces. **(6)**

EXCEPTION HANDLING AND MULTITHREADING: Exception Handling basics – Multiple catch clauses – Nested try statements – Java's built-in exceptions – User defined exception. Multithreaded programming: Java thread model – creating a thread and multiple threads – Priorities – Synchronization – Inter thread communication- Suspending – Resuming and Stopping threads. **(6)**

I/O AND STRING HANDLING: I/O Basics – Reading and Writing console I/O – Reading and writing files. Strings: Basic String class, methods and String buffer class – Wrappers – Auto boxing. **(6)**

GENERICS AND COLLECTIONS: Generics: Generic programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Collection Framework in Java: List – Array list – Hash table – Hash set – Tree set – Stack – Priority queue. **(6)**

LIST OF EXPERIMENTS

1. Classes and Methods
2. Inheritance
3. Abstract Classes
4. Interfaces and Packages
5. Exception Handling
6. Multithreading Concepts
7. I/O and Files
8. Generics and Lambda Expressions
9. Collection Classes

Total L: 30 + P: 30 = 60 periods

TEXTBOOKS:

1. Herbert Schildt, *'Java: The Complete Reference'*. 11th Edition, McGraw Hill Education, New Delhi, 2019.
2. Deitel P and Deitel H, '*Java: How to Program*'. 11th Edition, Prentice Hall, 2018.

REFERENCES:

1. Cay S. Horstmann, *'Core Java Fundamentals'.* Volume 1, 11th Edition, Prentice Hall, 2018.
2. James Gosling, Bill Joy, Guy Steele, Gilad Bracha, Alex Buckley and Daniel Smith, '*The Java Language Specification – Java SE*'. 13th Edition, Oracle America Inc., USA, 2019.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the core Object Oriented Programming concepts and their applications.	**K2**
CO2	Apply Java constructs to develop various applications.	**K3**
CO3	Analyze solutions involving code reusability and complexity management	**K4**
CO4	Develop modular and reusable applications by integrating OOP principles and advanced programming concepts.	
CO5	Demonstrate problem-solving skills through the development of well-structured and maintainable applications.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												2	2	2
CO2	3											3	3	3
CO3		1										1	1	1
CO4					3			3				2	2	2
CO5					1			1				1	1	1
	3	**1**			**3**			**3**				**3**	**3**	**3**

1-low, 2-medium, 3-high

25CS311 DATA STRUCTURES LABORATORY

0 0 4 2

1. Solving problems using arrays.
2. Searching and Sorting algorithms.
3. Implementation of linked list.
4. Applications of linked list.
5. Implementation of stack and queue.
6. Applications of stack.
7. Operations on Binary Search Trees.
8. Applications of Binary Search Tree, AVL tree.
9. Graphs – Depth First Search and Breadth First Search.
10. Hashing and Collision Resolution.

Total P: 60 periods

REFERENCES:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, '*Fundamentals of Computer Algorithms*'. 2nd Edition, Universities Press, 2019.
2. Jean Paul Tremblay and Sorenson, '*An Introduction to Data Structures with Applications*'. McGraw Hill Publishing Company, New Delhi, 2017.
3. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, '*Introduction to Algorithms*'. MIT Press, England, 2009.
4. Salaria R. S, '*Data Structures and Algorithms Using C*'. 5th Edition, Khanna Book Publishing, New Delhi, 2017.
5. Amol M. Jagtap, Ajit S. Mali, '*Data Structures Using C – A Practical Approach for Beginners*'. Chapman and Hall/CRC, 1st Edition, 2021.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply appropriate data structures to find solutions for computational problems.	**K3**
CO2	Analyze optimized solutions to improve algorithmic efficiency and performance.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3											3	3	3
CO2		3										3	3	3
	3	**3**										**3**	**3**	**3**

1-low, 2-medium, 3-high

25AD311 DATA ANALYTICS AND VISUALIZATION LABORATORY

0 0 4 2

1. Working with Numpy, Pandas, Matplotlib and Seaborn.
2. Frequency distributions, Averages, Variability
3. Normal curves, Correlation and scatter plots, Correlation coefficient
4. Regression
5. Z-test
6. T-test
7. ANOVA
8. Building and validating linear models
9. Building and validating logistic models
10. Time series analysis

Total P: 60 Periods

REFERENCES:

1. Robert S. Witte and John S. Witte, '*Statistics'.* 11th Edition, Wiley Publications, 2017.
2. Jake VanderPlas, '*Python Data Science Handbook*'. O'Reilly, 2016.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, '*Deep Learning*'. MIT Press, 2016
4. Allen B. Downey, '*Think Stats: Exploratory Data Analysis in Python'.* Green Tea Press, 2014.
5. Chirag Shah, '*A Hands-On Introduction to Data Science'*. Cambridge University Press, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Analyze the fundamental concepts, processes, and significance of data science, including data pre-processing, descriptive statistics, and inferential statistical techniques.	**K4**
CO2	Evaluate statistical techniques for regression, hypothesis testing for z-test, t-test and f-test for data interpretation and decision-making.	**K5**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3											3	3	3
CO2			3		3			3				3	3	3
	3		**3**		**3**			**3**				**3**	**3**	**3**

1-low, 2-medium, 3-high

25EEC02 FOUNDATIONS OF PROBLEM SOLVING

0 0 2 1

1. Speed Mathematics (SAW, Oz, Mirror methods)
2. Speed Mathematics (High5, Minion, Butterfly methods)
3. Speed Mathematics (Inception, Goldeneye methods)
4. Thinking with Numbers
5. Problem Solving with Visual information
6. Words Puzzles
7. Resume Writing Essentials

Total P: 30 period

REFERENCE:

1. R. S. Agarwal, '*Quantitative Aptitude for Competitive Examination'*. S Chand Publishing, New Delhi, 2017.

SEMESTER IV

25MA401 OPTIMIZATION TECHNIQUES FOR ANALYTICS

3 1 0 4

LINEAR PROGRAMMING: Modelling with linear programming model - Convex sets - Convex functions - Graphical solution for two dimensional problems – Transition from graphical to algebraic solution, Simplex method, M- method, Two phase simplex method; Special cases in the simplex method: Degeneracy, Alternative optima, Unbounded solution, Infeasible solution. **(9+3)**

DUALITY AND POST-OPTIMAL ANALYSIS: Definition of the Dual problem, Primal – Dual relationships, Economic interpretation of Duality, Dual Simplex algorithm, Generalized Simplex algorithm, Post optimal analysis. **(9+3)**

INTEGER PROGRAMMING: Gomory cutting plane methods for all integer and mixed integer programming problems - Branch and Bound method (Land – Dolg and Dakin algorithms). **(9+3)**

DYNAMIC PROGRAMMING AND CONVEX OPTIMIZATION: Principle of Optimality – Backward and forward induction methods-– Shortest path network problems – Cargo loading model, Equipment replacement model. Convex optimization problems- linear and quadratic programs; quasi-convex optimization problems. **(9+3)**

APPLICATIONS IN ANALYTICS AND CASE STUDIES: Optimization in machine learning (regularization, loss minimization), Supply chain and logistics optimization, Marketing analytics: campaign optimization, Finance analytics: risk-adjusted portfolio optimization, Real-time case studies and problem-solving using optimization models. **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXT BOOKS:

1. Michael H. Veatch, '*Linear and Convex Optimization*'. John Wiley and Sons, Inc, 2021.
2. Richard W. Cottle, Mukund N. Thapa, '*Linear and Nonlinear Optimization*'. Springer Science Business Media, LLC 2017.
3. Stephen J. Wright, Benjamin Recht, '*Optimization for Data Analysis*'. Cambridge University Press, March 2022.

REFERENCES:

1. Hamdy A Taha, '*Operations Research – An Introduction'.* Pearson Education Limited, 2017.
2. Stephen Boyd, Lieven Vandenberghe, *'Convex Optimization*'. Cambridge University Press, 2004.
3. David G. Luenberger, Yinyu Ye, '*Linear and Nonlinear Programming*'. Springer Nature Switzerland, 2021.
4. Edwin K P Chong, Stanislaw H Zak, '*Introduction to Optimization*'. Wiley India, 2017.
5. Charu C. Aggarwal, *'Linear Algebra and Optimization for Machine Learning'*. Springer Nature Switzerland, 2020.

COURSE OUTCOME

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamentals of linear programming, including convex sets and functions, and solve optimization problems using graphical and algebraic methods.	**K2**
CO2	Apply duality theory to linear programming problems, interpret primal-dual relationships, and perform post-optimality analysis including Dual and Generalized Simplex methods.	**K3**
CO3	Analyze and solve integer programming problems using Gomory's cutting plane and Branch and Bound methods for both pure and mixed-integer problems	**K4**
CO4	Formulate and solve dynamic programming models and convex optimization problems, including linear, quadratic, and quasi-convex types, in various decision-making scenarios.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3											2	2	2
CO2		2										2	2	2
CO3			2									2	2	2
CO4					1							2	2	2
	3	**2**	**2**		**1**							**2**	**2**	**2**

1-low, 2-medium, 3-high

25CS401 DATABASE MANAGEMENT SYSTEMS

3 0 0 3

DATA MODELS: Databases and database users, Database system concepts and architecture, Data models: Entity relationship model - Enhanced entity relationship model - Relational Model, Relational database constraints, Relational algebra, Conceptual to relational mapping, SQL, DB Vault. **(9)**

DATABASE DESIGN THEORY AND METHODOLOGY: Functional dependencies, Axioms, Normal Forms: First normal form - Second normal form - Third normal form - Boyce Codd normal form, Multi-valued dependency, Join dependency. **(9)**

DATA STORAGE AND INDEXING: Overview, Record storage, Primary file organization, Caching, Index structures for files: Single level Indexing - Multilevel Indexing, B-Trees. **(9)**

SYSTEM IMPLEMENTATION TECHNIQUES: Query processing, Query optimization, Transaction management: Transaction - Concurrency control - Recovery system. **(9)**

NON-RELATIONAL DATABASES: Need for NOSQL Databases, Types, MongoDB - Data types, Creating, Updating and Deleting Documents, Querying the database. **(9)**

Total L: 45 periods

TEXTBOOKS:

1. Ramez Elmasri and Shamkant B Navathe, '*Fundamentals of Database Systems*'. Pearson Education, 7th edition, New Delhi, 2017.
2. Abraham Silberchatz, Henry F Korth and Sudarshan S, '*Database System Concepts*'. Tata McGraw-Hill, 7th edition, New Delhi, 2021.

REFERENCES:

1. Atul Kahate, '*Introduction to Database Management Systems*'. 3rd Edition, Pearson Education, New Delhi, 2011.
2. Raghu Ramakrishnan and Johannes Gehrke, '*Database Management Systems*'. 4th Edition, Tata McGraw Hill, New Delhi, 2013.
3. Kristina Chodorow and Michael Dirolf, '*MONGODB: The Definitive Guide, Powerful and Scalable Storage*'. 3rd Edition, Shroff Publishers, Mumbai, 2019.
4. Thomas M Connolly Z Carolyn E, '*Database Systems: A Practical Approach to Design, Implementation, and Management*'. 6th Edition, Pearson Education, New Delhi, 2019.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the basic concepts of database management systems and data storage techniques.	**K2**
CO2	Apply database management system techniques to solve practical application problems.	**K3**
CO3	Analyse database concepts for the given scenario.	**K4**
CO4	Evaluate appropriate SQL queries and data models to optimize the performance and effectiveness of database applications.	**K5**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												2	2	2
CO2	3											3	3	3
CO3		2										2	2	2
CO4				2								2	2	2
	3	**2**		**2**								**3**	**3**	**3**

1-low, 2-medium, 3-high

25CS402 DESIGN AND ANALYSIS OF ALGORITHMS

3 1 0 4

DIVIDE AND CONQUER: Introduction to algorithm design techniques, Divide and conquer methodology: Solving recurrence relations – Finding maximum and minimum element – Quick sort – Merge sort – Convex hull.
Activities:

- Time and space complexity analysis and amortized analysis of divide and conquer algorithms
- Implement merge sort and quick sort methods for array of size N. Experiment for different values of N and compare their time complexity. **(9+3)**

GREEDY METHOD: Greedy strategy – Knapsack problem – Minimum spanning trees – Single source shortest path method – Huffman trees.
Activities:

- Implementation of minimum spanning tree algorithms and comparison of their time complexity
- Implementation of dijkstra's algorithm and its complexity analysis. **(9+3)**

DYNAMIC PROGRAMMING: Principle of optimality – Knapsack problem – All pairs shortest path – Optimal binary search tree – Multistage graphs
Activities:

- Implementation of 0/1 knapsack problem using dynamic programming and analysis of time and space complexity.
- Implementation of all pair shortest path algorithm and derive its complexity. **(9+3)**

BACKTRACKING: State space tree – Knapsack problem – The eight queens problem – Sum of subsets – Graph coloring.
Activities:

- NP complete and NP hard problems
- Implement N queen's problem using backtracking. **(9+3)**

BRANCH AND BOUND: Bounding functions – 0/1 Knapsack problem – Traveling salesman problem – Assignment problem.
Activities:

- Implementation of assignment problem
- Implementation of traveling salesman problem

Comparison of different approaches for solving knapsack problem. **(9+3)**

Total L: 45 + T: 15 = 60 Periods

TEXT BOOKS:

1. Anany Levitin, '*Introduction to the Design and Analysis of Algorithm*'. 3rd Edition, Prentice Hall of India, New Delhi, 2017.
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, '*Fundamentals of Computer Algorithms*'. Galgotia Publications, New Delhi, 2010.

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, '*Introduction to Algorithms*'. 3rd Edition, MIT Press, England, 2009.
2. Donald E. Knuth, '*The Art of Computer Programming*'. Volumes 1& 3, Pearson Education, 2009.
3. Jeffrey J. McConnell, '*Analysis of Algorithms*'. Jones and Bartlett Publishers, 2008.
4. Parag Himanshu Dave, Himanshu Bhalchandra Dave, '*Design and Analysis of Algorithms*'.Pearson Education, 2008.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental principles of algorithm design and performance analysis.	**K2**
CO2	Develop algorithmic solutions for computational problems using appropriate design strategies.	**K3**
CO3	Analyze the correctness and computational complexity of algorithms using a suitable approach.	**K4**
CO4	Evaluate alternative algorithmic solutions to determine the most efficient approach for a given problem.	**K5**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												**1**	**1**	**1**
CO2	**3**											**3**	**3**	**3**
CO3		**3**										**3**	**3**	**3**
CO4			**2**									**2**	**2**	**2**
	3	**3**	**2**									**3**	**3**	**3**

1-low, 2-medium, 3-high

25AD402 ARTIFICIAL INTELLIGENCE SYSTEMS

3 1 0 4

INTRODUCTION: Artificial Intelligence - The state of art - Intelligent Agents - Rationality - Nature of Environments – Structure of Agents - Examples. **(9+3)**

PROBLEM SOLVING AGENTS: Searching for solutions: Uninformed search - BFS, DFS, Uniform cost search, Iterative deepening search - Informed Search - Greedy Best First search, A* search, AO* search - Adversarial search – Games - Optimal decisions in Games, alpha - beta pruning. **(9+3)**

KNOWLEDGE AND REASONING: Representations and mappings – Approaches to knowledge representation – Property inheritance algorithm - First Order Predicate logic- Instance and ISA relationships – Computable functions and predicates - Unification-Resolution – Question Answering. **(9+3)**

ACTING UNDER UNCERTAINTY: Quantifying uncertainty – Efficient representation of conditional distributions – Probability and Bayes Theorem - Bayesian Networks - Exact and approximate inferences - Making simple decisions – Utility theory - Decision networks – Value of information – Decisions With multiple agent. **(9+3)**

PLANNING: Classical Planning- Algorithms for Planning as state space search - Planning Graphs – Classic planning as Boolean Satisfiability - Analysis of planning approaches – Time, schedules and resources – Hierarchical planning. **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXT BOOKS:

1. Stuart J Russell and Peter Norvig, '*Artificial Intelligence – A Modern Approach*'. 3rd Edition, Prentice Hall of India, Pearson Education, New Delhi, 2021.
2. Elaine Rich, Kevin Knight and Shivashankar B Nair, '*Artificial Intelligence'*. 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2019.

REFERENCES:

1. George F Luger, '*Artificial Intelligence: Structures and Strategies for Complex Problem Solving*'. 6th Edition, Pearson Education, New Delhi, 2021.
2. Deepak Khemani, '*A First Course in Artificial Intelligence*'. McGraw Hill Education, New Delhi, 2017.
3. John Paul Mueller, '*Artificial Intelligence for Dummies*'. Wiley, 2018
4. Lavika Goel, '*Artificial Intelligence: Concepts and Applications*'. Wiley,2021
5. Pradeepta Mishra, '*Practical Explainable AI Using Python: Artificial Intelligence Model Explanations Using Python-based Libraries, Extensions, and Frameworks'.* Apress,2021.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts of intelligent agents, problem-solving strategies, knowledge representation, and uncertainty handling.	**K2**
CO2	Identify search algorithms, probabilistic models, and planning methods to solve typical AI problems in various environments.	**K3**
CO3	Examine the performance of different AI approaches such as informed/uninformed search, logical inference, and decision-making under uncertainty.	**K4**
CO4	Interpret comprehensive AI solutions across search, reasoning, uncertainty, and planning domains.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												2	2	2
CO2	**3**											3	3	3
CO3		**3**										3	3	3
CO4				**2**				**2**	**2**			2	2	2
	3	**3**		**2**				**2**	**2**			**3**	**3**	**3**

1-low, 2-medium, 3-high

25AD403 MACHINE LEARNING FOR DATA SCIENCE

3 0 0 3

INTRODUCTION & PRE-PROCESSING: Introduction to Machine Learning: Supervised - Unsupervised - Reinforcement Learning. Examples of machine learning applications, Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Data Pre-processing: Importing the Dataset – Missing Data - Encoding Categorical data - Splitting the dataset – Feature-Scaling. **(9)**

REGRESSION: Supervised Learning: Classification and Regression - Generalization, overfitting and underfitting Ordinary Least Squares- Cost Functions - Gradient Descent based optimization - Simple Linear Regression - Multiple Linear Regression - Polynomial Regression, Ridge Regression and LASSO regression, Evaluating Regression Model Performance - Regression Model Selection. **(9)**

CLASSIFICATION: Classification - Logistic Regression, K-Nearest neighbors, Support Vector Machine - Kernel SVM, Naive Bayes, Decision Tree Classification, Random Forest Classification, XGBoost, Classification Model Selection, Measuring classifier performance. **(9)**

UNSUPERVISED LEARNING AND DIMENSIONALITY REDUCTION: Clustering: K-Means Clustering, Hierarchical Clustering, Association Rule Learning - Apriori, Gaussian mixture models and Expectation maximization, Principal Component Analysis, Linear Discriminant Analysis. **(9)**

NEURAL NETWORKS: Basics of Neural Networks - MP neurons, Perceptron, Weight, Bias, Activation, Loss function - Optimizer - Gradient based optimization; Artificial Neural Networks - Single Layer Neural Network – Multilayer Perceptron, Feed Forward Neural Networks, Error Backpropagation. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Ethem Alpaydin, '*Introduction to Machine Learning'*. 4th Edition, MIT Press, 2020.
2. Stephen Marsland, '*Machine Learning: An Algorithmic Perspective'*. 2nd Edition, CRC Press, 2014.

REFERENCE:

1. Aurélien Géron, '*Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems'.* O'Reilly Media, 2019.
2. Christopher M. Bishop, '*Pattern Recognition and Machine Learning'.* Springer, 2006.
3. Tom Mitchell, '*Machine Learning'.* 3rd Edition, McGraw Hill, 1997.
4. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, *'Foundations of Machine Learning'*. 2nd Edition, MIT Press, 2012, 2018.
5. Ian Goodfellow, Yoshua Bengio, Aaron Courville, '*Deep Learning'.* MIT Press, 2016.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the principles and foundations of machine learning, including key theoretical concepts and the trade-offs in model generalization.	**K2**
CO2	Apply various supervised and unsupervised machine learning algorithms to analyze datasets and solve classification, regression, and clustering problems.	**K3**
CO3	Analyze the effectiveness of different machine learning models, techniques, and ensemble methods in addressing complex real-world challenges.	**K4**
CO4	Design a machine learning solution as a team, demonstrating the ability to handle end-to-end processes, from problem formulation to model deployment.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2		1			2				3	3	3
	3	**3**	**2**		**1**			**2**				**3**	**3**	**3**

1-low, 2-medium, 3-high

25CS411 DATABASE MANAGEMENT SYSTEMS LABORATORY

0 0 4 2

1. Create a database table, add constraints (primary key, unique, check, not null), insert rows, update and delete rows using SQL DDL and DML commands.
2. Execute DCL and TCL commands.
3. Create a set of tables, add foreign key constraints and incorporate referential integrity.
4. Query the database tables using different 'where' clause conditions and also implement aggregate functions.
5. Implement sub queries, simple join operations and explore outer joins.
6. Write user defined functions and stored procedures in SQL.
7. Write SQL Triggers for insert, delete, and update operations in a database table.
8. Create view and index for database tables with a large number of records.
9. Create an XML database and validate it using XML schema.
10. Create document, column and graph-based data using NOSQL database tools.

Total P: 60 periods

REFERENCES:

1. Abraham Silberschatz, Henry F Korth and Sudarshan S, '*Database System Concepts*'. 7th Edition, Tata McGraw-Hill, New Delhi, 2021.
2. Ramez Elmasri and Shamkant B Navathe, '*Fundamentals of Database System'*. 7th Edition, Addison Wesley, USA, 2016.
3. Ivan Bayross, '*SQL, PL/SQL the Programming Language of Oracle*'. 4th Edition, BPB Publications, New Delhi, 2020.
4. Benjamin Rosenzweig and Elena Rakhimov, '*Oracle PL/SQL by Example*'. 5th Edition, Pearson Education, India, 2015.
5. Raghu Ramakrishnan and Johannes Gehrke, '*Database Management Systems*'. 4th Edition, Tata McGraw-Hill, New Delhi, 2015.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply database concepts to create and manage databases using SQL and connect them with applications by maintaining data accuracy and consistency.	**K3**
CO2	Analyze XML and NoSQL data models through schema validation and multi-model database tools.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3											3	3	3
CO2		2										2	2	2
	3	**2**										**3**	**3**	**3**

1-low, 2-medium, 3-high

25AD412 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LABORATORY

0 0 4 2

1. Implementation of Intelligent Agents and their types using a simple environment simulation.
2. Implementation of Uninformed Search algorithms: BFS, DFS, and Uniform Cost Search.
3. Implementation of Informed Search algorithms: Greedy Best First Search and A* Search.
4. Implementation of Adversarial Search using Minimax and Alpha-Beta Pruning in a two-player game.
5. Implementation of Decision Networks and Utility-based Decision Making.
6. Linear Regression and Logistic Regression
7. Support Vector Machine
8. Decision Tree and Random Forest
9. K-Means Clustering and Association Rule Mining
10. Gaussian mixture models and Expectation maximization
11. Principal Component Analysis and Linear Discriminant Analysis
12. Artificial neural network

Total P: 60 periods

REFERENCES:

1. George F Luger, '*Artificial Intelligence: Structures and Strategies for Complex Problem Solving'.* 6th Edition, Pearson Education, New Delhi, 2021.
2. Deepak Khemani, '*A First Course in Artificial Intelligence'.* McGraw Hill Education, New Delhi, 2017.
3. Aurélien Géron, '*Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems'.* O'Reilly Media, 2019.
4. Christopher M. Bishop, '*Pattern Recognition and Machine Learning'.* Springer, 2006.
5. Tom Mitchell, '*Machine Learning'.* 3rd Edition, McGraw Hill, 1997.
6. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, '*Foundations of Machine Learning'.* 2nd Edition, MIT Press, 2012, 2018.
7. Ian Goodfellow, Yoshua Bengio, Aaron Courville, '*Deep Learning'.* MIT Press, 2016

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Implement intelligent agents and machine learning algorithms including supervised, and unsupervised approaches, in simulated environments and complex datasets.	**K3**
CO2	Compare and analyze the performance of uninformed, informed, and adversarial search strategies as well as various regression and classification models based on accuracy, efficiency, and applicability to problem contexts.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3											3	3	3
CO2					3							3	3	3
	3				**3**							**3**	**3**	**3**

1-low, 2-medium, 3-high

25AD413 CORPUS CREATION LABORATORY

0 0 2 1

1. Introduction to Corpus Linguistics and Corpus Design
2. Text Data Collection from Multiple Sources (Web, PDFs, APIs, Social Media)
3. Text Encoding, Unicode, and Character Normalization
4. Data Cleaning and Noise Removal (HTML tags, emojis, stopwords)
5. Tokenization, Sentence Splitting, and Text Segmentation
6. Part-of-Speech Tagging and Lemmatization
7. Annotation Techniques (Manual and Semi-Automatic Annotation)
8. Metadata Creation and Corpus Documentation
9. Corpus Storage Formats (TXT, CSV, JSON, XML)
10. Corpus Validation, Versioning, and Quality Assessment

Total P: 30 periods

REFERENCES:

1. Tony McEnery and Andrew Hardie, '*Corpus Linguistics: Method, Theory and Practice*'. Cambridge University Press, 2012.
2. Stefan Th. Gries, '*Quantitative Corpus Linguistics with R*'. Routledge, 2017.
3. Christopher D. Manning and Hinrich Schütze, '*Foundations of Statistical Natural Language Processing'*. MIT Press, 1999.
4. Daniel Jurafsky and James H. Martin, '*Speech and Language Processing*'. Pearson, 3rd Edition, 2023.
5. Nitin Indurkhya and Fred J. Damerau, '*Handbook of Natural Language Processing*'. CRC Press, 2010.
6. Ian Goodfellow, Yoshua Bengio, Aaron Courville, '*Deep Learning'.* MIT Press, 2016.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Design and construct structured text corpora by collecting, cleaning, preprocessing, and organizing textual data from diverse sources using standard corpus creation methodologies.	**K3**
CO2	Apply & Analyze the linguistic annotation, metadata generation, validation techniques, and corpus quality evaluation methods to prepare reusable and domain-specific corpora for NLP and AI applications.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3											2	2	2
CO2		2	2					1				2	2	2
	3	**2**	**2**					**1**				**2**	**2**	**2**

1-low, 2-medium, 3-high

25ADE01 MINI PROJECT I

0 0 2 1

- Identification of a real time problem in thrust areas.
- Developing a mathematical model for solving the above problem.
- Finalization of system requirements and specification.
- Implementation of different solutions for the problem based on literature survey Future trends in providing alternate solutions.
- Consolidated report preparation of the above.

