KCG COLLEGE OF TECHNOLOGY

AFFILIATED TO ANNA UNIVERSITY | AUTONOMOUS

REGULATIONS - 2023

CURRICULUM AND SYLLABI

(2023-2024)

B.E COMPUTER SCIENCE AND ENGINEERING - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

INDEX

KCG COLLEGE OF TECHNOLOGY

AUTONOMOUS

REGULATIONS 2023

B.E. COMPUTER SCIENCE ENGINEERING – (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

CHOICE BASED CREDIT SYSTEM

CURRICULA FOR SEMESTERS I TO VIII

SEMESTER–I

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
	23IP101	Induction Programme		-	-	-	-	-
THEORY								
1	23HS101	Essential Communication	HSMC	3	0	0	3	3
2	23MA101	Matrices and Calculus	BSC	3	0	0	3	3
3	23AM101	Programming in C and C++	ESC	3	1	0	4	4
4	23HS102	Heritage of Tamils	HSMC	1	0	0	1	1
THEORY AND PRACTICALS								
5	23PH111	Engineering Physics	BSC	3	0	2	5	4
6	23CY111	Engineering Chemistry	BSC	3	0	2	5	4
PRACTICALS								
7	23AM121	Programming in C and C++ Laboratory	ESC	0	0	4	4	2
8	23HS121	Communication skills Laboratory	HSMC	0	0	2	2	1
9	23HS122	General Clubs / Technical Clubs / NCC/NSS/Extension Activities	HSMC	0	0	2	2	1*
TOTAL				16	0	12	28	22

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER –II

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23HS201/ 23HS202	Professional English /Foreign Language	HSMC	3	0	0	3	3
2	23MA202	Discrete Mathematics	BSC	3	1	0	4	4
3	23PH205	Physics for Information Science	BSC	3	0	0	3	3
4	23IT201	Data Structures and Algorithms	PCC	3	0	0	3	3
5	23HS203	Tamils and Technology	HSMC	1	0	0	1	1
THEORY AND PRACTICALS								
6	23EE281	Basic Electrical and Electronics Engineering	ESC	2	0	2	4	3
7	23ME211	Engineering Graphics	ESC	3	0	2	5	4
PRACTICALS								
8	23ME221	Engineering Practices Laboratory	ESC	0	0	4	4	2
9	23IT221	Data Structures and Algorithms Laboratory	PCC	0	0	4	4	2
10	23HS221	Soft Skills	EEC	0	0	2	2	1*
TOTAL				18	1	14	33	25

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER-III

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23MA204	Probability and Statistics	BSC	3	1	0	4	4
2	23CS302	Database Management Systems	PCC	3	0	0	3	3
3	23AM301	Python Programming for AI&ML	PCC	3	0	0	3	3
4	23HS301	Universal Human Values and Ethics	HSMC	3	0	0	3	3
THEORY AND PRACTICALS								
5	23AM311	Artificial Intelligence Essentials	PCC	3	0	2	5	4
6	23AM312	Data Warehousing and Knowledge Discovery	PCC	3	0	2	5	4
PRACTICALS								
7	23CS322	Database Management Systems Laboratory	PCC	0	0	4	4	2
8	23AM321	Python Programming for AI&ML Lab	PCC	0	0	4	4	2
9	23ES391	Presentation Skills	EEC	0	0	2	2	1*
TOTAL				18	1	14	33	25

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER-IV

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23AM401	Foundation of Software Engineering	PCC	3	0	0	3	3
2	23AM402	Object Oriented Programming using Java	PCC	3	0	0	3	3
3	23AM403	Principles and Practices of Machine Learning	PCC	3	0	0		3
THEORY AND PRACTICALS								
4	23AM411	Operating Systems Principles	PCC	3	0	2	5	4
5	23AM412	Automata Theory and Compiler Engineering	BSC	3	0	2	5	4
6	23AM413	Big Data Computing and Tools	PCC	2	0	2	4	3
PRACTICALS								
7	23AM421	Principles and Practices of Machine Learning Laboratory	PCC	0	0	4	4	2
8	23AM422	Object Oriented Programming using Java Laboratory	PCC	0	0	4	4	2
9	23ES491	Aptitude and Logical Reasoning - 1	EEC	0	0	2	2	1*
TOTAL				17	0	14	31	24

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER-V

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23RE501	Research Methodology and Intellectual Property Rights	ESC	2	0	0	2	2
2	23AM501	Deep Learning Techniques	PCC	3	0	0	3	3
3		Department Elective 1	DEC	-	-	-	-	3
4		Department Elective 2	DEC	-	-	-	-	3
5		Open Elective - 1 (Emerging Technology)	OEC	3	0	0	3	3
THEORY AND PRACTICALS								
6	23AM511	Computer Network Architecture and Protocols	PCC	3	0	2	5	4
PRACTICALS								
7	23AM521	Deep Learning Techniques Laboratory	PCC	0	0	4	4	2
8	23AD522	Mini Project	EEC	0	0	3	3	2
9	23AD523	Summer Internship	EEC	0	0	0	0	1
10	23ES591	Aptitude and Logical Reasoning – 2	EEC	0	0	2	2	1*
TOTAL				-	-	-	-	23

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	credits
				L	T	P		
THEORY								
1		Department Elective 3	DEC	-	-	-	-	3
2		Department Elective 4	DEC	-	-	-	-	3
3		Open Elective – 2 (Management / Safety Courses)	OEC	3	0	0	3	3
THEORY AND PRACTICALS								
4	23CE611	Environmental Science and Engineering	ESC	3	0	2	5	4
5	23AM611	Statistical Natural Language Processing	PCC	3	0	2	5	4
6	23AM612	Visual Data Processing	PCC	3	0	2	5	4
PRACTICALS								
7	23AD621	Project Work Phase - 1	EEC	0	0	4	4	2
8	23AD622	Technical Training	EEC	0	0	2	2	1
9	23AD623	Technical Seminar–1	ESC	0	0	2	2	1
TOTAL				-	-	-	-	25

SEMESTER -VII

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1		Open Elective - 3 (Management Courses)	OEC	3	0	0	3	3
2		Department Elective 5	DEC	-	-	-	-	3
3		Department Elective 6	DEC	-	-	-	-	3
4	23AD701	Technical Comprehension	EEC	2	0	0	2	2
THEORY AND PRACTICALS								
5	23AD711	Generative AI	PCC	3	0	2	5	4
PRACTICALS								
6	23AD721	Project Work Phase – 2	EEC	0	0	6	6	3
7	23AD722	Technical Seminar-2	ESC	0	0	4	4	2
TOTAL				-	-	-	-	20

SEMESTER -VIII

Sl. No	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
PRACTICALS								
1	23AM821/ 23AM822	Capstone Project / Internship cum Project	EEC	0	0	20	20	10
TOTAL				0	0	20	20	10

TOTALCREDITS: 173

DEPARTMENT ELECTIVE COURSES: VERTICALS

VERTICAL 1: GENERIC COMPUTER ENGINEERING

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23AM031	Digital Systems and Computer Organization	DEC	2	0	2	3	3
2	23AD032	Unified Modeling Language	DEC	2	0	2	4	3
3	23AD033	Web Essentials	DEC	2	0	2	4	3
4	23AM032	Distributed Computing	DEC	3	0	0	3	3
5	23AM033	AI in Wireless Communications	DEC	3	0	0	3	3
6	23AD036	Cryptography and Network Security	DEC	2	0	2	4	3
7	23AM034	Data Science in Practice	DEC	3	0	0	3	3
8	23AM035	Object Oriented Thinking in Software Design	DEC	3	0	0	3	3

VERTICAL 2 : ANALYTICAL SCIENCES

Sl. No.	Course Code	Course Title	Category	Periods Per Week L	T	P	Total Contact periods	Credits
1	23AD039	Responsible AI	DEC	3	0	0	3	3
2	23AD040	Natural Language Processing	DEC	2	0	2	4	3
3	23AD041	Exploratory Data Analysis	DEC	2	0	2	4	3
4	23AM036	Nature Inspired Computing Methods	DEC	3	0	0	3	3
5	23AD043	Intelligent Robots	DEC	3	0	0	3	3
6	23AM037	Multimodal AI	DEC	3	0	0	3	3
7	23AD045	Data Exploration and Visualization	DEC	2	0	2	4	3
8	23AM038	Optimization Techniques for Machine Learning	DEC	3	0	0	3	3

VERTICAL 3

FULL STACK DEVELOPMENT

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23CS031	Java Full Stack Development	DEC	2	0	2	4	3
2	23CS032	Mobile App Development	DEC	2	0	2	4	3
3	23CS033	UI and UX Design	DEC	2	0	2	4	3
4	23CS034	MERN Stack Web Development (Industry Supported Course)	DEC	2	0	2	4	3
5	23CS035	DevOps	DEC	2	0	2	4	3
6	23CS038	Python Full Stack Development with Machine Learning (Industry Supported Course)	DEC	2	0	2	4	3
7	23AM039	AI and Machine learning Integration in Web apps	DEC	3	0	0	3	3
8	23CS044	Explainable AI	DEC	3	0	0	4	3

VERTICAL 4

COMPUTATIONAL INTELLIGENCE

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23AM040	Embedded AI	DEC	3	0	0	3	3
2	23AD049	Immersive Technologies	DEC	2	0	2	4	3
3	23AD050	Ethics of AI	DEC	2	0	2	4	3
4	23AM041	Kernel Methods for Pattern Analysis	DEC	2	0	2	4	3
5	23AM042	MLOps	DEC	3	0	0	3	3
6	23AD053	Computer Vision	DEC	2	0	2	4	3
7	23AM043	Robotic Process Automation	DEC	2	0	2	3	3
8	23CS041	Game Development	DEC	2	0	2	4	3

VERTICAL 5

CYBER SECURITY AND CLOUD COMPUTING

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23AD054	Web Security	DEC	2	0	2	4	3
2	23AD055	AI for Cyber Security	DEC	2	0	2	4	3
3	23AD056	Cyber Threat Intelligence	DEC	3	0	0	3	3
4	23AM044	Ethical Hacking	DEC	3	0	0	3	3
5	23AM045	Quantum Computing	DEC	2	0	2	4	3
6	23AM046	Virtualization	DEC	2	0	2	3	3
7	23AD060	Cloud Databases	DEC	2	0	2	4	3
8	23CB058	Cryptocurrency	DEC	2	0	2	3	3

OPEN ELECTIVE – EMERGING TECHNOLOGIES

Sl. No.	Course code	Course title	Category	Periods per week			Total contact periods	Credits
				L	T	P		
1	23OMA971	Resource Management Techniques	OEC	3	0	0	3	3
2	23OAE971	Aviation Management	OEC	3	0	0	3	3
3	23OMT971	Foundation of Robotics	OEC	3	0	0	3	3
4	23OAS971	Space Engineering	OEC	3	0	0	3	3
5	23OEE973	Fundamentals of Electric and Hybrid Vehicles	OEC	3	0	0	3	3
6	23OEC972	Fundamentals of Wearable Devices	OEC	3	0	0	3	3

OPEN ELECTIVE – MANAGEMENT COURSES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23OMG971	Total Quality Management	OEC	3	0	0	3	3
2	23OMG972	Engineering Economics and Financial Accounting	OEC	3	0	0	3	3
3	23OMG973	Engineering Management and Law	OEC	3	0	0	3	3
4	23OMG974	Knowledge Management	OEC	3	0	0	3	3
5	23OMG975	Industrial Management	OEC	3	0	0	3	3
6	23OMG976	Entrepreneurship and Business Opportunities	OEC	3	0	0	3	3
7	23OMG977	Modern Business Administration and Financing	OEC	3	0	0	3	3
8	23OMG978	Essentials of Management	OEC	3	0	0	3	3

OPEN ELECTIVE – SAFETY RELATED COURSES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23OAU981	Automotive Safety	OEC	3	0	0	3	3
2	23OCE981	Disaster Management	OEC	3	0	0	3	3
3	23OME981	Industrial Safety	OEC	3	0	0	3	3

SEMESTER-WISE CREDIT DISTRIBUTION

SEMESTER	HSMC	BSC	ESC	PCC	DEC	OEC	EEC	Total
Semester I	5	11	5					21
Semester II	4	7	9	5				25
Semester III	3	4		18				25
Semester IV		4		20				24
Semester V			2	9	6	3	3	23
Semester VI			5	8	6	3	3	25
Semester VII			2	4	6	3	5	20
Semester VIII							10	10
Total – KCG Curriculum	**12**	**26**	**23**	**64**	**18**	**9**	**21**	**173**

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(R-2023)

(I to VIII Semesters)

SYLLABUS

SEMESTER –I

23IP101	INDUCTION PROGRAMME	L	T	P	C
		-	-	-	0

COURSE OBJECTIVES:

- This is a mandatory 2 weeks P rogramme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.
- The induction Programme has been introduced by AICTE with the following objectives
- Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.
- One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character
- Hence, the purpose of this Programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and

students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature • **Physical Activity** This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc., • **Life skills** Every student would choose one skill related to daily needs such as stitching, accounting, finance management, etc.,
Universal human values
This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through dos and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real-life activities rather than lecturing.
Club Activity
Students will be introduced to more than 20 Clubs available in the college-both technical and non-technical. The student can choose as to which club the student will enroll in.
Value Based Communication
This module will focus on improving the communication skills of students
Lectures by Alumni
Lectures by alumni are arranged to bring in a sense of belonging to the student towards the institution and also to inspire them to perform better
Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged
Familiarization to Dept./Branch & Innovations
They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities
Address by different heads
Heads of Placement, Training, Student affairs, counsellor, etc would be interacting with the students to introduce them to various measures taken in the institution for the betterment of students.
Induction Programme is totally an activity-based Programme and therefore there shall be no tests / assessments during this Programme.
REFERENCES:
Guide to Induction program from AICTE

23HS101	ESSENTIAL COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To help learners extract information from short and simple correspondence
- To familiarize learners with different text structures by engaging them in reading, writing and grammar learning activities
- To help learners write coherent, short paragraphs and essays
- To enable learners to use language efficiently while expressing their opinions via various media.

UNIT I	FORMATION OF SENTENCES	9

Reading- Read pictures-notices- short comprehension passages and recognize main ideas and specific details. Writing- framing simple and compound sentences, completing sentences, developing hints, writing text messages. Language development- Parts of Speech, Wh- Questions, yes or no questions, direct and indirect questions. Vocabulary development– prefixes- suffixes- articles – countable and uncountable nouns

UNIT II	NARRATION AND DESCRIPTION	9

Reading – Read short narratives and descriptions from newspapers, dialogues and conversations. Reading strategies and practices. Language development – Tenses- simple present, present continuous, present perfect, simple past, past continuous, past perfect, simple future, future continuous, past participle, pronouns. Vocabulary development- guessing meanings of words in context. Writing – Write short narrative paragraphs, biographies of friends/relatives - writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures.

UNIT III	COMPARING AND CONTRASTING	9
Reading- short texts and long texts -understanding different types of text structures, -coherence-jumbled sentences. Language development- degrees of comparison, concord- Vocabulary development – single word substitutes- discourse markers- use of reference words Writing - comparative and contrast paragraphs writing- topic sentence- main idea, free writing, compare and contrast using some suggested vocabulary and structures.		
UNIT IV	**SOCIAL MEDIA COMMUNICATION**	**9**
Reading- Reading blogs, social media reviews, posts, comments, process description, Language development - relative clause, Vocabulary development- social media terms-words, abbreviations and acronyms Writing- -e-mail writing-conventions of personal email, descriptions for simple processes, critical online reviews, blog, website posts, commenting to posts.		
UNIT V	**ESSAY WRITING**	**9**
Reading- Close reading non-technical longer texts Language development - modal verbs, phrasal verbs- Vocabulary development - collocation. Writing- Writing short essays- brainstorming – developing an outline- identifying main and subordinate ideas.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Summarize simple, level-appropriate texts of around 300 words recognizing main ideas and specific details.	
CO2:	Demonstrate the understanding of more complex grammatical structures and diction while reading and writing.	

CO3:	Use appropriate expressions to describe, compare and contrast people, things, situations etc., in writing.
CO4:	Establish the ability to communicate effectively through emails.
CO5:	Determine the language use appropriate for different social media platforms.
CO6:	Use appropriate expressions for narrative descriptions and process descriptions.
TEXT BOOKS:	
1	Susan Proctor, Jack C. Richards, Jonathan Hull. Interchange Level 2. Cambridge University Press and Assessment
2	Susan Proctor, Jack C. Richards, Jonathan Hull. Interchange Level 3. Cambridge University Press and Assessment
REFERENCES:	
1	Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013
2	Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning , USA: 2007

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
5	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
6	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
Overall Correlation	-	-	-	-	-	**1**	**1**	-	**3**	**3**	-	**2**	-	-	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23MA101	MATRICES AND CALCULUS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications

UNIT I	MATRICES	9

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II	DIFFERENTIAL CALCULUS	9

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.

UNIT III	FUNCTIONS OF SEVERAL VARIABLES	9

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multiplier.

UNIT IV	INTEGRAL CALCULUS	9

Definite and Indefinite integrals - Substitution rule - Techniques of

Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.		
UNIT V	**MULTIPLE INTEGRALS**	**9**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Apply the matrix algebra techniques and applications in Engineering Problems.
CO2:	Make use of the concept of limits and rules of differentiation to differentiate functions
CO3:	Find the derivative of functions of several variables
CO4:	Examine the application of partial derivatives
CO5:	Compute integrals by different techniques of Integration.
CO6:	Apply the concept of integration to compute multiple integrals.

TEXT BOOKS:

1	Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2	James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015.

REFERENCES:

1	Dr.P.Sivaramakrishnadas, Dr.C.Vijayakumari., — Matrices and Calculus‖ Pearson Publications Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2	Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016

3	Bali. N., Goyal. M. and Watkins. C., —Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4	Narayanan. S. and Manicavachagom Pillai.T. K., —Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**02-08-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

<table>
<tr><td rowspan="2">23AM101</td><td colspan="2" rowspan="2">PROGRAMMING IN C AND C++</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">
• To familiarize with C programming constructs.
• To know about the essence of programing.
• To study programs in C using arrays, strings and Pointers
• To learn programs in C++ using class and objects.
• To understand applications in C++ using operator overloading.
• To study applications in C using inheritance and polymorphism.
</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION TO PROGRAMMING LANGUAGE</td><td>9</td></tr>
<tr><td colspan="7">Introduction to programming language paradigms – Problem solving methods-Flowcharts and Algorithms, Introduction to C-Structure of C, Compilation and Execution, C-character set, identifiers & Keywords, variables and constants, data types, expressions, operators in C, Input and output statements in C.</td></tr>
<tr><td>UNIT II</td><td colspan="5">ESSENCE OF C PROGRAMMING</td><td>9</td></tr>
<tr><td colspan="7">Control structures – Decision making and branching, looping structures, switch-case, break and continue, goto statement, functions – advantages, storage classes, creating user-defined functions, recursion, Parameter passing, arrays- types of arrays, arrays and functions.- Introduction to pointers-pointer declaration, pointer operators, Dynamic memory allocation.</td></tr>
<tr><td>UNIT III</td><td colspan="5">OBJECT ORIENTED PROGRAMMING</td><td>9</td></tr>
<tr><td colspan="7">Introduction to object-oriented programming – Difference between function-oriented programming and object-oriented programming, Features of OOP, Applications of OOP, structure of C++ program with simple C++ program, basics of console Input and Output, C++ data types, Operators in C++, Control Structures, Functions-inline functions, default arguments, function overloading.</td></tr>
</table>

UNIT IV	CLASSES AND OBJECTS	9
Classes and Objects: Specifying a class, defining member functions, Access control, constructors and destructors, Friend functions – Inheritance – Class hierarchy, derived classes, types of inheritance, Polymorphism-static binding, dynamic binding, method overloading with virtual functions, pure virtual functions, abstract classes		
UNIT V	**OPERATOR OVERLOADING**	**9**
Operator overloading-this pointer, applications of this pointer, operator function, operator overloading. Exception handling- Try, throw and catch, Dynamic Memory management, new and delete operators, object copying, copy constructor.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	To familiarize with C programming constructs.
CO2:	To develop programs in C using basic constructs.
CO3:	To develop programs in C using arrays, strings and Pointers
CO4:	To develop programs in C++ using class and objects.
CO5:	To develop applications in C++ using operator overloading.
CO6:	To develop applications in C using inheritance and polymorphism.
TEXT BOOKS:	
1	Programming in C by E.Balaguruswamy, McGrawhill 6th Edition.
2	Object oriented Programming with C++ by E.Balaguruswamy McGrawHill Education.
3	ANSI and Turbo C++ by Ashoke N. Kamthane, Pearson Education.
REFERENCES:	
1	ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016.

2	The C++ Programming Language" (4th Edition) by Bjarne Stroustrup

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	-	-	-	-	1	3	1	-
2	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
3	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
5	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
6	3	2	1	1	1	-	-	1	1	1	1	1	3	1	1
Overall Correlation	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
Recommended by Board of Studies															
Approved										**Date**					

<table>
<tr><td rowspan="2">23HS102</td><td rowspan="2">HERITAGE OF TAMILS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">

Explain the classical literature of Tamil and highlight notable Tamil poets.
Explain the creation of traditional Tamil musical instruments.
Explain the sports and games associated with Tamil heritage.
Explore the education and literacy practices during the Sangam period.
Explain the contributions of Tamils to the Indian freedom struggle.
Explain the development and history of printing in Tamil Nadu.

</td></tr>
<tr><td>UNIT I</td><td colspan="4">LANGUAGE AND LITERATURE</td><td>3</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>UNIT II</td><td colspan="4">HERITAGE – ROCK ART PAINTINGS TO MODERN ART – SCULPTURE</td><td>3</td></tr>
<tr><td colspan="6">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.</td></tr>
</table>

UNIT III	**FOLK AND MARTIAL ARTS**	**3**
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance – Sports and Games of Tamils.		
UNIT IV	**THINAI CONCEPT OF TAMILS**	**3**
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 Cholas		
UNIT V	**CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**	**3**
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.		
		TOTAL: 15 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the evolution of Tamil language and literature, focusing on its cultural, ethical, and secular themes.	
CO2:	Outline the making of musical instruments related to Tamil heritage.	
CO3:	Discuss the sports and games of Tamils	
CO4:	Explain the education and literacy during Sangam age.	
CO5:	Express the importance and contribution of Tamils to Indian Freedom Struggle	
CO6:	Outline the print history of books in Tamil Nadu	

TEXT BOOKS:	
1	தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்). தமிழக வரலாறு-மக்களும் பண்பாடும்-கே.கேபிள்ளை (வெளியீடு:
2	கணினித்தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்).
REFERENCES:	
1	**கீழடி- வைவை நதிை◌்ை◌வையில் சங்ை◌ ை◌◌ால நைநை◌ நாை◌ை◌◌ிை◌ம் (ததால்லியல் Fவை தைளியீடு)**
2	ப ெ◌ாருனை- ஆற்றங்கனை **ததால்லியல் நாை◌ை◌◌ிை◌ம் Fவை தைளியீடு)**

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
2	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
3	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
4	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
5	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
6	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
Overall Correlation		-	-	-	-	2	2	-	-	-	-	-	-	-	-

Recommended by Board of Studies	28-07-2023		
Approved	1st ACM	Date	09-09-2023

23PH111	ENGINEERING PHYSICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To make the students effectively achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of optics and lasers.
- To equip the students successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I	MECHANICS	9

Types of stress, Stress-strain diagram and its uses- factors affecting elastic modulus- tensile strength- Bending of beams, bending moment – theory and experiment: Uniform and non-uniform bending, Center of mass (CM) – CM of continuous bodies –rod, motion of the CM. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of rod, disc, solid sphere – M.I of a diatomic molecule - torque -rotational energy state of a rigid diatomic molecule – M.I of disc by torsional pendulum

UNIT II	ELECTROMAGNETIC WAVES	9

Concept of field-introduction to gradient, divergence and curl of field – Stokes theorem (No proof)-Gauss divergence theorem (No proof) - The Maxwell's equations in integral form and differential form - wave equation; Plane electromagnetic waves in vacuum - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - Energy and momentum in EM waves-Poynting's vector - Cell-phone reception.

UNIT III	OPTICS AND LASERS	

Reflection and refraction of light waves - total internal reflection –

types of optical fiber, Numerical Aperture and acceptance angle - interference –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients(Qualitative) - population inversion - CO2 laser, semiconductor laser (Homo junction) - Applications of lasers in industry.		
UNIT IV	**BASIC QUANTUM MECHANICS**	**9**
Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization – Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.		
UNIT V	**ADVANCED QUANTUM MECHANICS**	**9**
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.		
		TOTAL: 45 PERIODS
PRACTICAL EXERCISES: (Any Seven Experiments)		
1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects 2. Simple harmonic oscillations of cantilever 3. Non-uniform bending- Determination of Young's modulus 4. Uniform bending–Determination of Young's modulus 5. Laser-Determination of the wavelength of the laser using grating 6. Airwedge- Determination of thickness of a thinsheet /wire		

7. a) Optical fibre-Determination of Numerical Aperture and acceptance angle b) Compact disc-Determination of width of the groove using laser. 8. Acoustic grating-Determination of velocity of ultrasonic waves in liquids. 9. Ultrasonic interferometer–determination of the velocity of sound and compressibility of liquids 10. Post office box-Determination of Band gap of a semiconductor. 11. Photoelectric effect 12. Michelson Interferometer. 13. Melde's string experiment 14. Experiment with lattice dynamics kit.	
TOTAL: 30 PERIODS	
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Determine the mechanical properties of materials.
CO2:	Apply the principles of electromagnetic waves to real world system.
CO3:	Determine the thickness of thin wire and the characteristic parameter of an optical fiber.
CO4:	Apply the principles of lasers to real world application.
CO5:	Organize the quantum mechanical properties of particles and waves.
CO6:	Utilize the quantum mechanical principles towards the formation of energy bands.
TEXT BOOKS:	
1	D.Kleppner and R.Kolenkow, "An Introduction to Mechanics", McGraw Hill Education (Indian Edition), 2017.
2	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", McGraw-Hill (Indian Edition), 2017.

REFERENCES:	
1	R.Wolfson," Essential University Physics", Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2	Paul A. Tipler, "Physic – Volume 1 & 2", CBS, (Indian Edition), 2004.
3	K.Thyagarajan and A.Ghatak,"Lasers: Fundamentals and Applications," Laxmi Publications, (Indian Edition), 2019.
4	D.Halliday, R.Resnick and J.Walker, "Principles of Physics", Wiley (Indian Edition), 2015.
5	N.Garcia, A.Damask and S.Schwarz, "Physics for Computer Science Students",Springer Verlag, 2016.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	28-07-2023		
Approved	1st ACM	Date	09-09-2023

23CY111	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage batteries.

UNIT I	WATER AND ITS TREATMENT	9

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, flouride and arsenic. Sewage treatment primary treatment and disinfection (UV, Ozonation, break-point chlorination). Hardness-Estimation of Hardness of water by EDTA-numerical Problems-Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process

UNIT II	NANOCHEMISTRY	9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials (Metal oxide and Metal) Synthesis and Characterization of nanomaterials: sol-gel, solvothermal, laser ablation, chemical

vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, energy, sensor , electronics and catalysis.		
UNIT III	**PHASE RULE AND COMPOSITES**	**9**
Phase rule: Introduction, definition of terms with examples. One component system – water system; CO_2 system; Reduced phase rule; Two component system: lead-silver system – Pattinson process. Composites: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites – definition and examples.		
UNIT IV	**FUELS AND COMBUSTION**	**9**
Fuels: Fossil Fuels, Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking – octane number, diesel oil – cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value – higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis – ORSAT Method. CO_2 emission and carbon sequestration, Green Hydrogen.		
UNIT V	**ENERGY SOURCES AND STORAGE DEVICES**	**9**
Nuclear fission and fusion- light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery – dry cell, Secondary battery – lead acid battery and lithium-ion battery; Electric vehicles – working		

principles; Fuel cells: H_2-O_2 fuel cell, microbial fuel cell and its advanced technology, supercapacitor.	
TOTAL: 45 PERIODS	
LIST OF EXPERIMENTS	**TOTAL: 30 PERIODS**
1. Determination of hardness causing salts in water sample by EDTA method. 2. Determination of alkalinity in water sample. 3. Determination of chloride content of water sample by argentometric method. 4. Determination of strength of given Barium chloride using conductivity meter. 5. Determination of strength of Acid using pH meter. 6. Determination of strength of FAS by potentiometer 7. Determination of strength of acids in a mixture using conductivity meter. 8. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method. **9.** Estimation of Nickel in steel	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Interpret the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2:	Illustrate the basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3:	Estimate the knowledge of phase rule and composites for material selection requirements
CO4:	Choose a suitable fuel for engineering processes and applications
CO5:	Relate the different forms of energy resources and apply them for suitable applications in energy sectors.
CO6:	Explain the different types of batteries, fuel cells and working principles of Electric vehicles

TEXT BOOKS:	
1	P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3	S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.

REFERENCES:	
1	B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2	O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3	Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014New Delhi, 2018.
4	ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019
5	O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
2	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
3	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
4	3	2	1	1	-	-	3	-	-	-	-	2	3	-	-
5	3	2	1	1	-	-	3	-	-	-	-	2	3	-	-
6	2	1	-	-	-	-	2	-	-	-	-	1		-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**2**		**-**	**-**

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23AM121	PROGRAMMING IN C AND C++ LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To familiarize with C programming constructs.
- To develop programs in C using basic constructs.
- To develop programs in C using arrays, strings and Pointers
- To develop programs in C++ using class and objects.
- To develop applications in C++ using operator overloading.
- To develop applications in C using inheritance and polymorphism.

List of Experiments

1	a) Write a C program to find sum and average of three numbers. b) Write a C program to find the sum of individual digits of a given positive integer. **c)** Write a C program to generate the first n terms of the Fibonacci sequence.
2	a) Write a C program to generate prime numbers between 1 to n. b) Write a C program to Check whether given number is Armstrong Number or Not. **c)** Write a C program to evaluate algebraic expression (ax+b)/(ax-b).
3	a) Write a C program to find the roots of a quadratic equation. b) Write a C program that performs arithmetic operations using switch statement.
4	a) Write a C program to find factorial of a given integer using non-recursive function. b) Write a C program to find factorial of a given integer using recursive function
5	a) Write a C program to find both the largest and smallest number in a list of integers. b) Write a C Program to Sort the Array in an Ascending

	Order. c) Write a C Program to find whether the given matrix is symmetric or not.
6	To write a C program to add and multiply two matrices.
7	a) To write a C program to sort the names in alphabetical order using string function. b) To write a C program to calculate area of a triangle using pointers and functions.
8	Write a Program to design a class having static member function named showcount() which has the property of displaying the number of objects created of the class.
9	Write a Program using class to process Shopping List for a Departmental Store. The list includes details such as the Code No and Price of each item and perform the operations like Adding, Deleting Items to the list and Printing the Total value of an Order.
10	Write a Program which creates & uses an array of objects of a class.(for e.g. implementing the list of Managers of a Company having details such as Name, Age, etc..).
11	Write a Program to find Maximum out of Two Numbers using friend function. Note: Here one number is a member of one class and the other number is a member of some other class.
12	Write a Program to overload operators like *, <<, >> using friend function. The following overloaded operators should work for a class vector.
13	Write a Program to design a student class representing student roll no. and a test class (derived class of student) representing the scores of the student in various subjects and sports class representing the score in sports. The sports and test class should be inherited by a result class having the functionality to add the scores and display the result for a student.
14	Write a program illustrating the use of virtual functions in class.

															TOTAL: 60 PERIODS
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	-	-	-	-	1	3	1	-
2	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
3	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
5	3	3	2	2	1	-	-	-	-	-	-	1	3	1	-
6	2	1	-	-	1	-	-	1	1	1	1	1	3	1	1
Overall Correlation	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
Recommended by Board of Studies															
Approved									**Date**						

23HS121	COMMUNICATION SKILLS LABORATORY	L	T	P	
		0	0	2	

COURSE OBJECTIVES:

- To enable the students to comprehend the main idea and specific information of the listening passage
- To help students express themselves clearly, and communicate effectively with others.
- To introduce authentic language use and context-specific vocabulary that might not be encountered in textbooks.