Total P: 30 periods

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Identify real-world problems, formulate appropriate solution approaches, and plan a structured mini-project with clear objectives and methodology.	**K3**
CO2	Develop and demonstrate a functional prototype by applying suitable tools and techniques, and effectively communicate project outcomes through technical presentation and documentation.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	2											2	2	2
CO2		2	2		2			1	2	1		2	2	2
	2	**2**	**2**		**2**			**1**	**2**	**1**		**2**	**2**	**2**

1-low, 2-medium, 3-high

25EEC03 PROBLEM SOLVING

0 0 2 1

1. Algorithmic Thinking, Branching & Repetition Problems
2. Logical Reasoning - Data Arrangements & Relations
3. Solving problems based on Coding & decoding, Series, Analogy, Odd man out and Visual reasoning
4. Problems based on Ages, Logical Connectives, Syllogisms, Data Interpretation & Data Sufficiency
5. Solving problems on Clocks Calendars, Direction Sense & Cubes
6. Problems based on Number system, Percentages, Simple & Compound Interest
7. Resume Update

Total P:30 periods

REFERENCE:

1. R. S. Agarwal, '*Quantitative Aptitude for Competitive Examination'.* S Chand Publishing, New Delhi, 2017.

SEMESTER V
25HS301 PROJECT AND FINANCE MANAGEMENT

3 0 0 3

INTRODUCTION TO PROJECT MANAGEMENT: Project: Trends in project management, project management versus general management, agile project management, the three goals of a project, life cycle of projects, project selection methods, project portfolio process, case study – friendly assisted living facility. **(9)**

ROLE OF PROJECT MANAGER AND ORGANISATION: Project managers roles and responsibilities, selection of a project manager, project management as a profession, fitting projects into the parent organization, the project team and agile team roles, case study – the company with traditional functional organizational structure setting up teams for the new initiatives. **(9)**

PROJECT ACTIVITIES: The planning process, work-breakdown structure and other aids, risk management, methods of budgeting, cost estimation, scheduling the project with PERT and CPM networks, allocating resources, resource loading and leveling, Goldratt's Critical Chain, application – using Project Libre for project management, case study – success of Chandrayan-3. **(9)**

INTRODUCTION TO FINANCE MANAGEMENT: Overview - finance and related disciplines, scope and objectives of financial management, time value of money, valuation of securities, and risk and return and calculations with spreadsheet, analysis using cash flow statement and financial statements. **(9)**

PERSONAL FINANCE: Compounding, debt, equity and financial markets and investments- debt and bonds. Equity, mutual funds, hedge funds, real estate, and commodities, Personal financial plan to enhance wealth and job marketability, components of a financial plan, tools for planning – financial statements, applying time value concept of money and tax planning. **(9)**

Total L: 45 periods

TEXTBOOKS

1. Jack R. Meredith and Scott M. Shafer, '*Project Management in Practice*'. Wiley, 2021.
2. Khan M. Y. and Jain P. K., '*Basic Financial Management*'. Tata McGraw Hill, 2012.
3. Michael Fisher, *'Saving and Investing*'. Author House, 2005.
4. Jeff Madura, '*Personal Finance*'. Pearson, 2020.

REFERENCES

1. National Finance Olympiad, '*Personal Finance Handbook'*. Pockvue Solutions, 2024
2. Glen Arnold, '*Investing'*. Financial Times Guides, 2020
3. Rachel Siegel and Carol Yacht, '*Personal Finance'*. Open Textbook Library, Saylor Foundation, 2009
4. Google, '*Google Project Management: Professional Certificate'*. Google Project Management: Professional Certificate, Coursera.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Identify various budgeting and cost estimation techniques suited to different project scenarios and the uses of project scheduling methods.	**K1**
CO2	Understand the basic concepts of project management, phases of project life cycle, the roles and responsibilities of project manager and how projects are integrated into different types of organizational structures.	**K2**
CO3	Apply theoretical knowledge and practical tools to support sound financial decision- making in real-world scenarios.	**K3**
CO4	Differentiate between various financial instruments and application of financial planning to enhance personal wealth.	**K4**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1										2				
CO2										3				
CO3										2	2			
CO4										3	3			
										3	3			

1-low, 2-medium, 3-high

25AD501 DEEP LEARNING

3 0 0 3

DEEP LEARNING FUNDAMENTALS: Artificial Intelligence, Machine Learning and Deep Learning - Fundamentals of neural networks: MP Neuron, Perceptron, activation functions, loss functions, Multilayer Perceptron, Gradient-based Optimization. Deep feed forward networks with error back propagation - Data Representations for Neural Networks - Tensor Operations - Computational Graph - Error Functions - Optimization Techniques -Initialization Techniques. **(9)**

CONVOLUTIONAL NETWORKS: Convolution Operation - Layers in CNN architecture CNN Features - ReLu and the variants - Feature Map – Pre-trained Models - Object Detection - Image segmentation - Model Evaluation. **(9)**

SEQUENCE MODELING: Recurrent Neural Networks Architecture –Back propagation through time (BPTT)- Vanishing and Exploding Gradients Bidirectional RNN - Truncated BPTT GRU- LSTMs - Recursive Neural Network - Word Embedding - Encoder Decoder Architecture - Attention Mechanism - Transformer Architecture - Beam Search - CTC Loss – Pre-trained Models - Applications of RNN. **(9)**

AUTOENCODER, RESTRICTED BOLTZMANN MACHINE: Features of auto encoders Vanilla auto encoder Convolutional auto encoder Regularized auto encoders – De-noising auto encoder - Sparse auto encoders - Contractive auto encoder - variational auto encoders - Applications of auto encoder. **(9)**

GENERATIVE, BAYESIAN, REINFORCEMENT DEEP LEARNING: RBM Deep Belief Networks - Generative Modeling- Generative Adversarial Networks - Bayesian Deep Learning - Deep Reinforcement Learning. **(9)**

Total L: 45 periods

TEXT BOOKS

1. Seth Weidman, '*Deep Learning from Scratch: Building with Python from First Principles'*. O"Reilly, 2019.
2. Francois Chollet, '*Deep Learning with Python*'. Manning Publications, New York, 2018.

REFERENCE BOOKS

1. Thomas Farth, '*Deep Learning: A Comprehensive Guide for Beginners*'. Atlantic Publishers, 2019.
2. David Foster, '*Generative Deep Learning'.* O'Reilly Media, Inc., 2019.
3. Eugene Charniak, '*Introduction to Deep Learning'.* MIT Press, London, 2018.
4. Ian Goodfellow, YoshuaBengio, Aaron Courville, '*Deep Learning'*. MIT Press, 2016

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamentals of deep neural networks	**K2**
CO2	Apply deep learning techniques to various types of data including tabular, image and text.	**K3**
CO3	Analyze the performance of deep learning models using various metrics and hyper parameter tuning methods to improve model accuracy.	**K4**
CO4	Carry out a mini project as a team using deep learning models, including optimization techniques to solve complex problems.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2		1				2			3	3	3
	3	3	2		1				2			3	3	3

1-low, 2-medium, 3-high

25CS501 OPERATING SYSTEM
(Common to CSE and AI&DS)

3 0 0 3

INTRODUCTION: Functions – History – Operating system concepts – System calls – Services – User operating system interface – Design and implementation – Introduction to virtual machines. **(7)**

PROCESS MANAGEMENT: Process model – Creation – Termination – Hierarchies – States – Implementation – Scheduling criteria – Scheduling algorithms – Multithreading models – Thread libraries – Threading issues – Thread and Multiprocessor scheduling algorithms – Inter–process communication. **(9)**

PROCESS SYNCHRONIZATION AND DEADLOCKS: Race conditions – Critical section – Mutual exclusion – Peterson‟s solution – Synchronization: hardware – Semaphores – Mutex – Monitor – Message passing, Dining philosopher‟s problem – Readers writer‟s problem. Deadlocks: conditions – detection – recovery – prevention – avoidance. **(9)**

MEMORY MANAGEMENT: Main Memory: Swapping – Contiguous memory allocation – Paging – Structure of page table – Segmentation – Examples. Virtual memory: Demand paging – Copy on Write – Page replacement – Allocation of frames – Thrashing – Memory–mapped files – Allocating kernel memory – Memory management utilities. **(10)**

STORAGE MANAGEMENT: Files: Naming – Structure – Types – Access – Attributes – Operations – Implementation. Directories: Operations – Path Names – Hierarchical directory system – Implementation – Allocation methods – Free space management – NFS – Efficiency and Performance – Recovery. Mass storage: Disk structure – Disk scheduling algorithms – Swap space management – Streams. **(10)**

Total L: 45 periods

TEXT BOOKS

1. Silberschatz A, Galvin P, Gagne G, ‘*Operating Systems Concept’*. 10th edition, John Wiley and Sons, Singapore, 2023.
2. William Stallings, ‘*Operating Systems: Internals and Design Principle’*. 9th edition, Pearson Education, New Delhi, 2019.

REFERENCES

1. Andrew S. Tanenbaum, *‘Modern Operating System’*. 5th edition, PHI Learning, New Delhi, 2023.
2. Dhamdhere, ‘*Operating Systems: A Concept Based approach’*. 3rd edition, Tata McGraw Hill, New Delhi, 2017.
3. Harvey M Deitel, Paul J Deitel, David R Choffnes, ‘*Operating Systems’.* 3rd edition, Pearson Education, New Delhi, 2013.
4. Remzi Arpaci–Dusseau, Andrea Arpaci–Dusseau, ‘*Operating Systems: Three Easy Pieces’*. 1st edition, Arpaci–Dusseau Books, 2018
5. Achyut S Godbole, Atul Kahate, ‘*Operating Systems’*. 3rd edition, McGraw Hill Education, 2016.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Explain the basic concepts of operating system structures, services and functionalities.	**K2**
CO2	Apply CPU scheduling, process synchronization, deadlock handling, memory management, disk and file system management to support OS functionalities.	**K3**
CO3	Analyze various operating system services to assess their efficiency in improving system performance.	**K3**
CO4	Evaluate CPU scheduling algorithms, process synchronization mechanisms, deadlock handling strategies, memory management techniques, and storage management methods to assess operating system performance.	

COs–POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														3
CO2	3											3	3	3
CO3		3										3	3	3
CO4				1								1	1	3
	3	3		1								3	3	3

1-low, 2-medium, 3-high

25AD503 NETWORK AND INFORMATION SECURITY

3 0 2 4

NETWORK FUNDAMENTALS: Introduction to Computer Networks – Network Types – Network Topologies – OSI Reference Model – TCP/IP Protocol Suite – Transmission Media – Switching Techniques: Circuit Switching and Packet Switching – Internet Architecture. **(9+6)**

DATA LINK AND NETWORK LAYER: Link Layer Services – Framing – Error Detection and Correction – Ethernet – Wireless LAN – IPv4 Addressing – Subnetting – ARP – ICMP – Routing Concepts – Distance Vector and Link State Routing – Introduction to IPv6. **(9+6)**

TRANSPORT AND APPLICATION LAYER: Transport Layer Services – UDP – TCP – Flow Control – Congestion Control – Application Layer Protocols – HTTP/HTTPS – DNS – DHCP – FTP – Electronic Mail Services. **(9+6)**

INFORMATION SECURITY FUNDAMENTALS: Introduction to Information Security – Security Goals (CIA) – Threats, Vulnerabilities and Attacks – Security Policies – Access Control Concepts – Authentication Principles – Cryptography Basics – Symmetric and Asymmetric Encryption – Digital Signatures. **(9+6)**

NETWORK SECURITY APPLICATIONS: Email Security – PGP and S/MIME – IPSec Overview – Authentication Header (AH) and Encapsulating Security Payload (ESP) – SSL/TLS – Web Security Concepts – Secure Electronic Transactions (SET) – Emerging Trends in Network Security. **(9+6)**

LIST OF EXPERIMENTS

1. Network Configuration and IP Addressing - Configure a small LAN and assign IPv4 addresses.
2. Design subnets for a given network and configure static routing using Cisco Packet Tracer.
3. Configure and analyze RIP/OSPF routing protocols in a simulated network.
4. Capture and analyze TCP, UDP, HTTP, DNS, and ICMP packets using Wireshark.
5. Configure and test DHCP and DNS services in a network environment.
6. Develop programs for encryption and decryption using AES/DES algorithms.
7. Implementation of symmetric, asymmetric key cryptography and digital signature
8. Configure SSL/TLS-based secure communication and basic firewall/access control rules.

Total L: 45 + P: 30 = 75 periods

TEXTBOOKS

1. Larry L Peterson and Bruce S Davie, '*Computer Networks: A systems approach'*. Morgan Kaufmann Publishers, USA, 6th Edition 2021.
2. Michael E Whitman and Herbert J Mattord, '*Principles of Information Security'*. Course Technology, 6th Edition, 2017.

REFERENCES

1. James F Kurose, Keith W Ross, *'Computer Networking - A Top-Down Approach Featuring the Internet'*. Pearson Education, New Delhi, Sixth Edition, 2012.
2. Behrouz A. Forouzan, *'Data Communications and Networking with TCP/IP Protocol Suit'*. 6th Edition, McGraw Hill, 2021.
3. Andrew S Tanenbaum and David J Wetherall, *'Computer Networks'.* Prentice Hall of India/ Pearson Education, New Delhi,6th Edition, 2021.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain network architectures, protocols, communication models, security principles, cryptographic techniques, and authentication mechanisms.	**K2**
CO2	Apply data link and network layer concepts for addressing, routing and network security protocols.	**K3**
CO3	Analyze transport and application layer protocols used in Internet communication and web security technologies used in secure communication	**K4**
CO4	Evaluate and select appropriate networking protocols and architectures for efficient data communication across different layers of the network.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												2	2	2
CO2	3											3	3	3
CO3		3										3	3	3
CO4				2	2							2	2	2
	3	3		2	2							3	3	3

1-low, 2-medium, 3-high

25AD511 DEEP LEARNING LABORATORY

0 0 4 2

Deep learning Packages Basics: Tensorflow, Keras

Implement the following from scratch

1. Train Simple Perceptron with Gradient Descent for regression
2. Train MLP with Backpropagation for classification
3. CNN with maxpooling
4. Bahdanau and Loung Attention
5. Transformer **(30)**

Implement the following using existing packages

1. Face Recognition using SSD
2. Time Series Prediction using LSTM
3. Image generation using GAN
4. Generating fake videos using autoencoders
5. Recommender systems using RBM **(30)**

Total P: 60 periods

REFERENCES

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, '*Deep Learning*'. MIT Press, 2017.
2. Josh Patterson, Adam Gibson, '*Deep Learning: A Practitioner's Approach*'. O'Reilly Media, 2017.
3. Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy, '*Deep Learning with TensorFlow: Explore neural networks with Python'.* Packt Publisher, 2017.
4. Antonio Gulli, Sujit Pal, '*Deep Learning with Keras'*. Packt Publishers, 2017.
5. Francois Chollet, '*Deep Learning with Python*'. Manning Publications, 2017.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Analyze the architecture and behavior of different neural network models and Autoencoders to understand their suitability for various applications.	**K4**
CO2	Evaluate and optimize deep learning approaches for performance improvement in complex applications.	**K5**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3											3	3	3
CO2					3							3	3	3
	3				**3**							**3**	**3**	**3**

1-low, 2-medium, 3-high

25CS511 OPERATING SYSTEMS LABORATORY
(Common to CSE and AI&DS)

0 0 2 1

1. Linux commands
2. Shell programming
3. Programs on system calls
4. Process management: creation, synchronization
5. Inter–process communication
6. CPU scheduling algorithms
7. Deadlock avoidance algorithm
8. Memory Allocation Methods like first fit, best fit and worst fit
9. Page Replacement Algorithms
10. Disk scheduling algorithms

Total P: 30 periods

REFERENCES

1. Silberschatz A, Galvin P, Gagne G, '*Operating Systems Concepts'*. 10th edition, John Wiley and Sons, Singapore, 2023.
2. William Stallings, '*Operating Systems: Internals and Design Principles'*. 9th edition, Pearson Education, New Delhi, 2019.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply operating system concepts through practical implementation and experimentation in a programming environment	**K2**
CO2	Analyze the performance and behavior of operating system mechanisms through experimental results	**K3**

COs–POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3											3	3	3
CO2		3										3	3	3
	3	3										3	3	3

1-low, 2-medium, 3-high

25CSE02 INTERNSHIP I / 25CSE03 COMMUNITY PROJECT

0 0 0 1

Internship / Community project: For B.E. and B.Tech. programmes, every student has to earn credit by internship / community project in the 5th semester. Internship I / community project is to be carried out during the 4th semester vacation.

25EEC04 APTITUDE SKILLS

0 0 2 1

1. Algorithmic Thinking, Branching & Repetition Problems
2. Logical Reasoning - Data Arrangements & Relations
3. Solving problems based on Coding & decoding, Series, Analogy, Odd man out and Visual reasoning
4. Problems based on Ages, Logical Connectives, Syllogisms, Data Interpretation & Data Sufficiency
5. Solving problems on Clocks Calendars, Direction Sense & Cubes
6. Problems based on Number system, Percentages, Simple & Compound Interest
7. Resume Update

Total P: 30 Periods

REFERENCES:

1. R. S. Aggarwal, '*Quantitative Aptitude for Competitive Examination*'. S Chand Publishing, New Delhi, 2017.

SEMESTER – VI

25MA601 GRAPH THEORY AND MINING

3 1 0 4

INTRODUCTION: Review on Definition and Basic Terminologies of Graphs – Representations of Graphs – Walks in Graphs and Digraphs- Subgraphs-Vertex Degrees - Path and Cycles - Regular and Bipartite Graphs- Representations of graphs – adjacency and incidence lists – adjacency and incidence matrices - Graph Traversals- Applications: Four Cubes Problem- Social Networks. **(9+3)**

EULERIAN AND HAMILTONIAN GRAPHS: Exploring and Travelling – Eulerian Graphs – Konigsberg bridge problem - Hamiltonian Graphs – Applications: Dominoes – Chinese Postman Problem - Travelling salesman problem. **(9+3**)

PATHS AND CONNECTIVITY: Connected Graphs and Digraphs-Manger's Theorem for Graphs-Applications: Reliable Telecommunication Networks. Network flows and applications- Flows and cuts in Networks, Maximum-flow problem, flows and connectivity– applications. Vertex-coloring - chromatic number of a gsraph, vertex coloring algorithms – sequential vertex coloring, largest degree first algorithm, applications. **(10+3)**

GRAPH MINING TECHNIQUES: Basics of data mining, Frequent subgraph mining, Graph pattern mining, Applications in web and social networks. Graph clustering and community detection, Graph classification and regression, Graph summarization, Anomaly detection in graphs. **(8+3)**

TOOLS AND APPLICATIONS: Graph databases and query languages, Graph visualization tools, Case studies in bioinformatics, social networks, and recommendation systems. **(9+3)**

Total L: 45 + T: 15 = 60 periods

TEXTBOOKS

1. Jonathan L. Gross and Jay Yellen, '*Graph Theory and its Applications'*. CRC Press, New York, 2016.
2. Douglas B West, '*Graph Theory*'. Prentice Hall, New Delhi, 2017.
3. Qi Xuan, Yong Min, Zhongyuan Ruan, '*Graph Data Mining: Algorithm, Security and Application'.* Springer Verlag, Singapore, 2021.

REFERENCES

1. Bondy J.A. and Murty U.S.R., '*Graph Theory'*. Springer, London, 2016.
2. Narsingh Deo, '*Graph Theory with Applications to Engineering and Computer Science'*. Prentice Hall, New Delhi 2017.
3. Joan M Aldous and Robin J Wilson, '*Graphs and Applications- An Introductory Approach'.* Springer-Verlag. New York, 2014.
4. Reinhard Diestel, '*Graph Theory'*. Springer-Verlag, Berlin Heidelberg, 2012.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the basic terminologies, properties, and types of graphs including subgraphs, paths, cycles, bipartite and regular graphs.	**K2**
CO2	Apply the graph algorithms to solve Eulerian and Hamiltonian problems including the Konigsberg bridge, Dominoes, Chinese Postman, and Travelling Salesman.	**K3**
CO3	Analyze connectivity in graphs and digraphs, apply Menger"s theorem, and evaluate flows and cuts in networks for real-world applications like telecommunication networks	**K4**
CO4	Compare and implement vertex coloring algorithms; assess their performance through applications and identify chromatic numbers.	**K4**
CO5	Evaluate tools and technologies like graph databases, query languages, and visualization tools in case studies involving bioinformatics, social networks, and recommendation systems.	**K5**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												2	2	2
CO2	3											3	3	3
CO3		1										3	3	3
CO4			1		1							2	2	2
	3	1	1		1							3	3	3

1-low, 2-medium, 3-high

25AD601 REINFORCEMENT LEARNING

3 0 2 4

INTRODUCTION: Reinforcement Learning (RL) – elements, limitations and scope; Probability basics - Axioms of probability, concepts of random variables, PMF, PDFs, CDFs, Expectation. Concepts of joint and multiple random variables, joint, conditional and marginal distributions. Correlation and independence. **(9+6)**

FINITE MARKOV DECISION PROCESS: Agent-environment interface, Markov property; Goals and rewards, returns and episodes; Policies and value functions – Bellman equation; Optimal policies and optimal value functions - Bellman optimality equations. **(9+6)**

DYNAMIC PROGRAMMING: Iterative policy evaluation, policy improvement theorem, policy iteration, value iteration, asynchronous dynamic programming, Generalized policy iteration, Efficiency of dynamic programming. **(9+6)**

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. **(9+6)**

TEMPORAL-DIFFERENCE (TD) LEARNING: TD prediction – TD(0) and TD(λ), optimality of TD(0), Sarsa, Q-learning – Deep Q networks; Function approximation methods – stochastic gradient and semi-gradient methods; Policy gradient methods; RL for real world problems. **(9+6)**

LIST OF EXPERIMENTS

1. Case Study: Exploration–Exploitation in a Bernoulli Multi-Armed Bandit
2. Objective: Model a Bernoulli multi-armed bandit, estimate each arm's reward probability from trial outcomes, and select actions using an ϵ-greedy policy.
3. Analyze a grid-world Markov Decision Process with policy evaluation.
4. Case Study: Optimal Policy Computation in a Finite Markov Decision Process
5. Objective: Evaluate dynamic programming methods - policy iteration and value iteration, to compute the optimal policy and optimal state-value function for a given Markov decision process.
6. Evaluate Q-learning Temporal Difference (TD) learning algorithm.
7. Implement OFF-policy Monte Carlo control with importance sampling.

Total L: 45 + P: 30 = 75 periods

TEXT BOOKS:

1. Richard S. Sutton and Andrew G. Barto, '*Reinforcement Learning: An Introduction*'. MIT Press, 2nd edition, 2018.

REFERENCES:

1. Russell, Stuart J., and Peter Norvig. '*Artificial intelligence: a modern approach'*. Pearson Education Limited, 2021.
2. Kevin P. Murphy, '*Machine Learning: A Probabilistic Perspective'*. MIT Press, 2012.
3. Csaba Szepesvári, '*Algorithms for Reinforcement Learning'*. Morgan & Claypool (lecture notes / synthesis series), 2010.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the core concepts of reinforcement learning including probability theory, Markov decision processes, and the role of value functions and Bellman equations in sequential decision-making.	**K2**
CO2	Apply dynamic programming, Monte Carlo methods and value iteration to compute optimal policies in Markov decision processes.	**K3**
CO3	Analyze and compare the accuracy of Monte Carlo methods, temporal-difference learning algorithms, and their roles in policy and value estimation.	**K4**
CO4	Estimate the value functions for finite Markov Decision Processes using dynamic programming, and temporal-difference learning techniques.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4				2								2	2	2
	3	3		2								3	3	3

1-low, 2-medium, 3-high

25AD602 LARGE LANGUAGE MODELS

3 0 0 3

INTRODUCTION: Introduction to Generative AI and Large Language Models – Evolution from NLP to LLMs – Language modeling fundamentals – Tokens, tokenization and embeddings – Transformer architecture – Self-attention and positional encoding – Encoder-only, Decoder-only and Encoder–Decoder architectures – Overview of BERT, GPT and T5 models. **(9)**

PRETRAINING, FINETUNING AND INFERENCE IN LLMS: Self-supervised learning – Autoregressive and masked language modeling – Pretraining datasets and data preparation – Instruction tuning and supervised fine-tuning – Decoding strategies: greedy search, beam search, top-k and top-p sampling – Hallucination issues and mitigation basics. **(9)**

PARAMETER - EFFICIENT TUNING METHODS (PETM): Fine-tuning fundamentals – Parameter-Efficient Fine-Tuning (PEFT) – Prompt tuning and Prefix tuning – Adapters and Layer freezing – Low Rank Adaptation (LoRA) and QLoRA – Quantization basics – Trade-offs between accuracy, latency and computational cost. **(9)**

PROMPT ENGINEERING: Principles of prompt engineering – Zero-shot, one-shot and few-shot prompting – Instruction prompting and role prompting – Chain-of-thought prompting – Prompt optimization basics–Retrieval-Augmented Generation (RAG) architecture – Embeddings and vector databases. **(9)**

EVALUATION, SAFETY AND DEPLOYMENT OF LLMs: Intrinsic and extrinsic evaluation – Benchmark datasets: GLUE, and MMLU – Human evaluation methods – Bias, fairness and toxicity in LLMs – Responsible AI practices – Model compression and inference optimization – Introduction to deployment and LLMOps. **(9)**

Total L: 45 periods

TEXTBOOKS

1. Alammar, Jay, Grootendorst, Maarten, '*Hands-On Large Language Models: Language Understanding and Generation'*. O'Reilly Media, 2024
2. Louis-François Bouchard and Louie Peters, '*Building LLMs for Production: Enhancing LLM Abilities and Reliability with Prompting, Fine-Tuning, and RAG'*. O'Reilly Media, 2024.

REFERENCES

1. Lewis Tunstall, Leandro von Werra and Thomas Wolf, '*Natural Language Processing with Transformers'*. O'Reilly Media, 2022.
2. Sebastian Raschka, '*Build a Large Language Model from Scratch'*. Manning Pubns Co , 2024.
3. Hunter, Nathan, ' *The Art of Prompt Engineering with ChatGPT: A Hands-on Guide'*. Nathan Hunter, United Kingdom, 2023.
4. Radi, Mouad, ' *Introduction to Prompt Engineering: Prompt-based Systems Examples. N.p'*. Amazon Digital Services LLC - Kdp, USA, 2023.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the fundamentals and architecture of large language models including transformers and attention mechanisms.	**K2**
CO2	Apply prompting, fine-tuning and parameter-efficient adaptation techniques for LLM-based tasks and applications.	**K3**
CO3	Analyze the performance of Large Language Models using decoding strategies, evaluation metrics and Retrieval-Augmented Generation (RAG) methods.	**K4**
CO4	Evaluate ethical considerations, biases, and fairness issues in large language models, safety and deployment requirements.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2						2			3	3	3
	3	3	2						2			3	3	3

1-low, 2-medium, 3-high

25AD611 LARGE LANGUAGE MODELS LABORATORY

0 0 4 2

1. Implement text generation using different decoding strategies such as Greedy Search, Beam Search, Top-k Sampling, and Top-p (Nucleus) Sampling.
2. Perform prompt engineering using pretrained Large Language Models through Zero-shot, One-shot, and Few-shot prompting techniques.
3. Explore transformer-based Large Language Models and compare their performance on text generation and question-answering tasks.
4. Fine-tune a pretrained transformer model using Parameter-Efficient Fine-Tuning (PEFT) techniques such as LoRA for a domain-specific application.
5. Generate and compare text embeddings using transformer models for semantic similarity and information retrieval tasks.
6. Build a Retrieval-Augmented Generation (RAG) pipeline using embeddings and vector databases for knowledge-grounded responses.
7. Develop a conversational AI chatbot using open-source LLM frameworks and evaluate its performance using appropriate metrics.
8. Mini Project: Design and implement an LLM-based application for a real-world use case such as document question answering, content generation, educational assistance, or customer support.

Total P: 60 Periods

REFERENCES

1. Alammar, Jay, Grootendorst, Maarten, '*Hands-On Large Language Models: Language Understanding and Generation'*. O'Reilly Media, 2024
2. Louis-François Bouchard and Louie Peters, '*Building LLMs for Production: Enhancing LLM Abilities and Reliability with Prompting, Fine-Tuning, and RAG'*. O'Reilly Media, 2024.
3. Sebastian Raschka, '*Build a Large Language Model from Scratch'*. Manning Pubns Co , 2024.
4. Hunter, Nathan, *'The Art of Prompt Engineering with ChatGPT: A Hands-on Guide'*. Nathan Hunter, United Kingdom, 2023.
5. Radi, Mouad, ' *Introduction to Prompt Engineering: Prompt-based Systems Examples. N.P'*. Amazon Digital Services LLC - Kdp, USA, 2023.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply prompting, fine-tuning, and embedding techniques using pretrained Large Language Models to develop domain-specific AI applications.	**K2**
CO2	Analyze the performance of Large Language Models and Retrieval-Augmented Generation (RAG) systems using appropriate evaluation metrics and optimize them for real-world applications.	**K3**

COs–POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3											3	3	3
CO2		3										3	3	3
	3	3										3	3	3

1-low, 2-medium, 3-high

25CSE04 MINI PROJECT II

0 0 2 1

- Identification of a real time problem in thrust areas.
- Developing a mathematical model for solving the above problem.
- Finalization of system requirements and specification.
- Implementation of different solutions for the problem based on literature survey Future trends in providing alternate solutions.
- Consolidated report preparation of the above.

Total P: 30 periods

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Identify real-world problems, formulate appropriate solution approaches, and plan a structured mini-project with clear objectives and methodology.	**K2**
CO2	Develop and demonstrate a functional prototype by applying suitable tools and techniques, and effectively communicate project outcomes through technical presentation and documentation.	**K3**

COs–POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	2											2	2	2
CO2		2	2		2			1	2	1		2	2	2
	2	2	2		2			1	2	1		2	2	2

1-low, 2-medium, 3-high

25EEC06 ENHANCING ARITHMETIC PROBLEM SOLVING

0 0 2 1

1. Logarithms, Progressions, Geometry and Quadratic equations
2. Attention to detail Image Interpretation
3. Voices and Speech
4. Algebraic Expressions
5. Surds, Indices and Simplification
6. Set Theory & Functions
7. Cryptarithmetic & Trigonometry
8. Advance Quantitative
9. Advance Verbal
10. Advance Logical
11. Preparing for Business roles, Case studies, Guesstimation techniques
12. Handling Stress
13. Handling Peer pressure
14. Resume progress check

Total P: 30 Periods

REFERENCES:

1. R.S. Aggarwal, '*Quantitative Aptitude for Competitive Examination'*. S Chand Publishing, New Delhi, 2017.
2. P.C. Wren and H. Martin, '*High school English grammar & composition'*. S Chand Publishing, New Delhi, 2017.
3. Norman Lewis, '*Word Power Made Easy'*. Goyal Publisher, New Delhi, 2011.
4. Arun Sharma, '*How to Prepare for Quantitative Aptitude for the CAT'*. 8th edition, McGraw Hill Education, 2018.

SEMESTER – VII

25AD701 BIG DATA AND ADVANCED DATABASE SYSTEMS

3 0 2 4

BIG DATA OVERVIEW: Big data Characteristics – Architecture of big data systems – NoSQL: Principles of NoSQL data models – CAP theorem – NoSQL data models – Hadoop: Components of Hadoop Ecosystem – HDFS Architecture – Map Reduce Architecture – Map Reduce programming – Columnar Database - HBase, big data software lifecycle. **(9+6)**

DOCUMENT DATABASE: Introduction to MongoDB - Installation of MongoDB – Create Database, collection and documents – CRUD Operations - Query and Criteria-MongoDB Atlas - Redis. **(9+6)**

GRAPH DATABASE: - Overview of Neo4j - Neo4j Architecture - - Exploring Neo4j using Cypher Query Language: Create Nodes and Relationships - Importing Data with Neo4j. **(9+6)**

MINING DATA STREAMS: Concepts - Stream Data Model and SPARK Architecture – RDD – Transformations– Bloom Filters - parallel programming - Data Frames and Spark SQL. **(9+6)**

DATABASE INTEGRATION: Importance – Types and Complexity - ETL – data lakes- Schema Extraction Approaches– Data Integration Framework - Semantic Integration - RDF Schema –Traditional Ontology Languages: OWL. **(9+6)**

LIST OF EXPERIMENTS

1. Map Reduce Programs
2. CRUD Operations in MongoDB
3. MongoDB – case study.
4. CRUD Operations in Neo4j
5. Neo4j – Case study
6. Spark streaming using R - Case Studies
7. Local and global schema generation through XML.

Total L: 45 + P:30 =75 Periods

TEXT BOOKS

1. G. Sudha Sadasivam, R. Thirumahal, '*Big Data Analytics'*. Oxford University Press, 2020.
2. April Reeve, '*Managing Data in Motion'*. Elsevier 2013.
3. Tom White '*Hadoop: The Definitive Guide'.* Third Edit on, O'reilly Media, 2012.
4. Seema Acharya, Subhasini Chellappan, '*Big Data Analytics'*. Wiley 2015.
5. Tom Plunkett, Mark Hornick, '*Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop'*. McGraw-Hill/Osborne Media (2013), Oracle press

REFERENCES

1. EMC Educational Series, '*Data Science and Big Data Analytics'*. Wiley, New Delhi, 2015.
2. David Stevenson, '*Big Data Demystified'*. Pearson Education, 2018.
3. Mohammed Guller, '*Big Data Analytics with Spark'*. Apress,2015
4. Jeffrey A. Hoffer, Ramesh Venkataraman, Heikki Topi, '*Modern Database Management'*. 12th Edition, Pearson, New Delhi, 2016.
5. Ian Robinson, Jim Webber, Emil Eifrem, '*Graph Databases: New Opportunities for Connected Data'*. Second Edition, O'Reilly, January 2016.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the architecture, characteristics, and lifecycle of big data systems and NoSQL databases.	**K2**
CO2	Apply distributed processing techniques using Hadoop and MapReduce to solve big data problems.	**K3**
CO3	Analyze stream data models and implement real-time data analytics using Spark and associated tools.	**K4**
CO4	Design MapReduce programs for tasks like matrix multiplication and word count in Hadoop.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			3		3			3				3	3	3
	3	3	3		3			3				3	3	3

1-low, 2-medium, 3-high

25AD702 COMPUTER VISION

3 0 2 4

IMAGE PROCESSING TECHNIQUES: Introduction to vision challenges - Classical filtering operations: mode, median, rank order filters - Gaussian filters -Thresholding techniques: Region-Growing methods - Adaptive thresholding - Edge detection techniques-Template matching - Canny, Laplacian operators Corner and Interest point detection: Harris Interest point operator – Local Invariant Feature Detectors and Descriptors. **(9+6)**

SHAPES AND PATTERNS ANALYSIS: Binary shape analysis -Object labeling and counting- Size filtering- Distance functions -Skeletons and thinning -Boundary tracking procedures- Pattern Analysis- Boundary Tracking Procedures- Centroidal profiles- Problems with the Centroidal Profile Approach. **(9+6)**

LINE, CIRCLE AND ELLIPSE DETECTION: Line detection Hough Transform (HT) for line detection-Foot-of-Normal Method- Longitudinal Line Localization- Final Line Fitting -Circle and Ellipse Detection-Hough-Based Schemes for Circular Object Detection- The Problem of Unknown Circle Radius and Accurate Center Location- Ellipse Detection- Hole Detection. **(9+6)**

3D VISION: Methods for 3D vision - Projection Schemes for Three-Dimensional Vision – Shape from Shading- Photometric Stereo- Shape from Texture- Image Transformations and Camera Calibration- Intrinsic and Extrinsic Parameters- Correcting for Radial Distortions-The Essential Matrix and Fundamental Matrix. **(9+6)**

3D MOTION: Introduction- Optical Flow- Interpretation of Optical Flow Fields- Using Focus of Expansion to Avoid Collision- Time-To-Adjacency Analysis- Stereo from Motion- The Kalman Filter. **(9+6)**

LIST OF EXPERIMENTS:

OpenCV computer vision Library for OpenCV in Python / PyCharm or C++ / Visual Studio or or equivalent

1. Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis, Blob detection
2. Image Annotation – Drawing lines, text circle, rectangle, ellipse on images
3. Image Enhancement - Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection
4. Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB
5. Image features, Feature matching, cloning, Feature matching based image alignment
6. Image segmentation using Graphcut / Grabcut
7. Camera Calibration with circular grid
8. Pose Estimation
9. 3D Reconstruction – Creating Depth map from stereo images
10. Object Detection and Tracking using Kalman Filter, Camshift

Total L: 45 + P:30 =75 Periods

TEXT BOOKS

1. E.R. Davies, '*Computer & Machine Vision'*. 4th Edition, Academic Press, 2012.
2. R. Szeliski, '*Computer Vision: Algorithms and Applications'*. 2nd Edition, Springer, 2022

REFERENCES

1. David A Forsyth, Jean Ponce., '*Computer Vision : A Modern Approach'*. 2nd Edition, Pearson, 2015.
2. Simon J.D. Prince, *'Computer Vision:Models, Learning, and Inference'*. Cambridge University Press, 2012.
3. Martin Goerner, Ryan Gillard, Valliappa Lakshmanan, *'Practical Machine Learning for Computer Vision: End- to- End Machine Learning for Images'*. O'Reilly Media, 2021.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts of image processing, feature detection, shape analysis, 3D vision, and motion analysis techniques	**K2**
CO2	Apply image processing and computer vision techniques such as filtering, edge detection, feature extraction, segmentation, and object detection using appropriate tools and libraries.	**K3**
CO3	Analyze visual data using shape analysis, Hough transform, optical flow, and 3D reconstruction methods to interpret patterns, motion, and spatial information.	**K4**
CO4	Design and implement computer vision solutions using OpenCV and related tools for tasks such as image enhancement, object detection, tracking, and camera calibration.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												2	2	2
CO2	3				3							3	3	3
CO3					3							3	3	3
CO4					3							3	3	3
	3	**3**			**3**							**3**	**3**	**3**

1-low, 2-medium, 3-high

25CSE05 PROJECT WORK I

0 0 4 2

The project I involves the following:

- Identification of Real-World Problem
- System Requirement Analysis and Specification
- Developing a Model and Solution for the Identified Problem
- Consolidated Report Preparation and Presentation

Total P: 60 Periods

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the problem domain, analyze user requirements, and define project objectives and specifications for a real-world application.	**K2**
CO2	Apply engineering knowledge and appropriate tools to design a feasible solution model and present the project work through technical reports and seminars.	**K3**

COs–POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	2											2	2	2
CO2		2	2		2			1	2	1		2	2	2
	2	2	2		2			1	2	1		2	2	2

1-low, 2-medium, 3-high

25CSE06 INTERNSHIP II

0 0 0 1

This course involves preparing students to think innovatively and present possible solutions to identified industry/academic problems or issues.

SEMESTER – VIII
25CSE07 PROJECT WORK II

0 0 8 4

The Project work II involves
Preparing a project - brief proposal including

- Problem Identification
- A statement of system / process specifications proposed to be developed
- List of possible solutions including alternatives and constraints
- Cost benefit analysis
- Timeline of activities
- Presentation highlighting the
- Design based on functional requirements
- Implementation
- Testing and Validation
- Results and future work
- Consolidated report based on standards

Total P: 120 periods

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Design and develop a complete system by applying appropriate methodologies, tools, and technologies to address identified real-world problems.	**K3**
CO2	Evaluate the functionality, performance, and effectiveness of the developed system through testing, validation, result analysis, and professional reporting.	**K4**

COs–POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3											3	3	3
CO2		3	2		2			1	2	1	1	3	3	3
	3	3	2		2			1	2	1	1	3	3	3

1-low, 2-medium, 3-high

PROFESSIONAL ELECTIVE COURSES
25CSP01 MICRO SERVICES ARCHITECTURE

2 0 2 3

INTRODUCTION TO MICROSERVICES AND ARCHITECTURE STYLES: Monolithic vs Microservices Architecture – Principles and characteristics of Microservices – Benefits and challenges – Decomposition of applications – Role of domain–driven design. **(6+6)**

DESIGNING MICROSERVICES: Designing Services: Business capabilities and bounded context – Data Management: Database per service, Event sourcing – API design and communication: REST, gRPC, Message brokers – Service contracts and versioning – Circuit breaker, Service discovery. **(6+6)**

IMPLEMENTATION AND INTEGRATION: Implementing Microservices with Spring Boot / Node.js – Inter–Service Communication Patterns – Integrating third–party APIs. **(6+6)**

DEPLOYMENT AND ORCHESTRATION: Containerization using Docker – Orchestration with Kubernetes – CI/CD Pipelines for Microservices logging, Monitoring (ELK, Prometheus, Grafana) – Configuration management (Spring Cloud Config, etcd). **(6+6)**

EMERGING TRENDS AND CASE STUDIES: Security in Microservices: OAuth2, JWT, API Gateway – Microservice Anti–Patterns – Event–driven architecture and CQRS – Serverless Microservices. **(6+6)**

LIST OF EXPERIMENTS

1. Creating a simple Microservice using Spring Boot / Node.js
2. Developing a RESTful Microservice using Spring Boot
3. Implementing Inter–Service Communication using REST and RabbitMQ
4. Containerizing Microservices with Docker
5. Deploying Microservices on Kubernetes

Total L: 30 + P: 30 = 60 periods

TEXTBOOK

1. Sam Newman, *'Building Microservices: Designing Fine–Grained Systems'*. 2nd edition, O'Reilly Media, 2021.

REFERENCES

1. Mike Amundsen, '*Ronnie Mitra, Matt McLarty, Irakli Nadareishvili, Microservice Architecture: Aligning Principles Practices and Culture'*. O'Reilly, 2016.
2. Chellammal Surianarayanan, Gopinath Ganapathy, Raj Pethuru, *'Essentials of Microservices Architecture'*. CRC Press, 2019.
3. Sam Newman, *'Monolith to Microservices–Evolutionary Patterns to Transform Your Monolith'*. O'Reilly, 2019.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe microservices architecture concepts, principles, and application decomposition using domain–driven design.	**K2**
CO2	Apply micro service design practices including service design, data management, APIs, communication patterns, and resilience mechanisms.	**K3**
CO3	Analyze micro service implementation, integration, deployment, containerization, orchestration, and monitoring techniques.	**K4**
CO4	Design microservices applications using modern tools, containerization, and prepare technical documentation or demonstrations.	**–**

COs–POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												2	2	2
CO2	3											2	2	2
CO3		2										2	2	2
CO4								2	2			2	2	2
	3	2						2	2			2	2	2

1-low, 2-medium, 3-high

25CSP02 UI/UX DESIGN

2 0 2 3

FOUNDATIONS OF UX AND UI: Introduction to Human–Computer Interaction (HCI) and User Experience (UX) – Principles of Usability and UX – Difference between UI and UX – Human–Centered Design Process – Stages in UX Design – Empathy Mapping – User Personas – Journey Mapping. **(6+6)**

INTERACTION DESIGN AND WIREFRAMING: Information Architecture – Interaction Design Principles – Task Flows – Storyboarding – Wireframing – Mockups – UI Design Patterns – Paper Prototyping – Low–Fidelity and High–Fidelity Prototypes. **(6+6)**

VISUAL DESIGN AND FRONTEND TECHNOLOGIES: Typography – Color Theory – Layout Design – Responsive Design Principles – HTML – CSS – Javascript Basics – Frontend Frameworks – Bootstrap – Introduction to Cross-Platform UI Development using Flutter – Building UI Components. **(6+6)**

USABILITY TESTING AND EVALUATION: Usability Testing Methods – Heuristic Evaluation – Usability Metrics (SUS – NPS – Time–On–Task) – A/B Testing – Moderated and Unmoderated Testing – Cognitive Walkthroughs – User Feedback Collection – Iterative Design Process. **(6+6)**

EMERGING TECHNOLOGIES: UX Design for Mobile and Wearable Devices – Gesture–Based Interaction – Voice User Interfaces – Conversational Interfaces (Chatbots) – Introduction to AI in UX Design. **(6+6)**

LIST OF EXPERIMENTS

1. Analyze UI interaction patterns in existing applications.
2. Design a user interface using UI design principles and style guides.
3. Create wireframes and wireflows using tools like Figma.
4. Apply design thinking process to solve a given problem.
5. Identify a user problem and design a prototype solution.

Total L: 30 + P: 30 = 60 periods

TEXT BOOKS

1. Alan Dix, Janet Finlay, Gregory Abowd and Russell Beale, *'Human–Computer Interaction'*. 5th edition, Pearson, 2020.
2. Joel Marsh, *'UX for Beginners'*. O"Reilly Media, 2022.

REFERENCES

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, Niklas Elmqvist and Nicholas Diakopoulos, *'Designing the User Interface: Strategies for Effective Human–Computer Interaction'*. 6th edition, Pearson, 2016.
2. Jennifer Tidwell, Charles Brewer and Aynne Valencia, *'Designing Interfaces: Patterns for Effective Interaction Design'*. 2nd edition, O"Reilly Media, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain principles of human–computer interaction, user experience, and human–centered design.	**K2**
CO2	Apply interaction design techniques to create wireframes, prototypes, and user interfaces.	**K3**
CO3	Analyze usability of interfaces using evaluation methods and metrics to improve user experience.	**K4**
CO4	Design user–centric solutions incorporating modern UX trends and emerging interaction technologies.	**-**

COs–POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4												3	3	3
	3	3										3	3	3

1-low, 2-medium, 3-high

25CSP03 DEVOPS

2 0 2 3

INTRODUCTION: Dev Vs Ops Practices – Devops Principles and Culture – Overview of Devops Lifecycle – Adopting Devops – Identifying the Target State – Basic Transformation Strategies – Distributed Vs Centralized Version Control Systems – Git Fundamentals (Repository, Commits, Branching, Merging). **(6+6)**

CONTINUOUS INTEGRATION AND DELIVERY: CI/CD Concepts – Benefits and Best Practices – Stages Of A CI/CD Pipeline – Build Automation – Test Automation – Artifact Management – Introduction to CI/CD Tools – Pipeline Creation Concepts using Jenkins and Github Actions – Testing in CI/CD – Unit Testing – Automated Test Suites – Test Pyramid – Overview of Deployment Strategies. **(6+6)**

CONTINUOUS DEPLOYMENT AND INFRASTRUCTURE AUTOMATION: Concepts of Infrastructure Automation – Configuration Management – Introduction to Ansible – Features – Benefit – Terminology Workflow and Usage – Introduction to Containers Using Docker – Container Lifecycle and Images – Introduction to Cloud Foundry and Application Deployment – Monitoring – Prometheus. **(6+6)**

DEVSECOPS: Devops to Devsecops – Integration of Security in Devops Lifecycle – Types of Attacks – Common Vulnerabilities – Layered Security Approach – Methodologies – Automation– Security Principles in Docker and Kubernetes – Kubernetes Security Architecture, RBAC, Network Policies, Secrets Management, Pod Security Standards – Image and Runtime Security. **(6+6)**

MLOPS AND ADVANCED PRACTICES: Overview – Key Features – MLOps Lifecycle – Developing Models – Preparing for Production – Monitoring and Feedback Loop – Model Governance – MLOps in Practice. **(6+6)**

LIST OF EXPERIMENTS:

1. Version Control and Branch Management using Git (Includes basic Git commands, branch creation, merging, and conflict resolution).
2. Remote Repository Management and Collaboration using GitHub (Includes pushing to remote repositories, creating pull requests, code reviews, and merging PRs).
3. Build a simple application using a build automation tool.
4. Create CI pipeline using a CI tool, integrate with GitHub repository and automate build process.
5. Extend CI pipeline to CD, deploy application to local server and Validate deployment.
   Suggested Tools: Maven / Gradle, Jenkins / GitHub Actions, Docker, Cloud Foundry

Total L: 30 + P: 30 = 60 periods

TEXT BOOKS

1. Sanjeev Sharma, *'The DevOps Adoption Playbook: A Guide to Adopting DevOps in a Multi–Speed IT Enterprise'*. John Wiley & Sons, Inc., IBM Press, 2017.
2. Gene Kim, Jez Humble, Patrick Debois and John Willis, *'The DevOps Handbook: How to Create World–Class Agility, Reliability and Security in Technology Organizations'*. O"Reilly Media, 2nd Edition, 2021.

REFERENCES

1. Noah Gift and Alfredo Deza, *'Practical MLOps'*. O"Reilly Media, Inc., 2021.
2. Mark Treveil, Nicolas Omont, Clement Stenac, Kenji Lefevre, Du Phan, Joachim Zentici, Adrien Lavoillotte, Makoto Miyazaki and Lynn Heidmann, *'Introducing MLOps'*. O"Reilly Media, Inc., 2020.
3. Sricharan Vadapalli, *'DevOps – Continuous Delivery, Integration, and Deployment with DevOps'*. Packt Publishing, 2018.
4. Ankita Patil and Mitesh Soni, *'Hands–on Pipeline as Code with Jenkins: CI/CD Implementation for Mobile, Web, and Hybrid Applications Using Declarative Pipeline in Jenkins'*. BPB Publications, 2021.

COURSE OUTCOMES

At the end of this course students will be able to:		**Bloom's Level**
CO1	Explain the principles, lifecycle, and practices of DevOps for modern software development.	**K2**
CO2	Apply DevOps practices to design and implement automated workflows for software development and deployment.	**K3**
CO3	Analyze and utilize tools and techniques for automation, containerization, monitoring, and security in software systems.	**K4**
CO4	Evaluate modern practices including DevSecOps and MLOps for building reliable and scalable software systems.	**-**

COs–POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	
CO2	3											3	3	
CO3		3										3	3	
CO4				3								3	3	
	3	**3**		**3**								**3**	**3**	

1-low, 2-medium, 3-high

25CSP04 SOFTWARE TESTING AND AUTOMATION

2 0 2 3

INTRODUCTION TO TESTING: Introduction to testing as an engineering activity – The role of process in Software Quality – Testing as a process – Overview of Testing Maturity Model (TMM) – Testing fundamentals: Basic definitions, Software testing principles, Tester's role in a Software development organization. **(6+6)**

TEST DESIGN STRATEGIES-I: Black Box approach to test case design – Random testing – Equivalence class partitioning – Boundary value analysis – API Testing – Other Black Box test design approaches. **(6+6)**

TEST DESIGN STRATEGIES-II: White Box approach to test case design – Test adequacy criteria – Coverage and control flow graphs – Covering code logic – Paths – Additional white box test design approaches – White box testing methods. **(6+6)**

ADVANCED TESTING CONCEPTS: Performance testing: Load testing, Stress testing, Volume testing, Fail-Over testing, Testing the documentation, Security testing, Testing in the agile environment, Testing web and mobile applications. Types of reviews – Inspection – Walkthroughs – Components of review plan. **(6+6)**

TEST AUTOMATION AND TOOLS: Automated software testing – Automate testing of web applications, Selenium: Introducing web driver and web elements, locating web elements, Actions on web elements, Different web drivers, understanding web driver events, Testing: Understanding testing, Methods to test, Test reports, Testim tool for AI-based test automation. **(6+6)**

LIST OF EXPERIMENTS

1. Design the test cases for testing the e-commerce application
2. Test the e-commerce application and report the defects in it.
3. Develop the test plan and design the test cases for an inventory control system.
4. Test the performance of the e-commerce application.
5. Automate the testing of e-commerce applications using Selenium.

Total L: 30 + P: 30 = 60 periods

TEXTBOOK

1. Yogesh Singh, *'Software Testing'*. Cambridge University Press, 2012.
2. Roger. S. Pressman, ' *Software Engineering A Practitioner's Approach'*. 9th edition, McGraw Hill International Edition, 2020.
3. Unmesh Gundecha, Satya Avasarala, *'Selenium WebDriver 3 Practical Guide'*. 2nd edition, Packt Publishing, 2018.

REFERENCES

1. Kshirasagar Naik, Priyadhrshini Tripathy, *'Software Testing and Quality Assurance'*. John wiley & sons Inc Publication, 2008.
2. Paul C. Jorgensen, *'Software Testing: A Craftsman's Approach'*. 4th edition, Taylor & Francis Group, 2014.
3. Nina S Godbole, *'Software Quality Assurance–Principles and Practice'*. 2nd edition, Narosa Publishing, 2016.
4. Carl Cocchiaro, *'Selenium Framework Design in Data–Driven Testing'*. Packt Publishing, 2018.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts of software testing, defects and testing processes.	**K2**
CO2	Apply black–box and white–box strategies to design effective test cases for software systems.	**K3**
CO3	Analyze software systems using advanced testing methods and review techniques.	**K4**
CO4	Design automated testing solutions for web and mobile applications using modern testing tools and frameworks	**–**

COs–POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												2	2	
CO2	3											3	3	
CO3		2										2	2	
CO4								2	2			2	2	
	3	2						2	2			2	2	

1-low, 2-medium, 3-high

25CSP05 FULL STACK WEB DEVELOPMENT

3 0 0 3

PRINCIPLES OF SECURE FULL STACK DEVELOPMENT: Full stack architecture overview – Client-server communication – HTTP/HTTPS – HTML5 – CSS3 – JS security – Secure DOM handling – Input validation and sanitization – Basics of secure backend frameworks (Node.js / Django / Spring). **(9)**

SECURE FRONTEND ENGINEERING: Component security – Secure routing – State handling risks – Avoiding inline scripts – Prevention of Cross-site scripting (XSS) – Cross-site request forgery (CSRF) – Content security policy (CSP) – Preventing clickjacking – Secure API consumption. **(9)**

BACKEND SECURITY: JSON web tokens (JWT) – Oauth2 – Single sign-on (SSO) – Password hashing (bcrypt/Argon2) – Role-based and attribute-based access control (RBAC/ABAC) – Secure session management – Rate limiting – Logging and monitoring – Secure error handling – API gateway security – STRIDE Analysis. **(9)**

SECURE DATABASE AND DEVSECOPS: SQL injection prevention – Prepared statements – ORM security – NoSQL injection – Secrets management (vault environment encryption) – Static/Dynamic code analysis (SAST/DAST) – CI/CD pipelines (Jenkins/GitHub action) – Docker security – Package vulnerability scanning. **(9)**

SECURE DEPLOYMENT AND CLOUD SECURITY: TLS/SSL – Secure headers (CSP, HSTS, X-Frame-Options) – Server hardening – Reverse proxy security (Nginx) – Cloud IAM (AWS/Azure/GCP) – Kyma – Cloud foundry – API keys and secret rotation – Logging and alerting – Zero trust principles. **(9)**

Total L: 45 periods

TEXTBOOKS:

1. Andrew Hoffman, '*Web Application Security: Exploitation and Countermeasures'*. O"Reilly Media, 2020.
2. Neil Madden, '*API Security in Action'*. 1st edition, Manning Publications, 2020.

REFERENCES:

1. Prabath Siriwardena and Nuwan Dias, '*Advanced API Security: Oauth 2.0 and Beyond'.* Apress, 2020.
2. Dafydd Stuttard and Marcus Pinto, ' *The Web Application Hacker's Handbook'*. 2nd edition, Wiley Publishing, 2011.
3. Steve Fulton and Jeff Fulton, '*HTML5 Canvas'*. O'Reilly Media, 2013.
4. Frank Zammetti, ' *Modern Full-Stack Development: Using TypeScript, React, Node.js, Webpack, and Docker'*. Apress, New Delhi, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe secure software architectures, communication models, and development principles used in modern full stack applications.	**K2**
CO2	Apply secure development methodologies, programming practices, and tools for building and managing full stack systems.	**K3**
CO3	Analyze system interactions, security challenges, and operational factors affecting the reliability and performance of software applications.	**K4**
CO4	Evaluate techniques, frameworks, and deployment strategies for ensuring security, scalability, and efficiency throughout the software development life cycle.	**-**

COs–POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2					2				2	2	2
	3	3	2					2				3	3	3

1-low, 2-medium, 3-high

25CSP06 MERN STACK

2 0 2 3

MERN STACK FOUNDATIONS & ENVIRONMENTS: Full Stack Development – Benefits and Responsibilities of Full Stack Developers – Overview of MongoDB: Document-Oriented NoSQL Database, Express.js: Lightweight Framework for Web APIs, React.js: Virtual DOM, and Node.js: Event Loop – Environment Setup: Node.js, npm, Git, MongoDB Atlas. **(6+6)**

UI DESIGN WITH REACT: Components, Props, and State Functional and Class Components – Passing props between components – React router – Dynamic routing with params – Event Handling – Hooks (useState, useEffect) – Axios for API Calls. **(6+6)**

SERVER-SIDE LOGIC & API ARCHITECTURE: Introduction to Node.js and Express.js – Express Routing Basics – RESTful API Design – REST Principles – Middleware and Routing – Express Router for Modular Code – JWT Authentication & Authorization – JSON Web Token Workflow. **(6+6)**

RELATIONAL & NOSQL DATA MANAGEMENT: Introduction to Relational vs. Non-Relational (NoSQL) Databases – Structured Database Fundamentals (SQL Basics, Tables, and Joins) – Overview of Connecting Node.js to Relational Databases – MongoDB Basics and CRUD Operations – Creating Databases and Collections – Insert, Read, Update, Delete Documents – Mongoose ODM Connecting to MongoDB – Schema and Model Design – Aggregation and Relationships – Population in Mongoose. **(6+6)**

SYSTEM INTEGRATION & CLOUD DEPLOYMENT: Integrating Frontend and Backend – Environment Variables and CORS Setup – State Management (Context API or Redux) – Vercel – Render – Preparing Projects for Deployment – Deploying Backend to Heroku – Deploying Frontend to Vercel and Render – Version Control with Git and GitHub. **(6+6)**

LIST OF EXPERIMENTS

1. Build an interactive application (e.g., a Voting Dashboard or a multi-functional Calculator) using React.js.
2. Create a robust backend HTTP server, interacting with client using Node.js and Express.js.
3. Develop an application to store, maintain data using Node.js and relational database.
4. Develop advanced data-driven backend feature using NoSQL (MongoDB Atlas) and Mongoose ODM.
5. Build a Full stack live cloud integrated app with React, Node, Express & MongoDB.