Exercise : 1	Listening to conversations set in everyday social context and complete gap-filling exercise
Exercise : 2	Listening to a monologue in everyday social context. Diagram labelling and MCQ
Exercise : 3	Listening to a group conversation in academic setting and answer MCQ
Exercise : 4	Listening to a lecture and answer MCQ or gap filling
Exercise : 5	Listening to Ted Talks, podcasts, documentaries - discussion
Exercise : 6	Listening to a lecture and reading a text on the same subject- compare and contrast
Exercise : 7	Speaking Introducing oneself
Exercise : 8	Answering questions based on the introduction
Exercise : 9	Speaking on a given prompt for 2 mins.
Exercise :10	Answering questions based on the topic spoken
Exercise :11	Role play- Engaging in conversation
Exercise :12	Engaging in Podcast Discussion

TOTAL: 25 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Demonstrate fluency in speaking in variety of situations
CO2:	Express their knowledge by talking continuously for more than two minutes on a topic

CO3:	Develop active listening for more meaningful interactions and conversations
CO4:	Use a full range of structures naturally and appropriately
CO5:	Identify the specific information in conversations, interviews, talks and lectures
CO6:	Develop the ability to compare and analyse different forms of information, identifying key similarities and differences.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
5	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
6	-	-	-	-	-	1	1	-	2	3	-	-	-	-	-
Overall Correlation	-	-	-	-	-	**1**	**1**	-	**3**	**3**	-	**2**	-	-	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

SEMESTER - II

23HS201	PROFESSIONAL ENGLISH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To help learners extract information from longer, technical and scientific texts
- To familiarize learners with different text structures by engaging them in reading, writing and grammar learning activities
- To help learners write coherent, extensive reports and essays.
- To enable learners to use language efficiently while expressing their opinions in professional and business situations

UNIT I	WORKPLACE COMMUNICATION	9

Reading – Reading brochures (technical context), advertisements, telephone messages, gadget reviews social media messages, digital communication relevant to technical contexts and business. Writing – Writing emails -emails on professional contexts including introducing oneself, writing checklist, writing single sentence definition, product description- advertising or marketing slogans, Language Development– Tenses, Concord, Question types: Wh/ Yes or No/ and Tags, imperative sentences, complex sentences. Vocabulary - One-word substitutes; Abbreviations & Acronyms as used in technical contexts and social media.

UNIT II	EXPRESSING CAUSE AND EFFECT	9

Reading - Reading longer technical texts– Cause and Effect Essays, and emails of complaint. Writing - writing complaint emails (raising tickets) and responses to complaints, writing Cause and effect paragraphs and essays. Language Development– Active, Passive and Impersonal Passive Voice transformations, Infinitive and Gerunds Vocabulary – Synonyms- contextual meaning of

words, Same word acting as different parts of speech, causal expressions.		
UNIT III	**PROVIDING SOLUTIONS TO PROBLEMS**	**9**
Reading - Case Studies, editorials, news reports etc. Writing – Letter to the Editor, Writing instructions and recommendations, Problem solution essay / Argumentative Essay, Language Development – Error correction; If conditional sentences Vocabulary - Compound Words, discourse markers.		
UNIT IV	**INTERPRETATION OF GRAPHICS**	**9**
Reading - Reading newspaper articles, nonverbal communication (charts and graphs) Writing –Transferring information from nonverbal (chart, graph etc, to verbal mode) Process– description. Language development–Possessive & Relative pronouns, numerical adjectives Vocabulary Homonyms and Homophones, sequence words.		
UNIT V	**REPORT WRITING AND RESUME WRITING**	**9**
Reading – Company profiles, journal reports. Language Development– Reported Speech Vocabulary-reporting words and phrases. Writing - Writing accident report, survey report and progress report, project proposal, minutes of the meeting, writing statement of purpose, internship application and resume		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Summarize long technical and scientific text of not less than 500 words recognizing main ideas and specific details
CO2:	Demonstrate the understanding of more complex grammatical structures and diction while reading and writing
CO3:	Use appropriate expressions to describe process and product, compare and contrast data, analyze problems, provide solutions and prove an argument in writing

CO4:	Establish the ability to communicate effectively in professional environment through emails and reports
CO5:	Determine the language use appropriate for different social media platforms used for digital marketing
CO6:	Convert skills to assets and position themselves in job market through their own professional narratives

TEXT BOOKS:

1	V. Chellammal, Deepa Mary Francis, K N Shoba, P R Sujatha Priyadharshini, Veena Selvam, English for Science & Technology I, Cambridge University Press and Assessment
2	V. Chellammal, Deepa Mary Francis, K N Shoba, P R Sujatha Priyadharshini, Veena Selvam, English for Science & Technology II, Cambridge University Press and Assessment

REFERENCES:

1	Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
2	Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	-	1	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
5	-	-	-	-	-	-	1	-	2	3	-	2	-	-	-
6	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
Overall Correlation	-	-	-	-	-	1	1	-	2	3	-	3	-	-	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23MA202	DISCRETE MATHEMATICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To develop student's logical and mathematical maturity and ability to deal with abstraction.
- To introduce most of the basic terminologies used in computer science related courses and application of ideas to solve practical problems.
- To understand the basic concepts of combinatorics and graph theory.
- To familiarize the applications of algebraic structures
- To understand the concepts and significance of Lattices and Boolean algebra which are widely used in computer science and engineering.

UNIT I	LOGIC AND PROOFS	9+3

Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers – Rules of inference - Introduction to proofs – Proof methods and strategy.

UNIT II	COMBINATORICS	9+3

Mathematical induction - The basics of counting - Well ordering - Strong induction – The pigeonhole principle – Permutations and Combinations – Recurrence relations - Solving linear recurrence relations – Generating functions – Inclusion and exclusion principle and its applications.

UNIT III	GRAPHS	9+3

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

UNIT IV	ALGEBRAIC STRUCTURES	9+3

Algebraic systems – Semi groups and monoids - Groups – Subgroups – Homomorphism's – Normal subgroup and cosets – Lagrange's theorem – Definitions and examples of Rings and Fields.

UNIT V	LATTICES AND BOOLEAN ALGEBRA	9+3
Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra – Boolean Homomorphism.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply the concepts of propositional and predicate calculus to the given logical statements.
CO2:	Apply the idea of combinatorial techniques to various engineering problems.
CO3:	Find the solutions for technical problems using graphs.
CO4:	Apply the concepts and properties of algebraic structures in computational theory.
CO5:	Apply the lattice structure and its properties to engineering problems.
CO6:	Apply Boolean expressions in areas like computational theory.
TEXT BOOKS:	
1	Rosen. K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2017.
2	Tremblay. J.P. and Manohar. R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.
REFERENCES:	
1	Dr.P.Sivaramakrishnadas, Dr.C.Vijayakumari,‖ Discrete Mathematics‖ Pearson Publications.
2	Grimaldi. R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 5thEdition, Pearson Education Asia, Delhi, 2013

3	Koshy. T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.
4	Lipschutz. S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**08-04-2023**		
Approved by Academic	**2^{nd} ACM**	**Date**	**25-05-2025**

23PH205	PHYSICS FOR INFORMATION SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students understand the importance in studying electrical properties of materials.
- To enable the students to gain knowledge in semiconductor physics
- To instill knowledge on magnetic properties of materials.
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement, ensuing nano device applications and quantum computing.

UNIT I	ELECTRICAL PROPERTIES OF MATERIALS	9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three-dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole.

UNIT II	SEMICONDUCTOR PHYSICS	9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration – Carrier transport in Semiconductor: random motion, drift, mobility and diffusion (qualitative) – Hall effect and devices – Ohmic contacts – Schottky diode – introduction to solid state drive (SSD)

UNIT III	MAGNETIC PROPERTIES OF MATERIALS	9

Magnetic dipole moment – atomic magnetic moments- magnetic permeability and susceptibility - Magnetic material classification:

diamagnetism – paramagnetism – ferromagnetism – antiferromagnetism – ferrimagnetism – Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory- M versus H behaviour – Hard and soft magnetic materials – examples and uses-– Magnetic principle in computer data storage – Magnetic hard disc (GMR sensor).		
UNIT IV	**OPTICAL PROPERTIES OF MATERIALS**	**9**
Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in a P-N diode – solar cell - LED – Organic LED – Laser diodes – Optical data storage techniques.		
UNIT V	**NANODEVICES AND QUANTUM COMPUTING**	**9**
Introduction - quantum confinement – quantum structures: quantum wells, wires and dots –– band gap of nanomaterials. Tunneling – Single electron phenomena: Coulomb blockade - resonant- tunneling diode – single electron transistor – quantum cellular automata - Quantum system for information processing - quantum states – classical bits – quantum bits or qubits –CNOT gate - multiple qubits – Bloch sphere – quantum gates – advantage of quantum computing over classical computing.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply the knowledge of classical and quantum electron theories to energy band structures.
CO2:	Utilize the basics of intrinsic and extrinsic semiconductor physics and its application in various devices.
CO3:	Apply the knowledge of magnetic properties of materials in data storage.
CO4:	Explain the electro optical properties and optoelectronic devices.
CO5:	Explain the quantum structures, quantum confinement and Nano devices.

CO6:	Explain the role of quantum structures in information processing technique.
TEXT BOOKS:	
1	Jasprit Singh, “Semiconductor Devices: Basic Principles”, Wiley (Indian Edition), 2007.
2	S.O. Kasap. Principles of Electronic Materials and Devices, McGraw-Hill Education (Indian Edition), 2020.
3	Parag K. Lala, Quantum Computing: A Beginner's Introduction, McGraw-Hill Education (Indian Edition), 2020.
REFERENCES:	
1	Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
2	Y.B.Band and Y.Avishai, Quantum Mechanics with Applications to Nanotechnology and Information Science, Academic Press, 2013.
3	V.V.Mitin, V.A. Kochelap and M.A.Stroscio, Introduction to Nanoelectronics, Cambridge Univ.Press, 2008.
4	G.W. Hanson, Fundamentals of Nanoelectronics, Pearson Education (Indian Edition) 2009.
5	B.Rogers, J.Adams and S.Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2014.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
5	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
6	2	1	-	-	-	-						1	2		
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23IT201	DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart the basic concepts of data structures and algorithms.
- To be familiar with writing recursive methods.
- To implement operations on Linked List, Stack and Queues.
- To implement traversal operations of trees and graphs.
- To understand concepts about various algorithm design techniques, searching and sorting techniques.

UNIT I	INTRODUCTION TO ALGORITHMS	9

Introduction to Data vs Information - Data Structures - Classification Abstraction - Abstract data types (ADT) - Array - Characteristics - Storage Representations. Array Order Reversal- Recursion- Array operations, Algorithm- complexity Time and Space trade off.

UNIT II	LINKED LIST	9

Array vs Linked List Singly linked list - Representation of a linked list in memory - Operations on a singly linked list - Merging two singly linked lists into one list - Reversing a singly linked list Polynomial Manipulation using List - Advantages and disadvantages of singly linked list - Circular linked list- Doubly linked list - Circular Doubly Linked List.

UNIT III	STACKS & QUEUES	9

Introduction Array Representation of a Stack Linked List Representation of a Stack - Stack Operations - Algorithm for Stack Operations - Stack Applications: Tower of Hanoi - Infix to postfix Transformation - Evaluating Arithmetic Expressions. Queue Introduction Array Representation of Queue Linked List Representation of Queue - Queue Operations - Algorithm for Queue Operations - Queue Applications: Priority Queue.

UNIT IV	TREES AND GRAPHS	9

Preliminaries of Tree ADT - Binary Trees - The Search Tree ADT Binary Search Trees - AVL Trees - Tree Traversals - B-Trees – Heap

Tree Preliminaries of Graph ADT - Representation of Graph, Graph Traversal - BFS DFS Applications of Graph Shortest – Path Algorithms Minimum Spanning Tree Prims Algorithm.		
UNIT V	**GRAPH ALGORITHM DESIGN TECHNIQUES AND SEARCHING AND SORTING TECHNIQUES**	**9**
Divide and Conquer Strategy - Greedy Algorithm - Dynamic Programming - Backtracking Strategy - List Searches using Linear Search - Binary Search – Fibonacci Search - Sorting Techniques - Insertion sort - Heap sort - Bubble sort - Quick sort - Merge sort - Analysis of sorting techniques.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Illustrate the concept of recursive algorithms.	
CO2:	Demonstrate the different types of data structures.	
CO3:	Illustrate the operations on linear data structures.	
CO4:	Select appropriate data structure as applied to specified problem definition.	
CO5:	Explain and implement the various algorithm design techniques.	
CO6:	Identify appropriate sort and search algorithm for a given application.	
TEXT BOOKS:		
1	Jean-Paul Tremblay, Paul G. Sorenson, 'An Introduction to Data Structures with Application', TMH, 2017.	
2	Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C., "Introduction to algorithms", 3rd edition, MIT.	
REFERENCES:		
1	Richard F, Gilberg, Forouzan, "Data Structures", Cengage, 2nd Edition, 2004.	
2	Darren R. Hayes, "Practical Guide to Computer Forensics Investigations", 2014.	

3	Larry R. Nyhoff, ADTs, “Data Structures, and Problem Solving with C++”, Prentice Hall Edition, 2004.
4	Thomas H. Cormen, Charles E. Leiserson, “Introduction to Algorithms”, 3rd Edition, 2010

Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	-	-	1	1	-	-
2	2	1	-	-	-	-	-	-	-	-	-	2	3	-	-
3	2	1	-	-	1	-	-	-	-	-	-	2	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
5	2	1	-	-	1	-	-	-	-	-	-	1	3	1	-
6	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
Overall Correlation	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-

Recommended by Board of Studies			
Approved		**Date**	

23HS203	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To summarize the weaving industry and ceramic technology during Sangam Age
- To explain the design and construction of houses during Sangam Age and the sculptures and temples of Chola,Pallava and Pandya period
- To Explain about the water bodies of Sangam age and relate it to the agricultural usage
- To Outline to students the agriculture and irrigation technology during the Chola Period
- To help students Interpret and explain the digitalization of Tamil books and development of Tamil software

UNIT I	WEAVING AND CERAMIC TECHNOLOGY	3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II	DESIGN AND CONSTRUCTION TECHNOLOGY	3

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.

UNIT III	MANUFACTURING TECHNOLOGY	3

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.

UNIT IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**
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 - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.		
UNIT V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
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.		
		TOTAL: 15 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Summarize the weaving industry and ceramic technology during Sangam Age
CO2:	Explain the design and construction of houses during Sangam Age
CO3:	Explain the sculptures and temples of Chola,Pallava and Pandya period.
CO4:	Explain about the water bodies of Sangam age and relate it to the agricultural usage
CO5:	Outline the agriculture and irrigation technology during the Chola Period.
CO6:	Interpret and explain the digitalization of tamil books and development of Tamil software
TEXT BOOKS:	
1	Dr.K.K.Pillay ,"Social Life of Tamils", A joint publication of TNTB & ESC and RMRL

REFERENCES:	
1	Dr.S.Singaravelu ,"Social Life of the Tamils - The Classical Period", Published by: International Institute of Tamil Studies.
2	Dr.S.V.Subatamanian , Dr.K.D. Thirunavukkarasu, "Historical Heritage of the Tamils", Published by: International Institute of Tamil Studies

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
2	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
3	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
4	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
5	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
6	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
Overall Correlation	-	-	-	-	-	**1**	**1**	**1**	-	-	-	-	-	-	-

Recommended by Board of Studies	28-07-2023		
Approved	1st ACM	**Date**	09-09-2023

23EE281	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics, functional elements and working of measuring instruments
- To demonstrate the load test on DC machines, working of PN Junction diodes, Zener diodes and rectifiers.

UNIT I	ELECTRICAL CIRCUITS	6

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor– Ohm 's Law-Kirchhoff's Laws -Nodal Analysis, Mesh analysis with independent sources only (Steady State)- Introduction to AC Circuits –Steady state analysis of RL, RC, and RLC circuits (Simple problems only).

UNIT II	ELECTRICAL MACHINES	6

Construction and Working principle of DC Generators, EMF equation, Types and Applications- Working Principle of DC motors, Torque Equation, Types and Applications. - Construction, Working principle and Applications of Single- Phase Transformer.

UNIT III	ANALOG ELECTRONICS	6

PN Junction Diodes, Zener Diode–Characteristics & Applications–Bipolar Junction Transistor, JFET, SCR, MOSFET, – Types, I-V Characteristics and Applications – Rectifier.

UNIT IV	DIGITAL ELECTRONICS	6

Review of number systems, Combinational logic (adder and subtractor) – representation of logic functions-SOP and POS forms, K-map representations and minimization using K-maps (up to 3 variables).

UNIT V	MEASUREMENTS AND INSTRUMENTATION	6
Functional elements of an instrument, Standards and calibration, Operating Principle, types- Moving Coil and Moving Iron meters, Instrument Transformers- CT and PT, DSO-Block Diagram		
		Total : 30 PERIODS

LAB COMPONENT

1. Verification of Ohms and Kirchhoff's Laws.
2. Load test on DC Shunt Motor.
3. Characteristics of PN and Zener Diodes
4. Design and analysis of Half wave and Full Wave rectifiers
5. Implementation of Binary Adder and Subtractor
6. Study of DSO

Total : 30 + 30 = 60 Periods

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Apply fundamental laws to DC electric circuits and demonstrate it experimentally.
CO2:	Explain the steady state AC circuits with RL, RC, and RLC circuits
CO3:	Identify the working principle and applications of electrical machines with experimental results
CO4:	Demonstrate the characteristics of various analog electronic devices
CO5:	Experiment with the basic concepts of digital electronics and demonstrate the implementation of Binary Adder and Subtractor
CO6:	Illustrate the operating principles of measuring instruments and demonstrate DSO for the basic measurements.

TEXT BOOKS:

1	Kothari D P and I.J Nagrath,—Basic Electrical and Electronics Engineering‖ , Second Edition, McGraw Hill Education,2020
2	Sedha R. S.,—A textbook book of Applied Electronics‖, S. Chand & Co.,2008

3	A.K. Sawhney, Puneet Sawhney ‗A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.
REFERENCES:	
1	Kothari D P and I.J Nagrath, ―Basic Electrical Engineering‖, Fourth Edition, Mc Graw Hill Education, 2019.
2	S.K. Bhattacharya ―Basic Electrical and Electronics Engineering‖, Pearson Education, Second Edition, 2017.
3	Thomas L. Floyd,‗ Digital Fundamentals', 11thEdition,Pearson Education,2017.
4	Albert Malvino, David Bates, ‗Electronic Principles, McGraw Hill Education; 7th edition, 2017.
5	Mahmood Nahvi and Joseph A. Edminister, ―Electric Circuits‖, 86 Schaum 'Outline Series, McGraw Hill, 2002.
6	H.S. Kalsi, ‗Electronic Instrumentation' , Tata McGraw-Hill, New Delhi, 2010
7	James A. Svoboda, Richard C. Dorf,― Dorf's Introduction to Electric Circuits‖, Wiley, 2018.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	1	1	1	-	1	3	-	1
2	2	1	-	-	-	-	-	1	1	1	-	1	2	-	1
3	3	2	1	1	-	1	1	1	1	1	-	1	3	-	1
4	2	1	-	-	-	1	1	1	1	1	-	1	2	-	1
5	3	2	1	1	-	-	-	1	1	1	-	1	3	-	1
6	2	1	-	-	-	-	-	1	-	-	-	-	3	-	1
Overall Correlation	**3**	**2**	**1**	**1**	**-**	1	1	1	1	1	-	1	**3**	**-**	1

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23ME211	ENGINEERING GRAPHICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Gain a solid foundation in the fundamental principles and concepts of engineering graphics, including conic sections, orthographic projection, isometric projection, section views and development of surfaces, perspective projection, and dimensioning.
- Develop graphic skills for communication of concepts, ideas and design of engineering products.
- Gain knowledge on drafting software to construct part models.
- Familiarize with existing national standard practices and conventions related to technical drawings.
- Enhance the ability to visualize objects in three dimensions and translate them into 2D representations.

UNIT I	PLANE CURVES	9+6

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid - construction of involutes of square and circle - Drawing of tangents and normal to the above curves.

LIST OF EXERCISES:

1. Drawing of a title block with necessary text, projection symbol and lettering using drafting software
2. Drafting of Conic curves - Ellipse, Parabola and Hyperbola

UNIT II	PROJECTION OF POINTS, LINES AND PLANE SURFACE	9+6

Orthographic projection - principles - Principal planes - First angle projection - projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. Projection of planes (hexagonal and pentagonal planes

only) inclined to both the principal planes by rotating object method. **LIST OF EXERCISES:** 1. Draw the projection of points when it is placed in different quadrants 2. Draw the projection of lines when it is placed in first quadrant 3. Draw the planes when it is placed in first quadrant.		
UNIT III	**PROJECTION OF SOLIDS AND FREE HAND SKETCHING**	**9+6**
Projection of simple solids - hexagonal prism, pentagonal pyramid and cone inclined to the horizontal plane by rotating object method. Free Hand sketching: Visualization principles - Representation of Three Dimensional objects - Layout of views - Free hand sketching of multiple views from pictorial views of objects **LIST OF EXERCISES:** 1. Practicing three dimensional modelling of simple objects. 2. Drawing of orthographic views from the given pictorial diagram		
UNIT IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**	**9+6**
Sectioning of hexagonal prism, pentagonal pyramid and cone when the cutting plane is inclined to the horizontal plane, Development of lateral surfaces of simple and sectioned solids – hexagonal prism and cone cut by a plane inclined to horizontal plane only. **LIST OF EXERCISES:** 1. Draw the sectioned views of prisms and pyramids 2. Draw the development of hexagonal prism cut by a section plane inclined to the horizontal plane		

UNIT V	ISOMETRIC PROJECTION	9+6
Principles of isometric projection - Isometric scale – Isometric view - Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. **LIST OF EXERCISES:** 1. Drawing Isometric view and projection of simple solids. 2. Drawing three dimensional modeling of isometric projection of combination of solids.		
TOTAL: 75 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Construct the conic curves, involutes and cycloids.
CO2:	Develop and Sketch the orthographic projections of points, lines and plane surfaces.
CO3:	Develop and Sketch the orthographic projections of simple solids.
CO4:	Construct the projections of sectioned solids and development of the lateral surfaces of solids.
CO5:	Develop and Sketch the isometric sections of solids.
CO6:	Develop and Sketch the orthographic projection 2D and 3D objects using Auto CAD.
TEXT BOOKS:	
1	Bhatt N.D. and Panchal V.M., ―Engineering Drawing‖, Charotar Publishing House, 53rd Edition, 2019.
2	Basant Agarwal and Agarwal C.M.,―Engineering Drawing‖, McGraw Hill, 2nd Edition, 2019
REFERENCES:	
1	Natrajan K.V., ―A Text Book of Engineering Graphics‖, Dhanalakshmi Publishers, Chennai, 2018.
2	Gopalakrishna K.R., ―Engineering Drawing‖ (Vol. I and II combined), Subhas Publications, Bangalore, 27th Edition, 2017.

3	Luzzader, Warren.J. and Duff, John M., —Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4	Parthasarathy N. S. and Vela Murali, —Engineering Graphics‖, Oxford University, Press, New Delhi, 2015. 5. Shah M.B., and Rana B.C., —Engineering Drawing‖, Pearson Education India, 2nd Edition, 2009.
5	Venugopal K. and Prabhu Raja V., —Engineering Graphics", New Age International (P) Limited, 2008.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
2	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
3	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
4	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
5	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
6	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
Overall Correlation	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23ME221	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- Familiarize students with basic engineering tools and equipment.
- Educate students on the importance of safety practices, including proper handling of equipment, adherence to safety protocols, and understanding potential hazards in the laboratory environment. Develop basic manufacturing and fabrication skills.
- Provide hands on training to the students in plumbing and woodworking.
- Provide hands on training to the students in welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment; Making a tray out of metal sheet using sheet metal work.
- Demonstrate the wiring and measurement methods in common household electrical applications.
- Study the basic electronic components, gates and provide hands on training in soldering.

GROUP A (CIVIL and MECHANICAL)

PART I	CIVIL ENGINEERING PRACTICES	15

PLUMBING WORK

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in households.
b) Preparation of plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK a) Sawing b) Planning c) Making of T-Joint, Mortise joint and Tenon joint and Dovetail joint. **WOOD WORK STUDY** a) Study of joints in door panels and wooden furniture **b)** Study of common industrial trusses using models.		
PART II	**MECHANICAL ENGINEERING PRACTICES**	**15**
WELDING WORK a) Study of Welding and its tools. b) Welding of Butt Joints, Lap Joints and Tee Joints by metal arc welding. c) Study of Gas Welding. **BASIC MACHINING PRACTICE** a) Facing and Plain Turning b) Taper Turning c) Drilling and Tapping **SHEET METAL WORK** a) Forming and Bending b) Making of a square Tray **MACHINE ASSEMBLY WORK** a) Study of Centrifugal Pump b) Study of Air Conditioner **FOUNDRY PRACTICE** Demonstration on Foundry operations like mould preparation.		
TOTAL: 30 PERIODS		
GROUP B (ELECTRICAL & ELECTRONICS)		
PART III	**ELECTRICAL ENGINEERING PRACTICES**	**15**
1. Residential House wiring using Switches, Fuse, Indicators, Lamp and Energy Meter. 2. Staircase Wiring.		

3. Fluorescent Lamp Wiring with Introduction to CFL and LED Types.
4. Measurement of Energy using Single Phase Energy Meter.
5. Study of Iron Box Wiring and Assembly
6. Study of Fan Regulator – Electronic Type

PART IV	ELECTRONICS ENGINEERING PRACTICES	15

1. Study of Electronic components and equipment – Resistors, Colour coding measurement of AC signal parameter (peak-peak, RMS period, frequency) using CRO.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering simple electronic circuits and checking continuity.
5. Study the elements of smart phone
6. Study of LED TV (Block diagram

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Plan the pipeline layout for common household plumbing work.
CO2:	Make use of welding equipment and carpentry tool for making joints.
CO3:	Demonstrate on centrifugal pump, air conditioner and foundry operations.
CO4:	Demonstrate the electrical wiring connections for household applications and study the working of iron box and fan regulator.
CO5:	Identify the basic electronic components and explain the gates and soldering methods.
CO6:	Examine the performance and operation of CRO, LED TV and Smart phone.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
2	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
3	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
4	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
5	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
6	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**2**	**2**	**2**	**2**	**1**	**-**
Recommended by Board of Studies							**28-07-2023**								
Approved							**1st ACM**			**Date**			**09-09-2023**		

23IT221	DATA STRUCTURES AND ALGORITHMS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To impart the basic concepts of data structures and algorithms.
- To be familiar with writing recursive methods.
- To implement operations on Linked List, Stack and Queues.
- To implement traversal operations of trees and graphs.
- To understand concepts about various algorithm design techniques, searching and sorting techniques.

PRACTICALS:

1) Program to find the largest and smallest number in an unsorted array.
2) Program to construct operations on a Singly linked list.
3) Program to implement operations on a doubly linked list.
4) Program to sort the elements using insertion sort.
5) Program to sort the elements using quick sort.
6) Program to sort the elements using merge sort.
7) Program to construct t a Stack using an array and Linked list.
8) Program to perform Queue using an array and Linked list.
9) Program to execute Circular Queue.
10) Program to convert an infix expression to postfix expression.
11) Program to achieve BFS and DFS
12) Program to implement N Queens problem.
13) Program to apply Binary Tree Traversal
14) Program to carry out Travelling Salesman Problem

TOTAL : 60 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Discuss the concept of data structures through ADT including List, Stack and Queues.
CO2:	Explain basic concepts about stacks, queues, lists, trees and graphs.

CO3:	Apply and implement various tree traversal algorithms and ensure their correctness.
CO4:	Apply algorithms and develop algorithms through step-by-step approach in solving problems with the help of fundamental data structures.
CO5:	Build applications and justify use of specific linear data structures for various Applications.
CO6:	Apply binary data structures for various Applications.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	-	-	-	1	-	1	1	1	-
2	2	1	-	-	1	-	-	-	-	1	-	1	2	1	-
3	3	2	1	1	1	-	-	-	-	1	-	1	2	1	-
4	3	2	1	1	1	-	-	-	-	1	-	1	2	1	-
5	3	2	1	1	1	-	-	-	-	1	-	1	2	1	-
6	3	2	1	1	1	-	-	-	-	1	-	1	2	1	-
Overall Correlation	3	2	1	1	1	-	-	-	-	1	-	1	2	1	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23HS221	SOFT SKILLS	L	T	P	C
		0	0	2	1*

COURSE OBJECTIVES:

- To help learners improve their interpersonal skills and critical thinking
- To familiarize learners with the attributes of a leader to enhance team performance
- To prepare students to face job interviews
- To help learners to know the importance of ethics in work place

UNIT I	INTERPERSONAL COMMUNICATION	

Basic communication- verbal and non-verbal communication; passive, assertive and aggressive communication; presentation skills; giving feedback and responding to feedback.

UNIT II	TEAM WORK AND LEADERSHIP	

Vision- setting realistic goals and objectives, collaboration, cooperation, dependability, empathy, sympathy, motivation, delegation of responsibilities, open mindedness, creativity, flexibility, adaptability, cross cultural communication and group dynamics.

UNIT III	TIME MANAGEMENT AND STRESS MANAGEMENT	

Effective Planning, Planning activities at macro and micro levels, setting practical deadlines and realistic limits/targets, punctuality, prioritizing activities, spending the right time on the right activity, positive attitude, emotional intelligence, self- awareness and regulation.

UNIT IV	CRITICAL THINKING AND WORK ETHICS	

Questioning, analysing, inferencing, interpreting, evaluating, solving problems, explaining, self-regulation, open-mindedness, conflict management- ethical dilemmas, appearance, attendance, attitude, character, organizational skills, productivity, respect.

UNIT V	**INTERVIEW SKILLS AND RESUME BUILDING TECHNIQUES**	
Telephonic interview, online interviews, f2f interviews, FAQ soft skills interview questions, drafting error-free CVs/ Resumes and Cover Letters, selecting the ideal format for resume, content drafting along with sequencing, art of representing one's qualifications and most relevant work history, video resume, website resume.		
		TOTAL: PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Express their thoughts, opinions and ideas confidently to one or more people in spoken form	
CO2:	Develop evolving competences required for professional success	
CO3:	Demonstrate knowledge and skills in a group as team player and leader	
CO4:	Compose a comprehensive resume reflecting qualifications, exposure and achievements	
CO5:	Exhibit knowledge and skills confidently during job interviews	
CO6:	Demonstrate ethical and professional behaviour at workplace in all situations	
TEXT BOOKS:		
1	Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman & Shalini Upadhyay. Cengage	
REFERENCES:		
2	English for Job Seekers (Language and Soft Skills for the Aspiring) by Geetha Rajeevan, C.L.N. Prakash) Cambridge University Press pvt, Ltd.	
2	Business Benchmark by Norman Whitby. Cambridge University Press pvt, Ltd	

Cos	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-
2	-	-	-	-	-	2	2	2	3	3	2	2	-	-	2
3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
6	-	-	-	-	-	-	-	3	3	3	-	-	-	-	3
Overall Correlation	-	-	-	-	-	2	2	2	3	3	2	2	-	-	2
Recommended by Board of Studies							28-07-2023								
Approved							1st ACM			Date			09-09-2023		

SEMESTER –III

23MA204	PROBABILITY AND STATISTICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of Estimation Theory for small and large samples this plays an important role in real life problems.
- To provide required advanced statistical tools in solving engineering problems
- To introduce the basic concepts of classifications of statistical quality control this plays very important roles in the field of agricultural engineering

UNIT I	PROBABILITY AND RANDOM VARIABLES	9+3

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II	TWO- DIMENSIONAL RANDOM VARIABLES	9+3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Curve Fitting-Method of Least Squares-Central limit theorem (for independent and identically distributed random variables, without proof)-Simple problems.

UNIT III	ESTIMATION THEORY	9+3

Unbiased estimators - Efficiency - Consistency - Sufficiency - Robustness - Method of moments - Method of maximum Likelihood - Interval estimation of Means - Differences between means.

UNIT IV	NON- PARAMETRIC TESTS	9+3
Introduction - The Sign test - The Signed - Rank test - Rank - sum tests - The U test - The H test- Tests based on Runs - Test of randomness - The Kolmogorov Tests.		
UNIT V	**STATISTICAL QUALITY CONTROL**	**9+3**
Control charts for measurements ($\bar{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Apply the fundamental knowledge of the concepts of probability and one dimensional random variables in engineering.
CO2:	
CO3:	Apply the basic concepts of two dimensional random variables in engineering applications.
CO4:	Apply the concept of estimation theory for small and large samples in real life problems.
CO5:	Apply the notion of sampling distributions and statistical techniques used in engineering and management problems.
CO6:	Apply the basic concepts of classifications of statistical quality control in the field of engineering.

TEXT BOOKS:

1	Johnson. R.A., Miller. I.R and Freund. J.E, " Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
2	Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata Mc Graw Hill, 4th Edition, 2007.

REFERENCES:

1	Dr.P. Sivaramakrishna Das, C. Vijayakumari, ―A text book of probability and statistics‖, Pearson Publications.
2	Gupta. S.C. and Kapoor. V. K., ―Fundamentals of Mathematical Statistics‖, Sultan Chand & Sons, New Delhi, 12th Edition, 2020.

3	Devore. J.L., "Probability and Statistics for Engineering and the Sciences‖, Cengage Learning, New Delhi, 8th Edition, 2014.
4	Ross. S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5thEdition, Elsevier, 2014.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23CS302	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the fundamentals of data models, conceptualize and depict a database system using ER diagram.
- To study the principles to be followed to create an effective relational database and write SQL queries to store/retrieve data to/from database systems.
- To know the fundamental concepts of transaction processing, concurrency control techniques and recovery procedure.
- To learn about the internal storage structures using different file and indexing techniques and the basics of query processing and optimization.
- To study the basics of distributed databases, semi-structured and un-structured data models.

UNIT I	RELATIONAL DATABASES	9

Purpose of Database System – Views of Data – Data Models – Database System Architecture – Introduction to Relational Databases – Relational Model – Keys – Relational Algebra – Relational Calculus – SQL Fundamentals – Advanced SQL features – Triggers – Embedded SQL

UNIT II	DATABASE DESIGN	9

Mapping Entity-Relationship Model – ER Diagrams – Functional Dependencies – Non-Loss Decomposition Functional Dependencies – First Normal Form – Second Normal Form – Third Normal Form – Dependency Preservation – Boyce/Codd Normal Form – Multi-Valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT III	TRANSACTION MANAGEMENT	9
Transaction Concepts – ACID Properties – Serializability – Transaction Isolation Levels – Concurrency Control – Need for Concurrency – Lock-Based Protocols – Deadlock Handling - Recovery System – Failure Classification – Recovery Algorithm**.**		
UNIT IV	**IMPLEMENTATION TECHNIQUES**	**9**
Overview of Physical Storage Media – RAID – File Organization – Organization of Records in Files – Indexing and Hashing – Ordered Indices – B+ tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Catalog Information for Cost Estimation – Query Optimization**.**		
UNIT V	**NOSQL DATABASE**	**9**
Overview of Distributed Databases – Data Fragmentation – Replication – NOSQL Database: Characteristics – CAP theorem – Outline of NOSQL Datastores: Column Oriented, Document, Key-Value and Graph Types – Applications – CRUD Operations.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Explain the concepts of Database Management Systems and Apply SQL Queries Using Relational Algebra
CO2:	Apply conceptual modeling to real world applications and design database schemas
CO3:	Apply the knowledge of normalization theory to normalize database.
CO4:	Explain the concepts of Transaction Processing and maintain consistency of the database.
CO5:	Explain basic database storage structures, access techniques and query processing.
CO6:	Illustrate distributed, semi-structured and unstructured database systems.

TEXT BOOKS:	
1	Abraham Silberschatz, Henry F. Korth, S. Sudharshan,
2	Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education, 2021.

REFERENCES:	
1	C. J. Date, A. Kannan, S. Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
2	Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, Fourth Edition, Tata McGraw Hill, 2010.
3	G. K. Gupta, “Database Management Systems”, Tata McGraw Hill, 2011.
4	Carlos Coronel, Steven Morris, Peter Rob, “Design Implementation and Management”, Ninth Edition, Cengage Learning, 2011.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	-	-	2	1	1	2	2	1	-
2	3	2	1	1	1	-	-	-	2	1	1	2	3	1	-
3	3	2	1	1	1	-	-	-	2	1	1	2	3	1	-
4	2	1	-	-	-	-	-	-	2	1	1	1	2	-	-
5	2	1	-	-	-	-	-	-	1	1	-	1	2	-	-
6	2	1	-	-	1	-	-	-	-	1	-	2	2	1	-
Overall Correlation	3	2	1	1	1	-	-	-	2	1	1	2	3	1	-

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23AM301	PYTHON PROGRAMMING FOR AI&ML	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know the basics of Programming.
- To convert an algorithm into a Python program.
- To construct Python programs with control structures.
- To structure a Python Program as a set of functions.
- To use Python data structures-lists, tuples, dictionaries and files.

UNIT I	INTRODUCTION TO PYTHON	9

Introduction to Python Programming: Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements, Reading Input, Print Output, Type Conversions, type() Function and Is Operator, Dynamic and Strongly Typed Language. Control Flow Statements: if, if…else, if…elif…else Decision Control Statements, Nested if Statement, while Loop, for Loop, continue and break Statements.

UNIT II	FUNCTIONS AND STRINGS	9

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments. Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

UNIT III	LISTS, TUPLES, DICTIONARIES AND FILES	9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list Parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension.

Files and Exception: text files, reading and writing files, format operator.

Command line arguments, errors and exceptions, handling

exceptions, modules, packages.		
UNIT IV	**NUMPY AND PANDAS**	**9**
Introduction to NumPy, NumPy Arrays, Array Operations, Advanced Array Manipulations Linear Algebra with NumPy, Random Module in NumPy. Introduction to Pandas, Series, DataFrames, DataFrame Operations, Handling Missing Data, Data Transformation, GroupBy and Aggregation, Merging, Joining, and Concatenation, Time Series Data, Data Input and Output, Visualization (Basic)		
UNIT V	**CASE STUDY**	**9**
Applications of AI&ML: Healthcare, Education, Fintech, Retail & E-commerce, Media & Content Creation, Security & Surveillance. Report writing submission on these applications.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Develop algorithmic solutions to simple computational problems
CO2:	Develop and execute simple Python programs using Control Statements
CO3:	Develop simple Python programs for solving problems using Functions and Strings
CO4:	Build a Python program using lists, tuples, dictionaries and files
CO5:	Construct a code related to Object-Oriented.
CO6:	Construct a code related to Functional Programming.
TEXT BOOKS:	
1	Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist“, 2ndedition, Updated for Python 3, Shroff/O‘Reilly Publishers,2016 (http://greenteapress.com/wp/think-python/).
2	Karl Beecher, ―Computational Thinking: A Beginner's Guide to Problem Solving and Programming‖, 1st

	Edition, BCS Learning & Development Limited, 2017.
REFERENCES:	
1	Learning to Program with Python. RichardL. Halterman. Copyright©2011
2	PythonforEverybody,Exploring Data Using Python 3. Dr.Charles R. Severance. 2016
3	Paul Deitel and Harvey Deitel, ―Python for Programmers‖, Pearson Education, 1st Edition, 2021.
4	G Venkatesh and Madhavan Mukund, ―Computational Thinking: A Primer for Programmers and Data Scientists‖, 1st Edition, Notion Press, 2021.
5	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data‗‗, Third Edition, MIT Press , 2021
6	Eric Matthes, ―Python Crash Course, A Hands - on Project Based Introduction to Programming‖, 2nd Edition, No Starch Press, 2019.
7	https://www.python.org/
8	Martin C. Brown, ―Python: The Complete Reference‖, 4th Edition, Mc-Graw Hill, 2018.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	-	-	-	-	1	3	1	-
2	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
3	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
5	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
6	3	2	1	1	1	-	-	1	1	1	1	1	3	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

Recommended by Board of Studies			
Approved		**Date**	

23HS301	UNIVERSAL HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT I	COURSE INTRODUCTION	9

Need, Basic Guidelines, Content and Process for Value Education - Understanding the need, basic guidelines, content and process for Value Education -Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration - Continuous Happiness and Prosperity- A look at basic Human Aspirations -Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority -Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario - Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT II	UNDERSTANDING HARMONY IN THE HUMAN BEING	9

Harmony in Myself- Understanding human being as a co-existence of the sentient 'I' and the material 'Body' -Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) -Understanding the characteristics and activities of 'I' and harmony in 'I' -Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity.

UNIT III	**UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY**	**9**
Harmony in Human-Human Relationship -Understanding Harmony in the family – the basic unit of human interaction - Understanding values in human-human relationship; meaning of Nyaya and program for its fulfilment to ensure satisfaction; Trust(Vishwas) and Respect as the foundational values of relationship -Understanding the meaning of Vishwas; Difference between intention and competence -Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship -Understanding the harmony in the society (society being an extension of family)-Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order- from family to world family.		
UNIT IV	**ENGINEERING ETHICS**	**9**
Senses of ‗Engineering Ethics‟ – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.		
UNIT V	**SAFETY, RESPONSIBILITY AND RIGHTS**	**9**
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination-Moral Leadership –Code of Conduct – Corporate Social Responsibility.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Understand the need of value education.	
CO2:	Comprehend the difference between self and body.	

CO3:	Understand the need to exist as an unit of Family and society.
CO4:	Understand Harmony at all levels.
CO5:	Apply the values acquired in the professional front.
CO6:	Identify appropriate technologies for ecofriendly production systems.
TEXT BOOKS:	
1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010 3.
2	Mike W. Martin and Roland Schinzinger, —Ethics in Engineering‖, Tata McGraw Hill, New Delhi, 2003.
3	Govindarajan M, Natarajan S, Senthil Kumar V. S, —Engineering Ethics‖, Prentice Hall of India, New Delhi, 2004
REFERENCES:	
1	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3	The Story of Stuff (Book).
4	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi AICTE Model Curriculum in Humanities, Social Science and Management Courses (UG Engineering & Technology) 169 | Page .
5	Small is Beautiful - E. F Schumacher.
6	Slow is Beautiful - Cecile Andrews.
7	Economy of Permanence - J C Kumarappa 8. Bharat Mein Angreji Raj – Pandit Sunderlal.
8	Rediscovering India - by Dharampal.
9	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
10	India Wins Freedom - Maulana Abdul Kalam Azad.
11	Vivekananda - Romain Rolland (English) 13. Gandhi - Romain Rolland (English).

12	Charles B. Fleddermann, ―Engineering Ethics‖, Pearson Prentice Hall, New Jersey, 2004.
13	Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, ―Engineering Ethics – Concepts and Cases‖, Cengage Learning, 2009.
WEB SOURCES:	
1	www.onlineethics.org
2	www.nspe.org
3	www.globalethics.org

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
2	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
3	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
4	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
5	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
6	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
Overall Correlation	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**3**

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23AM311	ARTIFICIAL INTELLIGENCE ESSENTIALS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Will gain knowledge in the basic concepts of Artificial Intelligence.
- To acquire skills in problem solving and machine learning techniques.
- To learn the concepts of neural networks and NLP techniques for Artificial intelligence.
- To acquire knowledge in reasoning and ontology techniques.
- To understand the ethics for artificial intelligence

UNIT I	INTRODUCTION	9

Introduction–Definition – Foundation and History of AI - Future of Artificial Intelligence – Intelligent Agents– Environments – Structure of Agents – Typical Intelligent Agents - Problem solving Methods – AI Problems - Search Strategies – Uninformed Search Techniques.

UNIT II	INFORMED SEARCH TECHNIQUES	9

Informed – Heuristics – Local Search Algorithms and Optimization Problems – Best first Search – A* Algorithm - Searching with partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search - Game playing – Minimax Algorithm- Optimal Decisions in Games – Alpha – Beta Pruning.

UNIT III	KNOWLEDGE REPRESENTATION	9

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining- Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering- Categories and Objects – Time and Event Calculus - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information - Uncertainty- Bayes' Rule - Naive Bayes Models - Probabilistic Reasoning - Bayesian Networks

UNIT IV	LEARNING	9
Learning – Regression– Linear algebra - Supervised learning – Logical formulation of learning – Learning using inductive logic programming – Statistical learning- learning with complex data – Learning with hidden variables (EM Algorithm) – Learning Decision Trees – Reinforcement learning.		
UNIT V	**ADVANCES AND APPLICATIONS**	**9**
Expert systems – Architecture of expert systems – CNN – RNN – NLP – Language Models – Grammar – Parsing – RNN for NLP - NLT (Natural language tasks) - Computer vision.		
		TOTAL: 45 PERIODS
PRACTICAL EXERCISES : 30 PERIODS		

1. Implementing Search Algorithms:
   a. Write programs to implement various search algorithms like Depth-First Search (DFS), Breadth-First Search (BFS), Uniform Cost Search (UCS), and A* Search.
   b. Test these algorithms on different problem spaces such as simple mazes or the 8-puzzle problem.
2. **Machine Learning Basics:**
   a. Implement simple machine learning algorithms like linear regression or k-nearest neighbors from scratch.
   b. Use libraries like scikit-learn or TensorFlow to implement more complex algorithms like decision trees or neural networks.
3. **Prolog Programming:**
   a. Write a program to implement a basic implementation of sorting a list using Prolog concepts.
   b. Demonstrate its effectiveness on a simple binary tree by
   c. Insertion
   d. Deletion

4. **Natural Language Processing (NLP):**

a. Develop a program to perform text classification using techniques like bag-of-words or TF-IDF.

b. Implement sentiment analysis on a dataset of movie reviews or tweets.

5. **Reinforcement Learning:**

a. Implement basic reinforcement learning algorithms like Q-learning or SARSA.

b. Apply them to simple environments like grid worlds or maze navigation problems.

6. **Ontological Engineering:**

a. Build an inheritance concepts using ontology engineering concepts.

b. Develop the concepts of ontology integrating of different modules within an enterprise software system to facilitate communication and interoperability.

7. **Computer Vision:**

a. Use libraries like OpenCV to implement basic computer vision tasks like edge detection or object recognition.

b. Develop a program to detect faces in images using Haar cascades.

8. **Bayesian Networks:**

a. Implement algorithms for Bayesian networks such as variable elimination or belief propagation.

b. Demonstrate their use for probabilistic reasoning in scenarios like medical diagnosis or sensor fusion.

9. **Expert Systems:**

a. Create a basic expert system using a rule-based approach.

b. Use it to provide recommendations or solutions in a specific domain like troubleshooting computer problems or diagnosing illnesses.

10. Game Playing: a. Develop programs to play classic board games like Tic-Tac-Toe, Connect Four, or Chess. b. Implement different strategies such as minimax with alpha-beta pruning for more efficient search.	
TOTAL: 45 +30 =75 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the foundational concepts to approach AI problem-solving systematically
CO2:	Apply informed search techniques to optimize problem-solving in various AI scenarios
CO3:	Make use of knowledge representation techniques using logical reasoning, ontological frameworks, and probabilistic models
CO4:	Utilize supervised and statistical learning techniques for predictive modeling and data analysis.
CO5:	Utilize reinforcement learning and algorithms to solve dynamic decision-making problems
CO6:	Experiment with advanced AI techniques and their applications to address real-world problems
TEXT BOOKS:	
1	Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2022.
REFERENCES:	
1	Elaine Rich, Kevin Knight, Shivashankar B. Nair "Artificial Intelligence", Third Edition, McGraw-Hill Education, 2017
2	Dan W Patterson, "Introduction to Artificial Intelligence & Expert Systems", Pearson Education India, 2015.
3	Deepak Khemani," First Course in Artificial Intelligence", McGraw Hill Education, 2017.
4	Nils J. Nilsson," Artificial Intelligence: A New Synthesis", Morgan Kaufmann Publishers, 1998.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	-	1	-	1	1	1	2	1	1
2	3	2	1	1	1	-	-	1	1	1	1	1	3	1	1
3	3	2	1	1	1	-	-	1	1	1	1	1	3	1	1
4	3	2	1	1	2	-	-	1	1	1	1	1	3	1	1
5	3	2	1	1	1	-	-	1	1	1	1	1	3	1	1
6	3	2	1	1	1	3	-	1	-	1	1	1	3	1	1
Overall Correlation	3	2	1	1	1	1	-	1	1	1	1	1	3	1	1
Recommended by Board of Studies															
Approved									**Date**						

23AM312	DATA WAREHOUSING AND KNOWLEDGE DISCOVERY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the principles of Data warehousing
- Learn basic Data Mining concepts and architecture.
- To be familiar with the association mining.
- To know the classification algorithm implementation
- To understand the clustering algorithms and its application
- To know about the real time application of mining

UNIT I	INTRODUCTION TO DATA WAREHOUSE	9

Data Warehousing and Business Analysis: - Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools – Metadata – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

UNIT II	DATA MINING AND ASSOCIATION MINING	12

Data Mining: - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture of A Typical Data Mining Systems- Classification of Data Mining Systems.

Association Rule Mining: - Apriori Algorithm - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.

UNIT III	CLASSIFICATION MINING	9

Classification and Prediction: - Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification

by Back propagation – Support Vector Machines – Associative Classification.		
UNIT IV	**CLUSTER ANALYSIS**	**9**
Cluster Analysis: - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods –Outlier Analysis.		
UNIT V	**MINING OBJECT, SPATIAL, MULTIMEDIA, TEXT AND WEB DATA**	**6**
Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.		
		TOTAL: 45 PERIODS
PRACTICAL EXERCISES: 30 PERIODS		
1. Data exploration and integration with WEKA 2. Apply WEKA tool for data validation 3. Plan architecture for real time application 4. Write the query for schema definition 5. Design data warehouse for real time applications 6. Analyze the dimensional Modeling 7. Case study using OLAP 8. Case study using OTLP 9. Implementation of warehouse testing		
		TOTAL: 45 +30 =75 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Infer Data warehousing concepts and Implementation.
CO2:	Identify the core principles of the mining process.
CO3:	Utilize association mining principles.
CO4:	Apply classification mining across diverse applications.
CO5:	Apply clustering algorithms to a range of datasets.

CO6:	Infer the utilization of mining across different sectors
TEXT BOOKS:	
1	Jiawei Han, Jian Pei, Hanghang Tong "Data Mining Concepts and Techniques", Fourth Edition, Elsevier, 2023.
REFERENCES:	
1	Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.
2	K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.
3	G. K. Gupta "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.
4	Pang-Ning Tan, Michael Steinbach and Vipin Kumar "Introduction to Data Mining", Pearson Education, 2007.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	-	-	-	1	1	2	1	-
2	3	2	1	1	1	-	-	-	-	-	1	-	3	1	-
3	3	2	1	1	1	-	-	-	-	-	1	-	3	1	-
4	3	2	1	1	1	-	-	-	-	-	1	-	3	1	-
5	3	2	1	1	1	-	-	-	-	-	1	-	3	1	-
6	2	1	-	-	1	-	-	1	1	1	1	-	2	1	1
Overall Correlation	**3**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

Recommended by Board of Studies			
Approved		**Date**	

23CS322	DATABASE MANAGEMENT SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To learn and implement important commands in SQL.
- To learn the usage of nested and join queries.
- To understand functions, procedures and procedural extensions of databases.
- To understand design and implementation of typical database applications.
- To understand design of NoSQL
- To be familiar with the use of a front end tool for GUI based application development and its integration with databases

LIST OF EXPERIMENTS:

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. Create a set of tables, add foreign key constraints and incorporate referential integrity.
3. Query the database tables using different 'where' clause conditions and also implement aggregate functions.
4. Query the database tables and explore sub queries and simple join operations.
5. Write user defined functions and stored procedures in SQL.
6. Create View and index for database tables with a large number of records.
7. Write row level and statement level SQL Triggers.
8. Create Document, column and graph based data using NOSQL database tools.
9. Add Implement CRUD operation using NOSQL Database.
10. Develop a simple GUI based database application and incorporate all the above mentioned features

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Create databases with different types of key constraints.

CO2:	Create join queries and explore sub queries.
CO3:	Implement queries using aggregate functions.
CO4:	Use advanced features such as stored procedures and triggers and incorporate in GUI based application development.
CO5:	Create and manipulate data using NOSQL database.
CO6:	Develop applications that require a Front-end Tool linked with database

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	1	1	1	-	1	3	2	1
2	3	2	1	1	2	-	-	1	1	1	-	1	3	2	1
3	3	2	1	1	2	-	-	1	1	1	-	1	3	2	1
4	3	2	1	1	2	-	-	1	1	1	-	1	3	2	1
5	3	2	1	1	2	-	-	1	1	1	-	1	3	2	1
6	3	2	1	1	2	-	-	1	1	1	-	1	3	2	1
Overall Correlation	3	2	1	1	2	-	-	1	1	1	-	1	3	2	1

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23AM321	PYTHON PROGRAMMING LABORATORY FOR AI&ML	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objective of this laboratory is to put into practice computational thinking. The students will be expected to write, compile, run and debug Python programs to demonstrate the usage of:

- Operators and Conditional Statements
- Control Structures and Functions (both recursive and iterative) and Recursion.
- String functions
- Lists, Sets, Dictionaries, Tuples and Files.
- Object-Oriented Programming

Exercise 1	**Programs to demonstrate the usage of operators and conditional statements.**

1. Write a program that takes two integers as command line arguments and prints the sum of two integers.
2. Program to display the information: Your name, Full Address, Mobile Number, College Name, Course Subjects.
3. Program that reads the URL of a website as input and displays contents of a webpage.

Exercise 2	**Programs to demonstrate usage of control structures.**

4. Program to find the sum of all prime numbers between 1 and 1000.
5. Program to find the product of two matrices.
6. Program to find the roots of a quadratic equation.

Exercise 3	**Programs to demonstrate the usage of Functions and Recursion**

7. Write both recursive and non-recursive functions for the following:
   a. To find GCD of two integers
   b. To find the factorial of positive integer
   c. To print Fibonacci Sequence up to given number n
   d. To convert decimal number to Binary equivalent

8. Program with a function that accepts two arguments: a list and a number n. It should display all the numbers in the list that are greater than the given number n. 9. Program with a function to find how many numbers are divisible by 2, 3,4,5,6 and 7 between 1 to 1000.	
Exercise 4	**Programs to demonstrate the usage of String functions.**
10. Program that accepts two strings S1, S2, and finds whether they are equal are not. 11. Program to count the number of occurrences of characters in each string. 12. Program to find whether a given string is palindrome or not.	
Exercise 5	**Programs to demonstrate the usage of lists, sets, dictionaries, tuples and files.**
13. Simple sorting, Histogram, Students marks statement, Retail bill preparation 14. Write a program that combines lists L1 and L2 into a dictionary. 15. Program to display a list of all unique words in a text file and word count, copy file, Voter's age validation, Marks range validation (0-100).	
Exercise 6	**Programs to demonstrate the usage of Object-Oriented Programming**
16. Program to implement the inheritance. 17. Program to implement polymorphism	
	TOTAL: 60 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Develop algorithmic solutions to simple computational problems.
CO2:	Develop and execute simple Python programs.
CO3:	Construct programs in Python using conditionals and loops for solving problems.

CO4:	Utilize functions to decompose a Python program.
CO5:	Analyse compound data using Python data structures.
CO6:	Interpret data from/to files in Python Programs

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	-	-	-	-	1	3	1	-
2	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
3	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
5	3	3	2	2	1	-	-	-	-	-	-	1	3	1	-
6	2	1	-	-	1	-	-	1	1	1	1	1	3	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

Recommended by Board of Studies			
Approved		**Date**	

23ES391	PRESENTATION SKILLS	L	T	P	C
		0	0	2	1*

COURSE OBJECTIVES:

- To help learners use brainstorming techniques for generating, organizing and outlining ideas.
- To familiarize learners with different speech structures by engaging them in watching speeches with great opening and closing
- To give practice on voice modulation and use of body language and eye contact for making captivating presentations
- To give hands on training on preparing presentation slides and using remote presentation tools
- To train students on responding to question and feedback with confidence.

UNIT I	BRAINSTORMING AND OUTLINING	6

Mind Mapping based on prior knowledge, collecting additional information from external resources, giving prompts to Generative AI tools seeking information, organizing ideas generated, knowing your audience.

UNIT II	STRUCTURING THE PRESENTATION	6

3 Ts of a presentation, writing effective introduction- Beginning the introduction with a hook (question, data, storytelling) and closing the introduction with the objective of the presentation. Structuring the body paragraphs -Choosing key ideas from the list of ideas generated during brainstorming. Substantiating ideas with examples, data, reasons and anecdotes. Summarizing the ideas for conclusion.

UNIT III	DELIVERY TECHNIQUES	6

Vocal variety, intonation, reducing filler words and improving articulation, inflection, engaging the audience. Body language- eye

contact, gestures, movement on stage.		
UNIT IV	**USE OF TECHNOLOGICAL AIDS**	**6**
Use of presentation software like MS Power Point, Google Slides etc, incorporating images, graphs, charts and videos, using interactive tools like quizzes and polls, using remote presentation tools like zoom, MS Teams, WebEx for screen sharing, virtual whiteboards and chat functionalities, incorporating AR/VR for more immersive presentations.		
UNIT V	**HANDLING QUESTIONS AND FEEDBACK**	**6**
Audience engagement through questions, PAR (Point, Answer, Redirect) strategy for structuring responses to questions. Understanding feedback process - Receiving, interpreting and evaluating constructively, active listening techniques for processing feedback, responding to feedback- acknowledging, clarifying and appreciating, Dealing with challenging feedback.		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Construct ideas for presentation through mind mapping techniques
CO2:	Organize ideas and structure the presentation with captivating introduction, body paragraphs illustrated with examples and reasons and compelling conclusion
CO3:	Apply vocal variety and body language techniques to enhance delivery
CO4:	Prepare engaging presentations by integrating multimedia elements
CO5:	Demonstrate proficiency in delivering presentations in remote platforms utilizing various technological tools and strategies to engage audience in Virtual environments
CO6:	Exhibit active listening skills by responding to questions with clarity and confidence and incorporating constructive feedback for professional development

TEXT BOOKS:

1	Nancy Duarte "Slide:ology: The Art and Science of Creating Great Presentations" O' Reilly Media.
2	Garr Reynolds "The Naked Presenter: Delivering Powerful Presentations with or Without Slides" New Riders.

REFERENCES:

1	Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds" by Carmine Gallo.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
2	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
3	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
4	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
5	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
6	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
Overall Correlation	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**2**	**2**	**1**

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

SEMESTER –IV

		L	T	P	C
23AM401	**FOUNDATION OF SOFTWARE ENGINEERING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand Software Engineering Process and Models.
- To perform software requirements analysis.
- To gain knowledge of the System Analysis and Design concepts using Design and Data flow model.
- To understand software testing and maintenance approaches.
- To work on the software metrics process.

UNIT I	**SOFTWARE PROCESS**	**9**
Introduction-The software process-software Engineering Practice-A generic process model-prescriptive process models specialized process models. -Unified process-Personal and Team Process Models –process technology - product and process Agility-Agile Process-Extreme Programming (XP)-Other Agile Process models.		
UNIT II	**UNDERSTANDING REQUIREMENTS**	**9**
Requirements Engineering -Establishing the Groundwork -Eliciting Requirements -Developing Use Cases - Building the Requirements Model -Negotiating Requirements - Validating Requirements-Requirements Analysis - Scenario-Based Modeling - UML Models That Supplement the Use Case -Data Modeling Concepts- Class-Based Modeling.		
UNIT III	**DESIGN CONCEPTS AND PRINCIPLES**	**9**
Design within the Context of Software Engineering - The Design Process - Design -The Design Model - Software Architecture -Architectural Genres - Architectural Styles -Architectural Design –Assessing – Alternative Architectural Designs -Architectural Mapping Using Data Flow.		
UNIT IV	**TESTING**	**9**

A Strategic Approach to Software Testing - Strategic Issues -Test Strategies for Conventional Software - Test Strategies for Object-Oriented Software - Test Strategies for Web Apps - Validation Testing –System- - The Art of Debugging- White Box Testing-Basis Path Testing-Control Structure Testing-Black Box Testing-Model Based Testing-Object Oriented Testing Strategies-Object Oriented Testing Methods-Testing Concepts for Web Apps-The Testing Process.		
UNIT V	**SOFTWARE METRICS**	**9**
The Management Spectrum - The People - The Product - The Process -The WHH Principle - Metrics in the Process and Project Domains - Software Measurement - Metrics for Software Quality - Integrating Metrics within the Software - Metrics for Small Organizations - Establishing a Software Metrics Program - Decomposition - Empirical Estimation Models - Specialized Estimation Techniques -The Make/Buy Decision.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Compare various Software Development Lifecycle Models.
CO2:	Examine project management approaches as well as cost and schedule estimation strategies.
CO3:	Develop formal analysis on specifications.
CO4:	Make use of UML diagrams for analysis and design.
CO5:	Develop architectural styles and design patterns, and test the system
CO6:	Build relationships among objects.
TEXT BOOKS:	
1	Roger S. Pressman. “Software Engineering: A Practitioner's Approach.”, Sixth Edition, Mc Graw-Hill International Edition, 2017.
2	Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli. “Fundamentals of Software Engineering.”, 2nd edition, PHI Learning Pvt. Ltd., 2010.
REFERENCES:	

1	Bernd Bruegge and Allen H. Dutoit. "Object-Oriented Software Engineering: Using UML, Patterns and Java.", Third Edition, Pearson Education, 2009.
2	Craig Larman. “Applying UML and Patterns.”, 3rd ed, Pearson Education, 2005.
3	Len Bass, Ingo Weber and Liming Zhu. “DevOps: A Software Architect‘s Perspective.”, Pearson Education, 2016

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	-	-	2	3	1	3	3	1	-
2	3	3	2	2	1	-	-	-	1	2	1	3	3	2	-
3	3	2	1	1	1	-	-	-	3	1	1	3	3	1	-
4	3	2	1	1	3	-	-	-	3	3	1	2	3	3	-
5	3	2	1	1	3	-	-	-	2	2	1	2	3	2	-
6	2	1	-	-	3	-	-	-	2	2	1	2	3	3	-
Overall Correlation	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**3**	**2**	**3**	**3**	**3**	**-**

Recommended by Board of Studies			
Approved		**Date**	

23AM402	OBJECT ORIENTED PROGRAMMING USING JAVA	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the concepts of Object-oriented Programming and discuss the important elements of java
- To understand and apply the concepts of classes, Inheritance, and exception handling.
- To understand and apply the concepts of packages, interfaces, and Multithread.
- To develop applications using Event Driven Programming.
- To develop applications using Swing Programming.

UNIT I	INTRODUCTION AND OPPS CONCEPTS	10

Java Programming- History of Java, comments, Data types, Variables, Constants, Scope and Lifetime of variables, Operators, Type conversion and casting, Enumerated types, Control flow-block scope, conditional statements, loops, break and continue statements, arraya, simple java standalone programs, class, object and its methods, constructors and its types, methods, static fields and methods, access control, this reference, overloading methods and constructors, garbage collection, exploring string class.

UNIT II	INHERITANCE, POLYMORPHISM AND PACKAGES	9

Inheritance – Inheritance types, super keyword, preventing inheritance: final classes and methods.

Polymorphism – method overloading and overriding, abstract classes and methods.

Interfaces- Interfaces Vs Abstract classes, defining an interface, implement interfaces, accessing implementations through interface references, extending interface.

Packages- Defining, creating and accessing a package, importing packages.

<table>
<tr><td>UNIT III</td><td>EXCEPTION HANDLING AND MULTITHREADING</td><td>9</td></tr>
<tr><td colspan="3">Exception handling- Define Exception, advantages of exception handling, the classification of exceptions- exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, creating own exception sub classes.

Multithreading –Define Thread, multithreading, thread life cycle, creating threads, interrupting threads, thread priorities, synchronizing threads, inter-thread communication.</td></tr>
<tr><td>UNIT IV</td><td>GEN.PROG, I/O AND FILES</td><td>8</td></tr>
<tr><td colspan="3">Generic Programming – Generic classes – generic methods. Strings, Input /Output.
Files- Streams- Byte streams, Character streams, Text input/output, Binary input/output, random access file operations, File management using File class.</td></tr>
<tr><td>UNIT V</td><td>EVENT DRIVEN PROGRAMMING</td><td>9</td></tr>
<tr><td colspan="3">Applets – Define applets, differences between applets and applications, Life cycle of an applet, Passing parameters to applets.
GUI Programming with Java- The AWT class hierarchy, Introduction to Swing, Swing Vs AWT, Hierarchy for Swing components, Overview of some Swing components – Jbutton, JLabel, JTextField, JTextArea, simple Swing applications, Layout management – Layout manager types – border, grid and flow.
Event Handling- Events, Event sources, Event classes, Event Listeners, Event sources and Listeners, handling button click, Handling Mouse events.</td></tr>
<tr><td colspan="3" align="right">TOTAL: 45 PERIODS</td></tr>
<tr><td colspan="3">COURSE OUTCOMES:</td></tr>
<tr><td colspan="3">After completion of the course, the students will be able to:</td></tr>
<tr><td>CO1:</td><td colspan="2">Apply the concepts of classes and objects to solve simple problems.</td></tr>
<tr><td>CO2:</td><td colspan="2">Identify relationships among classes needed for a specific</td></tr>
</table>

	problem with interfaces and inheritance.
CO3:	Illustrate error handling techniques using exception handling and multithreading.
CO4:	Develop a Java programs with the concepts of a hierarchy of Java collection framework.
CO5:	Illustrate I/O streams and Generic programming to provide a solution to a given set of requirements.
CO6:	Apply the ability to employ various types of event handling using swing.
TEXT BOOKS:	
1	Java Fundamentals – A Comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.
2	Core Java: An Integrated Approach – Dr R Nageswara Rao
REFERENCES:	
1	Java for Programmers, P.J.Deitel and H.M.Deitel, PEA (or) Java: How to Program , P.J.Deitel and H.M.Deitel, PHI
2	Object Oriented Programming through Java, P. Radha Krishna, Universities Press.
3	Thinking in Java, Bruce Eckel, PE
4	Programming in Java, S. Malhotra and S. Choudhary, Oxford Universities Press.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	-	1	-	-	-	1	2	1	1
2	3	2	1	1	1	-	-	1	1	1	-	1	3	1	1
3	2	1	-	-	1	-	-	1	1	1	-	1	2	1	1
4	2	1	-	-	1	-	-	1	1	1	-	1	3	1	1
5	2	1	-	-	1	-	-	1	1	1	-	1	2	1	1
6	3	2	1	1	1	-	-	1	1	1	-	1	2	1	1
Overall Correlation	3	2	1	1	1	-	-	1	1	1	-	1	3	1	1

Recommended by Board of Studies			
Approved		**Date**	

23AM403	PRINCIPLES AND PRACTICES OF MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Apply the basic concepts of machine learning
- To analyze the principles and algorithms of supervised machine learning
- Study about ensembling and unsupervised learning algorithms
- Learn the basics of deep learning using neural networks
- Design and analyse machine learning experiments

UNIT I	INTRODUCTION TO MACHINE LEARNING	10

Definition of learning systems - Goals and applications of machine learning - Aspects to develop a Learning system: Training data, Concept representation - Function approximation - Learning Techniques - Supervised learning, unsupervised learning and Reinforcement learning.