Total L: 30 + P: 30 = 60 periods

TEXT BOOK:

1. Andrew Mead, '*Learning Full–Stack JavaScript Development: MongoDB, Node, and React'.* Packt Publishing, 2017.

REFERENCES:

1. Vasan Subramanian, *'Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node'*. 2nd edition, Apress, 2019.
2. Shama Hoque, '*Full–Stack React Projects: Modern Web Development Using React 16, Node, Express, and MongoDB'.* 2nd edition, Packt Publishing, 2020.
3. Kristina Chodorow, *'MongoDB: The Definitive Guide'*. 3rd edition, O'Reilly Media, 2019.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the fundamentals of MERN stack architecture and the role of Node.js event loops	**K2**
CO2	Apply dynamic routing using react.js components and hooks to design responsive user interfaces	**K3**
CO3	Integrate MongoDB with Node.js and Express.js using CRUD operations and Mongoose ODM.	**K4**
CO4	Evaluate full–stack deployment strategies using cloud platforms like Heroku, Vercel, and Render.	**–**

COs–POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			3									3	3	3
	3	3	3									3	3	3

1-low, 2-medium, 3-high

25CSP07 AGILE METHODOLOGIES

2 0 2 3

AGILE METHODOLOGY: Agile software development – Traditional model vs. Agile model – Classification of agile methods – Agile manifesto and principles – Agile project management – Ethics in Agile teams. **(6+6)**

AGILE PROCESSES: Lean production – SCRUM – Crystal – Adaptive software development – Extreme programming (XP): Method overview – Lifecycle – Work products, roles and practices. **(6+6)**

AGILE PROJECT MANAGEMENT: Agile project management – Traditional model Vs RAD model for project management – Task planning and effort tracking – The project managers new work – Agile development management – Agile product management. **(6+6)**

AGILE SOFTWARE TOOL: Introduction to JIRA – JIRA version – JIRA cloud instance setup – JIRA administration: Creating a new user and group – Permission levels – Global permission – Project roles and permissions – JIRA schemes: Issue types, screens, custom fields and workflow. **(6+6)**

AGILITY AND QUALITY ASSURANCE: Agile product development – Agile metrics – Feature driven development (FDD) – Quality assurance in FDD– Financial and production metrics in FDD – Agile approach to quality assurance. **(6+6)**

LIST OF EXPERIMENTS

1. Creating and Managing an Agile Scrum Board.
2. Sprint Planning and Effort Tracking in Agile Projects.
3. Implementing Agile Roles, Permissions and designing Agile Workflow and Issue Types.
4. Implementing Extreme Programming (XP) Practices.
5. Agile Metrics and Quality Assurance using Feature Driven Development (FDD).

Total L: 30 + P: 30 = 60 periods

TEXTBOOKS

1. Mark C. Layton, Steven J Ostermiller, and Dean J. Kynaston, '*Agile Project Management for Dummies'*. John Wiley & Sons, Inc 3rd Edition, 2020.
2. David J. Anderson and Eli Schragenheim, '*Agile Management for Software Engineering: Applying the Theory of Constraints for Business Result'.* Prentice Hall, 2009.

REFERENCES

1. Andrew Stellman, Jennifer Greene, '*Learning Agile: Understanding Scrum, XP, Lean and Kanban'*. O'Reilly, 2015
2. Hazza and Dubinsky, '*Agile Software Engineering, Series: Undergraduate Topics in Computer Science'.* Springer, 2009.
3. Robert C. Martin, '*Agile Software Development, Principles, Patterns and Practices'.* First International Edition, Prentice Hall, 2014.
4. Rubin K, '*Essential Scrum : A practical guide to the most popular Agile process'.* Addison-Wesley, 2013.
5. Jira Software Tutorials: https://www.atlassian.com/agile/tutorials/how-to-do-scrum-with-jira

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the core principles of the Agile manifesto, compare traditional and agile software development models and identify techniques to enhance team collaboration	**K2**
CO2	Apply agile process frameworks including SCRUM, XP, Lean and Crystal to plan, execute and track software development activities.	**K3**
CO3	Analyze agile project management strategies, effort tracking approaches and the evolving role of the project manager in agile environments	**K4**
CO4	Evaluate agile quality assurance practices, feature-driven development metrics, and utilize JIRA for project configuration and workflow management.	**K5**
CO5	Design and implement agile artefacts, scrum boards, sprint plans, XP practices and FDD-based quality assurance setups using JIRA and related tools.	**K6**

COs–POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2		2	2						2	2	2
CO5			3		2	2						3	3	3
	3	**3**	**3**		**2**	**2**						**3**	**3**	**3**

1-low, 2-medium, 3-high

25CSP08 VIBE CODING

2 0 2 3

VIBE CODING FOUNDATIONS: AI in programming - Evolution - Co-creator Role - Vibe coding concepts - Programming with emotion, Tone, and Intention - Clarity and expressiveness - Cognitive flow in coding - Coding environments and themes - Music and mood integration - Developer states and creativity. **(6+6)**

EXPRESSIVE CODING & VISUAL AR: Clean and creative code - ASCII art - Generative art - Audio-reactive visuals - Tools: Processing, p5.js, Python turtle - Aesthetic terminal outputs - Mood - Aware design - Code poetry - Emotional signatures in code - Weekly vibe coding plan. **(6+6)**

HUMAN-AI COLLABORATION IN CODE: AI as partner - AI tools like ChatGPT, Copilot, Claude - Context- aware generation - Code refactoring - Coder to curator shift - Ethical considerations - Authorship and AI bias - personal expression in AI outputs - Responsible use of AI tools. **(6+6)**

WEB APIS & CREATIVE APPLICATIONS: Web APIs and Mood-based projects - Creative problem-solving - Playlist boards - Visual journals - Journaling logic - Weather/Mood apps - Real-World projects - User-Focused design - Quizzes and challenges. **(6+6)**

ETHICAL DIMENSIONS: The creative coder in an AI world - Bias, Ethics, and Authorship - Personal expression in AI-generated output - AI as teammate or tool. **(6+6)**

LIST OF EXPERIMENTS

1. AI-Assisted Prompt-Based Code Generation using ChatGPT and GitHub Copilot.
2. Creative Generative Art and Interactive Visual Design using p5.js and Processing.
3. Emotion-Based User Interface Development and Mood-Responsive Design.
4. Web API Integration and Dynamic Content Display using Flask and Postman.
5. Basic Workflow Automation and Continuous Integration using GitHub Actions.

Total L: 30 + P: 30 = 60 periods

TEXT BOOKS

1. Michael A. Angelo, '*Vibe Coding #1: Revolution in AI Driven Programming – Comprehensive Reports'*. Kindle Edition, 2025.

REFERENCES

1. Addy Osmani, '*Vibe Coding: The Future of Programming'*. O'Reilly Media, 2024.
2. GitHub Copilot, '*Documentation and Real–World Case Studies'*. GitHub Inc., 2023.
3. Daniel Shiffman, '*The Nature of Code'*. D. Shiffman Publishing 2nd edition, 2021.
4. Addy Osmani, '*Beyond Vibe Coding'*. O'Reilly Media, Inc., 2025.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts of vibe coding, AI–assisted programming, and creativity in coding practices.	**K2**
CO2	Apply expressive coding techniques using tools for aesthetic and interactive outputs.	**K3**
CO3	Analyze the role of AI tools in coding workflows and collaboration.	**K4**
CO4	Evaluate creative Web API–based applications in terms of user experience, functionality, and ethical considerations.	**-**

COs–POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2	3											3	3	
CO3		3										3	3	
CO4			1									1	1	
	3	3	1									3	3	

1-low, 2-medium, 3-high

25ADP01 RECOMMENDER SYSTEMS

2 0 2 3

INTRODUCTION: Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems - similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD). **(6+6)**

CONTENT-BASED RECOMMENDATION SYSTEMS: High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms. **(6+6)**

COLLABORATIVE FILTERING: A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection. **(6+6)**

ATTACK-RESISTANT RECOMMENDER SYSTEMS: Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms. **(6+6)**

EVALUATING RECOMMENDER SYSTEMS: Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures. **(6+6)**

Total L: 30 + P: 30 = 60 periods

LIST OF EXPERIMENTS

1. Implement Data similarity measures using Python
2. Implement content-based recommendation systems
3. Implement collaborative filter techniques
4. Create an attack for tampering with recommender systems
5. Implement accuracy metrics like Receiver Operated Characteristic curves

TEXT BOOKS

1. Jannach D., Zanker M. and Felfering A., '*Recommender Systems: An Introduction'*. Cambridge University Press, 2011.
2. Charu C. Aggarwal, '*Recommender Systems: The Textbook'*. Springer, 2016
3. Francesco Ricci, Lior Rokach, Bracha Shapira, '*Recommender Systems Handbook'*. 1st ed, Springer (2011).

REFERENCES

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

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts, functions, techniques, evaluation methods, and security issues associated with recommender systems.	**K2**
CO2	Apply collaborative filtering, content-based, knowledge-based, and matrix factorization techniques to build recommendation models.	**K3**
CO3	Analyze the performance of recommender systems using evaluation metrics and assess the effectiveness of hybrid recommendation approaches.	**K4**
CO4	Evaluate recommender system designs by considering hybridization strategies and security challenges in recommendation environments.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2					2				2	2	2
	3	3	2					2				3	3	3

1-low, 2-medium, 3-high

25ADP02 PREDICTIVE ANALYTICS

3 0 0 3

SIMPLE REGRESSION ANALYSIS: Concept Fundamentals of Regression Analysis -Requirements in Regression Model Building - Model Diagnostics - Interpretation of Regression results for Management Decision. Multiple Regression Analysis: Concept - Significance of Multiple Regression Analysis -Structure of Model Estimation - Testing Rule of Multiple Regression Analysis. Case study: Healthcare Resource Optimization. **(9)**

NON-LINEAR REGRESSION ANALYSIS: Concept - Types of Non-linear Regression Models - Model Transformation - Difference between Linear and Non-linear Regression Models. Diagnostics of Regression Modelling: Model Diagnostics - Multicollinearity – Autocorrelation. case study: Agricultural Crop Yield Prediction. **(9)**

DUMMY MODELLING AND PANEL DATA MODEL DUMMY MODELING: Dummy independent modelling-linear probability Model-Logit model-Probit model. Panel Data Model: Concept - Panel Data Models - Fixed Effects Model - Random Effects Model - Forms of Panel Data Models - Applications to use Panel Data Models. case study: Industrial automation and operational optimization. **(9)**

FORECASTING AND MACHINE LEARNING: Time Series Forecasting: Concept - Forecasting Techniques - Measures of Forecast Error - Trend Analysis - Time Series Models - Auto Regressive Model - Applications of Time Series Models. Machine Learning: Concept - Predictive Analysis under Machine Learning - Model of Artificial Neural Networks (ANN) - Model of Random Forest - Model of Support Vector Machine - Assumptions under Machine Learning. case study: Predictive Maintenance in Manufacturing. **(9)**

DATA MINING AND SIMULATION: Data Mining: Concept - Data Interpretation - Data Reduction - Classification and Clustering Techniques - Association Rule Mining - Cause and Effect Model. Simulation: Concept - Monte Carlo Simulation - Discriminant Event Simulation - Application Using Simulation. case study: urban mobility optimization. **(9)**

Total L: 45 periods

TEXT BOOKS

1. Max Kuhn , Kjell Johnson , '*Applied Predictive Modeling'.* Springer Publications, 2018.
2. Vijay Kotu and Bala Deshpande,'*Predictive Analytics and Data Mining: Concepts and Practice with RapidMiner'.* Morgan Kaufmann Publishers, 2019.

REFERENCES

1. John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy, '*Fundamentals of Machine Learning for Predictive Data Analytics'.* MIT Press, 2020.
2. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, '*The Elements of Statistical Learning: Data Mining, Inference, and Prediction'.* Springer, 2017

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the fundamental concepts of regression analysis, forecasting techniques, and predictive analytics models.	**K2**
CO2	Apply regression, panel data, and forecasting models to analyze and interpret predictive data for decision making.	**K3**
CO3	Analyze machine learning, data mining, and simulation techniques to identify patterns, trends, and predictive outcomes from datasets.	**K4**
CO4	Evaluate predictive analytics models and simulation approaches for solving industrial and research problems.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2	3											3	3	3
CO3		3										3	3	3
CO4			3	3	3			3	3			3	3	3
	3	3	3	3	3			3	3			3	3	3

1-low, 2-medium, 3-high

25ADP03 SMART SYSTEMS

3 0 0 3

INTRODUCTION TO SMART SYSTEMS: Introduction to Smart Systems – Characteristics and Features – Smart Devices and Smart Environments – Cyber Physical Systems (CPS) – Components of CPS – Embedded Systems and Real-Time Systems – Architecture of IoT-based Smart Systems – Sensors, Actuators, and Controllers – Smart System Design Challenges. **(9)**

EMBEDDED PLATFORMS AND CONNECTIVITY: Sensors and Transducers – Sensor Classification – Signal Conditioning – Actuators and Interfacing – Microcontrollers and Embedded Platforms – Arduino, Raspberry Pi, ESP32 Overview – Data Acquisition Systems – Wireless Sensor Networks – Communication Technologies: Wi-Fi, Bluetooth, ZigBee, RFID, NFC – MQTT and CoAP Protocols – Edge Devices and Smart Gateways. **(9)**

INTERNET OF THINGS AND CLOUD INTEGRATION: Internet of Things Architecture – IoT Functional Blocks – IoT Communication Models – Cloud Computing for Smart Systems – Edge and Fog Computing – Data Storage and Device Management – IoT Middleware – Smart System Networking – Security and Privacy Issues – Authentication and Access Control. **(9)**

INTELLIGENT DATA ANALYTICS FOR SMART SYSTEMS: Data Collection and Preprocessing – Real-Time Data Analytics – Machine Learning for Smart Systems – Supervised and Unsupervised Learning – Predictive Analytics – Intelligent Decision Making – AI-enabled Smart Systems – Stream Processing – Visualization Techniques. **(9)**

APPLICATIONS AND INDUSTRIAL CASE STUDIES: Smart Grid and Energy Management – Intelligent Transportation Systems – Smart Manufacturing and Industry 4.0 – Smart Healthcare Systems – Smart Agriculture – Smart Buildings and Smart Cities. **(9)**

TOTAL L: 45 periods

TEXT BOOKS

1. Bahga Arshdeep and Madisetti Vijay, *'Internet of Things: A Hands-On Approach'*. Universities Press, 2015.
2. Rajkumar R., Lee Insup, Sha Ling and Stankovic John, '*Cyber-Physical Systems: Foundations, Principles and Applications'*. Elsevier, 2017.
3. Mahmood Zaigham, '*Smart Systems and IoT: Innovations in Computing'*. CRC Press, 2020.

REFERENCES

1. Vermesan Ovidiu and Friess Peter, '*Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry'*. Wiley, 2016.
2. Valvano Jonathan W., '*Embedded Systems: Real-Time Interfacing to Arm Cortex-M Microcontrollers'*. CreateSpace Independent Publishing Platform, 2019.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the architecture and components of smart systems and cyber physical systems.	**K2**
CO2	Apply sensors, embedded platforms, and communication technologies in smart applications.	**K3**
CO3	Analyze different tools and techniques to enhance the IoT architectures and cloud-enabled smart systems.	**K4**
CO4	Design smart system applications in industrial and societal domains.	**-**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												3	3	3
CO2	3											3	3	3
CO3		2										2	2	2
CO4			2	2	2							2	2	2
	3	2	2	2	2							3	3	3

1-low, 2-medium, 3-high

25ADP04 IMAGE AND VIDEO ANALYTICS

2 0 2 3

IMAGES IN DIFFERENT DOMAINS AND OPERATORS: Images in the Spatial Domain, Images in the Frequency Domain, Operators: Point - Local - Global, Three Procedural Components, Classes of Local Operators, Advanced Edge Detectors. **(6+6)**

IMAGE AND MOTION ANALYSIS: Basic Image Topology, Geometric 2D Shape Analysis, Image Value Analysis, Detection of Lines and Circles,3D-Motion and 2D-OpticalFlow, Algorithms: Horn–Schunck - Lucas–Kanade - BBPW, Performance Evaluation of Optical Flow Results. **(6+6)**

IMAGE AND VIDEO SEGMENTATION: Image Segmentation: Mean-Shift, Image Segmentations as an Optimization Problem, Video Segmentation and Segment tracking. **(6+6)**

OBJECT DETECTION IN IMAGES AND VIDEO: Post Processing methods, multi-frame methods using 3-D convolution, multi-frame methods using recurrent neural networks, Sparse feature propagation, multi-frame feature aggregation. **(6+6)**

APPLICATIONS OF MACHINE LEARNING FOR IMAGE AND VIDEO ANALYSIS: Face recognition using eigen faces, Face recognition using LBP, Face detection with Haar-Cascades in real-time video, Object detection with YOLO. Tracking moving object in video. **(6+6)**

LIST OF EXPERIMENTS:

1. Develop a program to compute the T-pyramid and quad tree representation of an image using the homogeneity criterion of equal intensity.
2. Develop programs for the following geometric transformations on images:
   - Rotation
   - Scaling
   - Skewing
   - Affine Transformation using three pairs of corresponding points
   - Bilinear Transformation using four pairs of corresponding points.
3. Develop a program for object detection and recognition in digital images.
4. Develop a program for facial detection and facial recognition using image processing techniques.
5. Develop a program for motion analysis and event detection in video surveillance systems using moving edge analysis on image sequences.

Total L: 30 + P: 30 = 60 Periods

TEXT BOOKS:

1. Reinhard Klette, '*Concise Computer Vision: An Introduction into Theory and sAlgorithm'.* Springer, 2014
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, '*Image Processing, Analysis, and Machine Vision'.* 4th edition, Thomson Learning, 2013.
3. Vaibhav Verdhan,'*Computer Vision Using Deep Learning: Neural Network Architectures with Python, Keras and Tensorflow'*. Thomson Learning 2021

REFERENCES:

1. Simon J. D. Prince, '*Computer Vision: Models, Learning, and Inference'*. Cambridge University Press, 2012.
2. D. A. Forsyth, J. Ponce, '*Computer Vision: A Modern Approach'*. Pearson Education, 2003

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the basic concepts of Image and Video segmentation and object detection	**K2**
CO2	Apply the fundamentals of image processing and acquire knowledge of image acquisition, storage, and display technologies.	**K3**
CO3	Analyze different tools and techniques to enhance image quality, reduce noise, and extract information from images and videos.	**K4**
CO4	Design and implement image and video analysis algorithms using software tools .	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2	2	2							3	3	3
	3	3	2	2	2						2	3	3	3

1-low, 2-medium, 3-high

25ADP05 TEXT AND SPEECH ANALYSIS

2 0 2 3

INTRODUCTION: Introduction to Natural Language Processing (NLP) and Levels of NLP Regular Expression Basic Text processing- Text normalization Vector Semantics and embedding: Lexical Semantics, Vector Semantics, Words and Vectors - Pointwise Mutual Information, N-gram Language Models: N-grams, Smoothing. **(6+6)**

PARTS OF SPEECH AND NAMED ENTITIES: Parts of Speech Tagging, Hidden Markov Model, Conditional Random Fields. Constituency Grammars: Constituency, Context-Free Grammars, Dependency Parsing: Dependency Relations, Dependency Formalism, Neural Dependency Parser. Logical Representations of Sentence Meaning, Word Sense and Word Net. **(6+6)**

APPLICATIONS OF TEXT AND NLP: Naive Bayes and Sentiment Analysis: Naive Bayes for text classification, Information Extraction, and Relationship Extraction. Learning Architectures for Sequence Processing: Recurrent Neural Networks for text classification - Long Short-Term Memory (LSTM). **(6+6)**

AUTOMATIC SPEECH RECOGNITION: Speech Sounds and Phonetic Transcription, Articulatory Phonetics, Acoustic Phonetics and Signals - Phonetic Resources, Prosody-Automatic Speech Recognition (ASR) Task - Feature Extraction: Log Mel Spectrum -Speech Recognition Architecture: Introduction: Gaussian Mixture Model Connectionist Temporal Classification (CTC) - ASR Evaluation: Word Error Rate. **(6+6)**

TEXT-TO-SPEECH: Text-to-Speech (TTS) Preprocessing: Text normalization, TTS: Spectrogram Prediction - TTS: Vocoding - TTS Evaluation. **(6+6)**

LIST OF EXPERIMENTS

1. Implement text preprocessing techniques using Python and NLTK for tokenization, word pattern matching, vocabulary analysis, frequency distribution, collocations, and bigrams.
2. Access and analyze text corpora using NLTK and develop a program to identify the 50 most frequent non-stop words from a given text.
3. Implement the Word2Vec model for generating word embeddings and semantic similarity analysis.
4. Use a transformer for implementing classification
5. Convert text to speech and find accuracy

Total L: 30 + P: 30 = 60 periods

TEXT BOOKS

1. Jurafsky, D. and J. H. Martin, '*Speech and language processing: An Introduction to Natural Language Processing'*. Computational Linguistics, and Speech Recognition (3rd Draft), 2021.
2. John Atkinson-Abutridy, '*Text Analytics: An Introduction to the Science and Applications of Unstructured Information Analysis'*. CRC Press, 2022.

REFERENCES

1. Jim Schwoebel, NeuroLex,'I*ntroduction to Voice Computing in Python'*. 2018
2. Lawrence R. Rabiner, Ronald W. Schafe, 'T*heory and Applications of Digital Speech Processing'*. 1st Edn. Pearson, 2010.
3. Srinivasa-Desikan, Bhargav, '*Natural Language Processing and Computational Linguistics: A practical guide to text analysis with Python'*. Gensim, spaCy, and Keras, Packt Publishing Ltd, 2018.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the foundations of data mining by identifying various data types, data preprocessing and data transformation techniques.	**K2**
CO2	Apply the basic principles and techniques to discover the knowledge to collect, clean pre-process.	**K3**
CO3	Analyze OLAP and data warehousing concepts including data warehouse models, OLAP operations, and data cube computation methods to support analytical processing.	**K4**
CO4	Demonstrate the ability to mine patterns from data using frequent itemset mining, sequential pattern mining, and constraint-based methods, and evaluate their applicability in real-world scenarios.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2					2	2			3	3	3
	3	**3**	**2**					**2**	**2**			**3**	**3**	**3**

1-low, 2-medium, 3-high

25CSP13 EDGE AI

3 0 0 3

INTRODUCTION TO EDGE COMPUTING AND AI: Fundamentals of edge computing: Introduction: Need, Key techniques, Benefits – Systems paradigms of edge computing – Edge computing frameworks – Value scenarios for edge computing – Edge computing system architectures – Applications – Challenges and opportunities. Fundamentals of artificial intelligence: Artificial intelligence and Deep learning – Neural networks in deep learning – Deep reinforcement learning – Potential DL libraries for edge. **(9)**

EDGE AI COMPUTING TOOLS: Role in edge computing: A high-level hardware hierarchy of edge computing paradigm. Virtualization: Virtual machine and container – Network Virtualization. Introduction to DevOps: Understanding the history and evolution – Overview of the benefits and challenges – Introduction to DevOps tools and practices. CI/CD: tools such as Jenkins – Travis CI – CircleCI. **(9)**

INFERENCE AND TRAINING IN EDGE AI: Artificial intelligence inference in edge: Optimizing AI models in Edge: General method – Edge device – Overview and benefits – Introduction to Open Neural Network Exchange (ONNX) format and its advantages – Understanding NVIDIA TensorRT format and its optimizations for inference Segmentation of AI Model – Segmentation of AI Model, Early Exit of Inference (EEoI) – Sharing of AI Computation. Artificial Intelligence Training at Edge: Distributed training at edge, Federated learning (FL) at edge. **(9)**

MOBILE EDGE AI: Overview – Edge inference: On-device inference – Computation offloading– Server-based edge inference – Device-edge joint inference – Edge training: Data partition based – Model partition based – Coded computing. **(9)**

ARTIFICIAL INTELLIGENCE APPLICATIONS ON EDGE: Real-time video analytic – Autonomous Internet of Vehicles (IoVs) – Intelligent Manufacturing – Smart Home and City – Urban Healthcare – Urban Energy Management – Manufacturing – Transportation and traffic. **(9)**

Total L: 45 Periods

TEXTBOOKS:

1. Wang, X., Han, Y., Leung, V. C., Niyato, D., Yan, X., & Chen, X., '*Edge AI: Convergence of edge computing and artificial intelligence*'. Singapore: Springer, 2020.
2. Yuanming Shi, Kai Yang, Zhanpeng Yang, Yong Zhou., '*Mobile Edge Artificial Intelligence Opportunities and Challenges'*. Elsevier Science publication, 2021

REFERENCES:

1. Jie Cao, Quan Zhang, Weisong Shi, '*Edge Computing: A Primer'*. Springer International Publishing, 2021.
2. Liu, Deyin; Chen, Xu; Zhou, Zhi; Ling, Qing, HierTrain., '*Fast Hierarchical Edge AI Learning with Hybrid Parallelism in Mobile-EdgeCloud Computing'*. IEEE Open Journal of the Communications Society, 634-645.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts and recent advancements in modern computing technologies.	**K2**
CO2	Analyze different methodologies and tools used for designing and managing intelligent computing systems.	**K3**
CO3	Apply computational techniques to solve complex real-world problems effectively.	**K4**
CO4	Evaluate the performance and impact of emerging technologies in industrial and societal applications.	**-**

COs–POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1												2	2
CO2	3											3	3
CO3		2										2	2
CO4					1							1	1
	3	**2**			**1**							**3**	**3**

1-low, 2-medium, 3-high

25ADP18 CLOUD SERVICES MANAGEMENT

2 0 2 3

INTRODUCTION: Introduction – Cloud computing at a Glance – Historical Development – Building Cloud Computing Environments – Computing Platform and Technologies – Principles of Parallel and Distributed Computing – Elements of parallel and Distributed Computing. **(6+6)**

VIRTUALIZATION: Introduction - Hypervisors - Main Categories of Virtualization - Application Server - Application Network - Storage Service - Benefits of Virtualization - Cost of Virtualization Case study: Creation of Virtual machines in Google Cloud, AWS. **(6+6)**

CLOUD COMPUTING ARCHITECTURE AND CLOUD SERVICES: Introduction to Cloud Computing Architecture - Cloud Reference Model -Microservices - Architecture - RESTful Web Services- Storage as a Service - Database as a Service - Information as a Service - Process as a Service - Application as a Service - Platform as a Service - Integration as a Service - Security as a Service - Management as a Service - Testing as a Service - Infrastructure as a Service - Case Study - Google Cloud, AWS. **(6+6)**

CLOUD APPLICATIONS: Scientific Applications - Gene Expression Data Analysis for Cancer Diagnosis - Business and Consumer Applications - Social Networking - Media Applications. **(6+6)**

CLOUD COMPUTING INFRASTRUCTURE: Introduction to Dockers Deploying, maintaining and scaling containerized applications using cloud infrastructure - Cloud storage Identity Access Management Cloud monitoring - Case Study: Google Cloud, AWS. **(6+6)**

LIST OF EXPERIMENTS

1. Launch and configure a Virtual Machine using AWS EC2 / GCP Compute Engine.
2. Deploy a static website on AWS S3 or Azure Blob Storage.
3. Set up and deploy a containerized application using Docker.
4. Manage a Kubernetes cluster and deploy microservices using kubectl.
5. Connect a web application to a cloud database (RDS / Firebase / Cosmos DB) and configure Load Balancer with Auto-scaling Group for scalability and high availability.

Total L: 30 + P: 30 = 60 Periods

TEXT BOOKS

1. Rajkumar Buyya, Christian Vecchiola, ThamaraiSelvi, '*Mastering Cloud Computing'*. Tata McGraw Hill Education Private Limited, New Delhi, 2017.
2. Kai Hwang, '*Distributed and Cloud Computing: From Parallel Processing to the Internet of Things'*. 1st edition, Morgan Kaufmann, 2013

REFERENCES

1. Shailendra Singh, '*Cloud Computing'*. 1st edition, Oxford University Press, 2018.
2. Sandeep Bhowmik, '*Cloud Computing'*. 1st edition, Cambridge University Press, July 2017.
3. Priyanka Vergadia, '*Visualizing Google Cloud: Illustrated References for Cloud Engineers & Architects: 101 Illustrated References for Cloud Engineers & Architects'*. 1st edition, John Wiley & sons Inc, May 2022.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the evolution, principles, and elements of cloud computing, parallel, and distributed computing.	**K2**
CO2	Apply cloud computing architecture models and service models (IaaS, PaaS, SaaS, etc.) in real-time scenarios and analyze service integration strategies.	**K3**
CO3	Analyze various scientific, business, and consumer cloud applications including social and media-based use cases.	**K4**
CO4	Design and manage containerized applications and evaluate cloud infrastructure elements such as identity management, monitoring, and storage with tools like Docker, Google Cloud, and AWS.	**K5**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3										3	3	3	3
CO3		3									2	3	3	3
CO4			2	2	3						2	3	3	3
	3	**3**	**2**	**2**	**3**						**2**	**3**	**3**	**3**

1-low, 2-medium, 3-high

25ADP08 STREAM PROCESSING

3 0 0 3

INTRODUCTION TO STREAMING DATA: Streaming Data – Sources – Difference between Streaming Data and Static Data. Overview of Large - Scale Stream Processing Engines – Issues in Stream Processing. **(9)**

STREAMING ARCHITECTURE: Phases in Streaming Architecture - Vital Attributes - High Availability – Low Latency – Horizontal Scalability-Fault Tolerance - Service Configuration and Management - Apache Zookeeper. **(9)**

DATA FLOW MANAGEMENT: Distributed Data Flows – At Least One Delivery – Apache Kafka – Apache Flume – Zero MQ - Messages, Events, Tasks& File Passing. **(9)**

PROCESSING & STORING STREAMING DATA: Distributed Stream Data Processing: Co-ordination, Partition and Merges, Transactions. Duplication Detection using Bloom Filters - Apache Spark Streaming Examples Choosing a storage system – NoSQL Storage Systems. **(9)**

DELIVERING STREAMING METRICS: Visualizing Data – Mobile Streaming Apps –Times Counting and Summation - Stochastic Optimization – Delivering Time Series Data. **(9)**

Total L: 45 periods

TEXT BOOKS

1. Tyler Akidau, Slava Chernyak and Reuven Lax, '*Streaming Systems: The What, Where, When, and How of Large-Scale Data Processing'*. O'Reilly Media, 2018.
2. Bill Bejeck, '*Real-Time Stream Processing'*. Manning Publications, 2022.
3. Holden Karau, Andy Konwinski, Patrick Wendell and Matei Zaharia, '*Learning Spark: Lightning-Fast Big Data Analysis'*. O'Reilly Media, 2nd Edition, 2020.

REFERENCES

1. Neha Narkhede, Gwen Shapira and Todd Palino, '*Kafka: The Definitive Guide Real-Time Data and Stream Processing at Scale'*. O"Reilly Media, 2nd Edition, 2021.
2. Nathan Marz and James Warren, '*Big Data: Principles and Best Practices of Scalable Real-Time Data Systems'*. Manning Publications, 2015.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the fundamentals of streaming data, stream processing engines, and challenges in large-scale stream processing.	**K2**
CO2	Apply streaming architecture concepts including scalability, fault tolerance, and distributed service management.	**K3**
CO3	Analyze distributed data flow management techniques using Apache Kafka, Flume, and messaging systems.	**K4**
CO4	Implement stream data processing, storage systems, and real-time analytics techniques for delivering streaming metrics and applications.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2		3									1	3	3	1
CO3			2	2							2	3	3	2
CO4				3	3						2	3	3	2
	3	**3**	**2**	**2**	**3**						**2**	**3**	**3**	**2**

1-low, 2-medium, 3-high

25ADP09 NATURAL LANGUAGE PROCESSING

2 0 2 3

INTRODUCTION: Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model. **(6+6)**

WORD EMBEDDINGS AND NEURAL NETWORKS Feedforward Neural Networks for NLP - Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Long Short-Term Memory (LSTM) and Gated Recurrent Units (GRU) - Bidirectional RNNs and Deep RNNs - Limitations of recurrent architectures – Transition from recurrent models to transformers. **(6+6)**

TRANSFORMERS AND ADVANCED LANGUAGE MODELS: Transformer Architecture – Self-Attention Mechanism – Multi-Head Attention – Positional Encoding – BERT and GPT (Introduction) – Architecture and Working – Transfer learning and fine-tuning pretrained models – Transformer-based NLP pipelines. **(6+6)**

NLP TASKS AND APPLICATIONS: Text Classification and Sentiment Analysis – Named Entity Recognition (NER) – Question Answering Systems – Text Summarization and Machine Translation – Text Generation – Chatbots and Conversational AI – Evaluation Metrics: Accuracy, Precision, Recall, F1-Score, BLEU, ROUGE. **(6+6)**

EMERGING TRENDS AND ETHICS IN NLP: Next-Generation Pre-trained Models: BART – T5 – XLNet – Overview of Prompt-Based Learning – GPT-3 and Few-shot Learning – Adapter and Prefix Tuning – Multilingual NLP: SentencePiece Tokenization – mBART – XLM-R – BLEU Score – Fairness and Ethics in NLP – Bias in Language Models – Responsible Use of NLP Tools. **(6+6)**

LIST OF EXPERIMENTS

1. Text Preprocessing with BoW & TF-IDF Classification
2. Implementation of Word2Vec & GloVe Embeddings
3. BERT Fine-Tuning for Sentiment Analysis & NER
4. Implementation of MLP & CNN for Document Classification
5. Implementation of Seq2Seq Neural Machine Translation with Attention and BLEU Evaluation

Total L: 30 + P: 30 = 60 periods

TEXTBOOKS

1. Daniel Jurafsky and James H. Martin, *'Speech and Language Processing'*. 3rd Edition, Prentice Hall, 2023.
2. Dipanjan Sarkar, '*Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data'*. APress,2018.

REFERENCES

1. Delip Rao and Brian McMahan, '*Natural Language Processing with PyTorch'.* O'Reilly Media, 2019.
2. Yoav Goldberg, *'Neural Network Methods for Natural Language Processing'.*Morgan & Claypool Publishers, 2017.
3. Delip Rao and Brian McMahan, '*Natural Language Processing with PyTorch'.* O'Reilly Media, 2019.
4. Thomas Wolf et al., *'Transformers for Natural Language Processing'*. Second Edition, Packt Publishing, 2022.
5. Sebastian Ruder, *'NLP Progress'*. Online Resource (Updated regularly).

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the foundational concepts of natural language structure, syntax, and statistical text processing techniques.	**K2**
CO2	Apply neural network architectures and word embedding techniques to represent and model textual data.	**K3**
CO3	Analyze the architecture and mechanisms of Transformer-based language models and their role in transfer learning.	**K4**
CO4	Evaluate the performance and Develop solutions for NLP tasks such as sentiment analysis, text classification, question answering, and machine translation using state-of-the-art models.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2						2			3	3	3
	3	**3**	**2**						**2**			**3**	**3**	**3**

1-low, 2-medium, 3-high

25ADP10 MLOPS

2 0 2 3

INTRODUCTION: Overview of MLOps – Machine Learning Lifecycle – DevOps vs MLOps - Data Collection and Versioning – Model Training and Evaluation – Model Deployment and Monitoring – Tools Overview: Git, Docker, Kubernetes basics. **(6+6)**

DATA AND MODEL VERSIONING, PIPELINES, AUTOMATION: Data Versioning using DVC and Pachyderm – Model Versioning and Registry with MLflow – Building Reproducible Pipelines with Apache Airflow and Kubeflow Pipelines – Continuous Integration and Continuous Deployment (CI/CD) for ML – Containerization and Virtualization Concepts. **(6+6)**

MODEL DEPLOYMENT AND SERVING: Deployment Strategies: Batch, Online, Streaming – Serving Models with REST APIs and gRPC – Scalable Model Serving using Kubernetes and Istio – Cloud-based Deployment on AWS SageMaker and GCP AI Platform – Production Monitoring and Logging. **(6+6)**

MONITORING, MANAGEMENT, AND GOVERNANCE: Performance Monitoring and Data/Model Drift Detection – Model Retraining Strategies and Lifecycle Management – Security, Privacy, and Compliance in MLOps – Explainability and Fairness in ML Models – Ethics and Responsible AI in Production. **(6+6)**

EMERGING TRENDS: AutoML and MLOps Integration – Feature Stores and Automated Feature Engineering – MLOps for Edge Computing and IoT – Federated Learning and Privacy-preserving MLOps – Industry Case Studies (Netflix, Google, Uber). **(6+6)**

LIST OF EXPERIMENTS

1. Version control and collaborative workflow management using Git for ML projects.
2. Experiment tracking and model versioning using MLflow.
3. Data versioning and reproducible dataset management using DVC.
4. Building and automating ML pipelines using workflow orchestration frameworks.
5. Containerizing and deploying ML models using Docker and REST API.

Total L: 30 + P: 30 = 60 periods

TEXTBOOKS

1. Emmanuel Ameisen, '*Building Machine Learning Powered Applications'*. O'Reilly, 2020.
2. Mark Treveil, Alok Shukla, et al., *'Machine Learning Engineering'*. O'Reilly, 2020.
3. Andreas Mueller, *'Practical MLOps'.* Manning Publications, 2023.

REFERENCES

1. Chip Huyen, *'Designing Machine Learning Systems'.* Manning, 2020.
2. S. Srinivasan, '*MLOps Engineering at Scale'*. Packt Publishing, 2022.

WEB URLs

1. https://www.coursera.org/specializations/machine-learning-engineering-for-production-mlops
2. https://nptel.ac.in/courses/106105179
3. https://www.udemy.com/course/mlops-machine-learning-operations-for-production/

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the concepts of MLOps and the machine learning lifecycle, and the core differences between traditional DevOps and MLOps practices.	**K2**
CO2	Apply principles of workflow automation and pipeline orchestration to design reproducible systems for data and model management.	**K3**
CO3	Analyze the architecture and mechanisms of model serving patterns, deployment strategies, and the integration of cloud-based infrastructure.	**K4**
CO4	Evaluate the performance, governance, and ethical implications of machine learning systems, including drift detection, model fairness, and responsible AI practices.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2						2			3	3	3
	3	**3**	**2**						**2**			**3**	**3**	**3**

1-low, 2-medium, 3-high

25ADP11 IMMERSIVE TECHNOLOGIES

3 0 0 3

INTRODUCTION: Evolution of AR and VR – Differences between AR, VR, and Mixed Reality (MR) – Components of AR and VR Systems – Key Terminology: Immersion, Presence, Latency, Field of View – VR Devices: Head-Mounted Displays (HMDs), Controllers, Sensors – AR Devices: Mobile Devices, Smart Glasses, HoloLens – Tracking Techniques: Optical Tracking, Inertial Tracking, Sensor Fusion. **(9)**

AUGMENTED REALITY: System structure of Augmented Reality - Key technologies in AR - Marker-less tracking for Augmented Reality - Enhancing interactivity in AR environment - General solution for calculating geometric & illumination consistency in the augmented environment - Evaluating AR systems. **(9)**

VIRTUAL REALITY: Introduction – modern VR experiences – Bird‟s Eye View – Geometry of Virtual Worlds – Virtual Perception – Visual Rendering – Tracking – Evaluating VR Systems and Experiences – Types of Virtual Reality – Human-Computer Interaction in VR. **(9)**

AUGMENTED AND MIXED REALITY: Taxonomy, technology and features of augmented reality – difference between AR and VR – Challenges with AR – AR systems and functionality – Augmented Reality methods – Visualization techniques for Augmented Reality. **(9)**

AR/VR APPLICATIONS: AR & VR in Retail – AR & VR in Tourism – AR & VR in Education – AR & VR Medical Applications – VR and Media – AR & VR in Agriculture – Future Trends: Metaverse, AI Integration in AR/VR, Extended Reality Overview. **(9)**

Total L: 45 periods

TEXTBOOKS:

1. Alan B. Craig, '*Understanding Augmented Reality Concepts and Applications'*. Elsevier Science, 2013.
2. Steven M. LaValle, '*Virtual Reality'*. Cambridge University Press, 2023.
3. C.Burdea& Philippe Coiffet, '*Virtual Reality Technology'*. 2nd edition Gregory, John Wiley & Sons, Inc., 2013.

REFERENCES:

1. M. Claudia tom Dieck, Timothy Jung, '*Augmented Reality and Virtual Reality the Power of AR and VR for Business'*. Springer International Publishing,2019.
2. Jitendra Kumar Verma, Sudip Paul, '*Advances in Augmented Reality and Virtual Reality'*. Springer Nature Singapore,2022
3. Nawaz Mohamudally, '*State of the Art Virtual Reality and Augmented Reality Knowhow'*. IntechOpen, 2018.
4. Steve Benford, Gabriella Giannachi, '*Performing Mixed Reality'*. MIT Press, 2022.
5. Marc Aurel Schnabel, Xiangyu Wang, '*Mixed Reality in Architecture, Design, And Construction'*. Springer Netherlands, 2009.
6. Spencer Grey, '*Mind-Melding Unity and Blender for 3D Game Development'*. Packt Publishing, 2021.
7. Thomas Finnegan, '*Unity Android Game Development by Example'*. Packt Publishing, 2013.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the basic concepts, devices, and tracking methods used in AR, VR, and MR systems.	**K2**
CO2	Apply AR and VR technologies to create simple interactive experiences with development tools and frameworks to build basic AR and VR applications.	**K3**
CO3	Analyze the working and performance of AR and VR systems for different applications.	**K4**
CO4	Examine innovative AR and VR solutions using modern technologies like AI and XR.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2						2			3	3	3
	3	3	2						2			3	3	3

1-low, 2-medium, 3-high

25ADP12 CONVERSATIONAL AI

3 0 0 3

INTRODUCTION TO DIALOGUE SYSTEMS: Overview and History of Dialogue System – Types of Dialogue Systems: Task-Oriented vs Open-Domain – Dialogue System on Messaging Platforms, Smartphones, Smart Speakers, and Cars - Modeling Conversation in Dialogue Systems: User initiated Dialogues, System-Directed Dialogue, Multi-Turn Open-Domain Dialogue - Designing and Developing Dialogue Systems. **(9)**

RULE-BASED DIALOGUE SYSTEMS: Dialogue System Architecture: Automatic Speech Recognition, Natural Language Understanding, Dialogue Management, Natural Language Generation, Text to Speech Synthesis, designing a Dialogue System, Tools for Developing Dialogue Systems. **(9)**

STATISTICAL DATA-DRIVEN DIALOGUE SYSTEMS: Dialogue Components in the Statistical Data-Driven Approach - Natural Language Understanding, Dialogue Management, Natural Language Generation- Reinforcement Learning (RL) - Representing Dialogue as a Markov Decision Process, From MDPs to POMDPs, Dialogue State Tracking, Dialogue Policy, Problems and Issues with Reinforcement Learning and POMDPs. **(9)**

EVALUATING DIALOGUE SYSTEM AND NEURAL DIALOGUE SYSTEMS: Evaluating Task-Oriented Dialogue Systems - Evaluating Open-Domain Dialogue Systems - Evaluation Frameworks - Neural Network Approaches to Dialogue Modeling - Neural Conversational Model - Introduction to the Neural Dialogue - Retrieval-Based Response Generation - Task-Oriented Neural Dialogue Systems - Open-Domain Neural Dialogue Systems. **(9)**

APPLICATIONS, TOOLS, AND ETHICAL CONSIDERATIONS: Popular Conversational AI Platforms: Rasa, Dialog flow, Amazon Lex – Voice Assistants and Multimodal Bots – Personalization and User Profiling – Bias and Fairness in Conversational Agents – Safety, Privacy, and Security – Future Trends in Conversational AI. **(9)**

Total L: 45 periods

TEXT BOOKS

1. Michael McTear, '*Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots'*. Springer, 2020
2. Bird, Klein, Loper, '*Natural Language Processing with Python'*. O'Reilly, 2009
3. Jurafsky & Martin, '*Speech and Language Processing'*. 3rd Edition Draft, Pearson, 2023

REFERENCE BOOKS

1. Jason D. Brownlee, '*Deep Learning for Natural Language Processing'.* Machine Learning Mastery, 2018.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the architecture, components, and types of conversational AI systems including task-oriented and open-domain systems.	**K2**
CO2	Apply core natural language processing and statistical modeling techniques to represent dialogue context and manage information flow within conversational systems.	**K3**
CO3	Analyze the logic, mechanisms, and structural design behind state tracking and response generation strategies to differentiate between simple rule-based and advanced neural architectures.	**K4**
CO4	Evaluate the overall quality, reliability, and ethical standing of conversational agents by assessing performance metrics, bias, and the societal impact of human-AI	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2						2			3	3	3
	3	**3**	**2**						**2**			**3**	**3**	**3**

1-low, 2-medium, 3-high

25ADP13 GEN AI AND SMALL LANGUAGE MODELS

2 0 2 3

INTRODUCTION: Introduction to Small Language Models (SLMs) – Scaling Laws – Compute Optimal Training – Chinchilla Scaling Law – Dataset Engineering – TinyStories Dataset – RedPajama Dataset – Data Cleaning and Filtering – Tokenization – Byte Pair Encoding (BPE) – Vocabulary Mapping – Token IDs – Sequence Preparation. **(6+6)**

MODERN ATTENTION AND POSITIONING: Rotary Positional Embeddings (RoPE) – Attention with Linear Biases (AliBi) – Multi Head Attention – Softmax Optimization – Causal Masking – Decoder Only Attention Mechanism – Efficient Attention Computation. **(6+6)**

ARCHITECTURAL INNOVATIONS AND INFERENCE: RMSNorm – LayerNorm – SwiGLU – GeLU – Residual Connections – Feed Forward Networks – Multi Query Attention (MQA) – Grouped Query Attention (GQA) – Key Value (KV) Caching – Greedy Search – Beam Search – Top-k Sampling – Nucleus Sampling (Top-p Sampling) – Autoregressive Text Generation. **(6+6)**

BUILDING AND TRAINING THE SLM: Qwen Style Architecture – Llama Style Architecture – Transformer Block Integration – Weight Initialization – Next Token Prediction – Forward Pass – Backward Pass – Loss Computation – Mixed Precision Training (BF16) – Gradient Accumulation – Checkpointing – Distributed Training. **(6+6)**

EFFICIENCY AND SPARSE ARCHITECTURES: Post Training Quantization – 8-bit Quantization – 4-bit Quantization – BitsAndBytes – Mixture of Experts (MoE) – Sparse Activation – Expert Routing – Gating Mechanisms – Perplexity (PPL) – Benchmarking – Downstream Task Evaluation. **(6+6)**

LIST OF EXPERIMENTS:

1. GPU Resource Allocation, Memory Management, and Tensor Migration Between CPU and GPU Using CUDA Framework.
2. Text Preprocessing and Word-Level Tokenization Techniques for Natural Language Processing Applications.
3. Subword Vocabulary Construction and Compression Using Byte Pair Encoding (BPE) Algorithm
4. Positional Encoding Techniques and Rotary Positional Embedding (RoPE) Implementation for Transformer Models.
5. Scaled Dot-Product Self Attention Mechanism for Context-Aware Sequence Representation in Transformers.

Total L: 30 + P: 30 = 60 periods

TEXT BOOKS

1. Prashant Lakhera, '*Building A Small Language Model from Scratch: A Practical Guide'*. 1st Edition, Amazon/Kindle, 2025.
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, '*Deep Learning'.* MIT Press, 2016.

REFERENCES

1. Lewis Tunstall, Leandro von Werra and Thomas Wolf, '*Natural Language Processing with Transformers'*. O'Reilly Media, 2022.
2. Sebastian Raschka, '*Build a Large Language Model (From Scratch)'*. Manning Publications, 2024.
3. Hugging Face Course Documentation: https://huggingface.co/learn

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the fundamentals and architecture of large language models including transformers and attention mechanisms.	**K2**
CO2	Apply prompting, fine-tuning and parameter-efficient adaptation techniques for LLM-based tasks and applications.	**K3**
CO3	Analyze the performance of Large Language Models using decoding strategies, evaluation metrics and Retrieval-Augmented Generation (RAG) methods.	**K4**
CO4	Evaluate ethical considerations, biases, and fairness issues in large language models, safety and deployment requirements.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2						2			3	3	3
	3	**3**	**2**						**2**			**3**	**3**	**3**

1-low, 2-medium, 3-high

25ADP14 MARKETING ANALYTICS

3 0 0 3

INTRODUCTION TO MARKETING ANALYTICS: Role in Decision-Making – Structure and Tools – Marketing Data Sources – Marketing ROI – Overview of Analytical Techniques – Book Framework and Case-Based Approach - Marketing Resource Allocation – Frameworks for Resource Distribution – ROI Measurement – Case Study: Dunia Finance LLC – Applications in Financial Services – Cross-Sell and Retention Analytics. **(9)**

MARKET SEGMENTATION: Cluster Analysis for Market Segmentation – Segmentation Strategy – Case Study: Sticks Kebob Shop – Conjoint Analysis – Product Attribute Preferences – Case Study: Portland Trail Blazers. **(9)**

MARKETING-MIX ANALYTICS: Regression Analysis in Marketing – Price and Advertising Elasticity Models – Economic Significance and Demand Estimation – Case Study: SVEDKA Vodka – Integrated Marketing-Mix Models. **(9)**

CUSTOMER ANALYTICS: Customer Lifetime Value (CLV) – Retention Metrics – Logistic Regression for Choice Modeling – Case Studies: Netflix, Retail Relay – Acquisition and Retention Strategies. **(9)**

DIGITAL MARKETING ANALYTICS: Designing Marketing Experiments – Web and Field Experiments – Paid Search Advertising – SEM and Keyword Strategy – Case Studies: Motorcowboy, VinConnect, Cardagin – Mobile and Local Analytics. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Rajkumar Venkatesan, Paul Farris, Ronald T. Wilcox, '*Cutting Edge Marketing Analytics'*. Pearson, 2014.
2. Dominique M. Hanssens, Koen Pauwels, Paramveer S. Dhillon, and Allen Weiss, '*Cutting-Edge Marketing Analytics'*. Pearson, 2016.

REFERENCES:

1. Wayne L. Winston, '*Marketing Analytics: Data-Driven Techniques with Microsoft Excel'*. Wiley, 2014.
2. Stephan Sorger, '*Marketing Analytics: Strategic Models and Metrics'*. CreateSpace, 2013.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain key concepts, tools, and models used in marketing analytics for decision making.	**K2**
CO2	Apply segmentation, regression, and optimization techniques to solve marketing problems.	**K3**
CO3	Analyze customer behavior and campaign effectiveness using advanced analytics methods.	**K4**
CO4	Design data-driven strategies using case-based learning and simulation-based analytics.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2						2			3	3	3
	3	**3**	**2**						**2**			**3**	**3**	**3**

1-low, 2-medium, 3-high

25ADP19 QUANTUM MACHINE LEARNING

3 0 0 3

INTRODUCTION: Qubits and Quantum States – Superposition and Entanglement – Quantum Gates and Circuits – Quantum Measurement – Classical Machine Learning Overview – Supervised and Unsupervised Learning – Linear Algebra and Probability for Quantum Computing. **(9)**

QUANTUM ALGORITHMS FOR MACHINE LEARNING: Grover's Search Algorithm – Quantum Fourier Transform – Quantum Phase Estimation – Quantum Principal Component Analysis (qPCA) – Quantum Support Vector Machines (QSVM) – Quantum k-Means Clustering – Speedups and Limitations of Quantum ML Algorithms. **(9)**

VARIATIONAL CIRCUITS AND HYBRID QUANTUM-CLASSICAL MODELS: Parametrized Quantum Circuits – Variational Quantum Eigensolver (VQE) – Quantum Approximate Optimization Algorithm (QAOA) – Cost Function Design – Hybrid Model Architectures – Training Challenges and Optimization Strategies – Gradient Estimation in Quantum Circuits. **(9)**

QUANTUM NEURAL NETWORKS AND DEEP LEARNING ARCHITECTURES: Quantum Percept – Quantum Convolutional Neural Networks (QCNN) – Quantum Boltzmann Machines – Quantum Generative Adversarial Networks (QGANs) – Transfer Learning in Quantum Models – Use Cases in Vision, Text, and Healthcare. **(9)**

IMPLEMENTATION TOOLS, TRENDS, AND ETHICS IN QUANTUM ML: Quantum Programming Frameworks: Qiskit, Cirq, PennyLane – Quantum Cloud Platforms: IBM Q, IonQ, Rigetti – Quantum Noise and Error Mitigation – Ethical Issues in Quantum AI – Scalability, Interpretability, and Explainability – Future Trends and Research Directions in Quantum Machine Learning. **(9)**

Total L: 45 periods

TEXTBOOKS

1. Santanu Ganguly, '*Quantum Machine Learning: An Applied Approach'*. Springer, 2021
2. Peter Wittek, '*Quantum Machine Learning: What Quantum Computing Means to Data Mining'.* Academic Press, 2014
3. Michael A. Nielsen & Isaac L. Chuang, '*Quantum Computation and Quantum Information'*. Cambridge University Press, 10th Anniversary Edition, 2010

REFERENCES

1. Maria Schuld & Francesco Petruccione, '*Quantum Machine Learning: An Introduction'*. Springer, 2018
2. Frank Zickert, '*Quantum Machine Learning with Python'.* Packt Publishing, 2022

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the core principles of quantum computing and their applicability in machine learning.	**K2**
CO2	Apply quantum algorithms for machine learning tasks and variational circuits.	**K3**
CO3	Analyze quantum models and train them using quantum hardware or simulators.	**K4**
CO4	Evaluate challenges such as noise, de-coherence, scalability, and ethical aspects of quantum ML systems.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2						2			3	3	3
	3	**3**	**2**						**2**			**3**	**3**	**3**

1-low, 2-medium, 3-high

25ADP16 COGNITIVE SCIENCE

3 0 0 3

FOUNDATIONS AND DESIGN PRINCIPLES: Foundation of Cognitive Computing: cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition. Design Principles for Cognitive Systems: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation and visualization services. **(9)**

NLP IN COGNITIVE SYSTEM: Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system, semantic web, Applying Natural language technologies to Business problems. Representing knowledge in Taxonomies and Ontologies: Representing knowledge, Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations. **(9)**

BIG DATA Vs COGNITIVE COMPUTING: Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data. Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, using advanced analytics to create value, Impact of open source tools on advanced analytics. **(9)**

COGNITIVE COMPUTING IN BUSINESS: The Business Implications of Cognitive Computing: Preparing for change, advantage of new disruptive models, knowledge meaning to business, difference with a cognitive system approach, meshing data together differently, using business knowledge to plan for the future, answering business questions, building business specific solutions, making cognitive computing a reality, cognitive application changing the market. **(9)**

APPLICATIONS: The process of building a cognitive application: Emerging cognitive platform, defining the objective and domain, understanding the intended users and their attributes, questions and exploring insights, training and testing - Building a cognitive healthcare application. **(9)**

Total L: 45 periods

TEXTBOOKS

1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowels, **'***Cognitive Computing and Big Data Analytics'*. Wiley, 2015.
2. Masood, Adnan, Hashmi, Adnan, '*Cognitive Computing Recipes-Artificial Intelligence Solutions Using Microsoft Cognitive Services and TensorFlow'*. Apress Berkeley, CA, 2015.