UNIT II	SUPERVISED LEARNING	11

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests.

UNIT III	ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING	9

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: Clustering, K-means, KNN, Anomaly Detection, Dimensionality reduction, Association Rule Mining, Apriori algorithm.

UNIT IV	NEURAL NETWORKS	8

Perceptron - Multilayer perceptron, activation functions, bias,

variance, overfitting and under fitting – gradient descent optimization – stochastic gradient descent, backpropagation, – Unit saturation (aka the vanishing gradient problem) – hyperparameter tuning, batch normalization, dropout.		
UNIT V	**DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS**	**9**
Guidelines for machine learning experiments, regularization - Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test, Case study		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Apply the machine learning concepts to solve real-world problems using machine learning algorithms.
CO2:	Extend the fundamentals of machine learning.
CO3:	Examine and implement supervised learning algorithms.
CO4:	Identify ensembling methods and unsupervised learning techniques.
CO5:	Discuss the fundamental understanding of deep learning apply them to simple tasks.
CO6:	Make use of machine learning experiments for various models across different datasets.
TEXT BOOKS:	
1	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
2	Tom M Mitchell, —"Machine Learning", Third Edition, Tata McGraw-Hill, 2017
REFERENCES:	
1	Peter Flach, —"Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012

2	Jason Bell, —"Machine learning – Hands on for Developers and Technical Professionals", First Edition, Wiley, 2014
3	Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
4	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.
5	Aman Kharwal, "Machine Learning Algorithms: Handbook", Clever Fox Publishing, 2023
6	Manaranjan Pradhan, U Dinesh Kumar, "Machine Learning Using Python", Wiley India Private Ltd, 2019

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	1	1	1	-	2	2	2	1
2	2	1	-	-	1	-	-	1	1	1	-	3	2	1	1
3	3	3	2	2	2	-	-	1	1	1	-	1	2	2	1
4	3	2	1	1	2	-	-	1	1	1	-	3	2	2	1
5	2	1	-	-	1	-	-	1	1	1	-	2	3	1	1
6	3	2	1	1	2	-	-	1	2	2	-	1		2	1
Overall Correlation	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**1**	**2**	**2**	**-**	**2**	**2**	**2**	**1**

Recommended by Board of Studies			
Approved		**Date**	

23AM411	OPERATING SYSTEMS PRINCIPLES	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the basics and functions of operating systems.
- To understand processes and threads
- To analyze scheduling algorithms and process synchronization.
- To understand the concept of deadlocks.
- To analyze various memory management schemes.
- To be familiar with I/O management and file systems.
- To be familiar with the basics of virtual machines and Mobile OS like iOS and Android**.**

UNIT I	INTRODUCTION	10

Introduction to Operating Systems – Views of Operating system, Computer System organization, Computer System Architecture; **Operating System Structures** – Operating System Services - User Operating System Interface - System Calls – System Programs - Design and Implementation - Structuring methods; **Processes** - Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication – Shared Memory Systems, Message Passing Systems, **Threads** - Multithread Models.

UNIT II	PROCESS MANAGEMENT	9

CPU Scheduling – Basic Concepts, Scheduling criteria - Scheduling algorithms; **Process Synchronization** - The Critical-Section problem, Synchronization hardware, Mutex Locks, Semaphores, Monitors, Classical problems of synchronization; **Deadlock** – Deadlock Characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

UNIT III	MEMORY MANAGEMENT	9

Main Memory – Address Binding, Logical and Physical Address Space, Contiguous Memory Allocation, Segmentation, Paging,

Structure of the Page Table; **Virtual Memory** - Demand Paging, Copy on Write, Page Replacement, Thrashing.		
UNIT IV	**STORAGE MANAGEMENT**	**9**
Mass Storage system –Disk Scheduling and Management; **I/O Systems** – I/O Hardware, Kernel I/O subsystem; File-System Interface - File concept, Access methods, Directory Structure, File system mounting - File Sharing and Protection; **File System Implementation** - File System Structure - Directory implementation - Allocation Methods - Free Space Management;		
UNIT V	**VIRTUAL MACHINES AND MOBILE OS**	**9**
Virtual Machines – Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization and Operating-System Components; Mobile OS - iOS and Android		
TOTAL: 45 PERIODS		
LIST OF EXPERIMENTS:		
1. Installation of windows operating system. 2. Illustrate UNIX commands and Shell Programming. 3. Process Management using System Calls: Fork, Exit, Getpid, Wait, Close. 4. Write a C program to implement various CPU Scheduling Algorithms. 5. Write a C program to simulate the concept of Dining-Philosophers problem. 6. Write a C program to implement inter process communication. 7. Implement a C program to avoid Deadlock using Banker's Algorithm. 8. Write C programs to implement the following Memory Allocation Methods a. First Fit b. Worst Fit c. Best Fit 9. Write C programs to implement the various Page Replacement Algorithms. 10. Implement various disk scheduling algorithms.		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain operating system structures and various services provided by operating systems	

CO2:	Apply Process synchronization, process scheduling, and deadlocks concepts in the given scenario to solve the problems.
CO3:	Apply algorithms and suitable techniques for memory management.
CO4:	Apply disk scheduling algorithm and explain the management schemes for storage systems such as file and I/O systems.
CO5:	Explain the concept of Virtual machines
CO6:	Explain the functionalities of iOS and Android Operating Systems.
TEXT BOOKS:	
1	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, 10th Edition, John Wiley and Sons Inc., 2018.
REFERENCES:	
1	Ramaz Elmasri, A. Gil Carrick, David Levine, “Operating Systems – A Spiral Approach”, Tata McGraw Hill Edition, 2010.
2	William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2018.
3	Achyut S.Godbole, Atul Kahate, “Operating Systems”, McGraw Hill Education, 2016.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	3	2	1	1	2	2	-	1	3	3	1
2	3	2	1	1	3	2	1	1	2	2	-	1	3	3	1
3	3	2	1	1	3	2	1	1	2	2	-	1	3	3	1
4	3	2	1	1	3	2	1	1	2	2	-	1	3	3	1
5	2	1	-	-	3	2	1	1	2	2	-	1	2	3	1
6	3	2	1	1	3	2	1	1	2	2		1	3	3	1
Overall Correlation	3	2	1	1	3	2	1	1	2	2	-	1	3	3	1

Recommended by Board of Studies			
Approved		**Date**	

<table>
<tr><td rowspan="2">23AM412</td><td rowspan="2">AUTOMATA THEORY AND COMPILER ENGINEERING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">

To understand a finite automaton for a given language.
To understand the relation between grammar and language.
To understand the basic principles of working of a compiler.
To study about the type checking procedure during the compilation.
To understand the storage structure of the running program.

</td></tr>
<tr><td>UNIT I</td><td colspan="4">AUTOMATA</td><td>9</td></tr>
<tr><td colspan="6">Introduction to formal proof – Additional forms of proof – Inductive proofs –Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Finite Automata with Epsilon transitions- Equivalence and minimization of Automata.</td></tr>
<tr><td>UNIT II</td><td colspan="4">REGULAR EXPRESSION (RE)</td><td>9</td></tr>
<tr><td colspan="6">Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen’s Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages, Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages.</td></tr>
<tr><td>UNIT III</td><td colspan="4">CONTEXT FREE GRAMMARS AND LANGUAGES</td><td>9</td></tr>
<tr><td colspan="6">GRAMMAR FORMALISM: Regular grammars-Right linear and left linear grammars, Equivalence Between regular linear grammar and FA; Context Free Grammar, Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs; Normal forms for CFGs - CNF and GNF, Closure</td></tr>
</table>

properties of CFLs; Decision Properties of CFLs-Emptiness, Finiteness and Membership, Pumping lemma for CFLs.		
UNIT IV	**PUSH DOWN AUTOMATA (PDA)**	**9**
Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG, Two stack PDA.		
UNIT V	**TURING MACHINES (TM)**	**9**
Basic model, Definition and representation, Instantaneous Description, Language acceptance by TM, Computable functions, Types of Turing machines, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to Undecidability, Undecidable problems about TMs, Post correspondence problem (PCP), Modified PCP.		
		TOTAL: 45 PERIODS
PRACTICAL EXERCISES:		
1. Write a LEX Program to scan reserved word & Identifiers of C Language language. 2. Implement Predictive Parsing algorithm 3. Write a C program to generate three address code. 4. Implement SLR(1) Parsing algorithm 5. Design LALR bottom up parser for the given language 6. Write a C program for implementing the functionalities of predictive parser for the mini language specified in Note 1. 7. a) Write a C program for constructing of LL (1) parsing. b) Write a C program for constructing recursive descent parsing.		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Build a finite automaton for a specific language.
CO2:	Discuss the regular expressions and its theorems.
CO3:	Identify the basic properties of formal languages and grammars.
CO4:	Examine regular, context-free and recursively enumerable languages.

CO5:	Make use of grammars to produce strings from a specific language.
CO6:	Identify the concepts relating to the theory of computation and computational models.
TEXT BOOKS:	
1	J.E. Hopcroft, R. Motwani and J.D. Ullman, “Introduction to Automata Theory, Languages and Computations”, Second Edition, Pearson Education, 2007.
2	Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D. Ullman, “Compilers: Principles, Techniques and Tools”, Second Edition, Pearson Education, 2008
REFERENCES:	
1	J. Martin, “Introduction to Languages and the Theory of computation” Third Edition, Tata Mc Graw Hill, 2007.
2	Randy Allen, Ken Kennedy, “Optimizing Compilers for Modern Architectures: A Dependence based Approach”, Morgan Kaufmann Publishers, 2002.
3	Steven S. Muchnick, “Advanced Compiler Design and Implementation”, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.
4	Muneeswaran. K, “Compiler Design”, Oxford University Press, 2012.

Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	-	-	-	-	-	-	2	1	-
2	2	1	-	-	1	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	1	-	-	-	-	-	-	-	3	1	-
4	3	3	2	2	1	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	1	-	-	-	-	-	-	-	3	1	-
6	3	2	1	1	1									1	
Overall Correlation	3	2	1	1	1	-	-	-	-	-	-	-	3	1	-

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23AM413	BIG DATA COMPUTING AND TOOLS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To Understand the Fundamentals of Big Data
- To Explore Big Data Storage Technologies
- To Learn Basics of Hadoop Framework
- To Familiarize with Hadoop Ecosystem Tools
- To Develop Proficiency in MapReduce Programming
- To Integrate Big Data Concepts with Practical Applications

UNIT I	INTRODUCTION TO BIG DATA	9

Overview of Big Data: Definition – Characteristics – unstructured data – Importance- - Challenges and Opportunities in Big Data Management – big data and marketing - Evolution of Big Data Technologies- Batch Processing vs. Stream Processing.

UNIT II	BIG DATA STORAGE	9

Data Storage Technologies: NoSQL databases - aggregate data models – key-value and document data models – relationships – graph databases– master-slave replication- MongoDB - Cassandra – cassandra data model – cassandra examples – cassandra clients.

UNIT III	BASICS OF HADOOP	9

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra – Hadoop integration.

UNIT IV	BIG DATA TOOLS	

Hbase – data model and implementations – Hbase examples – Hive- HiveQL queries. Introduction to Spark, Architecture, Data Structure, Introduction to Flink, Architecture, Programming Model.

UNIT V	MAPREDUCE APPLICATIONS	

MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats

TOTAL: 45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Downloading and installing Hadoop, Hive and HBase; Understanding different Hadoop modes. Startup scripts, Configuration files.
2. Hadoop Implementation of CRUD operations tasks for file management, such as Adding files and directories, retrieving files and Deleting files
3. Practice importing and exporting data from various databases with Hive and HBase
4. Implement of Matrix Multiplication with Hadoop MapReduce
5. Implement Word count by processing the dataset into HDFS and produce output by Map-Reduce.
6. Implementation of Hive along with CRUD operations.
7. Implementation of HBase, Installing thrift along with CRUD operations

TOTAL: 45 +30 =75 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Illustrate big data and use cases from selected business domains.
CO2:	Summarize the concept of NoSQL big data management.
CO3:	Experiment with Hadoop and HDFS to install, configure and run.
CO4:	Utilize Hadoop to solve map-reduce analytics.
CO5:	Utilize Hadoop-related tools such as HBase, Cassandra, Pig, and Hive
CO6:	Utilize and implement the concept of YARN

TEXT BOOKS:	
1	Balamurugan Balusamy, Nandhini Abirami R, Seifedine Kadry, Amir H. Gandomi, "Big Data: Concepts, Technology, and Architecture", Wiley, 2021.
2	Data Analytics with Hadoop, " Benjamin Bengfort, Jenny Kim", O'Reilly, 2016.
REFERENCES:	
1	Balamurugan Balusamy, Nandhini Abirami R, Seifedine Kadry, Amir H. Gandomi, "Big Data: Concepts, Technology, and Architecture", Wiley, 2021.
2	Data Analytics with Hadoop, " Benjamin Bengfort, Jenny Kim", O'Reilly, 2016.
3	Jeff Carpenter, Eben Hewitt, "Cassandra: The Definitive Guide", 3rd , O'Reilly, 2020.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	1	-	-	-	1	1	1	1	2	1	-
2	2	1	-	-	1	-	-	-	1	1	1	1	2	1	-
3	3	2	1	1	1	-	-	-	1	1	1	1	3	1	-
4	3	2	1	1	1	-	-	-	1	1	1	1	3	1	-
5	3	2	1	1	1	-	-	-	1	1	1	1	3	1	-
6	3	2	1	1	1	-	-	-	1	1	1	1	3	1	-
Overall Correlation	3	2	1	1	1	-	-	-	1	1	1	1	3	1	-

Recommended by Board of Studies			
Approved		Date	

23AM421	PRINCIPLES AND PRACTICES OF MACHINE LEARNING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To understand the data sets and apply suitable algorithms for selecting the appropriate features for analysis.
- To learn to implement supervised machine learning algorithms on standard datasets and evaluate the performance.
- To experiment the unsupervised machine learning algorithms on standard datasets and evaluate the performance.
- To build the graph based learning models for standard data sets.
- To compare the performance of different ML algorithms and select the suitable one based on the application

LIST OF EXPERIMENTS:

1. Working with Python packages - Numpy, Scipy, Scikit-learn, Matplotlib
2. Loan amount prediction using linear regression and visualize the interpretation
3. Handwritten character recognition using neural networks
4. Classification of Email spam and MNIST data using Support Vector Machines.
5. Predicting Diabetes using decision tree
6. Applications of Random Forest and AdaBoost ensemble techniques
7. K-means and k-Nearest Neighbor clustering for Euclidean distance metric
8. Implementation of Apriori algorithm.
9. Applications of dimensionality reduction techniques on any dataset
10. Mini Project

TOTAL : 30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Infer the data sets and apply suitable algorithms for selecting the appropriate features for analysis.
CO2:	Make use of supervised machine learning algorithms on standard datasets and evaluate the performance.
CO3:	Experiment with the unsupervised machine learning algorithms on standard datasets and evaluate the performance.
CO4:	Build the graph based learning models for standard data sets.
CO5:	Compare the performance of different ML algorithms and select the suitable one based on the application.
CO6:	Infer the data sets and apply suitable algorithms for selecting the appropriate features for analysis.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	1	-	-	-	1	1	2	-	-
2	3	2	1	1	-	-	-	-	-	-	1	-	3	-	-
3	3	2	1	1	-	-	-	-	-	-	1	-	3	-	-
4	3	2	1	1	-	-	-	-	-	-	1	-	3	-	-
5	2	1	-	-	-	-	-	-	-	-	1	-	2	-	-
6	2	1	-	-	1	-	-	1	1	1	1	-	2	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

Recommended by Board of Studies			
Approved		**Date**	

23AM422	OBJECT ORIENTED PROGRAMMING USING JAVA LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- Strengthen problem solving ability by using the characteristics of an object-oriented approach.
- Design applications using object-oriented features
- Handle Exceptions in programs.
- Write, compile, run and debug the programs
- To demonstrate the usage of object-oriented concepts in JAVA.

Exercise I	Basics of Java and Exception Handling

1. Develop a java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
2. Write a Java Program to create an abstract class named Shape that contains two integers, and an empty method named print Area (). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.
3. Write a Java program to implement user defined exception handling.
4. Write a Java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes.

Exercise II	The usage of Packages and Interfaces, Multithreaded programming, Generic Programming

5. Write a Java program to perform employee payroll processing using packages. In the java file, Emp.java creates a package employee and creates a class Emp. Declare the variables name, empid, category, bpay, hra, da, npay, pf, gross pay, income tax, and allowance. Calculate the values in methods. Create another java file Emppay.java. Create an object e to call the methods to perform and print values.
6. Write a Java program to create an interface Shape with the get Area () method. Create three classes Rectangle, Circle, and Triangle that implement the Shape interface. Implement the get Area() method for each of the three classes.
7. Write a java program that implements a multi-threaded application that has three threads. The first thread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.
8. Write a java program to find the maximum value from the given type of elements using a generic function.

Exercise III	The usage of Event Driven Programming

9. Write a java program to draw lines, arcs, figures, images and text in different Fonts, styles and colors.
10. Write a java program to create Frames using swing
11. Design a calculator using event-driven programming paradigm of Java with the following options.
    a) Decimal manipulations
    b) Scientific manipulations
12. Write a java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green with radio buttons. On selecting a button, an appropriate message with “stop” or “ready” or “go” should appear above the buttons in a selected

	color. Initially there is no message shown.
	TOTAL: 45 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Solve the problems using the characteristics of an object-oriented approach.
CO2:	Build applications using object-oriented features.
CO3:	Apply Java programs that make use of classes, packages and interfaces.
CO4:	Build and implement Java programs with exception handling and multithreading.
CO5:	Build an applications using file processing, generic programming and event handling.
CO6:	Apply swing components and solve the applications.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
2	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
3	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
4	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
5	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
6	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
Overall Correlation	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**-**

Recommended by Board of Studies			
Approved		**Date**	

23ES491	APTITUDE AND LOGICAL REASONING –1	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To improve the problem solving and logical thinking ability of the students.
- To acquaint student with frequently asked questions and patterns in quantitative aptitude and logical reasoning.

UNIT I		**4**
Numbers, LCM, HCF, Averages, Ratio & Proportion, Mixtures & Allegation.		
UNIT II		**4**
Percentages, Time and work, Pipes and Cistern, coding and decoding.		
UNIT III		
Time Speed Distance, Train, Boats and Streams, Analogy.		
UNIT IV		**4**
Data Interpretation (BAR,PIE,LINE), Seating arrangement.		
UNIT V		**4**
Simple Interest and Compound Interest, Profit loss and Discount, Partnership.		
		TOTAL: 20 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Analyse and solve complex problems, and foster critical thinking and logical reasoning skills.
CO2:	Solve fundamental mathematical problems, and enhance their computational skills and numerical ability.
CO3:	Develop strategies for tackling a variety of problem types, and encourage the use of multiple approaches to solve problems efficiently.
CO4:	Analyse and solve different data analysis problems for time and distance, and interpret data analysis for a case study.
CO5:	Derive information from graphs, and solve questions based on mathematical operations such as ratios, proportions, basic algebra, and statistical estimation.
CO6:	Solve questions in a fraction of a minute using shortcut methods

TEXT BOOK:	
1	Smith, John. "APTIPEDIA." 2nd ed., Wiley Publishers, 2020.
2	Agarwal, R.S. "Quantitative Aptitude." 2nd ed., S. Chand Publishing.

REFERENCES:	
1	Agarwal, R.S. "A Modern Approach to Verbal & Non-Verbal Reasoning." 2nd ed., S. Chand Publishing

Cos	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	-	-	2	1	1	2	1	2	3	1	-	3
2	2	3	3	-	-	2	-	1	3	2	2	3		1	3
3	3	3	3	-	-	2	-	1	2	2	2	3	2	-	3
4	2	3	2	3	-	2	1	2	3	3	2	3		2	3
5	3	2	2	-	1	3	-	2	2	3	3	3	3	1	3
6	3	3	3	3	2	3	1	3	3	2	3	3	3	1	3
Overall Correlation	3	3	3	1	1	3	1	2	3	3	3	3	2	1	3

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

SEMESTER -V

<table>
<tr><td rowspan="2">23RE501</td><td rowspan="2">RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">To provide an overview on selection of research problem based on the Literature review
To enhance knowledge on the Data collection and Analysis
To outline the importance of ethical principles to be followed in Research work and IPR</td></tr>
<tr><td>UNIT I</td><td colspan="4">INTRODUCTION TO RESEARCH FORMULATION</td><td>6</td></tr>
<tr><td colspan="6">Meaning of research problem, Sources of research problem, Criteria- good research problem, and selecting a research problem, Scope and objectives of research problem. Defining and formulating the research problem - Necessity of defining the problem - Importance of literature review in defining a problem</td></tr>
<tr><td>UNIT II</td><td colspan="4">LITERATURE REVIEW</td><td>6</td></tr>
<tr><td colspan="6">Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis</td></tr>
<tr><td>UNIT III</td><td colspan="4">DATA ANALYSIS</td><td>6</td></tr>
<tr><td colspan="6">Execution of the research - Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Generalization and Interpretation</td></tr>
<tr><td>UNIT IV</td><td colspan="4">REPORT, THESIS PAPER, AND RESEARCH PROPASAL WRITING</td><td>6</td></tr>
<tr><td colspan="6">Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports –</td></tr>
</table>

Illustrations and tables - Bibliography, types of referencing, citations- index and footnotes, how to write report- Paper Developing,- Plagiarism- Research Proposal- Format of research proposal- a presentation - assessment by a review committee		
UNIT V	**INTELLECTUAL PROPERTY AND PATENT RIGHTS**	**6**
Ethical principles- Plagiarism, Nature of Intellectual Property - Patents, Designs, Trade and Copyright- patent search, Process of Patenting and Development: technological research, innovation, patenting, and development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of Patent Rights – Scope of Patent Rights, Geographical Indications		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Analyze the literature to identify the research gap in the given area of research.
CO2:	Identify and formulate the research Problem
CO3:	Analyze and synthesize the data using research methods and knowledge to provide scientific interpretation and conclusion.
CO4:	Prepare research reports and proposals by properly synthesizing, arranging the research documents to provide comprehensive technical and scientific report
CO5:	Conduct patent database search in various countries for the research problem identified.
CO6:	Apply ethical principles in research and reporting to promote healthy scientific practice

TEXT BOOKS:

1	Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An Introduction to Research Methodology, RBSA Publishers.
2	Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.

3	Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4	Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5	Wadehra, B.L. 2000. Law relating to patents, Trade Marks, Copy right designs and Geographical indications. Universal Law Publishing
REFERENCES:	
1	Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2	Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
3	Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
4	Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
5	Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
6	Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.
7	Satarkar, S.V., 2000. Intellectual property rights and copy right. ESS Publications.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
2	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
3	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
4	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
5	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
6	2	2	1	1	1	-	-	1	1	2	-	1	3	2	1
Overall Correlation	3	2	**1**	**1**	**1**	**-**	**-**	**1**	**1**	2	**-**	**1**	**3**	**2**	**1**

Recommended by Board of Studies	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

<table>
<tr><td rowspan="2">23AM501</td><td rowspan="2">DEEP LEARNINGTECHNIQUES</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">
• Introduce the fundamental mathematical and theoretical foundations underlying deep learning models.
• Explain the architecture, components, and functioning of Convolutional and Recurrent Neural Networks.
• Illustrate various optimization and regularization techniques used for training deep neural networks effectively.
• Discuss model evaluation methods and hyperparameter tuning techniques to enhance model performance.
• Explore autoencoders and generative models for representation learning and data generation tasks.
</td></tr>
<tr><td>UNIT I</td><td colspan="4">INTRODUCTION</td><td>9</td></tr>
<tr><td colspan="6">Machine Learning Basics: Model Capacity — Overfitting and Underfitting — Hyperparameters and Validation Sets — Estimators — Bias and Variance — Stochastic Gradient Descent (SGD) — Gradient-Based Optimization — Probability Distributions — Key Challenges Motivating Deep Learning. Introduction to Deep Networks: Deep Feedforward Networks — Regularization Techniques — Optimization Methods.</td></tr>
<tr><td>UNIT II</td><td colspan="4">CONVOLUTIONAL AND RECURRENT NEURAL NETWORKS</td><td>9</td></tr>
<tr><td colspan="6">Convolution Operation — Sparse Interactions — Parameter Sharing — Pooling Mechanisms — Variants of Convolution (Strided, Transposed, Dilated). CNN Learning Process: Activation Functions — Loss Functions — Regularization — Optimizers. Recurrent Neural Networks: Unfolding Computational Graphs — Sequence Modeling — Bidirectional and Sequence-to-Sequence Models — Handling Long-Term Dependencies.</td></tr>
</table>

UNIT III	**LSTM AND GRU NETWORKS**	**9**
Gated Architectures: Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) — Network Design and Training — Addressing Vanishing and Exploding Gradients — Applications in Sequential and Temporal Data Modeling.		
UNIT IV	**MODEL EVALUATION, HYPERPARAMETER TUNING, AND LEARNING FOUNDATIONS**	**9**
Performance Metrics — Baseline Models — Model Debugging and Evaluation Strategies. Hyperparameter Optimization: Manual Tuning, Automatic Search, Grid Search, and Random Search. Learning Foundations: Perceptron Techniques — Boltzmann Machines and Energy-Based Models — Understanding Learning Dynamics and Convergence Behavior.		
UNIT V	**AUTOENCODERS, REGULARIZATION, AND TRANSFORMER ARCHITECTURES**	**9**
Autoencoders: Undercomplete and Regularized Autoencoders — Stochastic Encoders and Decoders — Learning Strategies for Autoencoders. Deep Generative Models: Variational Autoencoders (VAEs) — Generative Adversarial Networks (GANs). Regularization Techniques: L1 and L2 Regularization — Dropout — Early Stopping — Batch Normalization — Data Augmentation — Weight Sharing and Noise Robustness. Transformers: Attention Mechanism — Self-Attention and Multi-Head Attention — Encoder–Decoder Structure — Positional Encoding — Transformer Models for Sequence and Vision Tasks — Training Considerations and Applications.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		

CO1:	Explain the fundamental concepts of linear algebra, probability, and optimization.
CO2:	Analyze and design Convolutional Neural Network architectures.
CO3:	Implement and compare different Recurrent Neural Network architectures for sequence modeling problems.
CO4:	Evaluate deep learning models using suitable performance metrics..
CO5:	Apply hyperparameter tuning and debugging strategies to improve model generalization and efficiency.
CO6:	Interpret the principles of autoencoders and generative models such as VAEs and GANs.
TEXT BOOKS:	
1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MITPress,2018.
2	Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018
REFERENCES:	
1	Amit kumar Das, Saptarsi Goswami, Pabitra Mitra, Amlan Chakrabarti “Deep Learning", Pearson Education, 2022.
2	Li Deng, Dong, “Yu, Deep Learning: Methods and Applications”, NOW Publishers, 2014.
3	Charu C. Aggarwal, ”Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 2018.
4	Nikhil Buduma and Nicholas Locascio, Fundamentals of Deep Learning: Designing Next Generation Artificial Intelligence Algorithms, O'Reilly Media, 2017.
5	Stone, James,“Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning”, Sebtel Press, United States, 2019.

6	Navin Kumar Manaswi: Deep Learning with Applications Using Python,2018

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	1	-	-	1	1	2	1	1
2	3	2	1	1	1	-	-	1	-	-	1	-	3	1	1
3	3	3	2	2	1	-	-	1	-	-	1	-	3	1	1
4	3	2	1	1	1	-	-	1	-	-	1	-	3	1	1
5	2	1	-	-	1	-	-	1	-	-	1	-	2	1	1
6	3	2	1	1	1	-	-	1	1	1	1	-	3	1	1
Overall Correlation	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
Recommended by Board of Studies															
Approved									**Date**						

23AM511	COMPUTER NETWORK ARCHITECTURE AND PROTOCOLS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Introduce the fundamental concepts and architectures of computer networks.
- Explain the protocols, functions, and mechanisms at each layer of the OSI and TCP/IP models.
- Demonstrate data transmission, routing, and flow control techniques in networks.
- Illustrate the operation of transport and application layer protocols.
- Provide hands-on experience in network configuration, protocol simulation, and security mechanisms.

UNIT I	Introduction to Computer Networks	9

Network concepts – Goals and applications of computer networks – Network hardware and software – Network topologies – Reference models: OSI and TCP/IP architecture – Network components and protocols.

UNIT II	Data Link Layer	9

Functions of Data Link Layer – Framing – Error detection and correction – Flow control and error control – Medium Access Control (MAC) – LAN technologies: Ethernet, Token Ring, Wireless LANs – Switches and Bridges.

UNIT III	Network Layer and Software-Defined Networking	9

Network Layer Design Issues — Routing Concepts — Static and Dynamic Routing — Distance Vector and Link State Routing — Congestion Control — Quality of Service (QoS) — IPv4 and IPv6 Addressing — Subnetting and Supernetting — Software-Defined Networking (SDN): Concepts, Architecture, and Applications.

UNIT IV	Transport Layer	9

Transport layer services – Connection-oriented and connectionless

services – UDP and TCP – TCP connection establishment and termination – Flow control and congestion control in TCP – Socket programming concepts.		
UNIT V	**Application Layer & Emerging Trends**	**9**
Application layer protocols – DNS, HTTP, FTP, SMTP, POP3, IMAP, SNMP – Network security basics: Authentication, encryption, and firewalls – Introduction to emerging trends: IoT networking, Software Defined Networking (SDN).		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		
1. Study of network devices and topologies. 2. Implementation of error detection techniques (Parity, CRC, Checksum). 3. Simulation of data link layer protocols (Stop-and-Wait, Go-Back-N, Selective Repeat). 4. Implementation of routing algorithms (Distance Vector / Link State). 5. Configuration of IP addressing and subnetting. 6. Socket programming using TCP and UDP for client-server communication. 7. Simulation of congestion control mechanisms in TCP. 8. Demonstration of network security techniques using simple encryption algorithms.		
		TOTAL:30 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the basic architecture, topologies, and protocols used in computer networks.	
CO2:	Analyze data link layer functionalities including framing, error control, and LAN technologies.	
CO3:	Apply routing and addressing concepts for efficient data delivery across networks.	
CO4:	Describe the principles of transport layer protocols such as TCP and UDP.	

CO5:	Develop socket programs to establish communication between client and server.
CO6:	Demonstrate the working of application layer protocols and basic network security mechanisms.

TEXT BOOKS:	
1	James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", Pearson Education, 8th Edition, 2020.
2	Behrouz A. Forouzan, "Data Communications and Networking", McGraw Hill Education, 5th Edition, 2017.
3	Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", Pearson Education, 5th Edition, 2017.
REFERENCES:	
1	William Stallings, "Data and Computer Communications", Pearson Education, 10th Edition, 2013.
2	Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann, 6th Edition, 2022.
3	Douglas E. Comer, "Internetworking with TCP/IP: Principles, Protocols, and Architecture", Pearson Education, 6th Edition, 2013.
4	Olivier Bonaventure, "Computer Networking: Principles, Protocols and Practice", The Saylor Foundation, 2nd Edition, 2016.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	1	-	-	1	1	2	1	1
2	3	2	1	1	1	-	-	1	-	-	1	-	3	1	1
3	3	3	2	2	1	-	-	1	-	-	1	-	3	1	1
4	3	2	1	1	1	-	-	1	-	-	1	-	3	1	1
5	2	1	-	-	1	-	-	1	-	-	1	-	2	1	1
6	3	2	1	1	1	-	-	1	1	1	1	-	3	1	1
Overall Correlation	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
Recommended by Board of Studies															
Approved										**Date**					

23AM521	DEEP LEARNING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To implement basic neural network architectures using Python and deep learning frameworks.
- To understand and apply various optimization algorithms for training deep networks.
- To design and train Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN).
- To perform model evaluation and hyperparameter tuning for performance improvement.
- To implement Autoencoders and Generative Adversarial Networks (GANs) for deep generative modeling.

PRACTICALS

1. Implementation of Perceptron and Multilayer Perceptron
2. Implementation of Gradient Descent Optimization Algorithms
3. Design and Training of a Convolutional Neural Network (CNN)
4. Experiment on Regularization Techniques
5. Implementation of Recurrent Neural Networks (RNN) and LSTM
6. Hyperparameter Tuning and Model Evaluation
7. Implementation of Autoencoders
8. Implementation of Generative Adversarial Networks (GANs)

TOTAL: 30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Demonstrate the implementation of basic neural network architectures using Python.
CO2:	Apply various optimization algorithms for training deep learning models.
CO3:	Construct and train Convolutional Neural Networks (CNN) for image classification tasks.