REFERENCES

1. Peter Fingar, '*Cognitive Computing: A Brief Guide for Game Changers'*. PHI Publication, 2015
2. Gerardus Blokdyk , '*Cognitive Computing Complete Self-Assessment Guide'*. 5STARCooks, 2018.
3. Rob High, Tanmay Bakshi, '*Cognitive Computing with IBM Watson: Build smart applications using Artificial Intelligence as a Service'*. IBM Book Series, 2019.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the fundamental concepts of cognitive science.	**K2**
CO2	Apply cognitive computing concepts, NLP techniques, ontologies, big data analytics, and advanced analytics methods to solve complex problems.	**K3**
CO3	Analyze the relationship between big data and cognitive computing and evaluate cognitive business models.	**K4**
CO4	Develop cognitive computing applications by integrating cognitive platforms, data-driven insights, and domain-specific knowledge for intelligent decision-making systems.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2						2			3	3	3
	3	**3**	**2**						**2**			**3**	**3**	**3**

1-low, 2-medium, 3-high

25ADP17 SECURE CODING

3 0 0 3

INTRODUCTION: Security - CIA Triad - Viruses, Trojans, and Worms - Security Concepts- exploit, threat, vulnerability, risk, attack - Malware Terminology: Rootkits, Trapdoors, Botnets, Honeypots. - Active and Passive Security Attacks - IP Spoofing - Teardrop - DoS - DDoS - SQL injection - Man in middle - Format String attack. **(9)**

NEED FOR SECURE SYSTEM: Secure Software Development Cycle (SSDLC) - Security issues while writing SRS - Design phase security: Development Phase, Test Phase, Maintenance Phase - Writing Secure Code – Best Practices SD3 (Secure by design, default and deployment) - Security principles and Secure Product Development Timeline. **(9)**

THREAT MODELLING PROCESS: Identifying the Threats by Using Attack Trees and rating threats using DREAD - Risk Mitigation Techniques and Security Best Practices - Security techniques: authentication, authorization - Defence in Depth and Principle of Least Privilege. **(9)**

SECURE CODING TECHNIQUES: Protection against DoS attacks - Application Failure Attacks - CPU Starvation Attacks - ARP Spoofing - Avoiding Integer Overflows and Underflows - Type Conversion Issues - Memory Management Issues - Code Injection Attacks - Canary based countermeasures using StackGuard and Propolice - Socket Security - Avoiding Server Hijacking - Securing RPC. **(9)**

DATABASE AND WEB-SPECIFIC ISSUES: SQL Injection Techniques- Race conditions - Time of Check Versus Time of Use and its protection mechanisms - Validating Input and Inter-process Communication - Securing Signal Handlers and File Operations - XSS scripting attack – Persistent and Non-persistent attack - XSS Countermeasures. **(9)**

Total L: 45 periods

TEXT BOOKS

1. Michael Howard and David LeBlanc, ‘*Writing Secure Code’*. Microsoft Press, 2nd Edition, 2004.

REFERENCES

1. Jason Deckard, ‘*Buffer Overflow Attacks: Detect, Exploit, Prevent’*. Syngress Publishing, First Edition, 2005.
2. Frank Swiderski and Window Snyder, ‘*Threat Modeling’*. Microsoft Press, First Edition, 2004.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Discuss the core concepts of security, malware, and common software vulnerabilities.	**K2**
CO2	Apply secure software development practices across design, development, testing, and deployment.	**K3**
CO3	Analyze threats using structured modeling methods and propose effective mitigation techniques.	**K4**
CO4	Design and implement secure code by integrating industry best practices and countermeasures for software, web, and database applications.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3												3	3
CO3		3										3	3	3
CO4				1								1	1	1
	3	**3**		**1**								**3**	**3**	**3**

1-low, 2-medium, 3-high

25CSP14 CYBER FORENSICS

3 0 0 3

INTRODUCTION: Definition and Scope of Cyber Forensics – Digital Evidence: Types and Challenges – Categories and Trends in Cyber Crime – Forensic readiness – Incident response and management. **(9)**

EVIDENCE COLLECTION AND PRESERVATION: Handling digital evidence – Acquisition techniques – Disk imaging, cloning – Write blockers – Chain of custody – Ensuring evidence integrity – Use of hashing – Metadata analysis. **(9)**

OPERATING SYSTEM FORENSICS: Windows and Linux Forensics – System logs and artifacts – Registry forensics – File systems – FAT, NTFS, EXT – Data recovery – Live vs Dead forensics. **(9)**

NETWORK AND EMAIL FORENSICS: Fundamental of network forensics – Log analysis – Packet capturing tools – Wireshark, TCPDump – Email structure and header analysis – Phishing and spoofing investigations. **(9)**

LEGAL AND PROFESSIONAL ASPECTS: Cyber Laws in India and International standards – Admissibility of digital evidence – Forensics in law enforcement – Ethics in cyber forensics – Professional responsibilities. **(9)**

Total L: 45 periods

TEXTBOOKS

1. Bill Nelson, Amelia Phillips, Christopher Steuart, '*Guide to Computer Forensics and Investigations'*. 5th Edition, Cengage Learning, 2022.
2. John Sammons, '*The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics'*. 2nd Edition, Elsevier, 2014.

REFERENCES

1. Marjie T. Britz, '*Computer Forensics and Cyber Crime: An Introduction'*. Pearson, 2021.
2. Warren G. Kruse II, Jay G. Heiser, '*Computer Forensics: Incident Response Essentials'*. Wesley, 2020.
3. Eoghan Casey, '*Digital Evidence and Computer Crime: Forensic Science, Computers and the Internet'*. 3rd Edition, Academic Press, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe fundamental principles and investigative approaches for analyzing digital information in complex problems.	**K2**
CO2	Apply appropriate techniques to examine, handle, and interpret digital information for investigative purposes.	**K3**
CO3	Assess investigative approaches and analytical methods to identify and interpret digital evidence effectively.	**K4**
CO4	Evaluate strategies for ensuring secure and dependable digital investigation processes in different environments.	**-**

COs–POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2					2				2	2	2
	3	**3**	**2**					**2**				**3**	**3**	**3**

1-low, 2-medium, 3-high

25ADP20 APPLICATION SECURITY

3 0 0 3

INTRODUCTION: Overview of Application Security – Importance of Application Security – Secure SDLC – Defense in Depth – OWASP Top 10 Overview – Input Validation Fundamentals: Blacklist Validation, Whitelist Validation, Validation Best Practices – Attack Surface Reduction – Security Misconfigurations. **(9)**

SECURE DESIGN PRINCIPLES – Secure Application Architecture – Web Application Threat Landscape – Common Weakness Enumeration (CWE) – Common Vulnerability Scoring System (CVSS) – Vulnerability Assessment Techniques – Secure Deployment Practices – Secure Configuration Management – Security-focused Design Review – Case Studies in Secure Application Design. **(9)**

CROSS-SITE SCRIPTING (XSS) AND CSRF: Types of XSS: Reflected, Stored, DOM-based - XSS Prevention Techniques: Output encoding - Content Security Policy (CSP) - Cross-Site Request Forgery (CSRF) - Tokens and CSRF Mitigation - Secure Session Handling. **(9)**

AUTHENTICATION AND ACCESS CONTROL: Authentication Methods and Weaknesses: Password-based authentication - Multi-factor authentication - Password Storage and Policies - Broken Authentication and Session Management - Access Control Vulnerabilities - Role-Based Access Control. **(9)**

SECURITY TESTING AND BEST PRACTICES: Introduction to Security Testing - Tools for Security Testing - Secure Development Lifecycle - Common Mistakes and Avoidance - Case Studies in Secure Web Development - Analysis of successful security implementations. **(9)**

Total L: 45 periods

TEXT BOOKS

1. Bryan Sullivan & Vincent Liu, '*Web Application Security: A Beginner's Guide'*. First Edition, McGraw-Hill, 2021.
2. Andrew Hoffman, ' *Web Application Security: Exploitation and Countermeasures for Modern Web Applications'*. First Edition, O'Reilly Media, 2020.

REFERENCES

1. Dafydd Stuttard, Marcus Pinto, '*The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws'*. Second edition, Wiley, 2022.
2. Michael Cross, '*Security+ Guide to Network Security Fundamentals'*. Sixth edition, Cengage Learning, 2019.

COURSE OUTCOMES

At the end of this course students will be able to:		**Bloom's Level**
CO1	Explain the principles of web application security.	**K2**
CO2	Apply web security techniques to identify and mitigate vulnerabilities and insecure session handling using secure coding practices	**K3**
CO3	Analyze web application security using testing tools and secure development practices to evaluate vulnerabilities, interpret security flaws, and study successful secure web development implementations through case studies.	**K4**
CO4	Evaluate basic security testing and secure coding practices on web applications.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4					2							2	2	2
	3	**3**			**2**							**3**	**3**	**3**

1-low, 2-medium, 3-high

25ADP15 RESPONSIBLE AI

3 0 0 3

INTRODUCTION: Need for Responsible AI: Ethical, legal, social, and environmental perspectives - Core principles: Fairness, Accountability, Transparency, Safety, Sustainability, Data and Model Privacy - Fairness and Proxy Features: Key parameters, confusion matrix, common accuracy metrics, fairness metrics, proxy features, methods to detect proxy features, Case studies of AI failures and unintended consequences. **(9)**

BIAS DETECTION AND MITIGATION: Types of bias in AI: Historical bias, Representation bias, Measurement bias, Aggregation bias, Statistical Parity Difference, Disparate Impact, Remove Bias from ML Model: Reweighting the data, Additive Counterfactual Fairness, Remove Bias from ML Output: Reject Option Classifier Tradeoff between fairness and accuracy, What-If Tool. **(9)**

SECURE AND TRUSTWORTHY AI SYSTEMS: Privacy-preserving techniques: Anonymization: K-Anonymity, L-Diversity and T-Closeness, Differential privacy, Differentially private ML Algorithm, Federated learning - Adversarial threats: Model stealing, Adversarial examples, Membership inference - Trust and transparency in AI systems: Interpretability, Explainability (XAI) - Interpretable Models: Linear Regression, Logistic Regression, Decision Tree - Tools for explainability and privacy: LIME, SHAP, Captum, TensorFlow Privacy. **(9)**

SUSTAINABLE AND GREEN AI: Introduction to Green AI: Definition, Red vs Green AI paradigm - Carbon footprint of large-scale AI models: GPT, BERT, Training and inference phases - Estimating emissions: Experiment tracking, Energy profiling tools, ML CO2 - Infrastructure and sustainability: GPU vs TPU, Data centres, Renewable energy use - Strategies for sustainable AI: Efficient model design, Pruning, Quantization, Transfer learning - Green AI tools: CodeCarbon, ML CO2 Calculator, Energy monitoring tools. **(9)**

ACCOUNTABILITY IN AI: Data Drift: Covariate Drift, Jensen-Shannon Distance, Wasserstein Distance, Stability Index, Concept Drift: Kolmorgorov-Smirnov Test, Brier Score, Page-Hinkley Test, Early Drift Detection Method, Hierarchical Linear Four Rate (HLFR), Future directions in Responsible AI: Human-in-the-loop AI and Ethics by design. **(9)**

Total L: 45 periods

TEXT BOOKS

1. Agarwal, Sray., Mishra, Shashin, '*Responsible AI: Implementing Ethical and Unbiased Algorithms'*. Springer International Publishing, 2021.
2. Christoph Molnar, '*Interpretable Machine Learning'*. Lulu, 1st Edition, 2019.

REFERENCES

1. Dignum Virginia, '*Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way'*. Springer International Publishing, 2019.
2. Ammanath, Beena, '*Trustworthy AI: A Business Guide for Navigating Trust and Ethics in AI'*. Wiley, 2022.
3. Gambelin, Olivia, '*Responsible AI: Implement an Ethical Approach in Your Organization'*. Kogan Page 2024.
4. Alloghani, Mohamed Ahmed, '*Artificial Intelligence and Sustainability'*. Springer Nature, 2023.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental principles of Responsible AI, including fairness, transparency, and sustainability, while identifying ethical risks and historical failures in AI systems.	**K2**
CO2	Apply bias detection metrics and mitigation techniques to ensure equity in machine learning datasets and model outputs.	**K3**
CO3	Analyze AI systems for security vulnerabilities and interpretability using privacy-preserving techniques and XAI tools.	**K4**
CO4	Evaluate the environmental impact and operational stability of AI models by assessing carbon footprints and designing monitoring strategies for data and concept drift.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4					2							2	2	2
	3	**3**			**2**							**3**	**3**	**3**

1-low, 2-medium, 3-high

25ADP07 DATA PRIVACY AND SECURITY

3 0 0 3

PRIVACY REGULATIONS AND LEGAL FRAMEWORKS: Global principles of privacy law - European frameworks: GDPR and related EU data protection rules - United States approach: sector-based privacy regulation - India: Digital Personal Data Protection framework. ISO and International Standards: ISO/IEC 27001 for information security management - ISO/IEC 27701 for privacy information management - Mapping organizational controls to legal and compliance requirements - Case Studies and Legal Disputes. **(9)**

SESSION MANAGEMENT AND SOCIAL ENGINEERING DEFENSES: Session lifecycle and authentication basics - Cookies: types, attributes, secure storage, and risks - Profile management: user identity, permissions, password hygiene, and account recovery - Social engineering: phishing, pretexting, baiting, and impersonation attacks - Leak-proof practices: data minimization, secure logout, timeout policies, and exposure prevention - HIPAA Act: privacy, security, and breach-handling requirements for health information - Case studies and common attack scenarios**.** **(9)**

SECURITY MECHANISMS AND SERVICES: Security goals –threats and attacks. – Services and mechanisms – – symmetric key cryptography-substitution cipher – transposition cipher -stream ciphers and block ciphers – Data Encryption Standard - Advanced Encryption Standard (AES)) - Public key cryptosystem: Principles of Public key cryptosystem – RSA cryptosystem – Diffie – Hellman key agreement–Elliptic Curve cryptosystem. Message authentication: Message authentication code – Message authentication Requirements-Message Authentication Functions - Digital signatures- Digital Signature standard. Database Security: Security Requirements – SQL injection and exploitation and defense methods - database roles and permissions – Object level security. **(9)**

DATA PRIVACY: Foundations of privacy: Privacy and Contextual Integrity, Privacy regulations, Goals of Privacy engineering, taxonomy of privacy, Attacks on private data - Data Privacy Models and Disclosure Risk Measures: Formal model of Data privacy, K-anonymity: Definition of k-anonymity, Practical Implications, Mechanism design, Evaluating the risk of disclosure- Limitations of K-anonymity. Disclosure Risk Measures: Attribute disclosure, identity disclosure, Synthetic datasets and network trace analysis. **(9)**

MASKING METHODS & DIFFERENTIAL PRIVACY: Perturbative methods - non-Perturbative methods - Synthetic Data Generators. Differential Privacy: Definition of Differential Privacy (DP), Privacy and databases, Noiseless differential privacy - Promise of DP, Formalizing DP, Lower bounds, Mechanism Design, Machine learning and Differential Privacy- Differential privacy for large data- Differentially private social network analysis – Web privacy: online tracking and advertisement Applications of Differential privacy. **(9)**

Total L: 45 Periods

TEXT BOOKS

1. William Stallings, '*Cryptography and Network Security: Principles and Practice'*. 8th Edition, Prentice Hall of India, Pearson Education, New Delhi, 2020.
2. William Stallings, '*Information Privacy Engineering and Privacy by Design: Understanding Privacy Threats, Technology, and Regulations Based on Standards and Best Practices'*. Pearson Education, 2019.
3. Vicenc Torra, '*Data Privacy: Foundations, New Developments and Big Data Challenge'*. Springer, 2017.

REFERENCES

1. Behrouz A.Forouzan and Debdeep Mukhopadhyay, '*Cryptography and Network Security'*. Tata McGraw Hill, 2011.
2. AtulKahate, '*Cryptography and Network Security'*. Tata McGraw Hill, 2013.
3. TianqingZhu, GangLi, WanleiZhou, Philip S. Yu, '*Differential Privacy and Applications'.* Springer, 2017
4. Benjamin C.M. Fung, Ke Wang, Ada Wai-Chee Fu and Philip S. Yu, '*Introduction to Privacy-Preserving Data Publishing: Concepts and Techniques'*. Chapman & Hall/CRC, 2010. 5. Charu C. Aggarwal, '*Privacy-Preserving Data Mining: Models and Algorithms*'. Springer, 2008

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the fundamental goals of privacy regulations, types of cryptographic attacks, services, mechanisms, and classical cipher techniques	**K2**
CO2	Apply the knowledge of symmetric cryptographic and asymmetric cryptographic algorithms in secure communication and data privacy mechanisms.	**K3**
CO3	Analyze and compare different encryption algorithms in secure communication and various methods in data privacy.	**K4**
CO4	Evaluate cryptographic hash functions and digital signature schemes for integrity and authentication, and implement various techniques for data hiding in text and images.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			2									2	2	2
	3	**3**	**2**									**3**	**3**	**3**

1-low, 2-medium, 3-high

25CSP15 AI IN CYBER SECURITY

3 0 0 3

OVERVIEW OF AI IN CYBERSECURITY: Overview of cybersecurity threats – Introduction to AI and ML – Intersection of AI and Cybersecurity – AI use cases in cyber defense – Attack vectors that leverage AI –Threat intelligence. **(9)**

SUPERVISED LEARNING FOR THREAT DETECTION: Classification techniques: SVM, Decision Trees, Random Forest, Naive Bayes – Model training & evaluation – Dataset preparation – Case studies: Malware detection, phishing website classification. **(9)**

UNSUPERVISED LEARNING AND ANOMALY DETECTION: Clustering algorithms: K–Means, DBSCAN, PCA – Autoencoders – Detecting anomalous behavior in system logs and network traffic – Insider threat detection. **(9)**

DEEP LEARNING AND NLP IN CYBERSECURITY: Introduction to deep learning – DNNs, CNNs, RNNs – Natural Language Processing for spam/phishing detection – AI for fake news and social engineering defense – Overview of Embeddings – Transformers. **(9)**

SECURITY, PRIVACY, AND ETHICS IN AI: Adversarial machine learning – Model poisoning and evasion attacks – Fairness and bias in AI–based systems – Ethical considerations – Recent research and future trends. **(9)**

Total L: 45 periods

TEXT BOOKS

1. Mark Stamp, '*Introduction to Machine Learning with Applications in Information Security'*. 2nd edition, CRC Press, 2023.
2. Sumeet Dua and Xian Du, *'Data Mining and Machine Learning in Cybersecurity'*. CRC Press, 2023 edition.

REFERENCE BOOKS

1. Alessandro Parisi, '*Hands–On Artificial Intelligence for Cybersecurity'*. 1st edition, Packt Publishing, 2019.
2. Clarence Chio and David Freeman, *'Machine Learning and Security: Protecting Systems with Data and Algorithms'*. 1st edition, O"Reilly Media, 2018.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the fundamental concepts of AI and machine learning techniques used in cybersecurity.	**K2**
CO2	Demonstrate the use of AI/ML techniques to detect, analyze, and mitigate cybersecurity threats using various algorithms.	**K3**
CO3	Examine the effectiveness and limitations of these techniques in threat detection, anomaly detection, deep learning applications, and ethical and privacy concerns.	**K4**
CO4	Design AI–based models using machine learning and deep learning techniques to detect, prevent, and mitigate cybersecurity threats in real–world applications.	**–**

COs–POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			1		1							1	1	1
	3	**3**	**1**		**1**							**3**	**3**	**3**

1-low, 2-medium, 3-high

25CSP21 BLOCKCHAIN TECHNOLOGIES

3 0 0 3

BLOCKCHAIN DESIGN: History: Digital money to distributed ledgers – Design primitives: Protocols, security, consensus, permissions, privacy: Blockchain architecture and design – Basic crypto primitives: Hash, signature hash chain to block chain – Basic consensus mechanisms. **(9)**

BLOCKCHAIN CONSENSUS PROTOCOLS: Requirements for the consensus protocols – Proof of Work (PoW) – Scalability aspects of block chain consensus protocols: Permissioned blockchains – Design goals – Consensus protocols for permissioned blockchains. **(9)**

HYPERLEDGER FABRICS: Decomposing the consensus process – Hyper ledger fabric components – Chain code design and implementation: Hyper ledger Fabric II – Beyond chain code – Fabric SDK and front end – Hyper ledger composer tool. **(9)**

BLOCKCHAIN IN FINANCE AND TRADE: Blockchain in financial software and systems (FSS): Settlements – KYC – Capital markets – Insurance blockchain in trade/supply chain: provenance of goods, visibility –trade/supply chain finance – Invoice management/discounting. **(9)**

BLOCKCHAIN FOR GOVERNANCE AND SECURITY: Blockchain for Government: digital identity, land records and other kinds of record keeping between government entities, public distribution system / social welfare systems: Blockchain cryptography: Privacy and security on blockchain. **(9)**

Total L: 45 periods

TEXTBOOKS

1. Mark Gates, '*Blockchain: Ultimate guide to understanding blockchain, bitcoin, crypto currencies, smart contracts and the future of money'*. Wise Fox Publishing and Mark Gates 2017.
2. Imran Bashir, '*Mastering Blockchain: Inner workings of blockchain, from cryptography and decentralized identities, to DeFi, NFTs and Web3'*. Packt Publishing Limited, Fourth Edition, 2023.

REFERENCES:

1. Bahga, Vijay Madisetti, ' *Blockchain Applications: A Hands–On Approach'.* Arshdeep Bahga,Vijay Madisetti publishers 2017.
2. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, '*Hands–On Blockchain with Hyper ledger: Building decentralized applications with Hyperledger Fabric and Composer'.* 2018. Melanie Swa, *Block chain.*, O'Reilly Media 2014.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamental concepts, evolution, architecture and design principles of blockchain technology, including security, privacy and distributed ledgers.	**K2**
CO2	Apply blockchain development techniques, cryptographic primitives and Hyperledger Fabric tools to build basic decentralized applications.	**K3**
CO3	Analyze blockchain consensus mechanisms and permission models to determine their effectiveness in different environments.	**K4**
CO4	Prepare a case study on blockchain applications in finance, trade, governance and security for solving real–world challenges and improving digital trust systems.	

COs–POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1												3	3	3
CO2	3											3	3	3
CO3		3										3	3	3
CO4			1									1	1	1
	3	**3**	**1**									**3**	**3**	**3**

1-low, 2-medium, 3-high

25CSP12 ETHICAL HACKING

3 0 0 3

PENETRATION TESTING: Black Box, White Box, Grey Box, Types of Penetration test: Network Penetration Testing – Web Application Penetration Testing – Wireless Network Testing – Social Engineering. Writing Reports – Structure of a Penetration Testing Report – Vulnerability Assessment Summary – Risk Assessment, Methodology. **(9)**

FOOTPRINTING AND SOCIAL ENGINEERING: Using Web Tools for Footprinting: Search Engines – WHOIS Lookup – DNS Interrogation – Social Media Analysis – Conducting Competitive Intelligence – Introduction to Social Engineering – The Art of Shoulder Surfing, Dumpster Diving, Piggybacking, Phishing. **(9)**

PORT SCANNING AND ENUMERATION: Port Scanning: Basics of Port–Scanning Tools – Nmap, Unicornscan, Nessus and OpenVAS – Conducting Ping Sweeps – Fping – Hping. Crafting IP Packets Enumeration: Enumerating Windows Operating Systems – NetBIOS Basics – NetBIOS Enumeration Tools – Additional Enumeration Tools – Enumerating the NetWare Operating System – Enumerating the unix Operating system. **(9)**

NETWORK HACKING: Network Infrastructure: Network Infrastructure Vulnerabilities – Choosing Tools, Scanning – Poking – and Prodding – Common Router – Switch and Firewall Weaknesses – General Network Defenses. Wireless LANs: Understanding the Implications of Wireless – Choosing Tools – Wireless LAN Discovery – Wireless Network Attacks and Countermeasures – Rogue wireless devices – Countermeasures against rogue wireless devices – MAC spoofing – Countermeasures against MAC spoofing – Countermeasures against DoS attacks. **(9)**

OPERATING SYSTEM HACKING: Windows: Windows Vulnerabilities – Choosing Tools – Information Gathering – Null Sessions – Share Permissions: Assessing Shared Resources – Modifying Share Permissions – Missing Patch Exploitation: Identifying Unpatched Systems – Exploiting Missing Updates – Authenticated Scans. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Rafay Baloch, '*Ethical Hacking and Penetration Testing Guide'*. 2nd edition, Tata Mc Graw Hill, 2023.
2. Michael T. Simpson, Kent Backman, and James E. Corley, '*Hands–On Ethical Hacking and Network Defense'*. 2nd edition, Delmar Cengage Learning, 2020.
3. Kevin Beaver, '*Hacking for Dummies'*. 3rd edition, Wiley Publishing, Inc, 2022.

REFERENCES:

1. Stuart McClure, Joel Scambray and Goerge Kurtz, '*Hacking Exposed Network Security Secrets & Solutions'*. Tata Mc Graw Hill, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to:		Bloom's Level
CO1	Explain the different stages of penetration testing and social engineering.	**K2**
CO2	Examine the various footprint tools and port scanning tools.	**K3**
CO3	Interpret the vulnerabilities in network services and Windows operating systems using network hacking tools, null sessions and patch analysis.	**K4**
CO4	Investigate vulnerabilities to propose mitigation strategies using authenticated scans.	**–**

COs–POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1												3	3
CO2	3											3	3
CO3		3										3	3
CO4			2									2	2
	3	**3**	**2**									**3**	**3**

1-low, 2-medium, 3-high

MINOR DEGREE PROGRAMME COURSES
25ADM01 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

3 0 0 3

FOUNDATIONS OF AI AND PROBLEM SOLVING: Definition and History of AI – Applications of AI – Intelligent Agents – Types of Environments – Problem Formulation – Search Strategies: Uninformed (BFS, DFS) and Informed (A*). **(9)**

KNOWLEDGE REPRESENTATION AND REASONING: Propositional Logic – First-Order Predicate Logic – Inference Rules – Forward and Backward Chaining – Knowledge-Based Agents – Uncertainty and Bayesian Reasoning. **(9)**

MACHINE LEARNING AND NEURAL NETWORKS: Supervised vs Unsupervised Learning – Decision Trees – K-Nearest Neighbors – Neural Networks Basics – Perceptron – Introduction to Deep Learning – Applications. **(9)**

NATURAL LANGUAGE PROCESSING AND ROBOTICS: Basics of NLP – Syntax and Semantics – POS Tagging – Named Entity Recognition – Sentiment Analysis – Introduction to Robotics – Perception, Planning, and Action. **(9)**

RECENT TRENDS AND ETHICAL AI: AI in Healthcare, Finance, and Autonomous Systems – Introduction to Reinforcement Learning – Explainable AI (XAI) – AI Ethics – Bias and Fairness – Societal Impacts. **(9)**

Total L: 45 periods

TEXTBOOKS

1. Stuart Russell and Peter Norvig, *'Artificial Intelligence: A Modern Approach'*. 4th Edition, Pearson, 2021.

REFERENCES

1. Elaine Rich, Kevin Knight, Shivashankar B. Nair, '*Artificial Intelligence'*. 3rd Edition, McGraw-Hill, 2017.
2. Ethem Alpaydin, '*Introduction to Machine Learning'*. 4th Edition, MIT Press, 2020.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, '*Deep Learning'.* MIT Press, 2023.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Describe the basic concepts and applications of Artificial Intelligence, machine learning, NLP, robotics, and ethical AI.	**K2**
CO2	Utilize AI techniques, reasoning methods, and machine learning approaches to address intelligent system problems.	**K3**
CO3	Examine deep learning, NLP, robotics, and advanced AI technologies for automated decision-making.	**K4**
CO4	Develop and assess AI systems with consideration for recent trends, ethics, fairness, and social impact.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3													
CO2			3											
CO3		3												
CO4			2				2	2						
	3	**3**	**3**				**2**	**2**						

1-low, 2-medium, 3-high

25ADM02 MACHINE LEARNING ALGORITHMS

2 0 2 3

INTRODUCTION TO MACHINE LEARNING: Introduction to Machine Learning – Role of Machine Learning in Artificial Intelligence Applications – Learning Paradigms: Supervised, Unsupervised and Reinforcement Learning – PAC Learning – Version Spaces – Applications of Machine Learning in Healthcare, Finance, Agriculture and Industry. **(6+6)**

SUPERVISED LEARNING I: Linear and Non-Linear examples – Multi–Class & Multi-Label classification – Linear Regression – Multiple Linear Regression – Naïve Bayes Classifier – Decision Trees – ID3 – CART – Error bounds. **(6+6)**

SUPERVISED LEARNING II: K-Nearest Neighbor (K-NN) Classifier – Logistic Regression – Perceptron – Single Layer and Multi-Layer Neural Networks – Support Vector Machines: Linear and Non-Linear – Overfitting and Performance Metrics. **(6+6)**

UNSUPERVISED LEARNING: Introduction to Clustering – Partitioning, Hierarchical and Density-Based Clustering – K-Means Clustering – K-Modes Clustering – Principal Component Analysis (PCA) – Dimensionality Reduction – t-SNE (t-distributed stochastic neighbor embedding) – Applications of Unsupervised Learning. **(6+6)**

ENSEMBLE LEARNING AND ETHICS: Bias–Variance Tradeoff – Bagging and Boosting Techniques – Random Forest – AdaBoost – XGBoost – Ethical Issues in Machine Learning – Practical Applications of Machine Learning. **(6+6)**

LIST OF EXPERIMENTS

1. Implementation of Linear and Multiple Linear Regression for Prediction Problems.
2. Implementation of Naïve Bayes Classifier and Decision Tree (ID3/CART) for Classification.
3. Implementation and Performance Comparison of K-Nearest Neighbor (K-NN), Logistic Regression, and Neural Network Classifiers.
4. Implementation of K-Means Clustering and Principal Component Analysis (PCA) for Unsupervised Learning.
5. Implementation and Comparison of Ensemble Learning Techniques using Random Forest and AdaBoost.

Total L: 30 + P: 30 = 60 periods

TEXTBOOKS

1. Ethem Alpaydin, '*Introduction to Machine Learning'*. 4th Edition, MIT Press, 2020.
2. Richard S. Sutton and Andrew G. Barto, ' *Reinforcement Learning: An Introduction (Adaptive Computation and Machine Learning series)'*. 2nd edition, A Bradford Book; 2018.

REFERENCES

1. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, '*Foundations of Machine Learning'*. MIT Press, 2018.
2. TGéron, Aurélien,*'Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow'*. O'Reilly Media, 2022.
3. Charu C. Aggarwal, '*Data Classification Algorithms and Applications'.* CRC Press, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the core concepts, learning paradigms, and applications of machine learning in intelligent systems.	**K2**
CO2	Apply machine learning algorithms, evaluation methods, and analytical techniques to solve prediction, classification, and clustering problems.	**K3**
CO3	Analyze supervised, unsupervised, ensemble, and advanced machine learning models for intelligent decision-making and performance improvement.	**K4**
CO4	Evaluate machine learning models, emerging trends, and real-world applications using appropriate performance and assessment.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2	3													
CO3		3												
CO4			2					2						
	3	3	2					2						

1-low, 2-medium, 3-high

25ADM03 DEEP LEARNING ESSENTIALS

2 0 2 3

FUNDAMENTALS OF NEURAL NETWORKS: Introduction to Neural Networks – Biological and Artificial Neurons – Basic Architecture of Neural Networks – Perceptron and Multilayer Perceptron – Backpropagation Algorithm – Activation Functions – Binary and Multiclass Classification Models. **(6+6)**

TRAINING DEEP NEURAL NETWORKS: Challenges in Training Deep Neural Networks – Weight Initialization – Vanishing and Exploding Gradient Problems – Gradient Descent Optimization Techniques – Batch Normalization – Regularization Methods – Bias–Variance Tradeoff – Early Stopping – Model Evaluation and Hyper parameter Tuning – Ensemble Learning and Unsupervised Pre-training. **(6+6)**

CONVOLUTIONAL NEURAL NETWORKS: Introduction to Convolutional Neural Networks – Convolution and Pooling Operations – Training CNN Architectures – Popular CNN Models – Applications in Image and Video Processing – Attention Mechanism – Introduction to Transformers and Transfer Learning. **(6+6)**

RECURRENT NEURAL NETWORKS: Introduction to Sequential Data – Architecture of Recurrent Neural Networks – Challenges in Training RNNs – Long Short-Term Memory (LSTM) – Gated Recurrent Units (GRU) – Echo State Networks – Applications of RNNs in Speech, Text, and Time-Series Analysis. **(6+6)**

AUTOENCODERS AND GENERATIVE MODELS: Auto encoders: Under complete auto encoders - Regularized auto encoders -- Stochastic encoders and decoders, Deep Generative Models: Variational auto encoders - Generative adversarial network, Image generation with Generative Adversarial Networks. **(6+6)**

LIST OF EXPERIMENTS

1. Implementation of Perceptron, Multilayer Perceptron (MLP), and Backpropagation for Binary and Multiclass Classification.
2. Implementation and Evaluation of Deep Neural Networks using Optimization, Regularization, and Hyperparameter Tuning Techniques.
3. Design and Training of Convolutional Neural Networks (CNNs) for Image Classification and Transfer Learning Applications.
4. Implementation of Recurrent Neural Networks (RNNs), LSTM, and GRU for Sequential Data Analysis and Prediction.
5. Implementation of Autoencoders, Variational Autoencoders (VAE), and Generative Adversarial Networks (GANs) for Feature Learning and Image Generation.

Total L: 30 + P: 30 = 60 periods

TEXTBOOKS:

1. Aggarwal, Charu C, '*Neural Networks and Deep learning'*. 1st Edition, Springer Cham, 2018.

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courvill, '*Deep Learning'*. 1st Edition, MIT Press, USA, 2016.
2. Josh Patterson and Adam Gibson, '*Deep Learning – A Practitioner's Approach'*. 1st Edition, O'Reilly Series, August2017.
3. Indra den Bakker, '*Python Deep Learning Cookbook'.* 1st Edition, Packt Publishing, October 2017

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamentals, architectures, and applications of deep neural networks and deep learning models.	**K2**
CO2	Apply deep learning techniques and neural network models to image, text, and sequential data processing tasks.	**K3**
CO3	Analyze the performance, limitations, and computational challenges of various deep learning architectures.	**K4**
CO4	Evaluate and implement deep learning models and optimization strategies to solve real-world problems effectively.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2	3													
CO3		3												
CO4			2		1			2						
	3	**3**	**2**		**1**			**2**						

1-low, 2-medium, 3-high

25ADM04 MULTIVARIATE DATA ANALYTICS

2 0 2 3

INTRODUCTION TO MULTIVARIATE DATA ANALYSIS: Introduction to Multivariate Data – Types of Multivariate Techniques – Measurement Scales – Data Visualization for Multivariate Data – Missing Data Treatment – Outlier Detection – Standardization and Normalization. **(6+6)**

PREPARING DATA AND DIMENSION REDUCTION TECHNIQUES: Data Preparation for Multivariate Analysis – Testing Statistical Assumptions – Incorporating Non-metric Data using Dummy Variables – Principal Component Analysis (PCA) – Exploratory Factor Analysis (EFA) – Confirmatory Factor Analysis (CFA) – Factor Rotation Methods – Factor Scores and Interpretation – Singular Value Decomposition (SVD) – Multidimensional Scaling (MDS). **(6+6)**

CLASSIFICATION AND DISCRIMINATION METHODS: Linear Discriminant Analysis – Quadratic Discriminant Analysis – Logistic Regression – k-Nearest Neighbors – Support Vector Machines – Cross-validation Techniques. **(6+6)**

CLUSTERING AND SEGMENTATION TECHNIQUES: Introduction to Cluster Analysis – Hierarchical Clustering – Non-Hierarchical Clustering (k-Means Conceptual Approach) – Cluster Interpretation and Validation – Structural Equation Modelling (SEM) – Mediation Models – Moderation Models – Conditional Process Analysis – Introduction to Longitudinal Studies and Latent Variable Models. **(6+6)**

ADVANCED MULTIVARIATE TECHNIQUES: MANOVA – Conjoint Analysis – Correspondence Analysis – Multidimensional Scaling Applications – Introduction to Time Series Multivariate Analysis – Applications of Multivariate Techniques using Real-world Datasets from Business, Healthcare, Finance and Social Sciences – Case Studies and Interpretation of Results. **(6+6)**

LIST OF EXPERIMENTS

1. Data Preprocessing and Exploratory Analysis of Multivariate Datasets using Missing Value Treatment, Outlier Detection, Standardization, and Visualization Techniques.
2. Implementation of Principal Component Analysis (PCA), Factor Analysis, and Singular Value Decomposition (SVD) for Dimensionality Reduction.
3. Implementation and Performance Evaluation of Classification Techniques using Logistic Regression, Linear/Quadratic Discriminant Analysis, k-NN, and Support Vector Machines.
4. Implementation of Hierarchical Clustering and k-Means Clustering for Data Segmentation and Cluster Validation.
5. Application of Advanced Multivariate Techniques such as MANOVA, Multidimensional Scaling (MDS), and Correspondence Analysis on Real-World Datasets.

Total L: 30 + P: 30 = 60 periods

TEXTBOOKS

1. Joseph F. Hair, William C. Black, Barry J. Babin, Rolph E. Anderson, '*Multivariate Data Analysis'.* 7th Edition, Pearson, 2021
2. Richard A. Johnson and Dean W. Wichern, '*Applied Multivariate Statistical Analysis'.* 6th Edition, Pearson, 2020.

REFERENCES

1. James, Witten, Hastie, Tibshirani, '*An Introduction to Statistical Learning'*. Springer,2019.
2. Anderson, T. W., '*An Introduction to Multivariate Statistical Analysis'*. Wiley, 2022.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply foundational concepts of multivariate statistics to analyze complex datasets.	**K2**
CO2	Select appropriate multivariate techniques for real-world data problems.	**K3**
CO3	Interpret the results of multivariate models to support data-driven decision-making.	**K4**
CO4	Assess the suitability and implications of multivariate analysis techniques in various application domains.	

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1														
CO2	3													
CO3		3												
CO4			2		1			2						
	3	**3**	**2**		**1**			**2**						

1-low, 2-medium, 3-high

25ADM05 BIG DATA & AI INTEGRATION

3 0 0 3

BIG DATA ARCHITECTURE AND ECOSYSTEM: Characteristics of Big Data – 5 Vs – Big Data vs Traditional Data – Hadoop Architecture – HDFS – YARN – MapReduce Programming Model – NoSQL Databases (MongoDB, Cassandra) – Distributed File Systems – Spark Ecosystem – HBase, Hive, Pig. **(9)**

MACHINE LEARNING FOR BIG DATA: Overview of Supervised and Unsupervised Learning – Challenges of Machine Learning with Big Data – Distributed ML Algorithms – MLlib in Apache Spark – Regression, Classification, Clustering using Big Data Tools – Case Study: ML at Scale. **(9)**

DEEP LEARNING AND AI ON BIG DATA: Introduction to Deep Learning – CNN, RNN, LSTM Architectures – Deep Learning Frameworks (TensorFlow, PyTorch) – Integrating DL with Big Data using Spark + TensorFlow – Real-Time AI with Kafka + Spark Streaming – Use Cases in Vision and NLP. **(9)**

DATA PIPELINES AND INTELLIGENT ANALYTICS: Big Data Ingestion Tools – Apache NiFi, Kafka – ETL in Big Data – Data Lake Architecture – Real-Time Analytics – Feature Engineering at Scale – Model Deployment – AI/ML Model Lifecycle Management – MLOps Overview. **(9)**

APPLICATIONS, TRENDS, AND ETHICS: Big Data and AI Use Cases in Healthcare, Finance, Retail, Smart Cities – Generative AI for Big Data – Edge AI and Federated Learning – Privacy, Security, and Ethical Concerns – Responsible AI – Emerging Tools and Future Trends. **(9)**

Total L: 45 periods

TEXTBOOKS

1. Tom White, '*Hadoop: The Definitive Guide'*. 4th Edition, O'Reilly, 2015.
2. Aurobindo Sarkar and Amit Shah, '*Architecting Modern Data Platforms: A Guide to Enterprise Hadoop at Scale'*. Packt Publishing, 2016.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, '*Deep Learning'*. MIT Press, 2016.

REFERENCES

1. Dean Wampler, Jason Rutherglen, and Alex Payne, '*Programming Scala for Spark'*. O'Reilly Media, 2021.
2. Jules S. Damji, Brooke Wenig, Tathagata Das, and Denny Lee, '*Learning Spark: Lightning-Fast Big Data Analytics'*. 2nd Edition, O'Reilly, 2020.
3. Emmanuel Ameisen, '*Building Machine Learning Powered Applications'*. O'Reilly, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the architecture and tools in the big data ecosystem.	**K2**
CO2	Apply machine learning algorithms on large-scale data platforms.	**K3**
CO3	Analyze deep learning techniques and their integration with big data tools.	**K4**
CO4	Evaluate data pipelines and model deployment strategies at scale.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2	3													
CO3		3												
CO4			2		1			2						
	3	**3**	**2**		**1**			**2**						

1-low, 2-medium, 3-high

25ADM06 GEN AI TOOLS

2 0 2 3

INTRODUCTION: Generative AI – Working – Text Gen AI – Image Gen AI – Regulating the Use of Generative AI – Controversies Surrounding GenAI (deepfakes, misinformation, plagiarism) – Policy framework for Generative AI. **(6+6)**

FOUNDATIONAL TOOLS AND MODELS: Overview of foundational models: GPT, DALL·E, Stable Diffusion, BERT – Generative AI and Large Language Models – Understanding Large Language Models (LLMs) – Usage and Applications of LLMs – Training LLMs – Types of Generative AI Models and Challenges – Case Study: Evolution of GPT Models. **(6+6)**

PROMPT ENGINEERING FOR GENERATIVE AI: Fundamentals of Prompts – Types of Prompts: Zero-shot, Few-shot, Chain of Thought, ReAct – Creating Effective Prompts – Prompt Optimization Techniques – Ethics and Bias in Prompting – Tools and Platforms – Testing and Evaluation. **(6+6)**

GENERATION TOOLS: Text Generation – ChatGPT, Gemini (Google), Claude (Anthropic), Microsoft Copilot – Image Generation tools – DALL·E, Midjourney, Leonardo AI, Stable Diffusion – Audio & Video Generation Tools. **(6+6)**

CASE STUDIES: Generative AI for text to Image – AI powered tools for Linguistic and Sentiment Analysis – AI in ELT – The Human-Machine Nexus with Art-Making Generative AIs – Children's Book Visualizations from an Artmaking Generative AI. **(6+6)**

LIST OF EXPERIMENTS

1. Data Preprocessing and Exploratory Analysis of Multivariate Datasets using Missing Value Treatment, Outlier Detection, Standardization, and Visualization Techniques.
2. Implementation of Principal Component Analysis (PCA), Factor Analysis, and Singular Value Decomposition (SVD) for Dimensionality Reduction.
3. Implementation and Performance Evaluation of Classification Techniques using Logistic Regression, Linear/Quadratic Discriminant Analysis, k-NN, and Support Vector Machines.
4. Implementation of Hierarchical Clustering and k-Means Clustering for Data Segmentation and Cluster Validation.
5. Application of Advanced Multivariate Techniques such as MANOVA, Multidimensional Scaling (MDS), and Correspondence Analysis on Real-World Datasets.

Total L: 30 + P: 30 = 60 periods

TEXTBOOKS

1. Holmes, Wayne and Miao, Fengchun, UNESCO, '*Guidance for generative AI in education and research'*. 2023.
2. Anand Vemula, '*Mastering Prompt Engineering for Generative AI: Unlocking the Full Potential of AI Technology'*. Amazon Digital Services, 2024.
3. Marr, Bernard, '*Generative AI in Practice: 100+ Amazing Ways Generative Artificial Intelligence is Changing Business and Society'*. Wiley, 2024.

REFERENCES

1. Shalin Hai-Jew, '*Making Art with Generative AI Tools'*. IGI Global, 2024.
2. Nayef Jomaa, '*Using AI Tools in Text Analysis, Simplification, Classification, and Synthesis'*. IGI Global, 2025.
3. Numa Dhamani, Maggie Engler, '*Introduction to Generative AI'*. Manning Publications, 2024.
4. Babcock, Joseph, and Bali, Raghav, '*Generative AI with Python and TensorFlow 2'*. Packt Publishing, 2021

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the core concepts, evolution, architecture, and ethical concerns of Generative AI technologies, including foundational models such as GPT, DALL·E, BERT, and Stable Diffusion.	**K2**
CO2	Apply prompt engineering techniques and leading GenAI tools to create text, image, audio, and video content for real-world applications.	**K3**
CO3	Analyze case studies involving the use of Generative AI in education, art, language processing, and business to examine their impact and limitations.	**K4**
CO4	Evaluate the ethical concerns, regulatory frameworks, and societal implications of Generative AI technologies across various domains.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2	3													
CO3		3												
CO4			2		1			2						
	3	3	2		1			2						

1-low, 2-medium, 3-high

25ADM07 PROMPT ENGINEERING

2 0 2 3

INTRODUCTION TO PROMPT ENGINEERING: Evolution of Language Models – GPT – BERT – T5 – Claude – Understanding Prompt Engineering – Definition – History – Significance – Prompt Engineering vs. Fine-Tuning – Applications of Prompt Engineering in NLP and Intelligent Systems. **(6+6)**

LARGE LANGUAGE MODELS: Transformer Architecture Basics – Pre-training – Fine-tuning – In-Context Learning – Emergent Capabilities – Tokenization – Embeddings – Attention Mechanism – Foundation Models and Generative AI Applications. **(6+6)**

PROMPTING TECHNIQUES: Zero-shot Prompting – One-shot Prompting – Few-shot Prompting – Chain-of-Thought Prompting – Instruction-based Prompting – Prompt Tuning vs. Parameter Tuning – Role Prompting – Context Engineering Techniques. **(6+6)**

OPTIMIZING PROMPTS: Prompt Design Patterns – Prompt Templates – Prompting for Classification, Summarization, Generation and Question Answering – Evaluation Metrics: BLEU, ROUGE, Perplexity and Human Evaluation – Bias, Ethics and Safety in Prompt Design. **(6+6)**

APPLICATIONS OF PROMPT ENGINEERING: Multimodal Prompt Engineering for Text, Image, Video and Code – Code Generation – Reasoning with Prompts – Prompt Marketplaces and APIs – OpenAI – Anthropic – Google – Cohere – Building Applications using LLMs: Chatbots, Virtual Assistants and Automation Systems. **(6+6)**

LIST OF EXPERIMENTS

1. Exploration of Large Language Models (LLMs) and Prompt Engineering Fundamentals using GPT-based Models.
2. Design and Evaluation of Zero-shot, One-shot, Few-shot, and Chain-of-Thought Prompting Techniques for NLP Tasks.
3. Development of Prompt Templates for Classification, Summarization, Question Answering, and Content Generation Applications.
4. Implementation and Optimization of Role-based, Instruction-based, and Context-aware Prompts with Performance Evaluation.
5. Building AI Applications using Prompt Engineering for Chatbots, Code Generation, and Multimodal Content Generation**.**

Total L: 30 + P: 30 = 60 periods

TEXTBOOK

1. Hunter, Nathan, *'The Art of Prompt Engineering with ChatGPT'*. Shroff Publishers, 2024.

REFERENCES

1. Martin Ford, '*Architects of Intelligence: The Truth About AI from the People Building It'*. Packt Publishing, 2024 Revised Edition.
2. Ashish Vaswani et al., ' *Attention Is All You Need'.* arXiv preprint arXiv:1706.03762, 2017.
3. Rishi Bommasani et al., '*On the Opportunities and Risks of Foundation Models'*. Stanford CRFM, 2021.
4. OpenAI Cookbook – https://github.com/openai/openai-cookbook

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the fundamentals of prompt engineering, transformer architecture, and large language models used in generative AI systems.	**K2**
CO2	Apply prompting techniques and prompt optimization strategies for solving NLP and generative AI tasks.	**K3**
CO3	Analyze the effectiveness of prompts, tuning strategies, and evaluation metrics in improving LLM performance.	**K4**
CO4	Evaluate ethical issues, safety concerns, and reliability of large language model applications in real-world scenarios.	**K5**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1														
CO2	3													
CO3		3												
CO4			3		3			2						
	3	**3**	**3**		**3**			**2**						

1-low, 2-medium, 3-high

25ADM08 ETHICS IN AI

3 0 0 3

INTRODUCTION TO AI ETHICS: Definition and Scope of AI Ethics – Historical Context and Evolution of AI – Key Ethical Theories and Their Application to AI – Importance of Ethics in AI Development – Overview of Ethical Challenges in AI Systems. **(9)**

TRUST, RESPONSIBILITY, AND LIABILITY: Building Trust in AI Systems – Assigning Responsibility in AI Decision-Making – Legal and Moral Liability in AI Actions – Accountability Mechanisms for AI Developers and Users – Case Studies on Responsibility and Liability in AI. **(9)**

PRIVACY, RISK, AND SAFETY: Data Privacy Concerns in AI Applications – Risk Assessment and Management in AI Systems – Ensuring Safety in Human-AI Interactions – Ethical Implications of Surveillance and Data Collection – Strategies for Mitigating Ethical Risks in AI. **(9)**

HUMAN-AI INTERACTION AND SOCIAL IMPACT: Ethical Considerations in Human-Robot Interaction – Impact of AI on Employment and Society – Bias and Fairness in AI Algorithms – Cultural and Societal Implications of AI Deployment – Promoting Inclusivity and Equity in AI Systems. **(9)**

APPLICATIONS AND FUTURE DIRECTIONS: Ethical Challenges in Autonomous Vehicles – AI in Military and Defense: Ethical Considerations – Addressing Algorithmic Bias and Discrimination – Developing Ethical Frameworks for Emerging AI Technologies – Future Trends and the Role of Ethics in AI Advancement. **(9)**

Total L: 45 Periods

TEXTBOOKS

1. Christoph Bartneck, Christoph Lütge, Alan Wagner and Sean Welsh, '*An Introduction to Ethics in Robotics and AI'*. Springer Nature, 2021.
2. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield, '*The Ethics of Artificial Intelligence: Issues and Initiatives'*. EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA), PE 634.452, March 2020.
3. Patrick Lin, Keith Abney and George A. Bekey, '*Robot Ethics: The Ethical and Social Implications of Robotics'*. MIT Press, January 2014.

REFERENCES

1. Bernd Carsten Stahl, Doris Schroeder and Rowena Rodrigues, '*Ethics of Artificial Intelligence: Case Studies and Options for Addressing Ethical Challenges'*. Springer Nature, 2023.
2. Dan Hendrycks, '*Introduction to AI Safety, Ethics, and Society'*. 2023.
3. Mark Coeckelbergh, '*AI Ethics'*. MIT Press, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the ethical principles, moral theories, and societal implications associated with artificial intelligence systems and applications.	**K2**
CO2	Apply AI ethics, standards, regulations, and responsible AI practices to real-world intelligent systems and autonomous applications.	**K3**
CO3	Analyze ethical challenges related to privacy, bias, fairness, accountability, and societal impact in AI-driven environments.	**K4**
CO4	Evaluate ethical frameworks, safety mechanisms, and governance strategies for responsible AI development and deployment in diverse domains.	

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2	3													
CO3		3												
CO4						3		3						
	3	**3**				**3**		**3**						

1-low, 2-medium, 3-high

LANGUAGE ELECTIVES

25HS211 COMMUNICATION SKILLS FOR ENGINEERS
(Common to all B.E./B.Tech. Programmes)

0 0 4 2

COMMUNICATION CONCEPTS: Process of Communication – Inter and Interpersonal Communication – Essentials for effectiveness. **(9)**

ORAL COMMUNICATION: Oral presentations with visual aids and Group discussions. **(16)**

FOCUS ON SOFT SKILLS: Etiquette – Work Place etiquette – Telephone etiquette- Body Language – Critical Reasoning and Conflict Management based on Case Studies – Group Communication- Meetings -Interview Techniques. **(14)**

TECHNICAL WRITING: Technical Writing Principles - Style and Mechanics - Technical Definitions – Physical, Functional and Process Descriptions – Technical Report Writing – Preparing Instructions – Interpretation of Technical Data. **(14)**

BUSINESS CORRESPONDENCE: Writing Emails, Preparing Resumes. **(7)**

Total P: 60 periods

TEXT BOOKS

1. Course materials prepared by the Faculty, '*Department of English'.* PSG Institute of Technology and Applied Research, Neelambur, Coimbatore.

REFERENCES

1. Jeff Butterfield, '*Soft Skills for Everyone*'. Cengage Learning, New Delhi, 2020.
2. Sabina Pillai, and Agna Fernandez, '*Soft skills and Employability Skills*'. Cambridge University Press, New Delhi, 2019.
3. Prashant Sharma, '*Soft Skills Personality Development for Life Success*'. BPB Publications, New Delhi, 2021.
4. K. N. Shoba, and D. Praveen Sam, '*Technical English*'. Cambridge University Press, New York, 2020.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Produce clear and concise technical reports, compose professional and effective emails and develop well-structured and impactful resumes	**K2**
CO2	Plan, organize, and deliver engaging and informative presentations using appropriate visual aids and participate positively in group discussions	**K3**
CO3	Resolve disagreements constructively, embody professional conduct and a strong work ethic and apply critical thinking to generate effective solutions	**-**

COs-POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1										2			
CO2										3			
CO3									3	3			
									3	**3**			

1-low, 2-medium, 3-high

25HS212 BASIC GERMAN
(Common to all B.E./B.Tech. Programmes)

0 0 4 2

Guten Tag! - Learning: To greet, learn numbers till 20, practice telephone numbers & e mail address, learn alphabet, speak about countries & languages; **Vocabulary:** related to the topic; **Grammar:** W – Questions, Verbs & Personal pronouns I.

Freunde, Kollegen und ich - Learning: To speak about hobbies, jobs, learn numbers from 20; **Vocabulary:** related to the topic; **Grammar:** Articles, Verbs & Personal pronouns II, sein & haben verbs, ja/nein Frage, singular/plural.

In der Stadt – Learning: To know places, buildings, question, know transport systems, understand international words; **Vocabulary**: related to the topic; **Grammar:** Definite & indefinite articles, Negotiation, Imperative with Sie.
Guten Appetit! – Learning: To speak about food, shop, converse; **Vocabulary:** related to the topic; **Grammar:** Sentence position, Accusative, Accusative with verbs.

Tag für Tag and Zeit mit Freunden – Learning: To learn time related expressions, speak about family, ask excuse, fix appointments on phone, birthdays, understand & write invitations, converse in the restaurant; **Vocabulary:** related to the topic; **Grammar:** Preposition – am, im, um, von…bis, Possessive articles, Modal verbs.