CO4:	Develop Recurrent Neural Network (RNN) and LSTM models for sequence prediction.
CO5:	Perform model evaluation and hyperparameter tuning to enhance performance.
CO6:	Implement Autoencoders and Generative Adversarial Networks (GANs) for data generation and representation learning.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	3	-	-	1	1	3	3	1	2	3	1
2	3	2	1	1	2	-	-	-	2	2	1	3	3	2	-
3	3	2	1	1	3	-	-	-	3	3	3	3	3	3	-
4	3	2	1	1	2	-	-	-	3	1	2	2	3	2	-
5	3	2	1	1	2	-	-	-	3	1	2	2	3	2	-
6	3	2	1	1	2	-	-	-	2	1	3	1	3	2	-
Overall Correlation	3	2	1	1	3	-	-	1	3	2	3	2	3	3	1
Recommended by Board of Studies															
Approved									**Date**						

23AD522	MINI PROJECT	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES:

- Encourage students to apply foundational theoretical knowledge to practical engineering problems.
- Develop collaborative and project management skills through teamwork and effective communication.
- Train students in basic research methodology, technical documentation, and presentation techniques to articulate project outcomes clearly.
- Enhance students' ability to systematically design, analyze, and evaluate simple prototypes or models.
- Prepare students for real-world engineering challenges and lay the foundation for multidisciplinary teamwork and problem-solving in advanced projects.

COURSE DESCRIPTION:

This course serves as an introductory platform for students to apply the foundational knowledge acquired from their core and interdisciplinary subjects in a practical setting. This course enables students to work on small-scale, department-relevant projects that focus on problem identification, basic design, and preliminary prototype development. With limited prior expertise, students will explore the process of translating theoretical concepts into tangible solutions, fostering creativity, teamwork, and critical thinking. The course emphasizes hands-on learning, communication, and project documentation, laying a strong foundation for advanced projects and professional challenges in later semesters.

PROJECT OUTLINE:

Week 1	Course Orientation and Topic Selection
Week 2	Problem Definition and Objective Setting

Week 3	Literature Review and Research
Week 4	First Review and Feedback
Week 5	Problem Refinement and Research Gap Identification
Week 6	Conceptual Design and Initial Approach
Week 7	Methodology and Project Planning
Week 8	Second Review and Project Evaluation
Week 9	Design Refinement and Testing
Week 10	Resource Identification and Budget Estimation
Week 11	Report Writing and Presentation Preparation
Week 12	Third Review Presentation and Submission of Thesis

EVALUATION:

- The progress of the mini project will be evaluated through three reviews, conducted by a committee appointed by the Head of the Department. A final project report must be submitted at the end of the semester. Evaluation will be based on oral presentation and the written report, assessed by internal examiners designated by the Head of the Department.
- The project should focus on topics from first three or four semester (whichever is applicable) subjects / industry demand topics, or futuristic technologies. It is recommended for Faculty of Aeronautical Engineering, Civil Engineering, and Mechanical Engineering students, the project should demonstrate an understanding of first principles of engineering.
- Similarly for students of Faculty of Computer Science Engineering, the project may involve programming using Python or C language. For Faculty of Electronics and Communication Engineering, the student project shall

	incorporate appropriate techniques and systems relevant to the field. For the students of Faculty of Fashion Technology, the project based on material innovations, or technology in fashion is recommended. • The evaluation will focus on how well the project is structured, including clarity and logical flow in both oral presentations and written texts. • The relevance and innovation of the project will be assessed, particularly its potential to contribute to sustainability, innovation, and SDG-aligned goals. • The accuracy of English usage, including grammar, clarity, and coherence, will be reviewed in both oral and written communication to ensure effective delivery of technical content.
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Apply basic engineering principles to solve simple problems.
CO2:	Choose relevant sources to understand the current knowledge and identify areas to improve.
CO3:	Utilise basic tools and techniques to test simple solutions.
CO4:	Interpret the impact of engineering solutions on society and the environment.
CO5:	Combine in teams to plan and complete projects within given constraints.
CO6:	Develop comprehensive technical reports and deliver structured presentations to effectively convey project outcomes.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
2	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
3	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
4	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
5	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
6	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
Overall Correlation	3	2	**1**	**1**	**1**	**1**	**1**	**3**	**2**	**2**	**2**	**1**	**3**	**1**	**3**
Recommended by Board of Studies							**13-11-2024**								
Approved							**3rd ACM**			**Date**			**30-11-2024**		

23ES591	APTITUDE AND LOGICAL REASONING –2	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To improve the problem solving and logical thinking ability of the students.
- To acquaint the student with frequently asked patterns in quantitative aptitude and logical reasoning during various examinations and campus interviews

UNIT I	4
Probability, Permutation & Combination, Algebra, Problems on ages	
UNIT II	**4**
Mensuration, Logarithms, inequalities and modulus, Syllogism	
UNIT III	**4**
Directions, logical sequence words, number series, Analytical Reasoning	
UNIT IV	**4**
Blood relation, Clock and Calendar, Picture puzzles	
UNIT V	**4**
Data sufficiency, cube and cuboids, odd man out	
	TOTAL: 20 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Apply concepts of probability, permutation, and combination to solve real-world problems.
CO2:	Solve algebraic problems and age-related problems using logical approaches and techniques.
CO3:	Analyze and solve problems in mensuration, logarithms, and inequalities.
CO4:	Interpret and solve problems related to directions, logical sequence, and number series.
CO5:	Identify and solve problems in logical reasoning such as syllogism, blood relations, clock and calendar.
CO6:	Identify and solve problems in logical reasoning such as syllogism, blood relations, clock and calendar.

TEXT BOOK:	
1	Smith, John. "APTIPEDIA." 2nd ed., Wiley Publishers, 2020.
2	Agarwal, R.S. "Quantitative Aptitude." 2nd ed., S. Chand Publishing.
REFERENCES:	
1	Agarwal, R.S. "A Modern Approach to Verbal & Non-Verbal Reasoning." 2nd ed., S. Chand Publishing.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	1	3	2	2	2	1	3	1	2	3	2	2
2	3	2	2	2	3	2	3	2	1	2	1	2	3	2	3
3	3	3	2	2	2	2	2	2	1	3	1	2	3	3	2
4	2	3	2	1	2	3	1	2	3	3	2	3	2	2	3
5	2	3	3	2	2	2	2	3	2	2	2	3	3	3	3
6	3	3	2	2	3	2	3	3	2	2	1	2	3	3	2
Overall Correlation	3	3	3	2	3	3	3	3	2	3	2	3	3	3	3

Recommended by Board of Studies	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

SEMESTER –VI

23CE611	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To provide basic knowledge on environment impact assessment
- To create an awareness on the pollutants in the environment
- To familiarize the student with the technology for restoring the environment.
- Applying the technology for producing ECO safe products
- To develop simple climate models and evaluate climate changes using models

UNIT I	INTRODUCTION TO ENVIRONMENT IMPACT ASSESSMENT	9

Impacts of Development on Environment – Rio Principles of Sustainable Development- Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework

UNIT II	MOVEMENT OF POLLUTANTS IN ENVIRONMENT	9

Concepts of diffusion and dispersion, point and area source pollutants, pollutant dispersal; Gaussian plume model, hydraulic potential, Darcy's equation, types of flow, turbulence. Concept of heat transfer, conduction, convection; concept of temperature, lapse rate (dry and moist adiabatic); mixing heights, laws of thermodynamics; concept of heat and work, Carnot engine, transmission of electrical power, efficiency of turbines, wind mills and hydroelectric power plants.

UNIT III	ECOLOGICAL RESTORATION	9

Wastewater treatment: anaerobic, aerobic process, methanogenesis, treatment schemes for waste water: dairy, distillery, tannery, sugar, antibiotic industries; solid waste

treatment: sources and management (composting, vermiculture and methane production, landfill. hazardous waste treatment).		
UNIT IV	**ECOLOGICALLY SAFE PRODUCTS AND PROCESSES**	**9**
Biofertilizers, microbial insecticides and pesticides, bio-control of plant pathogen, Integrated pest management; development of stress tolerant plants, biofuel; mining and metal biotechnology: microbial transformation		
UNIT V	**CLIMATE CHANGE MODELS**	**9**
Constructing a climate model – climate system modeling – climate simulation and drift – Evaluation of climate model simulation – regional (RCM) – global (GCM) – Global average response to warming –climate change observed to date		
		TOTAL: 60 PERIODS
LIST OF EXPERIMENTS		
1. Determination of Bio fuel parameters such as flash point and fire point. 2. Determination of density of biofuels. 3. Determination of BOD/COD in water. 4. Simulating the RCM and GCM model for different geographic conditions. **5.** Measurement of Pollutant in environment by Gaussian Plume model.		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the importance of the process of Environmental impact assessment and its types.	
CO2:	Illustrate the chemical processes and pollutant chemistry	
CO3:	Identify the methods to solve environmental problems	
CO4:	Apply the knowledge to develop ecofriendly products.	
CO5:	Construct the various simple climate models for simulation	

CO6:	Apply the climate model simulation to monitor climate change
TEXT BOOKS:	
1	David .E Neelin "Climate Change and Modelling", Cambridge University Press, California 2012.
2	Evans, G.G. & Furlong, J. 2010. Environmental Biotechnology: Theory and Application (2nd edition). Wiley-Blackwell Publications.
3	Pani, B. 2007. Textbook of Environmental Chemistry. IK international Publishing House
4	N.S. Raman , A.R. Gajbhiye & S.R. Khandeshwar, Environmental Impact Assessment, 2014,IK International Pvt Ltd.
REFERENCES:	
1	Carson (1907-1964). Environment Conservation-book
2	Encyclopaedia of Environmental Issues by Craig W. Allin &Probe.
3	Encyclopaedia of Environmental studies by William Ashworth.
4	Climate Change and Climate Modeling- Kindle Edition.
5	Environmentally- Friendly Product development -Eberhand Abile ,Reiner Anderl,2005

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	2	1	-	-	-	-	-	2	-	-
2	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
3	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
4	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
5	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
6	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**

Recommended by Board of Studies	**07-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23AM611	STATISTICAL NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To introduce the statistical foundations underlying NLP tasks.
- To develop the ability to model linguistic phenomena using probabilistic and machine learning frameworks.
- To implement statistical models for syntactic, semantic, and discourse analysis.
- To explore data-driven approaches for machine translation and language generation.
- To evaluate NLP systems using statistical metrics and probabilistic reasoning.

UNIT I	Introduction to Statistical NLP	9

Introduction to NLP and Statistical Paradigm – Language Modeling and Probability Theory – Text Corpora and Data Preprocessing – Tokenization, Lemmatization, and Stemming Techniques (Porter Stemmer) – Regular Expressions and Pattern Matching – Finite-State Automata and Finite-State Transducers – Morphological Analysis using Statistical Models – Zipf's Law and Heaps' Law for Word Distributions.

UNIT II	Probabilistic Models and Word-Level Analysis	9

N-Gram Models and Markov Assumptions – Maximum Likelihood Estimation – Smoothing Techniques: Additive, Good-Turing, Kneser–Ney – Back-off and Interpolation – Entropy and Perplexity Measures – Word Frequency Analysis – Statistical POS Tagging: Hidden Markov Models (HMM), Viterbi Algorithm – Stochastic vs. Rule-based vs. Transformation-based Tagging

UNIT III	Syntactic Structures and Parsing Models	9

Statistical Context-Free Grammars (SCFGs) – Probabilistic Context-Free Grammars (PCFGs) – Parameter Estimation for PCFGs – Parsing Algorithms: CYK, Earley, and Chart Parsing –

<table>
<tr><td colspan="3">Dependency Parsing and Transition-based Models – Data-driven Parsing Techniques – Structural and Lexical Probabilities – Evaluation of Parsing Accuracy (Precision, Recall, F1).</td></tr>
<tr><td>UNIT IV</td><td>Semantic and Discourse Modeling</td><td>9</td></tr>
<tr><td colspan="3">Distributional Semantics – Word Embeddings: Word2Vec, GloVe, FastText – Statistical Word Sense Disambiguation (WSD) using Naïve Bayes and EM Algorithm – Latent Semantic Analysis (LSA) and Latent Dirichlet Allocation (LDA) – Statistical Models for Semantic Role Labeling – Information Retrieval and Similarity Metrics – Discourse Modeling: Coherence and Reference Resolution using Probabilistic Graphical Models.</td></tr>
<tr><td>UNIT V</td><td>Statistical Machine Translation and Language Generation</td><td>9</td></tr>
<tr><td colspan="3">Introduction to Statistical Machine Translation (SMT) – Alignment Models and the IBM Models (1–5) – Expectation-Maximization for Word Alignment – Phrase-Based Translation Models – Evaluation Metrics: BLEU, METEOR – Statistical Text Summarization – Probabilistic Dialogue Systems and Conversational Modeling – Neural and Hybrid Statistical Approaches (Transition to Seq2Seq and Attention-based Models).</td></tr>
<tr><td colspan="3" align="right">TOTAL: 60 PERIODS</td></tr>
<tr><td colspan="3">PRACTICAL EXERCISES:</td></tr>
<tr><td colspan="3">1. Text Preprocessing and Statistical Analysis of Word Frequencies
2. Implementation of N-Gram Language Models and Smoothing Techniques
3. Part-of-Speech Tagging using Hidden Markov Models
4. Probabilistic Parsing using PCFGs and CYK Algorithm
5. Statistical Word Sense Disambiguation using Naïve Bayes Classifier
6. Semantic Representation using Word Embeddings (Word2Vec / GloVe)
7. Statistical Machine Translation using IBM Model 1</td></tr>
</table>

	8. Evaluation of Statistical NLP Models using Perplexity, BLEU, and F1 Metrics
	TOTAL:30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Apply probabilistic and statistical methods to represent and analyze natural language.
CO2:	Build statistical models for lexical and syntactic processing.
CO3:	Implement and evaluate probabilistic parsing and tagging algorithms.
CO4:	Apply statistical approaches for semantic interpretation and discourse understanding.
CO5:	Develop and assess statistical machine translation and text generation systems.
CO6:	Critically analyze performance metrics and limitations of statistical NLP models.
TEXT BOOKS:	
1	Daniel Jurafsky and James H Martin," Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 3rd Edition, 2025.
REFERENCES:	
1	C. Manning and H. Schutze, Statistical Natural, "Foundations of Language Processing. C", 1st Edition, MIT Press Cambridge, MA:1999
2	Steven Bird, Ewan Klein, and Edward Loper, "Natural Language Processing with Python", O'Reilly Media, 2nd Edition, 2021.
3	Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2nd Edition, 2016.
4	Jacob Eisenstein, "Introduction to Natural Language Processing", MIT Press, 1st Edition, 2019.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	1	-	2	-	1	-	1	2	-	2
2	3	2	1	1	1	2	-	3	-	1	-	-	3	1	3
3	2	1	-	-	1	2	-	3	-	1	-	-	2	1	3
4	2	1	-	-	1	2	-	3	-	1	-	-	2	1	3
5	3	2	1	1	-	3	3	3	3	3	3	-	3	-	3
6	2	1	-	-	-	3	3	3	3	2	3	-	2	-	3
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**3**	**1**	**3**	**1**	**2**	**1**	**1**	**3**	**1**	**3**
Recommended by Board of Studies															
Approved										**Date**					

23AM612	VISUAL DATA PROCESSING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Provide foundational knowledge of visual data forms, representation, and storage mechanisms.
- Develop understanding of modeling techniques for high-dimensional and structured visual data.
- Apply learning-based and graph-based frameworks for visual understanding and reasoning.
- Explore temporal, 3D, and multimodal visual data for real-world applications.
- Examine recent trends in visual analytics, visual–language integration, and generative visual models.

UNIT I	FOUNDATIONS OF VISUAL DATA PROCESSING	9

Introduction to Visual Data — Visual Information and Perception — Types of Visual Data (Images, Video, 3D, Multiview, Multimodal) — Visual Computing Pipeline — Visual Data Representation and Storage Formats — Metadata and Annotation Standards — Visual Feature Encoding and Descriptors.

UNIT II	VISUAL DATA MODELING AND REPRESENTATION	9

High-Dimensional Visual Data — Feature Maps and Embeddings — Graph-Based Visual Representation — Spatio-Temporal Modeling — Visual Scene Graphs — Region-Based and Object-Centric Representations — Visual Relationship Detection — Visual Data Indexing and Retrieval Structures

UNIT III	VISUAL UNDERSTANDING AND LEARNING MODELS	9

Learning from Visual Data — Representation Learning and Embedding Spaces — Visual Concept Learning — Attention

Mechanisms for Visual Data — Multiview and Cross-Modal Learning — Visual Question Answering (VQA) — Scene Understanding and Reasoning Models.		
UNIT IV	**TEMPORAL AND 3D VISUAL DATA PROCESSING**	**9**
Video and Motion Analysis — Temporal Feature Extraction — Object Tracking and Trajectory Learning — 3D Visual Data: Depth Maps, Point Clouds, and Voxels — 3D Scene Reconstruction — Spatio-Temporal Fusion — Applications in AR/VR and Autonomous Systems.		
UNIT V	**VISUAL DATA APPLICATIONS AND TRENDS**	**9**
Visual Data Analytics — Visual Content Recommendation — Visual Summarization — Visual Data Compression and Transmission — Generative Visual Models (GANs, Diffusion Models) — Visual Data Privacy and Ethics — Emerging Trends: Visual-Language Models (e.g., CLIP, BLIP), Multimodal Foundation Models, and Vision-Language Integration.		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		
1. Exploration of Visual Datasets 2. Feature Representation and Extraction 3. Scene Graph Construction 4. Visual Question Answering (VQA) 5. Object Tracking in Videos 6. 3D Reconstruction 7. Generative Visual Modeling 8. Multimodal Integration		
		TOTAL:30 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Describe various forms and representations of visual data and their computational characteristics.
CO2:	Apply modeling and embedding techniques to represent and retrieve complex visual information.
CO3:	Implement learning-based approaches for scene understanding and reasoning with visual data.
CO4:	Analyze and process temporal and 3D visual information for applications like tracking and reconstruction.
CO5:	Design and evaluate systems for visual data analytics and multimodal integration.
CO6:	Investigate emerging technologies such as vision–language models and generative visual frameworks for advanced applications.
TEXT BOOKS:	
1	Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2nd Edition, 2022.
2	Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Pearson Education, 4th Edition, 2018.
3	Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 1st Edition, 2016.
REFERENCES:	
1	Simon J. D. Prince, “Understanding Deep Learning”, MIT Press, 1st Edition, 2023.
2	Adrian Rosebrock, “Deep Learning for Computer Vision”, PyImageSearch, 1st Edition, 2021.
3	Zhiyong Wang, Dacheng Tao, “Visual Data Processing and Representation: Learning, Retrieval and Applications”, Springer, 1st Edition, 2020.
4	Fei-Fei Li, Justin Johnson, Serena Yeung, “CS231n: Convolutional Neural Networks for Visual Recognition”, Stanford University Course Notes, 2022.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	2	-	1	2	1	2	-	2
2	2	1	-	-	-	1	-	2	-	1	2	1	2	-	2
3	2	1	-	-	1	2	-	3	-	1	3	-	2	1	3
4	3	2	1	1	1	2	-	3	-	1	3	-	3	1	3
5	3	2	1	1	-	3	3	3	3	3	2	-	3	-	3
6	3	2	1	1	-	1	-	2	-	1	2	1	3	-	2
Overall Correlation	3	2	1	1	1	2	1	3	1	2	3	1	3	1	3
Recommended by Board of Studies							**13-11-2024**								
Approved							**3rd ACM**		**Date**				**30-11-2024**		

23AD621	PROJECT WORK PHASE-1	L	T	P	C
		0	0	4	2

COURSE DESCRIPTION:

This course provides an opportunity for students to apply their engineering knowledge to solve real-world problems through project-based learning. Students, working in groups with maximum of 4 under faculty supervision, undertake a comprehensive project addressing an approved topic. The course focuses on fostering collaboration, research, and practical skills, culminating in a detailed Phase 1 project report and oral presentations. Regular reviews ensure consistent progress and adherence to academic standards.

COURSE OBJECTIVES:

- Encourage students to apply theoretical knowledge to practical engineering problems.
- Develop collaborative and project management skills through teamwork.
- Train students in research methodology, technical documentation, and presentation skills.
- Enhance students' ability to design, analyze, and evaluate solutions systematically.
- Prepare students for real-world engineering challenges and multidisciplinary teamwork

PROJECT OUTLINE:

Week 1	Orientation and course overview. Formation of project teams and approval of topics by HoD.
Week 2	Initial meeting with supervisors. Define problem statement and objectives
Week 3	Literature review: Research methodologies and topic-specific studies.
Week 4	Zeroth Review.

Week 5	Refinement of literature review and identification of research gaps.
Week 6	Identification of Base Paper.
Week 7	First Review.
Week 8	Conceptual design discussions and brainstorming solutions.
Week 9	Narrowing done on the exact work.
Week 10	Completion of first stage of the Project.
Week 11	Development of detailed conceptual design and methodology.
Week 12	Incorporation of feedback and refinement of design and methodology.
Week 13	Second Review.
Week 14	Compilation of Phase 1 results, report writing, and presentation preparation.
Week 15	Final Viva Voce Presentations.
Individual meetings will be set up on a need's basis in conjunction with developing work	

EVALUATION:

- The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A phase 1 project report is required to be submitted at the end of the semester. Evaluation is based on oral presentation and the phase 1 project report jointly by internal examiners constituted by the Head of the Department.
- Evaluate how effectively the project is structured and communicated in both oral presentations and written texts, emphasizing logical flow and coherence.
- Evaluate the relevance and innovation of practical resources or prototypes developed, focusing on their potential to support sustainability, innovation, and SDG-aligned goals.

- Review the accuracy of English usage, including grammar, clarity, and coherence in oral and written communication, ensuring effective delivery of technical content.

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Develop feasible solutions by analyzing complex engineering problems using foundational knowledge, mathematics, and science.
CO2:	Survey literatures to identify gaps, define research questions, and propose designs and methods for solving engineering problems.
CO3:	Make use of modern tools to check the feasibility of the solutions effectively.
CO4:	Evaluate societal and environmental impacts of solutions while incorporating sustainability and ethical practices.
CO5:	Combine in teams to plan, manage, and lead projects within professional and economic constraints.
CO6:	Formulate technical reports, deliver presentations, and engage in lifelong learning to adapt to new technologies.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	2	2	3	3	3	3	3	3	1	3
2	3	3	2	2	1	2	2	3	3	3	3	3	3	1	3
3	3	2	1	1	1	2	2	3	3	3	3	3	3	1	3
4	3	3	3	3	1	1	2	3	3	3	3	3	3	1	3
5	3	3	3	3	1	2	2	3	3	3	3	3	3	1	3
6	3	3	3	3	1	2	2	3	3	3	3	3	3	1	3
Overall Correlation	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**3**

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23AD622	TECHNICAL TRAINING	L	T	P	C
		0	0	2	1

PREAMBLE:

The course ‘Technical Training’ is intended to enable a B.E./B.Tech. graduate to practice, learn, apply and prepare report about the training undergone. The learner shall be trained in the latest technology in relevant Industry preferably in computer-oriented platform. This course can help the learner to experience training and learn practical skills for the relevant domain. Learner should also be able to present his learning through PPT and report articulating his level of learning about the specific training.

COURSE OBJECTIVES:

- To equip students with practical skills and real-world experience in technical domains, enabling them to effectively apply theoretical knowledge to hands-on applications.
- To develop competencies in working with industry-relevant tools and software technologies.
- To foster teamwork, problem-solving, and technical skills through innovative technologies

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Identify specific domain from the enrolled branch and to get training preferable in computer-oriented platform.
CO2:	Survey and apprehend the learning modules in the training program and to become expert in the specific domain.

CO3:	Apply theoretical learning in the practical environment and enhance the skillset of learner.
CO4:	Estimate the learning using available data.
CO5:	Defend a presentation about the learning done in the specified skillset.
CO6:	Construct a technical report about the training.

GUIDELINES:

- More than one training program may be given depending on availability and interest of the students. One training coordinator may be appointed for the same.
- Training coordinator shall provide required input to their students regarding the selection of training topic.
- Choosing a Training topic: The topic for a Technical Training should be current and broad based rather than very specific area of interest. It should also be outside the present syllabus. It's advisable to choose a training topic to be computer oriented as the resources for the same may be readily available. Every student of the program should be involved and assessed.
- Head of Department shall approve the selected training topic by the second week of the semester. Training may be assessed based on the ability to apply the skillset in a practical domain.

EVALUATION PATTERN:

Training Coordinator:

50 marks (Training Manual – 40 (Each student shall maintain a Training Manual and the Coordinator shall monitor the progress of the training work on a weekly basis and shall

approve the entries in the Training Manual during the weekly meeting with the student), Attendance – 10,).

Presentation of Application:

Candidate should apply the skillset attained in training. 20 marks to be awarded by the Examiners (Clarity of presentation – 5, Interactions – 10, Quality of the slides – 5).

Report about Application:

30 marks to be awarded by the Examiners (check for technical content, overall quality, templates followed, adequacy of application of the skillset etc.).

Training duration – 30 Hours

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	2	1	-	-	-	-	3	3	-	-
2	3	3	2	1	-	2	1	-	-	-	-	3	3	-	-
3	3	3	3	3	3	-	-	1	-	2	-	3	3	3	1
4	3	3	3	2	2	-	-	1	-	3	-	3	3	2	1
5	3	3	3	2	1	2	-	2	-	2	-	2	3	1	2
6	3	3	3	3	2	2	-	2	-	3	-	3	3	2	2
Overall Correlation	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**-**	**3**	**-**	**3**	**3**	**2**	**2**

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23AD623	TECHNICAL SEMINAR – 1	L	T	P	C
		0	0	2	1

PREAMBLE:

The course 'Technical Seminar' is intended to enable a B.E./B. Tech graduate to read, understand,present and prepare report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar coordinator. This course can help the learner to experience how a presentation can be made about a selected academic document and empower her/him to prepare a technical report.

COURSE OBJECTIVES:

- To do Literature surveys in a selected area of study
- To understand an academic document from the literature and to give a presentation about it
- To prepare a technical report.

GUIDELINES:

- The Department shall form an Internal Assessment Committee (IAC) for the seminar with academic coordinator for that program as the Chairperson and seminar coordinator as member. During the seminar presentation of a student, all members of IAC shall be present.
- Formation of IAC shall be completed within a week after the End Semester Examination (or last working day) of the previous semester.
- Seminar Coordinator shall provide required input to their students regarding the selection of topic/ paper.
- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than very specific research work, beyond the syllabus. Every member of the project team could choose or be assigned

Seminar topics that covers various aspects linked to the Project area. • A topic/paper relevant to the discipline shall be selected by the student during the semester break. • Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IAC. The IAC shall approve the selected topic/paper by the second week of the semester. • Accurate references from genuine peer reviewed published material to be given in the report and to be verified.
EVALUATION PATTERN
Seminar Coordinator: 40 marks (Background Knowledge – 10 (The coordinator shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10). (Seminar Diary – 10 (Each student shall maintain a seminar diary and the coordinator shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10). **Presentation:** 40 marks to be awarded by the IAC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10). **Report:** 20 marks to be awarded by the IAC (check for technical content, overall quality, templates followed, adequacy of references etc.).
TOTAL: 45 PERIODS
COURSE OUTCOMES:
After completion of the course, the students will be able to:

CO1:	Identify academic documents from the literature which are related to her/his areas of interest.
CO2:	Survey and apprehend an academic document from the literature which is related to her/ his areas of interest.
CO3:	Compile a presentation about an academic document.
CO4:	Estimate the Contents using available literature.
CO5:	Defend a presentation about an academic document.
CO6:	Construct a technical report.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	2	1	1	2	3	3	2	2	3	2	2
2	3	3	3	1	2	1	1	2	3	3	2	2	3	2	2
3	3	3	2	2	2	1	1	1	3	3	1	1	3	2	2
4	3	3	2	1	1	1	2	2	3	3	2	1	3	2	2
5	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
6	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
Overall Correlation	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**2**

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SEMESTER – VII

23AD701	TECHNICAL COMPREHENSION	L	T	P	C
		2	0	0	2

PURPOSE:

To provide a complete review of the topics covered in the previous semesters, to ensure that a comprehensive understanding of the subjects is achieved. The student will be tested as per the guidelines given by national level examinations like GATE, TANCET etc. It will also help students to face job interviews and competitive examinations.

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Analyse the phenomena involved in the concerned problem and solve them.
CO2:	Apply principles to new and unique circumstances.
CO3:	Estimate concepts and principles of concerned branch of engineering.
CO4:	Distinguish between facts and opinion in the engineering field.
CO5:	Deduct cause-and-effect relationships of any relationship.
CO6:	Interpret data from charts and graphs and judge the relevance of information.

GUIDELINES:

- The Department shall form an Internal Assessment Committee for the Comprehension with Academic coordinator for that class as the Comprehension Instructor and Class coordinator as member.
- Instructor shall provide required input to their students regarding the overview of all topics covered in the previous semesters.
- Periodic tests can be conducted to assess students.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	1	-	2	1	-	-	-	-	1	3	-	-
2	3	2	1	1	-	1	1	-	-	-	-	1	3	-	-
3	3	3	3	3	3	-	-	3	-	3	-	3	3	3	3
4	3	2	1	1	2	-	-	1	-	3	-	3	3	2	1
5	3	3	3	2	1	2	-	2	-	2	-	2	3	1	2
6	3	3	3	2	1	2	-	2	-	2	-	2	3	1	2
Overall Correlation	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**-**	**3**	**-**	**3**	**3**	**3**	**2**
Recommended by Board of Studies							**13-11-2024**								
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23AD711	GENERATIVE AI	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Understand the historical evolution and significance of generative models in AI and distinguish them from discriminative models.
- Explain the architecture and functioning of various generative models, including GANs, VAEs, autoregressive models, and diffusion models.
- Analyze generative models applied to text, explore language model structures, attention mechanisms, and advanced techniques like Retrieval-Augmented Generation.
- Explore LSTM in action for retrieval.
- Examine advanced generative methods for creating paintings, music, and gameplay, including style transfer and reinforcement learning.
- Apply knowledge of open-source tools, programming frameworks, and deployment practices for training, fine-tuning, and deploying generative AI models.

UNIT I	INTRODUCTION TO GENERATIVE AI AND FOUNDATIONS	9

Generative Versus Discriminative Modeling Advances in Machine Learning - The Rise of Generative Modeling - The Generative Modeling Framework - Probabilistic Generative Models - The Challenges of Generative Modeling - Structured and Unstructured Data - Deep Neural Networks - Keras and TensorFlow- Deep Neural Network - Loading the Data - Building the Model - Compiling the Model - Training the Model - Evaluating the Model - Improving the Model - Convolutional Layers - Batch Normalization - Dropout Layers

UNIT II	VARIATIONAL AUTOENCODERS (VAES)	9

Autoencoders - The Encoder - The Decoder - Joining the Encoder

to the Decoder - Analysis of the Autoencoder - The Variational Art Exhibition - Building a Variational Autoencoder - The Encoder - The Loss Function - Analysis of the Variational Autoencoder - Using VAEs to Generate Faces - Training the VAE - Analysis of the VAE - Generating New Faces - Latent Space Arithmetic - Morphing Between Faces		
UNIT III	**GENERATIVE ADVERSARIAL NETWORKS (GANS**	**9**
Ganimals - Introduction to GANs - The Discriminator - The Generator - Training the GAN GAN Challenges - Oscillating Loss - Mode Collapse - Uninformative Loss – Hyperparameters - Tackling the GAN Challenges - Wasserstein GAN - Wasserstein Loss The Lipschitz Constraint - Weight Clipping - Training the WGAN - Analysis of the WGAN - WGAN-GP - The Gradient Penalty Loss - Analysis of WGAN-GP		
UNIT IV	**ADVANCED GENERATIVE MODELS**	**9**
Apples and Organges – CycleGAN - The Generators (U-Net) - The Discriminators -Compiling the CycleGAN - Training the CycleGAN - Analysis of the CycleGAN - Creating a CycleGAN to Paint Like Monet -The Generators (ResNet) - Analysis of the CycleGAN - Neural Style Transfer -Content Loss -Style Loss -Total Variance Loss -Running the Neural Style Transfer -Analysis of the Neural Style Transfer Model - Long Short-Term Memory Networks – Tokenization -Building the Dataset - The LSTM Architecture - The Embedding Layer - The LSTM Layer - The LSTM Cell - Generating New Text -RNN Extensions -Stacked Recurrent Networks -Gated Recurrent Units -Bidirectional Cells - Encoder–Decoder Models		
UNIT V	**FUTURE OF GENERATIVE AI**	**9**
Five Years of Progress - The Transformer - Positional Encoding - Multihead Attention		

- The Decoder - Analysis of the Transformer – BERT - GPT-2 – MuseNet – Advances Image Generation – ProGAN -Self-Attention GAN (SAGAN) – BigGAN - StyleGAN Applications of Generative Modeling - AI Art - AI Music
TOTAL: 45 PERIODS
PRACTICALS:
1. Exploring Generative and Discriminative Models 2. Probabilistic Modeling and Generative Processes 3. Building a Basic Transformer for Text Generation 4. Experimenting with Prompt Engineering and GPT Models 5. Implementing a Basic GAN for Image Generation 6. Using a Variational Autoencoder (VAE) for Image Reconstruction 7. Style Transfer Using Neural Networks 8. Generating Music Using Recurrent Neural Networks (RNN) 9. Fine-Tuning a Pretrained Generative Model and Deploying on Hugging Face 10. Project: Develop a multimodal Generative AI application that generates text, images, and music based on user inputs.
PERIODS OUTCOMES:

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Compare between generative and discriminative models
CO2:	Illustrate VAE loss functions and the mathematical formulation
CO3:	Identify and address common training challenges in GANs
CO4:	Apply the models of GAN to various application
CO5:	Build models using Long Short-Term Memory Networks
CO6:	Apply generative AI to a real-world problem
TEXT BOOKS:	
1	David Foster, "Generative Deep Learning", O'Reily Books, 2024

REFERENCES:	
1	Denis Rothman, "Transformers for Natural Language Processing and Computer Vision", Third Edition , Packt Books, 2024
2	Altaf Rehmani, "Generative AI for Everyone", BlueRose One, 2024.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	2	1	3	3	2	-	-
2	2	1	-	-	-	-	-	-	2	1	3	3	2	-	-
3	3	2	1	1	-	-	-	-	-	-	1	-	3	-	-
4	3	2	1	1	-	-	-	-	-	-	1	-	3	-	-
5	3	2	1	1	-	-	1	-	-	-	1	-	3	-	-
6	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
Overall Correlation	3	2	1	1	1	1	1	1	1	1	2	2	3	1	1

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23AD721	PROJECT WORK PHASE-2	L	T	P	C
		0	0	6	3

COURSE DESCRIPTION:

Project Phase 2 is a continuation of Project Phase 1, focusing on implementing the proposed methodology through fabrication, simulation, or experimental validation. Students will refine their designs, validate test problems, and commission setups for final testing. This phase emphasizes hands-on application, calibration, and demonstration of results, culminating in a final presentation and report submission.

COURSE OBJECTIVES:

- Implement the proposed methodology to address engineering problems identified in Phase 1.
- Develop and fabricate prototypes or simulate solutions for the selected project integrating theoretical knowledge with practical application across hardware and software systems.
- Validate solutions through testing ensuring reliability and performance in both physical and virtual environments.
- Enhance problem-solving and critical thinking skills by troubleshooting and optimizing either experiment setups or software code to improve results.
- Prepare a research manuscript or applying for patent grant either for design or research.

PROJECT OUTLINE:

Week 1	Review of Phase 1 outcomes and refinement of proposed methodology.
Week 2	Material procurement/ software setup for simulation, and initiation of fabrication/simulation work.
Week 3	Intermediate fabrication/simulation work and initial testing or calibration, troubleshooting challenges.

Week 4	Second Review.
Week 5	Validation of test problem or refinement of prototype/simulation
Week 6	Optimisation of the test setup or solution trials, Data curation / uncertainty analysis
Week 7	Final testing of setup or simulation outcomes, Validation of Data.
Week 8	Third Review
Week 9	Demonstration of the solution with high level of data accuracy and precision.
Week 10	Compilation of Phase 2 results, report writing, and presentation preparation.
Week 11	Preparing or publishing of research article/ Filing or Grant of Patent
Week 12	Final Viva Voce Presentations.
Individual meetings will be set up on a need's basis in conjunction with developing work	
EVALUATION:	
• The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department. • Assess the depth of understanding demonstrated in the project's conceptualization and the ability to answer questions during public presentations.	

- Publication of Research article in indexed journal or Patent award is necessary at the end of completion of the project.

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Apply appropriate methodologies to implement solutions for complex engineering problems identified in phase -1 using hardware / software or both systems.
CO2:	Develop existing functional prototypes or simulations models by integrating theoretical and practical knowledge.
CO3:	Evaluate solutions ensuring compliance with design specifications.
CO4:	Appraise the performance of solutions by refining designs or improving algorithms for enhanced outcomes.
CO5:	Collaborate effectively with team members to plan, manage, and execute engineering projects adhering to ethical principles and professional standards.
CO6:	Prepare technical reports, impactful presentations that communicate solutions effectively.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
2	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
3	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
4	3	2	2	2	1	1	2	3	3	3	3	3	3	1	3
5	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
6	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
Overall Correlation	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**3**

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23AD722	TECHNICAL SEMINAR – 2	L	T	P	C
		0	0	4	2

PREAMBLE:

The course 'Technical Seminar 2' is intended to be continuation of Technical Seminar 1. It enables a B.E./B. Tech graduate to read, understand, present and prepare report about higher level academic document. The selected topic should be outside the given syllabus. The learner shall search in the literature / current affairs including mass media, print media, peer reviewed journals, conference, books, project reports etc., and identify an appropriate topic/paper/thesis/report in her/his area of interest, in consultation with her/his seminar coordinator. This course can help the learner to experience how a higher-level presentation can be made about a selected academic document and empower her/him to prepare a technical report.

COURSE OBJECTIVES:

- To do Literature surveys in a selected area of study
- To understand an academic document from the literature and to give a presentation about it
- To prepare a technical report.

GUIDELINES:

- The Department shall form an Internal Assessment Committee (IAC) for the seminar with academic coordinator for that program as the Chairperson and seminar coordinator as member. During the seminar presentation of a student, all members of IAC shall be present.
- Formation of IAC shall be completed within a week after the End Semester Examination (or last working day) of the previous semester.
- Seminar Coordinator shall provide required input to their students regarding the selection of topic/ paper.

- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than very specific research work, beyond the syllabus. Every member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.
- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IAC. The IAC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

EVALUATION PATTERN

Seminar Coordinator:

40 marks (Background Knowledge – 10 (The coordinator shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10).

(Seminar Diary – 10 (Each student shall maintain a seminar diary and the coordinator shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation:

40 marks to be awarded by the IAC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report:

20 marks to be awarded by the IAC (check for technical content, overall quality, templates followed, adequacy of references etc.).

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Identify academic documents from the literature which are related to her/his areas of interest.
CO2:	Survey and apprehend an academic document from the literature which is related to her/ his areas of interest.
CO3:	Compile a presentation about an academic document.
CO4:	Estimate the Contents using available literature.
CO5:	Defend a presentation about an academic document.
CO6:	Construct a technical report.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	2	1	1	2	3	3	2	2	3	2	2
2	3	3	3	1	2	1	1	2	3	3	2	2	3	2	2
3	3	3	2	2	2	1	1	1	3	3	1	1	3	2	2
4	3	3	2	1	1	1	2	2	3	3	2	1	3	2	2
5	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
6	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
Overall Correlation	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**2**

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SEMESTER -VIII

23AM821	CAPSTONE PROJECT	L	T	P	C
		0	0	20	10

COURSE DESCRIPTION:

Prerequisites:

i) Team segregation.

ii) Identification of Project Guide.

iii) Identification of Area of Interest.

iv) Literature Review on the chosen area of interest.

Zeroth Review needs to be completed in the previous semester by the project coordinator

The *Capstone Project* **(*CP)*** provides an opportunity for students to engage in high-level inquiry focusing on an area of specialization within the engineering field. Capstone projects will be investigative, practice-centered. All capstones aim to bridge theory and practice and are aimed to have an impact on the professional life of students

The aim of the course is to facilitate the development of your *Capstone Projects.* Students are encouraged to apply and expend knowledge gained on teaching and learning throughout the Bachelor of Engineering Education program as part of this process

COURSE OBJECTIVES:

The Capstone Project should demonstrate the depth and extent of knowledge of students

During this course, students will

- Investigate and evaluate prominent literature connected to your CP.
- Present a clearly articulated investigative framework, while situating projects within established academic

practices and/ or ideas.

- Develop and create practical resources (either computational or experimental) for the concerned area of interest in engineering field.
- Offer inquiry-based argumentation for development in the concerned area within engineering field.
- Summarize the findings in the form of report, documentation and presentation

PROJECT OUTLINE:	
Week 1	Identification problem.
Week 2	Literature review.
Week 3	Preliminary work.
Week 4	First review.
Week 5	Completion of first stage of the Project methodology.
Week 6	Development.
Week 7	Testing & Validation.
Week 8	Second review.
Week 9	Repeatability.
Week 10	Report correction and Documentation
Week 11	Third review-Submission of paper for conference/journal
Week 12	Thesis Correction and Submission
Individual meetings will be set up on a need's basis in conjunction with developing work	

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Take part in challenging practical problems and find solutions by formulating proper methodology.
CO2:	Plan research methodology to tackle a specific problem.
CO3:	Construct extensive study on particular research projects.
CO4:	Develop experimental and computational studies on innovative research projects.
CO5:	Estimate incremental study on existing research projects.
CO6:	Take part in real life engineering challenges and propose appropriate solutions.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2	3	2	3	3	2	3	2	3	2	3	2	3	3	2	3
3	2	3	3	3	3	3	3	3	3	3	3	3	2	3	3
4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	2	3	3	3	3	3	3	3	3	3	3	3	2	3	3
6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Overall Correlation	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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Approved	**3rd ACM**	**Date**	**30-11-2024**

VERTICAL 1: GENERIC COMPUTER ENGINEERING

23AM031	**DIGITAL SYSTEMS AND COMPUTERORGANIZATION**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES:

- Understand number systems, logic gates, and Boolean algebra fundamentals.
- Analyze and design combinational and sequential digital circuits.
- Study the structure, functions, and organization of digital computers.
- Learn the design of processor data path, control unit, and pipelining concepts.
- Understand memory organization, hierarchy, and programmable logic devices.

UNIT I	**COMBINATIONAL LOGIC**	**6**

Combinational Circuits – Boolean algebra – Karnaugh Map Simplification – Half and Full Adder – Subtractor – Binary Parallel Adder – Magnitude Comparator – Encoder and Decoder – Multiplexer and Demultiplexer – Code Converters.

UNIT II	**SEQUENTIAL LOGIC**	**6**

Flip-Flops: SR, JK, D, T types – Truth and Excitation Tables – Edge Triggering – Analysis and Design of Clocked Sequential Circuits – Registers and Counters – Synchronous and Asynchronous Counters – Moore and Mealy Models – State Reduction and Assignment.

UNIT III	**COMPUTER FUNDAMENTALS**	**6**

Functional Units of a Digital Computer – Von Neumann Architecture – Instruction Set Architecture (ISA) – Instruction Cycle and Sequencing – Addressing Modes – Machine Instruction Encoding – Interaction between Assembly and High-Level Languages.

UNIT IV	PROCESSOR ORGANIZATION	6
Instruction Execution – Building a Datapath – ALU Design (Arithmetic and Logic Operations, Status Flags, ALU Components, HDL/IC-based Design) – Control Unit Design (Hardwired and Microprogrammed Control) – Pipelining Concepts – Data Hazards and Control Hazards.		
UNIT V	**MEMORY AND INTERFACING**	**6**
Memory Concepts and Hierarchy – Cache Memory: Mapping and Replacement Techniques – Virtual Memory – DMA – ROM – Programmable Logic Array (PLA) – Programmable Array Logic (PAL).		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES		
1. Verification of basic Boolean theorems using logic gates. 2. Design and implementation of combinational circuits for arbitrary Boolean functions. 3. Implementation of 4-bit binary adder/subtractor circuits. 4. Realization of code converters (BCD, Gray, Excess-3, etc.). 5. Implementation of encoders, decoders, and multiplexers. 6. Implementation of synchronous and asynchronous counters. 7. Design and implementation of a Universal Shift Register. 8. Simulation-based study of computer architecture and data path.		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		

CO1:	Understand the principles of number systems, Boolean algebra, and logic gates.
CO2:	Design and implement combinational digital circuits.
CO3:	Construct and analyze sequential circuits such as flip-flops, counters, and registers.
CO4:	Explain the structure and functional units of a digital computer and its instruction set.
CO5:	Illustrate processor design, pipelining, hazards, and memory organization.

CO6:	Demonstrate the working of memory units, cache, and programmable logic devices.
TEXT BOOKS:	
1	M. Morris Mano & Michael D. Ciletti, Digital Design: With an Introduction to Verilog HDL, VHDL, and SystemVerilog, 7th Edition / Latest Reprint, Pearson.
2	David A. Patterson & John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, 7th Edition / Latest Reprint, Morgan Kaufmann.
REFERENCES:	
1	Floyd T.L., Digital Fundamentals, 11th Edition, Pearson, 2019.
2	Charles H. Roth Jr., Fundamentals of Logic Design, 7th Edition, Jaico Books, 2021.
3	M. Morris Mano, Digital Logic and Computer Design, Pearson, 2016.
4	William Stallings, Computer Organization and Architecture – Designing for Performance, 10th Edition, Pearson, 2016.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
2	3	2	1	1	2	1	-	1	-	-	-	3	2	2	1
3	3	2	1	1	3	-	-	1	-	-	-	3	2	3	1
4	3	2	1	1	2	1	-	1	-	-	-	3	2	2	1
5	3	2	1	1	1	2	-	2	-	-	-	3	2	1	2
6	3	2	1	1	3	-	-	1	-	3	2	3	2	3	1
Overall Correlation	3	2	1	1	2	1	-	1	-	3	2	3	3	2	1

23AD032	UNIFIED MODELING LANGAUGE	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the fundamentals of object oriented software development process.
- To know the concepts of object oriented methodology and workflow.
- To explain class design, interface types and polymorphism.
- To describe patterns and GUI programming
- To study the various framework, multi-threading and design pattern.

UNIT I	UNIFIED PROCESS AND USE CASE DIAGRAMS	6

Introduction to OOAD with OO Basics — Unified Process — UML diagrams — Use Case –Case study — the Next Gen POS system, Inception -Use case Modelling — Relating Use cases — include, extend and generalization — When to use Use-cases

UNIT II	STATIC UML DIAGRAMS	6

Class Diagram—- Elaboration — Domain Model — Finding conceptual classes and description classes — Associations — Attributes — Domain model refinement — Finding conceptual class Hierarchies — Aggregation and Composition — Relationship between sequence diagrams and use cases — When to use Class Diagrams

UNIT III	DYNAMIC AND IMPLEMENTATION UML DIAGRAMS	6

Dynamic Diagrams — UML interaction diagrams — System sequence diagram — Collaboration diagram — When to use Communication Diagrams — State machine diagram and Modelling –When to use State Diagrams — Activity diagram — When to use activity diagrams Implementation Diagrams — UML package diagram.

UNIT IV	DESIGN PATTERNS	6

GRASP: Designing objects with responsibilities — Creator — Information expert — Low Coupling — High Cohesion —

Controller Design Patterns — creational — factory method — structural — Bridge — Adapter — behavioural — Strategy — observer –Applying GoF design patterns — Mapping design to code		
UNIT V	**TESTING**	**9**
Object Oriented Methodologies — Software Quality Assurance — Impact of object orientation on Testing — Develop Test Cases and Test Plans		
TOTAL: 30 PERIODS		
PRACTICAL EXERCISES:		
1. Create standard UML diagrams using a UML modeling tool for a given case study, and how can the design be mapped to code and implemented in a three-layered architecture? Additionally, how can the developed code be tested to ensure it satisfies the Software Requirements Specification (SRS) 2. Identify a software system that needs to be developed. 3. Document the Software Requirements Specification (SRS) for the identified system. 4. Identify use cases and develop the Use Case model. 5. Ientify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that. 6. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams 7. Draw relevant State Chart and Activity Diagrams for the same system. 8. Implement the system as per the detailed design 9. Test the software system for all the scenarios identified as per the use-case diagram. 10. Improve the reusability and maintainability of the software system by applying appropriate design patterns. 11. Implement the modified system and test it for various scenarios.		
TOTAL:30 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		

CO1:	Summarize the basic concepts of UML modelling
CO2:	Explain the various object-oriented design process
CO3:	Illustrate dynamic UML diagrams used for software design
CO4:	Identify various scenarios based on software requirements
CO5:	Construct UML based software design into pattern-based design using design patterns
CO6:	Explain the various testing methodologies for OO software
TEXT BOOKS:	
1	Grady Booch, James Rumbaugh, Ivar Jacobson, ”The Unified Modeling Language User guide”, Pearson Education 2nd edition (2009).
2	Cay Horstmann,”Object-Oriented Design and Patterns”, Wiley India edition 2004, New Delhi, India.
REFERENCES:	
1	Meilir Page-Jones, “Fundamentals of Object Oriented Design in UML”, Pearson Education and NewYork 2000.
2	Craig Larman , “An introduction to Object –Oriented Analysis and Design and Unified Process Appling UML and Patterns”, 3rdedition,Pearson Education,2005, New Delhi, India.
3	John W. Satzinger, Robert B Jackson, Stephen D Burd, ”Object-Oriented Analysis and Design with theUnified Process”, Cengage learning 2004, India.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	2	-	1	2	1	2	-	2
2	2	1	-	-	1	2	-	3	-	1	3	-	3	1	3
3	2	1	-	-	1	2	-	3	-	1	3	-	3	1	3
4	3	2	1	1	1	2	-	3	-	1	3	-	3	1	3
5	3	2	1	1	1	2	-	3	-	1	3	-	3	1	3
6	2	1	-	-	-	1	-	2	-	1	2	1	2	-	2
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**2**	**-**	**3**	**1**	**1**	**3**	**1**	**3**	**1**	**3**

23AD033	WEB ESSENTIALS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the fundamentals of internet technologies and develop interactive websites using HTML, CSS and Web2.0.
- To know the concepts of client-side scripting.
- To emphasis server-side scripting.
- To develop web applications using PHP and XML.
- To study the various web application framework and recent tools

UNIT I	WEB TECHNOLOGY FUNDAMENTALS	9

Introduction - The internet- World Wide Web- Client -Server Communication- HTTP Protocol: Request and Response Message- Web Servers-Web Clients.

Frontend frameworks HTML5 – Tags - Tables – Lists – Formatting- Colors – Links - Image – Favicons - HTML5 Control Elements – HTML Iframes- HTML Symbols and Emojis - CSS3 – Inline, Embedded and External Style Sheets – Rule Cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations. Bootstrap Framework

UNIT II	CLIENT-SIDE SCRIPTING	9

Introduction to JavaScript – JavaScript DOM Model - Exception Handling - Validation Built-in Objects - Event Handling- DHTML with JavaScript- JSON Introduction – Syntax – Function Files

UNIT III	SERVER- SIDE JAVA SCRIPTING	9

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC

UNIT IV	WEB DEVELOPMENT TOOL	9

PHP: Introduction - Declaring Variables, Data Types, Arrays, Strings, Operations, Expressions, Control Structures, Functions,

Reading Data from Web Form Controls like Text Boxes, Radio Buttons, Lists , Handling File Uploads, Connecting to database (My SQL as reference), Executing Simple Queries, Handling Results, Handling Sessions and Cookies – File Handling **XML:** Introduction to XML, Defining XML Tags, Attributes and Values, Document Type Definition, XML Schemas, Document Object model, XHTML - Parsing XML Data - DOM and SAX parsers in Java		
UNIT V	**WEB APPLICATION FRAMEWORK AND RECENT TOOLS**	**9**
Angularjs- MVC Architecture- Basic Declaration –Tables- Forms – Events - Directives – Modules-JS: React – VUE – Meteor – Firebase.		
TOTAL: 30 PERIODS		
PRACTICAL EXERCISES:		

1. Create a webpage with HTML describing your department. Use paragraph and list tags, apply colors, use header fonts and styling, insert images, create links.
2. Create a table to show your class time-table. Use and tags to provide a layout to the above page instead of a table layout. Use frames such that page is divided into 3 frames 20% on left to show contents of pages, 60% in center to show body of page, remaining on right to show remarks. Embed audio and video into the page
3. Create a simple interactive form by applying in-line CSS using the elements of CSS.
4. Write a Client Side Scripts for Validating Web Form Controls using DHTML.
5. Installation of Apache Tomcat web server.
6. Write programs in Java using Servlets:
   a. To invoke servlets from HTML forms.
   b. Session Tracking
7. Build a dynamic webpage using PHP that involves displaying and updating user information.
8. Write programs in Java to create three-tier applications using JSP and Databases.

a. For conducting on-line examination. b. For displaying student mark list. Assume that student information is available in a database which has been stored in a database server. Develop a simple GUI based database application and incorporate all the above-mentioned features. **9.** Develop a currency converter application that allows users to input an amount in one currency and convert it to another. For the sake of this challenge, you can use a hard-coded exchange rate. Take advantage of React state and event handlers to manage the input and conversion calculations.	
	TOTAL:30 PERIODS
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the basics of world wide web, protocols and identify the roles of webservers and web clients.
CO2:	Demonstrate the concepts of JavaScript and develop form using JavaScript.
CO3:	Develop form handling using servlets.
CO4:	Apply fundamental PHP syntax to declare variables, data types , control structures and connecting to database in the development of web-based applications.
CO5:	Construct and manipulate the data in XML format
CO6:	Develop interactive web applications using recent frameworks and tools.
TEXT BOOKS:	
1	Deitel and Deitel and Nieto, "Internet and World Wide Web - How to Program", 5th Edition, Prentice Hall, 2011.
2	Jeffrey C and Jackson, "Web Technologies A Computer Science Perspective", Pearson Education, 2011.
REFERENCES:	
1	Doguhan Uluca ,"Angular 6 for Enterprise-Ready Web Applications", 1st edition, Packt Publishing.

2	Stephen Wynkoop and John Burke “Running a Perfect Website”, QUE, 2nd Edition,1999.
3	Chris Bates, “Web Programming – Building Intranet Applications”, 3rd Edition, Wiley Publications, 2009.
4	Gopalan N.P. and Akilandeswari J., “Web Technology”, Prentice Hall of India, 2011.
5	UttamK.Roy, “Web Technologies”, Oxford University Press, 2011.
6	Shyam Seshadri “Angular: Up and Running: Learning Angular, Step by Step”, 1st edition, O’Reilly.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	-	-	-	1	3	3	1	2	2	-
2	2	1	-	-	2	-	-	1	2	2	1	3	2	2	1
3	3	2	1	1	2	1	-	2	1	2	1	1	3	2	2
4	3	2	1	1	2	1	-	2	3	1	2	2	3	2	2
5	3	2	1	1	2	1	-	2	3	1	2	2	3	2	2
6	3	2	1	1	2	1	2	2	2	1	3	1	3	2	2
Overall Correlation	3	2	1	1	2	1	1	2	2	2	2	2	3	2	2

23AM032	DISTRIBUTED COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamentals of information security concepts.
- Explore the architectural design of security concepts.
- Describe different ISO standards and security framework.
- Comprehend the various techniques of access controls in information security.
- Explain various cloud security models and its challenges.
- Understand the concept of virtualization security.
- Use tools for penetration testing, vulnerability scanning, and security auditing.

UNIT I	INTRODUCTION TO DISTRIBUTED SYSTEMS	9

Definition and Goals of Distributed Systems – Hardware and Software Concepts – Types of Distributed Systems – Design Issues – System Architectures – Distributed Computing Models (Client-Server, Peer-to-Peer, Hybrid) – Distributed Data Management Basics: Database System Architecture (Three-level ANSI–SPARC Architecture, Data Independence) – Query Processing Overview (Parsing, Optimization Basics) – Recovery Concepts (Transactions, Logging, Checkpointing) – Brief example of Distributed File System (HDFS).

UNIT II	COMMUNICATION AND SYNCHRONIZATION	9

Interprocess Communication – Remote Procedure Call (RPC) – Remote Method Invocation (RMI) – Message-Oriented Communication – Group Communication – Synchronization: Logical Clocks, Lamport Timestamps, Vector Clocks – Global State and Snapshot Algorithms – Election Algorithms.

UNIT III	**CONSISTENCY, REPLICATION AND FAULT TOLERANCE**	**9**
Data-Centric Consistency Models – Client-Centric Consistency – Replica Management – Fault Tolerance – Recovery and Checkpointing – Byzantine Failures – Distributed Consensus: Two-Phase and Three-Phase Commit Protocols – Paxos Algorithm.		
UNIT IV	**PROCESS MANAGEMENT AND DISTRIBUTED FILE SYSTEMS**	**9**
Process Migration – Load Balancing – Naming and Directory Services – Distributed File Systems: NFS, AFS – Distributed Shared Memory – Distributed Transactions and Concurrency Control – Security in Distributed Systems.		
UNIT V	**MODERN DISTRIBUTED SYSTEMS AND TRENDS**	**9**
Distributed Middleware – Microservices Architecture – Cloud Computing – Distributed Databases – Edge & Fog Computing – Blockchain Systems – IoT Distributed Frameworks – Scalability and Performance Metrics.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the fundamental concepts, models, and architectures of distributed systems.
CO2:	Analyze communication and synchronization mechanisms in distributed environments.
CO3:	Evaluate fault tolerance, replication, and consistency management techniques.
CO4:	Describe process management, naming, and distributed file system architectures.
CO5:	Apply distributed computing principles to cloud, IoT, and edge-based environments.

CO6:	Assess emerging distributed technologies such as microservices, blockchain, and distributed databases.
TEXT BOOKS:	
1	Andrew S. Tanenbaum and Maarten Van Steen, Distributed Systems: Principles and Paradigms, 2nd Edition, Pearson Education, 2017.
2	George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, Distributed Systems: Concepts and Design, 5th Edition, Pearson Education, 2012.
REFERENCES:	
1	Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Morgan Kaufmann, 2012.
2	Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi, Mastering Cloud Computing: Foundations and Applications Programming, McGraw-Hill, 2013.
3	M. L. Liu, Distributed Computing: Principles and Applications, Pearson Education, 2009.
4	G. Coulouris et al., Distributed Systems, Addison Wesley, 5th Edition, 2012.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	1	1	-	-	2	-	-
2	3	2	1	1	1	-	-	-	1	1	1	1	3	1	-
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5	3	2	1	1	3	1	1	2	3	3	2	1	3	3	2
6	3	2	1	1	2	1	1	2	2	3	2	1	3	2	2
Overall Correlation	3	2	1	1	2	1	1	2	3	3	2	1	3	2	2

23AM033	AI IN WIRELESS COMMUNICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamentals of wireless communication systems and architecture.
- Explore the integration of AI and ML in wireless networks.
- Learn AI-based techniques for resource allocation, channel estimation, and spectrum management.
- Analyze and apply deep learning and edge intelligence methods in signal processing.
- Examine the role of AI in 5G/6G, edge computing, and IoT communications.
- Assess current research trends and challenges in AI-enabled wireless networks.

UNIT I	FUNDAMENTALS OF WIRELESS COMMUNICATIONS	9

Wireless Communication Concepts – Evolution from 1G to 6G – Spectrum, Modulation and Coding – Multiple Access Techniques (FDMA, TDMA, CDMA, OFDMA) – MIMO Systems – Fading and Channel Modeling – Cellular Network Architecture – Key Challenges in Modern Wireless Systems.

UNIT II	INTRODUCTION TO AI AND MACHINE LEARNING IN WIRELESS NETWORKS	9

AI Fundamentals – Machine Learning & Deep Learning Overview – Supervised, Unsupervised & Reinforcement Learning – AI-driven Network Optimization – Role of AI in Network Automation – Data Collection, Training & Deployment in Wireless Environments – Use Cases: Smart Resource Allocation, Mobility Management.

UNIT III	AI FOR RADIO RESOURCE AND SPECTRUM MANAGEMENT	9

Dynamic Spectrum Access – Spectrum Sensing via ML – Cognitive

Radio Concepts – Reinforcement Learning for Power Control & Channel Selection – AI-based Interference Management – Traffic Prediction & Load Balancing using Neural Networks – Energy-Efficient Communications with AI.		
UNIT IV	**EDGE INTELLIGENCE IN WIRELESS NETWORKS**	**9**
Edge AI and Federated Learning in Wireless Networks – Resource Optimization at the Edge – Distributed AI Models for IoT and Vehicular Communications – AI-Enabled Signal Detection & Prediction at the Edge – Federated Reinforcement Learning for Edge Resource Allocation – Privacy, Latency, and Energy Challenges in Edge Intelligence.		
UNIT V	**AI IN 5G, 6G AND FUTURE NETWORKS**	**9**
AI for 5G Network Slicing and Management – Security and Trust in AI-enabled Networks – Intelligent Handover & QoS Optimization – AI in Massive MIMO & mmWave Systems – AI-Driven Intelligent Surfaces, Digital Twins & Semantic Communications for 6G – Research Directions & Challenges.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the fundamental principles and challenges of modern wireless communication systems.
CO2:	Apply AI and ML models to optimize wireless network operations and performance.
CO3:	Analyze AI-based methods for dynamic resource allocation and spectrum management.
CO4:	Implement deep learning techniques for signal processing and channel estimation tasks.
CO5:	Evaluate the use of AI in 5G/6G networks, IoT, and edge intelligence.
CO6:	Assess emerging trends, technologies, and research directions in AI-enabled wireless communication.

TEXT BOOKS:	
1	Kwang-Cheng Chen, Mehdi Bennis, "Machine Learning for Future Wireless Communications", Cambridge University Press, 2020.
2	Haesik Kim, Artificial Intelligence for 6G, Springer, 2022.
3	Iacovos Ioannou, Prabagarane Nagaradjane, Vassos Vassiliou, Andreas Pitsillides & Christophoros Christophorou, Distributed Artificial Intelligence for 5G/6G Communications: Frameworks with Machine Learning, CRC Press, 2025.
REFERENCES:	
1	Mehdi Bennis, Mérouane Debbah, "Machine Learning and Wireless Communications", Elsevier, 2022.
2	Sudeep Tanwar, Sudhanshu Tyagi, Neeraj Kumar, "Machine Learning in Wireless Networks: Techniques, Applications, and Challenges", CRC Press, 2021.
3	Saeed Hamood Alsamhi, "AI-Driven Next-Generation Wireless Networks", Wiley, 2023.
4	Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications: From Real-World Propagation to Space-Time Code Design", Academic Press, 2010.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	-	-	-	1	1	-	1	3	1	-
2	3	3	2	2	2	1	-	-	2	2	1	1	3	2	1
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4	3	2	2	2	3	1	1	1	2	3	2	1	3	3	2
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6	3	3	2	2	3	1	1	2	3	3	2	1	3	3	3
Overall Correlation	3	3	2	2	3	1	1	1	2	3	2	1	3	3	2

<table>
<tr><td rowspan="2">23AD036</td><td rowspan="2">CRYPTOGRAPHY AND NETWORK SECURITY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">
• Understand the basic categories of threats to computers and networks
• Explain the importance and application of each of confidentiality, integrity, authentication and availability
• Understand various symmetric key cryptographic algorithms.
• Describe public-key cryptosystem
• Describe various message authentication models
• Understand Intrusions and intrusion detection
</td></tr>
<tr><td>UNIT I</td><td colspan="4">INTRODUCTION</td><td>6</td></tr>
<tr><td colspan="6">Overview of Cryptography and Its Applications - Secure Communications - Cryptographic Applications - Classical Cryptosystems - Shift Ciphers - Affine Ciphers - The Vigenère Cipher - Substitution Ciphers - Sherlock Holmes - The Playfair and ADFGX Ciphers - Enigma - Basic Number Theory -The Extended Euclidean Algorithm - The Chinese Remainder Theorem - Modular Exponentiation - Fermat's Theorem and Euler's Theorem - Primitive Roots</td></tr>
<tr><td>UNIT II</td><td colspan="4">SYMMETRIC KEY CRYPTOGRAPHY</td><td>6</td></tr>
<tr><td colspan="6">Block Cipher And Data Encryption Standards: Block Cipher Principles, Data Encryption Standards, The Strength Of Des.
Advanced Encryption Standards: Evaluation Criteria For Aes, The Aes Cipher.</td></tr>
<tr><td>UNIT III</td><td colspan="4">PUBLIC KEY CRYPTOGRAPHY</td><td>6</td></tr>
<tr><td colspan="6">Asymmetric Key Ciphers: Rsa Cryptosystem – Key Distribution – Key Management – Diffie Hellman Key Exchange -Elgamal Cryptosystem – Elliptic Curve Arithmetic-Elliptic Curve Cryptography.</td></tr>
</table>

UNIT IV	**MESSAGE AUTHENTICATION AND INTEGRITY**	**6**
Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA – Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications – Kerberos, X.509		
UNIT V	**SECURITY PRACTICE AND SYSTEM SECURITY**	**6**
Electronic Mail Security – Pgp, S/Mime – Ip Security – Web Security System Security: Intruders – Malicious Software – Viruses – Firewalls		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		
1. Implementation of Caesar Cipher technique 2. Implement the Play fair Cipher 3. Implement the Pure Transposition Cipher 4. Implement DES Encryption and Decryption 5. Implement the AES Encryption and decryption 6. Implement RSA Encryption Algorithm **7.** Implementation of Hash Functions		
		TOTAL:30 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Infer basic security attacks and services
CO2:	Illustrate confidentiality, integrity, authentication and availability concepts
CO3:	Make use of symmetric key algorithms for cryptography
CO4:	Make use of asymmetric key algorithms for cryptography and apply the knowledge of Key Management techniques
CO5:	Utilize the Authentication functions the manner in which Message Authentication Codes and Hash Functions works

CO6:	Examine the issues and structure of Authentication Service and Electronic Mail Security
TEXT BOOKS:	
1	Wade Trappe and Lawrence C. Washington "Introduction to Cryptography with Coding Theory", 3rd edition, Pearson, 2020
2	William Stallings, Cryptography and Network Security: Principles and Practice, 8th edition, Pearson Education, India, 2020.
REFERENCES:	
1	Behrouz A. Forouzan, "Cryptography and Network Security", McGraw Hill, is the 3rd edition (SIE) , 2015
2	Charlie Kaufman, Network Security: Private Communication in a Public World, 2nd edition, Prentice Hall of India, New Delhi, 2002.
3	Atul Kahate , "Cryptography and Network Security", 2nd edition, Tata Mc Grawhill, India, 2008.
4	Robert Bragg, Mark Rhodes, "Network Security: The complete reference", Tata Mc Grawhill, India, 2004.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	2	1	3	3	2	-	-
2	2	1	-	-	-	-	-	-	2	1	3	3	2	-	-
3	3	2	1	1	-	-	-	-	-	-	1	-	3	-	-
4	3	2	1	1	-	-	-	-	-	-	1	-	3	-	-
5	3	3	1	1	-	-	1	-	-	-	1	-	3	-	-
6	3	3	2	2	1	1	1	1	1	1	1	1	3	1	1
Overall Correlation	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1

23AM034	DATA SCIENCE IN PRACTICE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the principles and workflow of data science, including data collection, preprocessing, and visualization.
- Apply statistical and machine learning techniques for data analysis.
- Explore practical tools and programming environments for data science such as Python, R, and Jupyter notebooks.
- Develop skills to handle real-world datasets, perform exploratory data analysis, and draw actionable insights.
- Implement predictive modeling and evaluate model performance.
- Gain experience with cloud-based data science platforms and collaborative workflows.