Total P: 60 periods

TEXT BOOK:

1. Dengler, Stefanie et al., '*Netzwerk A1.1*'. Klett-Langenscheidt Gmbh, München, 2013.

REFERENCES:

1. Dengler, Stefanie et al., '*Netzwerk A1'.* Klett-Langenscheidt Gmbh München, 2013.
2. Sandra Evans, Angela Pude, and Franz Specht, '*Menschen A1*'. Hueber Verlag, 2012.
3. Hermann Funk, Christina Kuhn, and Silke Demme, '*Studio d A1*'. Goyal Publishers & Distributors Pvt. Ltd, 2009.
4. Rosa-Maria Dallapiazza, Eduard von Jan, '*Til Schönherr*'. Tangram Aktuell 1 (Deutsch als Fremdsprache), Max Hueber Verlag, 2004.

25HS213 BASIC JAPANESE
(Common to all B.E./B.Tech. Programmes)

0 0 4 2

Orientation Session, Geographic & Socio, economic perspective to Japan, Japanese people and culture and Basic greetings and responses.

Basic script, Method of writing hiragana and katakana, and Combination sounds and simple words.

Topic marker "wa", Desu / dewa arimasen cupolas, Interrogative particle "ka", Grammar particles "mo", "no", "Introducing someone: "Kochira wa ~" and Self introductions: Hajimemashite"

Demonstratives "Kore", "Sore", "Are", Demonstrative "Kono", "Sono", "Ano", Possessive noun particle "no" and Japanese apartments: Greeting your neighbor.

Place markers "Koko", "Soko", "Asoko", Direction markers "Kochira", "Sochira", "Achira" and Japanese department stores: Asking for and buying something.

Asking for and telling the time, Particle "ni (at)" for time, kara (from) ~ made (until), Particle "to (and)", Time periods: Days of the week, months, time of day, Verbs (Present / future and past tense) and Telephone enquiry: Asking for a phone no. And business hours.

Destination particle "e", Particles "de (mode of transportation)" and "to (with) and Japanese train station: Asking for Fare and track no. / types of trains.

Direct object particle "o", Particle "de (place of action)", Verbs ("~masen ka", "~mashou") and "Ohanami" Cherry blossom viewing.

Particle "de (by means of)", Particle "ni (to)", Aaemasu (give) and Moraimasu (receive) and Visiting a Japanese house.
Adjectives ("i" and "na" type), Adjectives (Positive and negative usage), Particle "ga (however, but), "Dore which?)" and Leaving a room, thanking someone for hospitality.

Likes and dislikes, Potential verbs (wakarimasu and dekimasu), "Kara (~ because)", Adverbs and Asking someone out over the phone.

Verbs denoting presence: "Imasu" and "arimasu", Particle "ni (in)", "Dare (who?)", Adverbs ("Chikaku ni ~ "), Particle "dare mo (negative ~ no one)" , Dare ka (anyone), dare ga (who) , Nani ka (anything) , nani ga (what) - ~ya (and) ~ nado (etc.) and Asking for directions.

Counters and Counting suffixes.

Introduction to Adjectives (na and ii type), Different usages of adjectives, Comparison, Likes and dislikes and Going to a trip.

Need and desire (ga hoshii), Wanting to … (Tabeti desu), Going for a certain purpose (mi –ni ikimasu) and Choosing from a menu.
Verb groups, I, II and III and Exercises to group verbs.

Please do (te kudasai), Present continuous tenses (te imasu), Shall I? (~ mashou ka) and Describing a natural phenomenon (It is raining).
To grant permission (~te mo ii desu), Asking for permission (~ te mo ii desu ka) and Should not do (~ te waikemasen) Describing a continuing state and Describing a habitual action.
Roleplays in Japanese.
A demonstration on usage of chopsticks and Japanese tea party. **Total P: 60 periods**

TEXT BOOK

1. '*Minna no nohongo'.* – Romaji ban (first 10 lessons of this book).

REFERENCE

1. '*Minna no Nihongo I Honsatsu Roma – ji ban (Main Textbook Romanized Version)'.* International publisher – 3A Corporation,Tokyo, Indian distributor – Goyal Publishers & Distributors, New Delhi

MANDATORY COURSES
25MC001 ENVIRONMENTAL SCIENCES
(Common to B.E./B.Tech. Programmes)

3 0 0 3

INTRODUCTION TO ENVIRONMENT: Environment - Definition, scope and importance. Types and composition of atmosphere – particles, ions and radicals. Ozone layer- significance, formation and depletion. Ecosystems- Structure and functions, components, energy flow, food chains, food web, Biodiversity-levels, values and threats – India as a mega-diversity nation, hotspots of biodiversity, endangered and endemic species of India, conservation of biodiversity. **(9)**

ENERGY RESOURCES: Introduction – National and International status- exploitation - sustainable strategies- Fossil fuels-classification, composition, physico-chemical characteristics and energy content of coal, petroleum and natural gas; solar energy - introduction, harnessing strategies. Wind energy - availability, wind power plants, wind energy conversion systems, site characteristics, and types of wind turbines. Supporting renewable energy resources -tidal, geothermal, hydroelectric. **(9)**

ENVIRONMENTAL POLLUTION: Definition, Sources, causes, impacts and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards, RF hazards, Role of an individual in prevention of pollution. Disaster Management: Floods, earthquake, cyclone and landslides – Case studies, consequences and rescue measures. **(9)**

WASTE MANAGEMENT: Waste water - Characteristics of domestic and industrial wastewater - COD and BOD, Various stages of treatment – primary, secondary, tertiary treatment- Biological and advanced oxidation processes. Solid waste management – Characteristics of municipal solid waste (MSW), biomedical, automobile and e-wastes and their management, landfills, incineration, pyrolysis, gasification and composting**.** **(9)**

SOCIAL ISSUES AND THE ENVIRONMENT: Environmentally Sustainable work practices- Rain water harvesting, Role of non-governmental organizations. Human ethics and rights- impact on environment and human health, role of information technology on environment and human kind. Green IT policies, Process of EIA - ISO 14000. Legislation- Environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act. **(9)**

Total L: 45 periods

TEXT BOOKS:

1. Gilbert M. Masters, '*Introduction to Environmental Engineering and Science*'. Pearson Education, New Delhi, 2004.
2. Deswal S and Deswal A, '*A Basic Course in Environmental Studies*'. Dhanpat Rai and Co, New Delhi, 2004.

REFERENCES:

1. Benny Joseph, '*Environmental Science and Engineering*'. Tata McGraw - Hill, New Delhi, 2006.
2. Koteswara Rao M V R, '*Energy Resources: Conventional & Non – Conventional*'. BSP Publications, New Delhi, 2006.
3. Botkin and Keller, '*Environmental Science*'. Wiley India Private Limited, New Delhi, 2013.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the basic concepts of environment, energy sources and waste management	**K2**
CO2	Use different renewable energy resources and environment protection measures for sustainable development	**K3**
CO3	Conduct a case study on real-time environmental issues and present findings as a team	**-**

COs-POs & PSOs MAPPING:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1														
CO2	1													
CO3						2	2	2			2			
	1					**2**	**2**	**2**			**2**			

1-low, 2-medium, 3-high

25MC002 INDIAN CONSTITUTION
(Common to B.E./B.Tech. Programmes)

2 0 0 0

INTRODUCTION: Evolution of Indian Constitution; significance of constitution; Composition; Preamble and its Philosophy. **(4)**

RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES: Fundamental Rights- Writs and Duties, Directive Principles of State Policy. **(5)**

UNION GOVERNMENT: Union Government, President and Vice President, Houses of the Parliament and their functions; Types of Bills, Stages of passing of Bill into an Act, Veto Power, Constitution Amendment Procedure, Various Amendments made and their significance for India. **(6)**

STATE GOVERNMENT AND FEDERALISM: Composition of State Legislature; Powers, Functions and Position of Governor, Function of Chief Ministers, Council of Ministers; The Indian Federal System, Administrative Relationship between Union and States. **(8)**

JUDICIARY: Supreme Court, High Court; District Court and Lower Courts - Functions and Powers – Judges – Qualifications and Powers - Judicial Review. **(7)**

Total L: 30 periods

TEXT BOOKS:

1. Subash C Kashyap, '*Our Political System*'. National Book Trust, 2011.
2. Praveenkumar Mellalli E, '*Constitution of India, Professional Ethics and Human Rights*'. Sage Publications India Pvt. Ltd., 2015.

REFERENCES:

1. Briji Kishore Sharma, '*Introduction to the Constitution of India*'. Prentice Hall of India, 2010.
2. Basu D D, '*Introduction to the Constitution of India*'. Prentice Hall of India, 2016.
3. Jain. M C, '*The Constitution of India*'. Law House, New Delhi, 2001.
4. Shukla V N, '*Constitution of India*'. Eastern Book Company Ltd., New Delhi, 2011.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the evolution, significance, and philosophy of the Indian Constitution, including its Preamble, composition, and core principles.	**K2**
CO2	Analyze the structure, powers, and functions of the Union and State Governments, including the roles of the President, Parliament, Governor, and Council of Ministers, as well as the legislative process, types of bills, and constitutional amendments.	**K4**
CO3	Conduct a case study on the Indian Constitution, demonstrating understanding of its evolution, fundamental rights and duties, structure of Union and State governments, federal system, and the role of the judiciary in governance.	**-**

COs-POs & PSOs MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2	2													
CO3								2	2		2			
	2							**2**	**2**		**2**			

1-low, 2-medium, 3-high

25MC003 INDUSTRIAL SAFETY
(Common to B.E./B.Tech. Programmes)

2 0 0 0

SAFETY TERMINOLOGIES: Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) -Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects-Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS. **(6)**

STANDARDS AND REGULATIONS: Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006. **(6)**

SAFETY ACTIVITIES: Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment. **(6)**

WORKPLACE HEALTH AND SAFETY: Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release. **(6)**

HAZARD IDENTIFICATION TECHNIQUES: Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment. **(6)**

Total L: 30 periods

TEXTBOOKS

1. Jain R. K. and Sunil S. Rao, '*Industrial Safety, Health and Environment Management Systems*'. Khanna Publisher, 4th Edition, 2000.
2. Deshmukh L. M., *'Industrial Safety Management: Hazard Identification and Risk Control'.* McGraw-Hill Education, 2007.

REFERENCES

1. John Ridley, John Channing, '*Safety at Work*'. Routledge, 7th Edition, 2008.
2. Dan Petersen, '*Techniques of Safety Management*: *A System Approach*'. Amer Society of Safety Engineers, 4th Edition, 2003.

COURSE OUTCOMES

At the end of the course, students will be able to		**Bloom's Level**
CO1	Describe the safety protocols and standard operating procedures in industrial settings to ensure compliance with safety regulations and minimize hazards in the workplace.	**K2**
CO2	Implement and test emergency response plans tailored to the industrial environments, ensuring effective action during emergencies such as fires, chemical spills or equipment malfunctions.	**K3**
CO3	Review and present on risk assessments and hazards using industry-specific tools to identify potential safety risks and choose appropriate corrective actions to prevent accidents and injuries.	**-**

CO - PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1													
CO2	2					2	2						
CO3						1	1	1	1		1		1
	2					**2**	**2**	**1**	**1**		**1**		**1**

1 - low, 2- medium, 3 – high

25MC004 DISASTER RISK REDUCTION AND MANAGEMENT
(Common to B.E./B.Tech. Programmes)

2 0 0 0

HAZARDS, VULNERABILITY AND DISASTER RISKS: Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced – Earthquake, Landslide, Flood, Drought, Fire, etc. – Technological disasters - Structural collapse, Industrial accidents, oil spills - Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, Inter relations between Disasters and Sustainable development Goals. **(6)**

DISASTER RISK REDUCTION (DRR): Sendai Framework for Disaster Risk Reduction, Disaster cycle - Community Based DRR, Structural – Non-structural measures, Roles and responsibilities of - community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders - Early Warning System – Relevance of indigenous Knowledge, appropriate technology and Local resources. **(6)**

DISASTER MANAGEMENT: Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction - Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Institutional Processes and Framework at State and Central Level - (NDMA – SDMA – DDMA – NRDF - Civic Volunteers). **(6)**

TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT: Early warning systems - Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness) – Role of GIS and Information Technology in Disaster Management – Disaster Damage Assessment - Elements of Climate Resilient Development – Standard operation Procedure for disaster response – Financial planning for disaster Management. **(6)**

DISASTER MANAGEMENT: CASE STUDIES: Case studies in the context of disasters - Landslide Hazard Zonation, Earthquake Vulnerability Assessment of Buildings and Infrastructure, Drought Assessment, Coastal Flooding, Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding, Forest Fire, Man Made disasters. **(6)**

Total L: 30 periods

TEXTBOOKS

1. Thomas D. Schneid, and Larry Collins, '*Disaster Management and Preparedness*'. CRC Publications, 2016.
2. R. Singh, '*Disaster Management Guidelines: Earthquakes, Landslides, Avalanches and Tsunami'*. Horizon Press Publications, 2017.
3. J. P. Singhal, '*Disaster Management'*. Laxmi Publications, 2024.
4. T. Bhattacharya, '*Disaster Science and Management'*. McGraw Hill India Education Pvt. Ltd., 2012.

REFERENCES

1. Government of India, '*Disaster Management Act'*. New Delhi, 2005.
2. Government of India, '*National Disaster Management Policy'*. New Delhi, 2009.
3. R. Shaw, '*Community based Disaster risk reduction*'. Natural Hazard Science, Oxford Research Encyclopedias, 2016.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Summarize the concepts, tools, technologies and strategies for disaster risk reduction and management.	**K2**

COs-POs & PSOs MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1					1	1	1	1	1		1		
					1	**1**	**1**	**1**	**1**		**1**		

1-low, 2-medium, 3-high

25MC005 INDIAN KNOWLEDGE SYSTEMS FOR SUSTAINABLE HUMAN DEVELOPMENT

2 0 0 0

INTRODUCTION TO INDIAN KNOWLEDGE SYSTEMS & HUMAN DEVELOPMENT (6)

- Meaning, scope, and significance of Indian Knowledge Systems
- Indian view of life: Purusharthas (Dharma, Artha, Kama, Moksha)
- Relationship between individual, society, and nature
- Relevance of IKS in modern education and engineering

INDIAN PERSPECTIVES ON SUSTAINABILITY & ECOLOGY (6)

- Indian worldview on nature: Pancha Mahabhutas
- Traditional water management, agriculture, and resource conservation
- Sustainable lifestyles in Indian traditions
- Comparison with modern sustainable development goals (SDGs

HEALTH, WELL-BEING & HUMAN POTENTIAL IN IKS (6)

- Indian concept of health: Body–Mind–Spirit integration
- Introduction to Ayurveda & Yoga for sustainable health
- Mental health and emotional balance in Indian wisdom
- Food, nutrition, and lifestyle from IKS perspective
- Preventive healthcare through traditional knowledge

ETHICS, VALUES & SOCIAL SUSTAINABILITY (5)

- Work ethics and leadership in Indian tradition
- Gender dignity and social justice in Indian thought
- Professional ethics through IKS

IKS, TECHNOLOGY & SUSTAINABLE DEVELOPMENT (7)

- Science and technology in ancient India
- Sustainable engineering in traditional architecture and town planning
- Metallurgy, textiles, and indigenous manufacturing systems
- IKS and modern innovation ecosystems and ethical responsibility
- Role of engineers in sustainable human development **Total L: 30 periods**

TEXTBOOKS

1. Dharampal, '*Indian Science and Technology in the Eighteenth Century'*.
2. Kapil Kapoor, *'Indian Knowledge Systems'*.
3. S Radhakrishnan, *'Indian Philosophy'*.
4. B K Matilal, '*The Character of Logic in India'*.
5. '*UGC–IKS Documents and AICTE IKS Modules'*.
6. David Frawley, '*Ayurvedic Healing'*.
7. *'IIT-IKS Foundation Course Materials'*.
8. 'Ministry of Education – IKS Portal Resources'.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the core concepts and evolution of Indian Knowledge Systems.	**K2**
CO2	Interpret Indian views on human development, ethics, and sustainability.	**K3**
CO3	Apply IKS principles to sustainable living and professional practices.	**K3**
CO4	Demonstrate social, ecological, and ethical responsibility in real-life situations.	**K3**

COs - POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						3	2				3
CO2						3	3				2
CO3			2			3	3		2	2	
CO4				2		3	3	2			
			2	**2**		**3**	**3**	**2**	**2**	**2**	**3**

1 - low, 2- medium, 3 - high

25MC006 STRATEGIC DATA MANAGEMENT AND GOVERNANCE
(Common to B.E./B.Tech. Programmes)

2 0 0 0

INTRODUCTION TO STRATEGIC DATA MANAGEMENT
Data and Its strategic Value; Types of Data, Data as a Source of Competitive Advantage; The Data Lifecycle; Aligning Data Management with Business Goals; Data Management challenges in Contemporary Organizations; Overview of Data driven Decision making. **(6)**

DATA GOVERNANCE AND FRAMEWORK
Introduction to Data Governance; Data Management Frameworks (DAMA-DMBOK, COBIT, ISO Data management Standards); Structuring Data Leadership Roles; Implementation of Data Policies and Standards. Master Data Management (MDM) and API Integration. **(6)**

DATA PRIVACY, ETHICS AND QUALITY MANAGEMENT
Data Privacy and Protection Regulations (DPDP Act, GDPR); Principles and Importance of Ethical data management; Ethical decision-making models; Key data Quality Dimensions; Role of Data Quality in Effective Decision-Making; Tools and techniques for ensuring data quality. **(6)**

DATA LITERACY AND ORGANIZATIONAL TRANSFORMATION
Role of Data Literacy in Modern Organisations; Strategies for implementing data-driven transformation; Communication and training for Overcoming Resistance to Change; Cross-Functional Collaboration across Organisational Departments; Fostering a Data-Driven Culture **(6)**

DATA ARCHITECTURE AND RECENT TRENDS
Business Intelligence (BI) Architecture; Big Data Ecosystem; AI/ML data pipelines in Business enterprises, Strategic Planning for Data Infrastructure; Build vs. Buy Decisions for Data Platforms; Generative AI in Data Management. **(6)**

Total L: 30 periods

TEXT BOOKS

1. Ladley, J. & Ladley, A. '*Data Governance: How to Design, Deploy, and Sustain an Effective Data Governance Program* (3rd ed.)'. Morgan Kaufmann (Elsevier).
2. Eryurek, E., Gilad, U., Kaye, B., Sicular, S., & Schur, E. (2021). '*Data Governance: The Definitive Guide: People, Processes, and Tools to Operationalize Data Trustworthiness'*. O'Reilly Media.

REFERENCE BOOKS

1. Plotkin, D. (2020). '*Data Stewardship: An Actionable Guide to Effective Data Management and Data Governance* (2nd ed.)'. Academic Press (Elsevier).2020.
2. DAMA International. (2024). '*DAMA-DMBOK: Data Management Body of Knowledge* (2nd ed. Revised)'. Technics Publications.2024.
3. Loukides, M., Mason, H., & Patil, D. J. (2018). '*Ethics and Data Science'*. O'Reilly Media.2018.

COURSE OUTCOMES:

At the end of the course, students will be able to:		Bloom's Level
CO1	Understanding the Management role in leveraging data for competitive advantage and strategic decision-making.	**K2**
CO2	Applying governance frameworks to design policies, roles, and standards.	**K3**
CO3	Analyzing ethical challenges in data management to improve data-literacy across organization departments.	**K4**
CO4	Evaluating enterprise data architecture and modern platforms for making strategic decisions on Data Management.	**K5**

COs - POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2				3				3	3
CO2			2			2	3	2		3	
CO3						3	3		3		2
CO4	2		2	2	3	2				3	2
	2	**2**	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**3**

1 - low, 2- medium, 3 - high

25MC007 PROFESSIONAL ETHICS
(Common to B.E./B.Tech. Programmes)

2 0 0 0

INTRODUCTION TO THE CONCEPTS OF ETHICS: Introduction to ethics – meaning, definition, dimensions of ethics, determinants and consequences of ethics; ethical dilemmas – types of ethical dilemmas. Morality – definition, types of moral values, levels of moral development. Ethics Versus morality. Professional Ethics – definition, components, types and significance. **(6)**

PSYCHOLOGY OF ETHICAL BEHAVIOUR: Attitude – components of attitude in promoting ethical behaviour; Motivation – human drives as a trigger for ethical behaviour; Role of Cognitive biases (self-serving bias, incrementalism and overconfidence bias) in shaping ethical behaviour. **(6)**

WORKPLACE ETHICAL BEHAVIOURS: Integrity, honesty, accountability, responsibility, fairness, civic virtue, conscientiousness, empathy, self-confidence, character, respect for others, transparency, loyalty. **(6)**

APPLICATION AREAS OF ETHICS: Application of Ethics in different fields - Engineering ethics, medical ethics, financial ethics, technological ethics, scientific ethics, legal ethics, business ethics, environmental ethics. **(6)**

INDICATORS OF PROFESSIONAL ETHICS IN ORGANIZATIONS: Corporate Governance – Definition, importance, Theories of Corporate Governance: Agency Theory, Stewardship theory, Stakeholder Theory, Resource Dependency Theory. Corporate Social Responsibility – Definition, Models of CSR. **(6)**

Total L: 30 periods

TEXT BOOKS

1. Govindarajan M, Natarajan S and Senthil Kumar VS, *'Engineering Ethics'*. Prentice Hall of India, New Delhi, 2013.
2. Stephen P. Robbins, *'Essentials of Organizational Behaviour'.* Pearson Education, 2023.
3. Subramanian. R. '*Professional Ethics'*. Oxford Publication, 2013.
4. Nagarasan. R.S. *Professional Ethics and Human Values'.* New Age International Publications, 2006.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the fundamental concepts of ethics, morality and the psychological principles behind ethical behaviour.	**K2**
CO2	Demonstrate the application of core ethical values in the different situations of the workplace.	**K3**
CO3	Analyze the ethical issues, challenges in different professional domains and the application of ethical principles to solve the issues	**K4**
CO4	Evaluate the relevance and effectiveness of corporate governance theories and CSR models in addressing ethical and managerial challenges in organizations.	**K5**

COs - POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						2	3				3
CO2						2	3	3	2		
CO3		2	2			3	3				
CO4						3	3	2		3	2
		2	**2**			**3**	**3**	**3**	**2**	**3**	**3**

1 - low, 2- medium, 3 - high

25HSO01 PHYSICAL EDUCATION
(Common to all B.E./B.Tech./B.Des. Programmes)

0 0 2 0

INTRODUCTION TO PHYSICAL EDUCATION: Importance and scope of physical education, Physical fitness and exercise fundamentals, Conditioning and calisthenics exercises, Posture, flexibility, balance, and coordination, Warm-up, cool-down, and relaxation techniques, Basics of injury prevention and first aid practices, Importance of teamwork, discipline, and sportsmanship

BASIC GYMNASTICS AND MOVEMENT EXERCISES: Warm-up exercises, conditioning drills, movement education, balance exercises, floor exercises, tumbling basics, swinging and grip exercises, simple apparatus activities, lead-up games, coordination drills, and safety practices.

SKILL DEVELOPMENT IN ANY ONE OF THE FOLLOWING OUTDOOR GAMES: Basketball, Volleyball, Ball Badminton, and Football.

SKILL DEVELOPMENT IN ANY ONE OF THE FOLLOWING INDOOR GAMES: Shuttle Badminton, Chess, Carrom, and Table Tennis.

Total P: 30 Periods

WEIGHTAGE
Continuous Assessment: 100%

ASSESSMENT
Attendance and Participation – 70%
Practical Assessment of Physical Fitness and Sports Skills – 30%

REFERENCES:

1. Singh, A. '*Essentials of Physical Education'*. Kalyani Publishers.
2. Kamlesh, M.L. '*Psychology in Physical Education and Sport'*.
3. Mangal, S.K. '*Psychology of Sports Performance'*. Sports Publication.
4. Kandappan, K. '*Foundations of Physical Education'*. Friends Publications.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Demonstrate basic movement, balance, coordination, and fitness exercises with proper technique and safety awareness.	**K2**
CO2	Demonstrate physical fitness parameters such as endurance, agility, flexibility, speed, and strength through regular participation in physical activities.	**K2**
CO3	Develop teamwork, discipline, leadership qualities, and sportsmanship through participation in games and group activities.	**K3**
CO4	Adopt active lifestyle habits and participate regularly in physical and recreational activities for overall well-being.	**K3**

COs - POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1							2	3			2
CO2						2		3			3
CO3							3	3	2		2
CO4						2	2	3			3
						2	**3**	**3**	**2**		**3**

1 - low, 2- medium, 3 - high

25HSO02 YOGA AND HEALTH
(Common to all B.E./B.Tech./B.Des. Programmes)

0 0 2 0

INTRODUCTION TO YOGA: Yoga as a tool for physical and mental wellness, Importance of posture, breathing, relaxation, and mindfulness, Role of yoga in stress management and lifestyle balance, Basic guidelines and safety precautions for yoga practice, Introduction to healthy habits including sleep hygiene, nutrition, and digital well-being

SURYA NAMASKAR – TYPES OF POSTURES: Pranamasana (Prayer Pose), Hastauttanasana (Raised Arms Pose), Padahastasana / Hastapadasana (Standing Forward Bend), Ashwa Sanchalanasana (Equestrian Pose), Dandasana (Plank Pose), Ashtanga Namaskara (Eight-Limbed Salutation), Bhujangasana (Cobra Pose), Adho Mukha Svanasana (Downward-Facing Dog), Ashwa Sanchalanasana (Equestrian Pose), Padahastasana (Standing Forward Bend), Hastauttanasana (Raised Arms Pose), and Pranamasana (Prayer Pose).

BASIC ASANAS:

1. Standing – Tadasana, Utkatasana, Trikonasana, Virabhadrasana, and Vrikshasana
2. Sitting – Sukhasana, Dandasana, Paschimottanasana, Vajrasana, and Gomukhasana
3. Prone Position – Bhujangasana, Salabhasana, Dhanurasana, Makarasana, and Urdhva Mukha Svanasana
4. Supine Position – Apanasana, Viparita Karani, Supta Baddha Konasana, Ardha Halasana, and Savasana

PRANAYAMA TECHNIQUES & MUDRAS: Ujjayi, Nadi Shodhana, Sheetali, Sitkari, Kapalabhati, Bhastrika, and Bhramari. Gyan Mudra (Chin Mudra), Prana Mudra, Apana Mudra, Vayu Mudra, Prithvi Mudra, Varun Mudra, Surya Mudra, Shunya Mudra, Linga Mudra, and Anjali Mudra.

Total P:30 Periods

WEIGHTAGE: Continuous Assessment: 100%
ASSESSMENT METHODOLOGY: Attendance and Participation – 70%, Practical Demonstration (Surya Namaskar, Asanas, and Pranayama) – 30%

REFERENCES:

1. *'The Heart of Yoga'.* – T.K.V. Desikachar
2. *'Yoga for Holistic Health'.* – Dr. H.R. Nagendra
3. *'Light on Yoga'.* – B.K.S. Iyengar
4. *'Asana Pranayama Mudra Bandha'.* – Swami Satyananda Saraswati

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Demonstrate Surya Namaskar and basic asanas in standing, sitting, prone, and supine positions with correct alignment and breathing.	**K2**
CO2	Demonstrate pranayama techniques for stress management and respiratory health.	**K2**
CO3	Improve flexibility, balance, posture, breathing efficiency, and relaxation through regular yoga practice.	**K3**
CO4	Apply principles of healthy living such as nutrition, sleep hygiene, and digital well-being in daily life.	**K3**

COs - POs & PSOs MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1							2	3			2
CO2						2	2				2
CO3						2	2	3			3
CO4						3	2	2			3
						3	**2**	**3**			**3**

1 - low, 2- medium, 3 - high