UNIT I	INTRODUCTION TO DATA SCIENCE	9

Data Science Overview – Importance and Applications – Data Science Lifecycle – Data Sources, Types, and Collection Techniques – Introduction to Data Wrangling and Preprocessing – Handling Missing and Noisy Data – Introduction to Data Ethics and Privacy.

UNIT II	DATA ANALYSIS AND VISUALIZATION	9

Exploratory Data Analysis (EDA) – Summary Statistics – Data Aggregation – Data Cleaning Techniques – Data Visualization Tools and Libraries: Matplotlib, Seaborn, Plotly – Visualization Best Practices – Storytelling with Data.

UNIT III	STATISTICAL AND MACHINE LEARNING TECHNIQUES	9

Descriptive and Inferential Statistics – Probability Distributions – Hypothesis Testing – Regression Analysis – Classification Techniques: Decision Trees, k-NN, Logistic Regression – Clustering Techniques: k-Means, Hierarchical – Introduction to Ensemble Methods.

UNIT IV	PRACTICAL DATA SCIENCE TOOLS	9

Python for Data Science – NumPy, Pandas, Scikit-learn – Jupyter

Notebooks for Reproducible Workflows – Data Import/Export and Manipulation – Feature Engineering and Selection – Model Training, Evaluation, and Hyperparameter Tuning – Introduction to R and RStudio for Data Analysis.		
UNIT V	**ADVANCED TOPICS AND APPLICATIONS**	**9**
Time Series Analysis – Text Mining and Natural Language Processing (NLP) – Introduction to Big Data Platforms (Hadoop, Spark) – Cloud-Based Data Science Platforms – Case Studies: Predictive Analytics, Recommender Systems, Fraud Detection, IoT Data Analysis – Deployment and Visualization of Models in Real-World Scenarios.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the fundamental concepts and workflow of data science.
CO2:	Perform data preprocessing, cleaning, and visualization on real datasets.
CO3:	Apply statistical and machine learning techniques to analyze data.
CO4:	Utilize Python/R-based tools for practical data analysis.
CO5:	Evaluate and interpret model performance and make data-driven decisions.
CO6:	Implement data science applications using advanced tools and cloud platforms.
TEXT BOOKS:	
1	Joel Grus, Data Science from Scratch: First Principles with Python, 2nd Edition, O'Reilly, 2019.
2	Cathy O'Neil and Rachel Schutt, Doing Data Science: Straight Talk from the Frontline, 2nd Edition, O'Reilly, 2013.
3	Jake VanderPlas, Python Data Science Handbook, 2nd Edition, O'Reilly, 2020.
REFERENCES:	
1	Peter Bruce, Andrew Bruce & Peter Gedeck, Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python, 2nd Edition, O'Reilly, 2020.

2	Gareth James, Daniela Witten, Trevor Hastie & Robert Tibshirani, An Introduction to Statistical Learning: with Applications in R, 2nd Edition, Springer, 2021/2022.
3	Hadley Wickham & Garrett Grolemund, R for Data Science, 2nd Edition, O’Reilly, 2022.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	-	-	1	1	-	1	3	2	1
2	3	3	2	2	2	1	-	-	2	2	1	1	3	3	2
3	3	3	2	2	3	1	-	-	2	3	2	1	3	3	2
4	3	3	3	3	3	1	1	1	3	3	2	2	3	3	3
5	3	3	2	3	3	1	1	2	3	3	2	2	3	3	3
6	3	3	2	2	2	2	2	3	2	3	3	3	3	3	2
Overall Correlation	3	3	2	2	3	1	1	2	2	3	2	2	3	3	2

23AM035	OBJECT ORIENTED THINKING IN SOFTWARE DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the principles of object-oriented thinking and design methodologies.
- Learn object modeling, abstraction, and encapsulation techniques.
- Apply inheritance, polymorphism, and composition to software design problems.
- Develop UML diagrams to represent system structure and behavior.
- Integrate design patterns to create reusable and maintainable solutions.
- Implement object-oriented design concepts in practical software development.

UNIT I	OBJECT-ORIENTED THINKING AND PRINCIPLES	9

Software Design Fundamentals – Object-Oriented Thinking vs Procedural Thinking – Abstraction, Encapsulation, Modularity, and Hierarchy – Object and Class Concepts – Responsibilities and Collaborations – Introduction to Design Thinking in Software Development.

Case Study: Modeling a Library Management System.

UNIT II	OBJECT MODELING AND UML BASICS	10

Overview of Object-Oriented Modeling – UML Diagrams: Class, Object, and Use Case Diagrams – Relationships: Association, Aggregation, Composition, Generalization – Use Case Modeling and Documentation – Applying Design Thinking to Identify Requirements.

Example: Designing a Student Information System using UML

UNIT III	MODELING DYNAMIC BEHAVIOR	9

Sequence Diagrams, Collaboration Diagrams, Activity Diagrams, and State Machine Diagrams – Modeling System Behavior and

Interactions – Interaction and Message Passing – Modeling Events and States – Incorporating User-Centric Design in Behavioral Models. Example: ATM Transaction and Online Shopping System Models.		
UNIT IV	**DESIGN PRINCIPLES AND PATTERNS**	**9**
SOLID Principles – Coupling and Cohesion – Introduction to Design Patterns: Creational, Structural, and Behavioral – Examples: Singleton, Factory, Adapter, Observer, Strategy Patterns – Applying Patterns in Real Systems. Example: Designing a Notification System using Observer Pattern.		
UNIT V	**OBJECT-ORIENTED DESIGN PROCESS**	**9**
Steps in Object-Oriented Design – Identifying Classes, Responsibilities, and Relationships – CRC Cards – Design Refinement – From Design to Implementation – Case Study: End-to-End Design of an E-Commerce System – Using UML Modeling Tools (StarUML / Visual Paradigm / Enterprise Architect) – Integrating Design Thinking for Solution Evaluation.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Understand the principles of object-oriented thinking and their role in modern software design.
CO2:	Apply object modeling and UML concepts to represent software systems.
CO3:	Develop dynamic and behavioral models for system interactions using design thinking.
CO4:	Employ design principles and patterns for reusable and maintainable software solutions.
CO5:	Construct object-oriented designs systematically and with modeling tools.
CO6:	Evaluate and refine software design models for real-world applications.

TEXT BOOKS:	
1	Grady Booch, Robert A. Maksimchuk, Michael W. Engel, Object-Oriented Analysis and Design with Applications, Addison Wesley, 3rd Edition, 2007.
2	Craig Larman, Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development, Pearson, 3rd Edition, 2005.
REFERENCES:	
1	Erich Gamma et al., Design Patterns: Elements of Reusable Object-Oriented Software, Addison Wesley, 1994
2	Bernd Bruegge and Allen H. Dutoit, Object-Oriented Software Engineering Using UML, Patterns, and Java, Prentice Hall, 3rd Edition, 2010.
3	Timothy C. Lethbridge & Robert Laganière, Object-Oriented Software Engineering: Practical Software Development using UML and Java, McGraw-Hill, 2005.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	-	-	1	1	-	1	3	2	1
2	3	3	2	2	2	1	-	-	2	2	1	1	3	3	2
3	3	3	2	2	3	1	-	-	2	3	2	1	3	3	2
4	3	3	3	3	3	1	1	1	3	3	2	2	3	3	3
5	3	3	3	3	3	1	1	2	3	3	2	2	3	3	3
6	3	3	2	3	3	2	2	3	2	3	3	3	3	3	2
Overall Correlation	3	3	2	2	3	1	1	2	2	3	2	2	3	3	2

VERTICAL 2: ANALYTICAL SCIENCES

23AD039	RESPONSIBLE AI	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand AI basics, misconceptions, responsible AI principles, and challenges in implementation.
- To understand and analyse biases in AI, fairness metrics, and mitigation techniques.
- To understand explainability, challenges, methods, and evaluation for interpretable machine learning models.
- To understand AI safety, security, privacy, and resilience, including model and data protection.
- To explore ethical issues and implications of AI in various real-world applications.

UNIT I	INTRODUCTION TO RESPONSIBLE AI	10

Overview of AI – Common misconception of AI – Introduction to Responsible AI – Characteristics of Responsible AI – Key principles of responsible AI - Challenges in implementing responsible AI - ELSI Framework and AI - Safety and Alignment – Fairness and Privacy.

UNIT II	FAIRNESS AND BIAS	9

Human Bias - Types of biases - Effects of biases on different demographics - Bias vs Fairness - Sources of Biases - Exploratory data analysis - Bias Mitigation Techniques - Pre-processing techniques - In-processing techniques - Post-processing techniques - Bias detection tools - Overview of fairness in AI - Demographic parity - Equalized odds - Simpson's paradox and the risks of multiple testing - Group fairness and Individual fairness - Counterfactual fairness - Fairness metrics - Bias and disparity mitigation with Fairlearn.

UNIT III	EXPLAINABILITY & INTERPRETABILITY	9

Importance of Explainability and Interpretability – Challenges -

Interpretability through simplification and visualization - Intrinsic interpretable methods - Post Hoc interpretability – Interpretability Evaluation methods - Explainability through causality - Model agnostic Interpretation - LIME (Local Interpretable Model-agnostic Explanations) - SHAP (SHapley Additive exPlanations).		
UNIT IV	**SAFETY, SECURITY, AND PRIVACY**	**9**
Overview of safety – security – privacy - resilience - Taxonomy of AI safety and Security - Adversarial attacks and mitigation - Model and data security - The ML life cycle - Adopting an ML life cycle MLOps and ModelOps - Model drift - Data drift - Concept drift - Privacy-preserving AI techniques- Differential privacy - Federated learning.		
UNIT V	**CASE STUDIES**	**9**
COMPAS Algorithm - Google Photos Tagging Controversy - ProPublica’s Analysis of Recidivism Predictions - Amazon’s AI Recruiting Tool - Facial Recognition Technology Misidentification - AI in Healthcare: Predictive Analytics in Patient Care - Tesla Autopilot and Ethical Implications of Autonomous Vehicles.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Demonstrate the key concepts of Responsible AI and evaluate its challenges in implementation.
CO2:	Identify types of biases in AI systems and apply bias mitigation techniques to ensure fairness.
CO3:	Explain the importance of explainability and interpretability in AI models and apply interpretability methods.
CO4:	Identify safety, security, and privacy issues in AI systems and implement techniques to mitigate risks.
CO5:	Apply privacy-preserving techniques
CO6:	Develop real-world case studies to assess the ethical implications and impact of AI technologies.

TEXT BOOKS:	
1	Virginia Dignum, "Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way", 2019.
2	Adnan Masood, Heather Dawe, "Responsible AI in the Enterprise", 2023.
REFERENCES:	
1	Beena Ammanath, "Trustworthy AI", O' Reilly, 2022.
2	Christoph Molnar "Interpretable Machine Learning", 1st Edition, 2019.
3	I Almeida, "Responsible AI in the Age of Generative Models: Governance, Ethics and Risk Management", Now Next Later AI, 2024.
4	Silja Voeneky, Philipp Kellmeyer et. al, "The Cambridge Handbook of Responsible Artificial Intelligence", Cambridge University Press, 2022.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	2	-	1	2	1	2	-	2
2	3	2	1	1	1	2	-	3	-	1	3	-	3	1	3
3	2	1	-	-	-	1	-	2	-	1	2	1	2	-	2
4	3	2	1	1	1	2	-	3	-	1	3	-	3	1	3
5	3	2	1	1	-	3	3	3	3	3	2	-	3	-	3
6	3	2	1	1	-	3	3	3	3	2	3	-	3	-	3
Overall Correlation	3	3	1	1	1	2	1	3	1	2	3	1	3	1	3

23AD040	NATURAL LANGUAGE PROCESSING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Explain fundamental tasks in NLP, including syntax, semantics, and pragmatics, along with associated challenges.
- Explore word-level syntax through N-grams, smoothing techniques.
- Explain context-free grammars and parsing techniques.
- Demonstrate linguistic meaning using first-order predicate calculus, syntax-driven semantic analysis, word sense disambiguation.
- Examine language generation frameworks and machine translation approaches.
- Analyze discourse structures, reference resolution, and the architecture of conversational agents for effective natural language communication.

UNIT I	OVERVIEW AND MORPHOLOGY	6

Introduction – Models -and Algorithms - -Regular Expressions Basic Regular Expression Patterns – Finite State Automata Understand the wireless sensor network principles. Morphology - Inflectional Morphology - Derivational Morphology. Finite-State Morphological Parsing -- Porter Stemmer.

UNIT II	WORD LEVEL AND SYNTACTIC ANALYSIS	6

N-grams Models of Syntax - Counting Words - Unsmoothed N-grams. Smoothing- Back-off Deleted Interpolation – Entropy - English Word Classes - Tag sets for English Part of Speech Tagging-Rule Based Part of Speech Tagging - Stochastic Part of Speech Tagging - Transformation-Based Tagging.

UNIT III	CONTEXT FREE GRAMMARS	6

Context Free Grammars for English Syntax- Context-Free Rules

and Trees -Understand the network simulation tools. Sentence-Level Constructions–Agreement – Sub Categorization, Parsing – Top-down – Early Parsing -feature Structures – Probabilistic Context-Free Grammars.		
UNIT IV	**SEMANTIC ANALYSIS**	**6**
Representing Meaning-Meaning Structure of Language-First Order Predicate Calculus Representing Linguistically Relevant Concepts -Syntax-Driven Semantic Analysis - Semantic Attachments -Syntax-Driven Analyzer. Robust Analysis - Lexemes and Their Senses - Internal Structure - Word Sense Disambiguation -Information Retrieval.		
UNIT V	**LANGUAGE GENERATION AND DISCOURSE ANALYSIS**	**6**
Discourse -Reference Resolution - Text Coherence -Discourse Structure – Coherence. Dialog and Conversational Agents - Dialog Acts – Interpretation -Conversational Agents. Language Generation–Architecture-Surface Realizations - Discourse Planning. Machine Translation -Transfer Metaphor– Interlingua – Statistical Approaches		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		

LIST OF EXPERIMENTS

1. Implement basic text preprocessing steps such as tokenization, lowercasing, removing punctuation and stop word removal.
2. Build an N-gram language model using a text corpus, calculate probabilities, and generate text.
3. Use regular expressions to find patterns in text, such as identifying dates, phone numbers, or specific words.
4. Implement part-of-speech tagging on a text corpus using NLTK's pre-trained POS tagger.
5. Perform word sense disambiguation using WordNet to identify the correct meaning of ambiguous words.

	6. Implement syntactic parsing using a context-free grammar and visualize the resulting parse tree. 7. Use a pre-trained NER model to identify and classify named entities like names, locations, and dates in text. 8. Implement a basic morphological parser to analyze word structures and identify morphemes, including prefixes, suffixes, and roots. 9. Build a simple sentiment analysis model to classify text as positive, negative, or neutral using a predefined dataset and basic machine learning techniques.	
	TOTAL: 30 PERIODS	
COURSE OUTCOMES:		
	After completion of the course, the students will be able to:	
CO1:	Outline the internal structure of a word of the natural language.	
CO2:	Apply N-grams rules to identify word patterns.	
CO3:	Explain the context free grammar.	
CO4:	Compare and contrast the meaning of the word.	
CO5:	Utilize syntax driven semantic analysis.	
CO6:	Demonstrate automatic machine translation procedure.	
TEXT BOOKS:		
1	C. Manning and H. Schutze, Statistical Natural, "Foundations of Language Processing. C", 1st Edition, MIT Press Cambridge, MA:1999	
2	Daniel Jurafsky and James H Martin," Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2008	
REFERENCES:		
1	Bharati A., Sangal R., Chaitanya, "Natural language processing: a Paninian perspective", 1st Edition, PHI, 2000.	
2	Siddiqui T., Tiwary U. S. "Natural language processing and Information retrieval", 1st Edition, OUP, 2008.	

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	2	-	1	-	1	2	-	2
2	3	2	1	1	1	2	-	3	-	1	-	-	3	1	3
3	2	1	-	-	1	2	-	3	-	1	-	-	2	1	3
4	2	1	-	-	1	2	-	3	-	1	-	-	2	1	3
5	3	2	1	1	-	3	3	3	3	3	3	-	3	-	3
6	2	1	-	-	-	3	3	3	3	2	3	-	2	-	3
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**3**	**1**	**3**	**1**	**2**	**1**	**1**	**3**	**1**	**3**

23AD041	EXPLORATORY DATA ANALYSIS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Apply data preprocessing techniques to ensure data accuracy, consistency, and completeness.
- Develop the ability to use descriptive statistics for summarizing and interpreting data characteristics.
- Utilize data visualization tools to represent data distributions, trends, and relationships effectively.
- Implement statistical measures to assess the correlation, central tendency, and variability in datasets.
- Apply data transformation and feature engineering techniques to refine data for analysis.
- Create EDA reports that systematically convey insights and facilitate data-driven decision-making

UNIT I	FOUNDATIONS OF EXPLORATORY DATA ANALYSIS	6

Introduction to EDA and its Importance - Basic data structures - numeric, categorical, ordinal, and time-series data - data sources - data quality and accuracy - data cleaning: missing values, duplicate data, handling erroneous entries.

Case Study: Load and inspect a dataset, identify data quality issues, and document observations.

UNIT II	DESCRIPTIVE STATISTICS AND DATA SUMMARIZATION	6

Univariate Descriptive Statistics: Measures of central tendency - Measures of spread - Data Distribution Analysis: Distribution shapes - Understanding and calculating skewness and kurtosis - Categorical Data Summarization - Frequency tables and cross-tabulation - Summary statistics for categorical data - Sampling and Data Partitioning - sampling, random sampling, and stratified sampling - Train-test splitting and its importance in model building. Case Study: Calculate and interpret descriptive statistics on a real-world dataset.

UNIT III	DATA VISUALIZATION TECHNIQUES FOR EXPLORATORY ANALYSIS	6
Univariate Visualizations: Visualizing single variables with histograms, bar charts, and box plots - Bivariate Visualizations: Scatter plots, line plots, and bar plots - Understanding relationships with grouped bar plots and clustered scatter plots - Multivariate Visualizations: Heatmaps, pair plots, and correlation matrices - Visualization techniques for high-dimensional data (facet grids and 3D plots) - Advanced Visualizations and Storytelling: Choosing the right chart for the data type and analysis goal Design principles for clear, impactful visualizations Case Study: Explore relationships and patterns in a dataset with appropriate visualizations.		
UNIT IV	**DATA TRANSFORMATION AND FEATURE ENGINEERING**	**6**
Data Transformation Techniques: Standardization and normalization of numeric data - Applying log, square root, and other transformations to handle skewed data -Encoding Categorical Variables: - Methods of encoding: One-hot encoding, label encoding, and binary encoding - Handling ordinal data and rare categories - Feature Engineering: Creating new features from existing data - Extracting useful features from dates, times, and textual data - Dimensionality Reduction: - Introduction to Principal Component Analysis (PCA) and its applications - Exploratory analysis of reduced data Case Study: Perform feature engineering and transformation on a dataset to prepare it for analysis or modeling.		
UNIT V	**ADVANCED TECHNIQUES AND REPORTING IN EDA**	**6**
Handling Outliers and Anomalies: Outlier detection using z-scores, IQR method - EDA for Different Data Types: Time series analysis: Trend, seasonality, and noise - Text data basics: Word frequencies, word clouds, and term frequency-inverse document frequency (TF-IDF) - Developing an EDA Report: Structuring an		

EDA report: Introduction, method, findings, and insights - Communicating findings with charts, graphs, and narrative summaries Case Study: Conduct a complete EDA on a new dataset, identifying insights and presenting findings in a detailed report.
TOTAL: 30 PERIODS
PRACTICAL EXERCISES:
1. Data loading and Initial Inspection - Load datasets from various sources (CSV,Excel and SQL) and inspect data structures. 2. Data Cleaning and Missing Value Treatment - Apply data cleaning techniques to handle missing values, duplicates, and outliers. 3. Descriptive Statistics and Data Summarization - Calculate and interpret key descriptive statistics (mean, median, mode, variance, standard deviation). 4. Univariate and Bivariate Visualization - Visualize univariate and bivariate distributions to understand data patterns. 5. Multivariate Visualization and Correlation Analysis - Create multivariate visualizations and perform correlation analysis. 6. Data Transformation and Feature Scaling - Practice data transformation techniques like standardization, normalization, and log transformation. 7. Encoding Categorical Variables and Feature Engineering 8. Outlier Detection and Analysis - Detect and handle outliers in the dataset using statistical and visualization techniques. 9. Comprehensive EDA and Reporting - Conduct a full exploratory analysis and compile findings into a structured report. 10. Capstone Project: Conduct a complete EDA on a new dataset, identifying insights and presenting findings in a detailed report.
TOTAL : 30 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply data cleaning and transformation techniques to improve data quality and prepare datasets for analysis.
CO2:	Discover the statistical summaries and visualize relationships to enhance understanding of data structures.
CO3:	Construct visualizations that accurately depict univariate, bivariate, and multivariate data distribution
CO4:	Discover the results of data transformations to refine dataset structure.
CO5:	Apply feature engineering and dimensionality reduction techniques to optimize dataset quality.
CO6:	Examine findings from EDA and compile structured reports that highlight critical insights and recommendations.
TEXT BOOKS:	
1	Wes McKinney, "Python for Data Analysis", 2nd Edition, O'Reilly, 2022
2	Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists, 2e: 50+ Essential Concepts Using R and Python",2nd Edition, O'Reilly, 2017
REFERENCES:	
1	Foster Provost and Tom Fawcett, "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking", 1st Edition, O'Reilly Media, 2013
2	Kieran Healy, ""Data Visualization: A Practical Introduction", 1st Edition , Princeton University Press, 2018
3	Max Kuhn and Kjell Johnson "Feature Engineering and Selection: A Practical Approach for Predictive Models", 1st Edition, Chapman & Hall/CRC Press, 2019
4	Roger D. Peng and Elizabeth Matsui," Exploratory Data Analysis with R", 1st Edition, Chapman & Hall/CRC Press, 2018

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	-	-	-	-	1	1	-	3	1	-
2	3	3	2	2	1	-	-	-	-	-	1	-	3	1	-
3	3	2	1	1	1	-	-	-	-	-	1	-	3	1	-
4	3	3	2	2	1	-	-	-	-	-	1	-	3	1	-
5	3	2	1	1	1	-	-	-	-	-	1	-	3	1	-
6	3	3	2	2	1	1	1	1	1	1	1	1	3	1	1
Overall Correlation	3	3	2	2	1	1	1	1	1	1	1	1	3	1	1

23AM036	NATURE INSPIRED COMPUTING METHODS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the principles and fundamentals of nature-inspired computing techniques.
- To explore optimization algorithms inspired by natural processes, such as evolutionary and swarm intelligence methods.
- To analyze problem-solving using heuristic and metaheuristic approaches.
- To implement bio-inspired algorithms for real-world engineering applications.
- To evaluate the performance and applicability of various nature-inspired computing techniques.

UNIT I	INTRODUCTION TO NATURE INSPIRED COMPUTING	9

Nature-inspired computing: Overview and significance – Biological inspiration in computing – Evolutionary algorithms – Swarm intelligence – Fundamentals of optimization – Search space, fitness function, and objective functions – Exploration vs. exploitation – Applications in engineering and real-world problems.

UNIT II	EVOLUTIONARY COMPUTATION	9

Genetic Algorithms (GA): Introduction, representation, fitness evaluation, selection, crossover, mutation – Evolution strategies – Genetic programming – Applications of evolutionary algorithms – Advantages and limitations – Performance evaluation.

UNIT III	SWARM INTELLIGENCE TECHNIQUES	9

Particle Swarm Optimization (PSO) – Ant Colony Optimization (ACO) – Artificial Bee Colony (ABC) – Firefly Algorithm – Cuckoo Search – Algorithm steps, mathematical formulation, and pseudocode – Applications in optimization problems – Comparative analysis.

UNIT IV	**BIO-INSPIRED AND NATURE-INSPIRED METAHEURISTICS**	**9**
Differential Evolution (DE) – Harmony Search (HS) – Bat Algorithm – Grasshopper Optimization Algorithm – Hybrid and multi-objective algorithms – Constrained and unconstrained optimization – Real-world engineering applications (e.g., scheduling, path planning, design optimization).		
UNIT V	**APPLICATIONS**	**9**
Application of GA in scheduling – PSO in power system optimization – ACO for routing problems – ABC in clustering – Nature-inspired techniques in image processing, robotics, and machine learning – Applications in Video Analytics: Object tracking optimization, motion segmentation using SI/EA methods – Applications in Text Analytics: Feature selection using metaheuristics, topic clustering optimization, semantic search optimization - Performance analysis and comparison of algorithms – Future research directions in nature-inspired computing.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the fundamentals of nature-inspired computing and its biological inspirations.
CO2:	Apply evolutionary computation techniques to solve optimization problems.
CO3:	Implement swarm intelligence algorithms for engineering and real-world applications.
CO4:	Analyze and compare bio-inspired metaheuristic algorithms for different optimization tasks.
CO5:	Solve real-world engineering problems using appropriate nature-inspired computing methods.
CO6:	Evaluate the performance and applicability of different nature-inspired techniques.

TEXT BOOKS:

1. Xin-She Yang, "*Nature-Inspired Optimization Algorithms*", 2nd Edition, Elsevier, 2020.
2. S.N. Sivanandam, S.N. Deepa, "*Introduction to Genetic Algorithms*", Springer, 2008.

REFERENCES:

1. Marco Dorigo, Thomas Stützle, "*Ant Colony Optimization*", MIT Press, 2004.
2. A.E. Eiben, J.E. Smith, "*Introduction to Evolutionary Computing*", 2nd Edition, Springer, 2015.
3. S. Mirjalili, "*Nature-Inspired Optimization Algorithms*", 2nd Edition, Elsevier, 2019.
4. K. Deb, "*Multi-Objective Optimization Using Evolutionary Algorithms*", Wiley, 2001.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	-	-	-	-	-	-	-	-	-	2	2	-	2
2	3	3	2	-	3	-	-	-	-	-	-	2	3	3	-
3	2	3	3	2	3	-	-	-	1	-	-	2	3	3	-
4	3	3	2	3	3	-	-	-	-	-	-	2	3	3	-
5	3	3	3	3	3	1	2	-	2	2	2	3	3	3	2
6	3	3	2	3	3	-	2	-	-	2	2	3	3	3	3
Overall Correlation	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**-**	**1**	**2**	**2**	**3**	**3**	**3**	**2**

23AD043	INTELLIGENT ROBOTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamental concepts and components of intelligent robotic systems
- To explore various algorithms for perception, planning, and control in robots
- To understand the integration of AI techniques in robotics for developing intelligent behaviors
- To analyze the design and development of autonomous robots for real-world applications
- To evaluate the ethical and societal implications of intelligent robots

UNIT I	INTRODUCTION TO INTELLIGENT ROBOTS	9

Overview of Robotics and Intelligent Robots- History and Evolution of Robotics - Components of Robotic Systems: Sensors, Actuators, and Controllers - Kinematics and Dynamics of Robots - Introduction to Robotic Operating Systems (ROS).

UNIT II	PERCEPTION IN ROBOTICS	9

Sensing and Perception: Camera, Lidar, and Sonar Sensors - Computer Vision for Robotics: Object Detection, Recognition, and Tracking - SLAM (Simultaneous Localization and Mapping) - Sensor Fusion Techniques - Machine Learning for Perception in Robots

UNIT III	PLANNING AND NAVIGATION	9

Motion Planning: Kinematic and Dynamic Constraints - Navigation in Unstructured Environments - Obstacle Avoidance and Reactive Planning - Multi-Robot Coordination and Swarm Robotics.

UNIT IV	**CONTROL AND LEARNING IN ROBOTS**	**9**
Classical Control: PID Controllers, State-Space Models - Reinforcement Learning for Robotics Adaptive Control and .om Demonstration - Human-Robot Interaction and Shared Control		
UNIT V	**APPLICATIONS AND ETHICAL CONSIDERATIONS**	**9**
Case Studies of Intelligent Robots: Industrial, Healthcare, and Service Robots - Ethical and Societal Implications of Intelligent Robots - Safety and Reliability in Autonomous Robots - Standards and Regulations for Intelligent Robots - Future Trends in Robotics: AI-driven Robotics, Human-Robot Collaboration		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Demonstrate the architecture, components, and basic functioning of Intelligent robotic systems.
CO2:	Utilize perception algorithms sensor technologies for object detection and environmental mapping in robots.
CO3:	Apply path planning and navigation algorithms for autonomous robot movement in various environments.
CO4:	Develop control strategies and integrate advanced techniques such as reinforcement learning for robotic behavior and decision-making.
CO5:	Analyze case studies and understand the applications of intelligent robots across different domains, including industrial, healthcare, and service sectors.
CO6:	Outline the ethical, societal, and safety considerations related to the deployment and operation of intelligent robots.

TEXT BOOKS:	
1	John J. Craig, “Introduction to Robotics: Mechanics and Control”,Pearson 4th Edition (2017) (Units I, III, and IV).
2	Sebastian Thrun, Wolfram Burgard, and Dieter Fox , “Probabilistic Robotics" The MIT Press, 1st Edition (2005) (Unit II)
3	Patrick Lin, Ryan Jenkins, and Keith Abney, “Robot Ethics 2.0: From Autonomous Cars to Artificial Intelligence" Oxford University Press 2nd Edition (2017) (Unit V)
REFERENCES:	
1	Aaron Martinez and Enrique Fernández, “Learning ROS for Robotics Programming”, 2nd Edition, Packt Publishing, 2015.
2	Roland Siegwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, “Introduction to Autonomous Mobile Robots”, 2nd Edition, MIT Press, 2011.
3	B. K. Ghosh, “Robotics: Fundamental Concepts and Analysis”, Oxford University Press, 2006.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	2	-	1	-	1	2	-	2
2	3	2	1	1	1	2	-	3	-	1	-	-	3	1	3
3	3	2	1	1	1	2	-	3	-	1	-	-	3	1	3
4	3	2	1	1	1	2	-	3	-	1	-	-	3	1	3
5	3	3	2	2	-	3	3	3	3	3	3	-	3	-	3
6	2	1	-	-	-	3	3	3	3	2	3	-	2	-	3
Overall Correlation	**3**	**3**	**1**	**1**	**1**	**3**	**1**	**3**	**1**	**2**	**1**	**1**	**3**	**1**	**3**

23AM037	MULTIMODAL AI	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand fundamentals of multimodal AI, including the integration of text, image, audio, and video data.
- To apply feature extraction, embedding, and representation techniques across multiple modalities.
- To analyze and implement multimodal fusion strategies for learning tasks.
- To explore state-of-the-art multimodal architectures such as transformers, CLIP, and multimodal pretraining.
- To study applications of multimodal AI in healthcare, robotics, autonomous systems, and human-computer interaction.

UNIT I	INTRODUCTION TO MULTIMODAL AI	9

Overview of multimodal AI – Motivation and applications - Modalities: Text, Image, Audio, Video, Sensor data - Challenges in multimodal learning: Alignment, Fusion, Missing data - Multimodal datasets and benchmarks - Evaluation metrics for multimodal systems.

UNIT II	REPRESENTATION LEARNING FOR MULTIMODAL DATA	9

Feature extraction techniques for each modality - Embeddings: Word embeddings, Image embeddings, Audio embeddings - Cross-modal representation learning - Pretrained models: BERT, ResNet, VGGish, CLIP embeddings - Dimensionality reduction and modality alignment.

UNIT III	MULTIMODAL FUSION STRATEGIES	9

Early fusion, late fusion, hybrid fusion - Attention-based fusion methods - Graph-based fusion - Transformers for multimodal data - Handling missing modalities

UNIT IV	MULTIMODAL AI MODELS AND ARCHITECTURES	9
Multimodal transformers (ViLT, VideoBERT, CLIP) - Generative multimodal models (VQ-VAE, DALL·E, Stable Diffusion) - Cross-modal retrieval and generation - Multimodal contrastive learning - Training strategies and fine-tuning multimodal models.		
UNIT V	**APPLICATIONS AND CASE STUDIES**	**9**
Healthcare: Medical image + text report fusion - Autonomous systems: Sensor fusion and perception - Human-computer interaction: Gesture + speech recognition - Multimodal sentiment analysis - Case studies: CLIP-based image-text retrieval, Audio-visual speech recognition, Multimodal emotion recognition.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the multimodal AI concepts, datasets, and challenges.
CO2:	Apply representation learning techniques to extract features across multiple modalities..
CO3:	Implement multimodal fusion strategies for learning tasks.
CO4:	Analyze and develop multimodal AI architectures and models.
CO5:	Evaluate multimodal AI systems using standard metrics and perform case studies.
CO6:	Apply multimodal AI methods to real-world applications in healthcare, robotics, and HCI.

TEXT BOOKS:	
1	Paul Pu Liang, Louis-Philippe Morency, Ruslan Salakhutdinov, “Multimodal Machine Learning: Techniques and Applications”, Morgan & Claypool, 2nd Edition, 2022.

2	Graham Neubig, “Representation Learning: A Deep Learning Approach”, MIT Press, 2023
3	Karthik Srinivasan, S. Winther, “Transformers for Multimodal Learning”, Packt, 2023
4	Amit Joshi, Nilanjan Dey, Simon James Fong, “Multimodal Artificial Intelligence in Practice: Applications in Healthcare, Robotics and HCI”, Springer, 2023
REFERENCES:	
1	Bing Liu, “*Deep Learning for Multimodal Data Fusion”*, CRC Press, 2022.
2	Jacob Devlin et al., *BERT: “Pre-training of Deep Bidirectional Transformers for Language Understanding”*, 2019.
3	Alec Radford et al.,” *Learning Transferable Visual Models From Natural Language Supervision”*, OpenAI, 2021.
4	Zhiwei Deng et al., “*Multimodal Deep Learning: Techniques and Applications”*, Springer, 2022.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	-	-	2	-	-	-	-	-	-	-	3	3	2
2	3	3	2	2	3	-	-	-	-	-	-	-	2	3	3
3	2	3	3	2	3	-	-	-	-	-	-	-	2	3	3
4	3	3	3	3	3	-	-	-	2	-	-	-	3	3	3
5	2	3	2	3	3	2	-	-	2	2	-	-	3	3	3
6	3	3	3	2	3	3	2	2	2	2	2	2	3	3	3
Overall Correlation	3	3	3	3	3	2	1	1	2	2	1	1	3	3	3

23AD045	DATA EXPLORATION AND VISUALIZATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Understand the core principles of Exploratory Data Analysis (EDA)
- Utilize various EDA tools and techniques to perform descriptive statistics, data transformation, and time series analysis.
- Analyze univariate, bivariate, and multivariate data using appropriate statistical and visualization methods to understand relationships and patterns.
- Implement 2D and 3D data visualization techniques
- Design interactive visualizations for text and document data

UNIT I	THE FUNDAMENTALS OF EXPLORATORY DATA ANALYSIS	6

Overview of EDA – Identifying Data quality – Missing values – Irregular Cardinality – Outliers – handling data Quality - Describing Data, Preparing Data Tables, Understanding Relationships - Identifying and Understanding Groups, Building Models from Data.

UNIT II	EDA TOOLS AND DESCRIPTIVE STATISTICS	6

Significance of EDA - Comparing EDA with classical and Bayesian analysis - Software tools for EDA - Visual Aids for EDA - EDA with Personal Email - Data Transformation - Descriptive Statistics - Grouping Datasets Correlation - Time Series Analysis.

UNIT III	UNIVARIATE, BIVARIATE, MULTIVARIATE DATA ANALYSIS	6

Univariate Data Analysis - Bivariate Association - Regression Analysis - Cluster Analysis - Visualization Design Principles – Tables - Univariate Data Visualization -

Bivariate Data Visualization - Multivariate Data Visualization - Visualizing Groups - Dynamic Techniques.		
UNIT IV	**DATA VISUALIZATION (2D / 3D)**	**6**
Simple Line Plots - Simple Scatter Plots - Visualizing Errors - Density and Contour Plots - Histograms, Binnings, and Density - Customizing Plot Legends - Customizing Colorbars - Multiple Subplots - Text and Annotation - Customizing Ticks - Customizing Stylesheets - Three-Dimensional Plots - Geographic Data with Basemap - Visualization with Seaborn.		
UNIT V	**INTERACTIVE DATA VISUALIZATION**	**6**
Text and Document Visualization - Levels of Text Representations -Single Document Visualizations - Document Collection Visualizations- Interaction Concepts and Techniques - Designing Effective Visualizations - Comparing and Evaluating Visualization Techniques - Visualization Systems - Systems based on Data Type - Systems based on Analysis Type - Text Analysis and Visualization - Modern Integrated Visualization Systems.		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		

LIST OF EXPERIMENTS

1. Generate the data quality report in terms of identifying missing values, irregular cardinality and outliers for an insurance company.
2. Descriptive feature identification for predicting a target feature by visualizing relationships.
3. Data preparation for Exploration using normalization, binning and sampling methods.
4. Design and create data visualizations.
5. Conduct exploratory data analysis using visualization.

6. Craft visual presentations of data for effective communication. 7. Use knowledge of perception and cognition to evaluate visualization design alternatives. 8. Design and evaluate color palettes for visualization based on principles of perception. 9. Apply data transformations such as aggregation and filtering for visualization. 10. Develop data exploration and visualization for an application - Mini Project
TOTAL: 30 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Illustrate fundamentals of exploratory data analysis and its commonly used techniques.
CO2:	Apply statistical concepts to analyze data and explore the tools used for EDA.
CO3:	Develop multivariate data visualization and analysis.
CO4:	Interpret results of exploratory data analysis using stylesheets
CO5:	Build and Implement visualization techniques in web for applications
CO6:	Apply exploratory data analysis methods using Python.
TEXT BOOKS:	
1	Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python",1st Edition, Packt Publishing, 2020.
2	Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media, 1st Edition, December 2016.
REFERENCES:	
1	Thomas Cleff , "Exploratory Data Analysis in Business and Economics", Springer International, 2013.
2	Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015.

3	Glenn J. Myatt, Wayne P. Johnson," Making Sense Of Data I", John Wiley & Sons, 2nd Edition, 2014.
4	Claus O. Wilke, "Fundamentals of Data Visualization", 1st Edition, O'reilly publications, 2019
5	Andy Kirk," Data Visualisation: A Handbook for Data Driven Design", Second Edition, Sage Publications Ltd, 2020.
6	Mike Kahn, "Data Exploration and Preparation with BigQuery: A practical guide to cleaning, transforming, and analyzing data for business insights", 1st Edition, Kindle Edition, Packt Publishing, 2023.
7	Dursun Delen, "Predictive Analytics: Data Mining, Machine Learning and Data Science for Practitioners", 1st Edition, Pearson Business Analytics Series, 2021.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	2	1	1	1	-	1	3	2	1	1
2	3	2	1	1	1	2	1	1	1	-	1	3	3	1	1
3	3	2	1	1	1	2	1	1	1	-	1	3	3	1	1
4	2	1	-	-	1	2	1	1	1	-	1	3	2	1	1
5	3	2	1	1	1	2	1	1	1	-	1	3	3	1	1
6	3	2	1	1	1	2	1	1	1	1	1	3	3	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**1**	**1**

23AM038	OPTIMIZATION TECHNIQUES FOR MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of optimization and Operations Research concepts, including constrained and unconstrained optimization with optimality conditions.
- To learn and apply gradient-based optimization techniques for training and improving machine learning models.
- To study and apply gradient-free numerical optimization methods for solving machine learning optimization problems.
- To explore metaheuristic optimization algorithms and their applications in hyperparameter tuning, feature selection, and neural network training.
- To apply optimization principles in reinforcement learning through value-based, policy-based, and actor–critic methods.

UNIT I	**INTRODUCTION TO OPTIMIZATION**	**9**

Overview of Optimization – Role of Optimization in Operations Research – Importance in Machine Learning – Types of Optimization Problems – Unconstrained and Constrained Optimization – Convex vs Non-Convex Optimization – Optimality Conditions – Lagrange Multipliers – Karush-Kuhn-Tucker (KKT) Conditions – Linear and Nonlinear Optimization Concepts (OR basics incorporated).

UNIT II	**DESCRIPTIVE STATISTICS AND DATA SUMMARIZATION**	**9**

Univariate Descriptive Statistics: Measures of central tendency - Measures of spread - Data Distribution Analysis: Distribution shapes - Understanding and calculating skewness and kurtosis - Categorical Data Summarization - Frequency tables and cross-tabulation - Summary statistics for categorical data - Sampling and

Data Partitioning - sampling, random sampling, and stratified sampling - Train-test splitting and its importance in model building. Case Study: Calculate and interpret descriptive statistics on a real-world dataset.		
UNIT III	**DATA VISUALIZATION TECHNIQUES FOR EXPLORATORY ANALYSIS**	**9**
Univariate Visualizations: Visualizing single variables with histograms, bar charts, and box plots - Bivariate Visualizations: Scatter plots, line plots, and bar plots - Understanding relationships with grouped bar plots and clustered scatter plots - Multivariate Visualizations: Heatmaps, pair plots, and correlation matrices - Visualization techniques for high-dimensional data (facet grids and 3D plots) - Advanced Visualizations and Storytelling: Choosing the right chart for the data type and analysis goal Design principles for clear, impactful visualizations Case Study: Explore relationships and patterns in a dataset with appropriate visualizations.		
UNIT IV	**METAHEURISTIC OPTIMIZATION ALGORITHMS**	**9**
Data Transformation Techniques: Standardization and normalization of numeric data - Applying log, square root, and other transformations to handle skewed data -Encoding Categorical Variables: - Methods of encoding: One-hot encoding, label encoding, and binary encoding - Handling ordinal data and rare categories - Feature Engineering: Creating new features from existing data - Extracting useful features from dates, times, and textual data - Dimensionality Reduction: - Introduction to Principal Component Analysis (PCA) and its applications - Exploratory analysis of reduced data Case Study: Perform feature engineering and transformation on a dataset to prepare it for analysis or modeling.		

UNIT V	OPTIMIZATION IN REINFORCEMENT LEARNING	9
Introduction to Reinforcement Learning – Markov Decision Processes (MDP) – Bellman Equations – Policy Evaluation and Iteration – Value Iteration – Policy Gradient Methods – REINFORCE Algorithm – Actor-Critor Methods – Q-Learning and Deep Q-Networks (DQN) – Exploration vs Exploitation Optimization – Applications in Control, Robotics, and Real-world RL Problems.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Understand the fundamentals of optimization and apply optimality conditions such as Lagrange Multipliers and KKT conditions.
CO2:	Implement gradient-based optimization methods and analyze their convergence in machine learning models.
CO3:	Apply gradient-free optimization techniques to solve complex ML problems.
CO4:	Implement metaheuristic optimization algorithms for hyperparameter tuning and feature selection.
CO5:	Analyze and compare different optimization techniques for various machine learning applications.
CO6:	Apply optimization techniques in reinforcement learning using value-based and policy-based methods.

TEXT BOOKS:

1	H. A. Taha, "Operations Research: An Introduction," Pearson, 10th Edition, 2017.
2	I. Goodfellow, Y. Bengio, and A. Courville, "*Deep Learning*", MIT Press, 2016.
3	R. S. Sutton and A. G. Barto," *Reinforcement Learning: An Introduction*", 2nd Edition, MIT Press, 2018.

4	S. Boyd and L. Vandenberghe, “*Convex Optimization*”, Cambridge University Press, 2004.
REFERENCES:	
1	J. Nocedal and S. Wright, “*Numerical Optimization*”, Springer, 2006.
2	E. Bonabeau, M. Dorigo, and G. Theraulaz, “*Swarm Intelligence*”, Oxford University Press, 1999.
3	K. Deb, “*Multi-Objective Optimization using Evolutionary Algorithms*”, John Wiley & Sons, 2001.
4	C. M. Bishop, “*Pattern Recognition and Machine Learning*”, Springer, 2006.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	2	-	-	-	1	-	2	2	3	2	1
2	2	3	2	2	3	-	-	-	2	-	2	2	3	3	2
3	2	2	2	2	3	-	-	-	2	-	2	2	2	3	1
4	2	3	3	2	3	1	-	-	2	-	2	2	3	3	2
5	2	2	2	2	3	-	-	-	2	-	2	2	2	3	2
6	3	3	3	3	3	2	-	2	3	2	3	3	3	3	2
Overall Correlation	2	3	2	2	3	1	-	1	2	1	2	2	2	3	2

VERTICAL 3: FULL STACK DEVELOPMENT

23CS031	JAVA FULL STACK DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand and familiarize with JavaScript and NodeJS environments.
- To learn about NoSQL database and basics of MongoDB.
- To acquire knowledge of the ReactJS frontend.
- To acquire knowledge of the ExpressJS backend.
- To acquire knowledge of how to develop and create real time web applications.

UNIT I	INTRODUCTION TO JAVA SCRIPT	6

Introduction to JavaScript- Brief history of NodeJS and its alternatives- Installing and setting up NodeJS environment - Introduction to NPM package manager and registry - Introduction to callbacks and events -File system access and handling streams- Introduction to common utility modules (OS, Path).

UNIT II	INTRODUCTION TO NOSQL DATABASE WITH MONGODB	6

Introduction to NoSQL -Benefits and disadvantages of NoSQL databases -Introduction to MongoDB - Installing and setting up MongoDB environment -Data model design (Embedded and Normalized) -Database manipulation (Create, Drop, Create and Drop Collections) -Document manipulation (Insert, Delete, Update, Query (Limit, Sort, Aggregation)) -Projection Introduction and setting up Mongoose ORM -Handling models and queries with Mongoose.

UNIT III	FRONTEND DEVELOPMENT WITH REACT JS	6

Introduction to ReactJS -Installation and creating a basic React application -Introduction to JSX- Components and props- State and lifecycle -Events and effects -Conditional rendering - Introduction to HTTP requests and fetch -Making HTTP GET and POST requests- Handling data from API.

UNIT IV	BACKEND DEVELOPMENT WITH EXPRESS JS	6
Introduction to ExpressJS- Separating the tasks of frontend and backend -Installing and setting up ExpressJS environment-Introduction to APIs -Routing and URL building -Error handling-Project directory structuring - Handling form data and request data -Handling and serving files -Authentication using session keys- Handling request of multiple methods and their placement (GET, POST, DELETE, PATCH) -Documenting an API.		
UNIT V	**CREATING A FULL STACK WEB APPLICATION**	**6**
React page with input fields -Extracting and validating data from input field(s)- Making a HTTP request with data from input field(s) Using Mongoose with an ExpressJS application -Inserting document with data from HTTP request -Writing, handling URL query parameters and using its values to write queries with Mongoose -Displaying data returned from backend- Handling errors in API requests.		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

LIST OF EXPERIMENTS

1. Develop a Life Line – A Health Assistance Web Application
2. Develop Employee Timesheet Management System
3. Build Paytm clone Page
4. Build Portfolio page
5. Creating a simple College website using HTML, CSS, and JS.
6. Develop a Hospital Management System
7. Develop an Online Banking Application

TOTAL: 30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Explain concepts of JavaScript and its environment.

CO2:	Apply NoSQL databases and develop deeper into it using MongoDB and performing basic database operations in it.
CO3:	Apply the concepts of JSX and ReactJS to display and manipulate data in a webpage and to make basic HTTP requests and handle them.
CO4:	Compare the roles of frontend and backend, and to work with ExpressJS.
CO5:	Develop complete API and interact with it from the ReactJS frontend.
CO6:	Develop and create real time web applications.
TEXT BOOKS:	
1	Herbert Schildt, “Java: The Complete Reference”, 11 th Edition, McGraw Hill Education, New Delhi, 2019
2	Bradshaw, Shannon., Brazil, Eoin., Chodorow, MongoDB: The Definitive Guide: United States: O'Reilly Media, 2019.
3	Herbert Schildt, “Introducing JavaFX 8 Programming”, 1 st Edition, McGraw Hill Education, New Delhi, 2015.
4	Chris Northwood, ‘The Full Stack Developer: Your Essential Guide to the Everyday Skills” APress; 1st ed. Edition (20 November 2018).
REFERENCES:	
1	’Expected of a Modern Full Stack Web Developer’, Apress; 1st edition, 2018
2	Cay S. Horstmann, “Core Java Fundamentals”, Volume 1, 11 th Edition, Prentice Hall, 2018.
3	Nicholas S. Williams, “Professional Java for Web Applications”, Wrox Press, 2014.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	3	-	-	1	-	-	-	1	2	3	1
2	3	2	1	1	1	-	-	1	-	-	-	2	3	1	1
3	3	2	1	1	2	-	-	1	-	-	-	2	3	2	1
4	3	2	1	1	2	-	-	1	-	-	-	1	2	2	1
5	3	2	1	1	2	-	-	1	-	-	-	1	3	2	1
6	3	2	1	1	2	-	-	1	-	-	-	1	3	2	1
Overall Correlation	3	3	1	1	2	-	-	1	-	-	-	2	3	2	1

<table>
<tr><td rowspan="2">23CS032</td><td rowspan="2">MOBILE APP DEVELOPMENT</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">
• To understand the need and characteristics of mobile applications
• To design the right user interface for mobile applications.
• To understand the design issues in the development of mobile applications
• To understand the development procedure for mobile applications forms
• To develop mobile applications using various tools and platform
</td></tr>
<tr><td>UNIT I</td><td colspan="4">INTRODUCTION TO ANDROID OS</td><td>6</td></tr>
<tr><td colspan="6">Android: An Open Platform for Mobile Development- Introducing the Open Handset Alliance- Introducing the Development Framework- Developing for Android-Developing for Mobile and Embedded Devices- Android Development Tools-Introducing the Application Manifest File -The Android Application Lifecycle.</td></tr>
<tr><td>UNIT II</td><td colspan="4">BUILDING USER INTERFACE AND INTENT CREATIONS</td><td>6</td></tr>
<tr><td colspan="6">Fundamental Android UI Design- Android User Interface Fundamentals- Introducing Layouts- The Android Widget Toolbox- Introducing Intents- Creating Intent Filters and Broadcast Receivers- Using Internet Services-Connecting to Google App Engine.</td></tr>
<tr><td>UNIT III</td><td colspan="4">DATABASES AND CONTENT PROVIDERS</td><td>6</td></tr>
<tr><td colspan="6">Introduction on SQLite- Working with SQLite Databases- Creating Content Providers Native Android Content Providers- Introducing Services -Using Background Threads- Using Alarms- Creating and Using Menus and Action Bar Action Items.</td></tr>
</table>

UNIT IV	LOCATION-BASED SERVICES AND WIRELESS SERVICES	6
Using Location-Based Services-Using the Emulator with Location-Based Services-Selecting a Location Provider- Finding Your Current Location- Using Bluetooth-Managing Network and Internet Connectivity- Managing Wi-Fi.		
UNIT V	**TELEPHONY AND SMS, PUBLISHING APPLICATIONS**	**6**
Using Telephony - Introducing SMS and MMS - Distributing Applications-Introducing the Google Play - Getting Started with Google Play-Publishing Applications.		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

LIST OF EXPERIMENTS

1. Develop an application that uses GUI components, Font and Colours
2. Develop an application that uses Layout Managers and event listeners.
3. Write an application that draws basic graphical primitives on the screen.
4. Develop an application that makes use of databases
5. Develop an application that makes use of Notification Manager
6. Implement an application that uses Multi-threading
7. Develop a native application that uses GPS location information
8. Implement an application that writes data to the SD card
9. Implement an application that creates an alert upon receiving a message
10. Write a mobile application that makes use of RSS feed

TOTAL: 30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Develop an application using Android development environment

CO2:	Develop mobile application development frameworks and tools
CO3:	Build a mobile application that manages Database operations
CO4:	Develop location based services and wireless environments
CO5:	Develop Telephony Applications for introducing SMS and MMS
CO6:	Develop applications based on Android OS
TEXT BOOKS:	
1	Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education, 2nd ed. (2011)
REFERENCES:	
1	Reto Meier, “Professional Android 4 Application Development”, Wiley, First Edition, 2012
2	Zigurd Mednieks, Laird Dornin, G. Blake Mike, Masumi Nakamura, “Programming Android”, O‘Reilly, 2ndEdition, 2012.
3	Alasdair Allan, “iPhone Programming”, O‘Reilly, First Edition, 2010.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	1	-	-		1	3	2	1
2	3	2	1	1	2	1	-	1	1	-	1	1	3	2	1
3	3	2	1	1	2	1	-	1	1	1	1	1	3	2	1
4	3	2	1	1	2	1	-	1	-	1	1	1	3	2	1
5	3	2	1	1	2		-	1	-	-	-	1	3	2	1
6	3	2	1	1	2	1	-	1	1	-	1	1	3	2	1
Overall Correlation	3	3	1	1	2	1	-	1	1	-	1	1	3	2	1

23CS033	UI AND UX DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To provide a sound knowledge in UI & UX.
- To understand the need for UI and UX.
- To understand the various Research Methods used in Design.
- To explore the various Tools used in UI & UX.
- To create a wireframe and prototype.

UNIT I	FOUNDATIONS OF DESIGN	6

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy.

UNIT II	FOUNDATIONS OF UI DESIGN	6

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides.

UNIT III	FOUNDATIONS OF UX DESIGN	6

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals.

UNIT IV	WIREFRAMING, PROTOTYPING AND TESTING	6

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools- Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration.

UNIT V	RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE	6
Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture.		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

LIST OF EXPERIMENTS

1. Designing a Responsive layout for an societal application
2. Exploring various UI Interaction Patterns
3. Developing an interface with proper UI Style Guides
4. Developing Wireflow diagram for application using open source software
5. Exploring various open source collaborative interface Platform
6. Hands on Design Thinking Process for a new product
7. Brainstorming feature for proposed product
8. Defining the Look and Feel of the new Project
9. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
10. Identify a customer problem to solve.
11. Conduct end-to-end user research - User research, creating personas, Ideation Process (User stories, Scenarios), Flow diagrams, Flow Mapping.
12. Sketch, design with popular tool and build a prototype and perform usability testing and Identify improvements.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Build UI for user Applications.
CO2:	Apply UX design in any product or application.
CO3:	Apply UX Skills in product development.

CO4:	Apply Sketching principles.
CO5:	Develop Wireframe and Wireflows.
CO6:	Develop Prototype Testing for High-Fidelity Mockups.

TEXT BOOKS:

1	Joel Marsh, “UX for Beginners”, O’Reilly, 2022 Edition
2	Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly,2020.

REFERENCES:

1	Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition, O’Reilly 2020.
2	Steve Schoger, Adam Wathan “Refactoring UI”, 2018.
3	Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015
4	Jenifer Tidwell, Charles Brewer, and Aynne Valencia, “Designing Interfaces: Patterns for Effective Interaction Design" O'Reilly Media ,2020.
5	https://www.nngroup.com/articles/
6	https://www.interaction-design.org/literature.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	-	1	3	3	2	1	3	1	1
2	3	2	1	1	2	-	-	1	1	2	2	2	3	2	1
3	3	2	1	1	2	-	-	-	2	3	1	2	3	2	1
4	3	2	1	1	1	-	-	1	3	2	1	3	3	1	1
5	3	2	1	1	1	-	-	1	2	1	1	1	3	1	1
6	3	2	1	1	1	-	-	1	2	1	1	1	3	1	1
Overall Correlation	3	2	1	1	2	-	-	1	3	2	2	2	3	2	1

23CS034	MERN STACK WEB DEVELOPMENT (ISC)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand MERN stack architecture
- To enrich the knowledge of different JavaScript libraries and frameworks
- To understand how Javascript libraries can be used in front end and backend process
- To understand NoSQL databases
- To build web applications using MERN Stack

UNIT I	INTRODUCTION TO MERN STACK	6

MERN Stack Overview, Modular Architecture, MERN support for modular architecture- Component-Based Frontend Development- Modular Server-Side Development - Separation of Concerns- Dependency Management- Testing and Deployment, Benefits/Features of Using Modular Architecture in MERN App.

UNIT II	JAVA SCRIPT AND ECMA SCRIPT	6

JavaScript Fundamentals, Grammar and types, Control flow and error handling, Loops, Function, Objects, Arrays, Promises,ES6 Let and const, Template literals, Arrow Function, Default parameter, Async Await.

UNIT III	BACKEND DEVELOPMENT USING Node.js AND Express.js with MONGO DB	6

Node.js overview, Node.js - basics and setup, Node.js console, Node.js command utilities,Node.js modules, concepts,Node.js events, database access ,Node.js with Express.js, Express.js Request/Response,Express.js Get, Express.js Post,Express.js Routing, Express.js Cookies,Express.js File Upload, Middleware,Express.js Scaffolding, Template, Migration of data into MongoDB, MongoDB with Node.js, Services offered by MongoDB.

UNIT IV	FRONTEND DEVELOPMENT with ReactJS	6
Introduction to React: Components, Props, and State, JSX Syntax, Functional Components vs. Class Components; Advanced React Concepts: React Hooks: useState, useEffect, useContext. Component Lifecycle and State Management, Forms and Controlled Components, React Router and Single Page Applications (SPA): Setting up React Router for Navigation, Building a Single Page Application with Multiple Routes.		
UNIT V	**CREATING A WEB APPLICATION USING MERN STACK**	**6**
Integrating Frontend and Backend, State Management with Redux, Deployment of Apps, Authentication and Security, WebSocket and Real-Time Applications, Performance Optimization.		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

LIST OF EXPERIMENTS

1. Create a simple calculator application using React.js
2. Create a simple login form using React.js
3. Write a node.js program to replace strings using Regular expression.
4. Create http server interacting with client using Node.js
5. Perform CRUD operations using MongoDB
6. Build migration of data using MongoDB
7. Create a REST backend API Using Express
8. Build an web application using React, Node, Express and MongoDB.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Apply the basic components of MERN stack architecture.
CO2:	Apply the basic fundamentals of javascript and ECMA Script.

CO3:	Build robust server-side applications with Node.js and Express.js.
CO4:	Build and interacting with MongoDB databases.
CO5:	Construct dynamic and responsive user interfaces using React.js.
CO6:	Develop a full stack application using MERN stack.
TEXT BOOKS:	
1	Nabendu Biswas ,"Ultimate Full-Stack Web Development with MERN: Design, Build, Test and Deploy Production-Grade Web Applications with MongoDB, Express, React and NodeJS ", Orange Education ,2023
2	Herbert Schildt, "The Complete Reference-Java", Tata Mcgraw- Hill Edition, Eighth Edition, 2014.
REFERENCES:	
1	Adam Freeman," Mastering Node.js Web Development: Go on a comprehensive journey from the fundamentals to advanced web development with Node.js", Packt Publishing, 2024.
2	Greg Lim ," Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express, React, Node.js App", Kindle Edition, 2021.
3	Shama Hogue," Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js",second edition , Packt Publishing2020.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	1	-	-	1	2	3	-	1
2	3	2	1	1	-	-	-	1	-	-	1	2	3	-	1
3	3	2	1	1	3	-	-	1	-	-	1	2	3	3	1
4	3	2	1	1	3	-	-	1	-	-	1	2	3	3	1
5	3	2	1	1	3	-	-	1	-	-	1	2	3	3	1
6	3	2	1	1	3	-	-	1	-	-	1	2	3	3	1
Overall Correlation	3	2	1	1	3	-	-	1	-	-	1	2	3	3	1

23CS035	DEVOPS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- To illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

UNIT I	INTRODUCTION TO DEVOPS	6

Devops Essentials - Introduction to AWS, GCP, Azure - Version control systems: Git and Github.

UNIT II	COMPILE AND BUILD USING MAVEN & GRADLE	6

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build usingGradle

UNIT III	CONTINUOUS INTEGRATION USING JENKINS	6

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

UNIT IV	CONFIGURATION MANAGEMENT USING ANSIBLE	6
Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible		
UNIT V	**BUILDING DEVOPS PIPELINES USING AZURE**	**6**
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Builda sample code, Modify azure-pipelines.yaml file.		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		
LIST OF EXPERIMENTS 1. Create Maven Build pipeline in Azure. 2. Run regression tests using Maven Build pipeline in Azure. 3. Install Jenkins in Cloud. 4. Create CI pipeline using Jenkins. 5. Create a CD pipeline in Jenkins and deploy in Cloud. 6. Create an Ansible playbook for a simple web application infrastructure. 7. Build a simple application using Gradle. 8. Build Devops Pipelines using Azure.		
		TOTAL: 30 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain different actions performed through Version control tools like Git.	
CO2:	Apply Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle	
CO3:	Deployment using Jenkins by building and automating test cases using Maven & Gradle.	

CO4:	Develop Pipeline in Jenkins and deploy in cloud.
CO5:	Apply Automated Continuous Deployment.
CO6:	Construct configuration management using Ansible.
TEXT BOOKS:	
1	Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.
2	Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014
REFERENCES:	
1	Mitesh Soni ,”Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for DevOps and Microsoft Azure”, BPB Publications, 2020
2	Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, Midwestern Mac, LLCFirst Edition, 2015.
3	David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Createspace Independent PubSecond Edition, 2016.
4	https://www.jenkins.io/user-handbook.pdf

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
2	3	2	1	1	3	-	-	2	-	-	-	-	3	3	2
3	3	2	1	1	3	-	-	2	-	-	-	-	3	3	2
4	3	2	1	1	3	-	-	2	-	-	-	-	3	3	2
5	3	2	1	1	3	-	-	2	-	-	-	-	3	3	2
6	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
Overall Correlation	3	2	1	1	3	-	-	2	-	-	-	-	3	3	2

23CS038	PYTHON FULL STACK DEVELOPMENT WITH MACHINE LEARNING (ISC)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn foundational backend development concepts using Python's Flask for API development
- To integrate advanced backend features to ensure secure, efficient, and scalable APIs.
- To build and train machine learning models using Scikit-Learn, focusing on data preprocessing, model evaluation, and tuning
- To integrate machine learning models within backend APIs to enable real-time predictions
- To deploy machine learning applications on Render with CI/CD pipelines and monitoring for production stability

UNIT I	PYTHON FOR BACKEND DEVELOPMENT	6

Backend Fundamentals and REST API Concepts – RESTful architecture, HTTP methods (GET, POST, PUT, DELETE), resource-based endpoint design, best practices for REST API design; **Flask Essentials** – Setting up Flask, routing and request handling, working with JSON, custom error handling; **Building CRUD APIs:** Implementing create, read, update, and delete operations using Flask-Introduction to database interactions using SQLite or in-memory data handling for testing.

UNIT II	ADVANCED BACKEND TECHNIQUES	6

API Security and Authentication – JWT authentication, Flask-JWT-Extended, role based access control;
Data Processing and Serialization – Handling large datasets in FLASK, using JSON and XML data serialization formats;
Implementing Caching and Redis– Introduction to Redis, Flask-

Redis integration, managing cache expiry and invalidation.		
UNIT III	**MACHINE LEARNING FUNDAMENTALS**	**6**
Types of Machine Learning – Supervised, unsupervised, and reinforcement learning, Supervised Learning Models; **Data Preprocessing and Feature Engineering**– Data cleaning techniques, Scaling and Normalization, Feature Selection and Engineering; **Building Machine Learning Models** – Linear regression and decision trees, Random Forest and SVM; **Model Evaluation and Optimization** – Metrics for evaluation, cross-validation techniques, hyperparameter tuning.		
UNIT IV	**MACHINE LEARNING MODEL INTEGRATION**	**6**
Exposing ML Models through APIs - Creating prediction endpoints in Flask, Formatting input data for predictions and handling JSON requests; **Data Processing for Model Inference -** Data Formatting and Validation , Batch Processing for Efficiency: **Optimizing and Scaling Model Serving-** Techniques for faster inference, asynchronous processing for handling large volumes of requests; **Monitoring and Logging Predictions** - Logging incoming prediction requests and analyzing data distribution, Health Checks and Error Tracking.		
UNIT V	**DEPLOYMENT AND PRODUCTION READINESS**	**6**
Render Deployment Essentials– Setting up a Render account and deploying Flask applications, Environment Configuration; **Preparing ML Models for Deployment**- Packaging models and dependencies for production, Creating Docker containers for scalable deployments; **CI/CD with GitHub Actions -** Setting up GitHub Actions for automated builds and deployments,		

Monitoring and Logging for Production APIs- Real-time Logging, Error Handling and Alerting.
TOTAL: 30 PERIODS
PRACTICAL EXERCISES:

LIST OF EXPERIMENTS

1. Basic CRUD API Creation: Develop a CRUD API for managing a library of books with operations for adding, viewing, editing, and deleting records.
2. Implementing JWT Authentication: Set up JWT authentication to secure the library API.
3. Using Redis Caching: Add Redis caching to cache frequently accessed endpoints, such as the "View All Books" endpoint
4. Data Cleaning and Feature Engineering: Clean a housing dataset and create engineered features to improve predictive performance.
5. Model Building and Evaluation: Train a classification model using a dataset, evaluating it with accuracy and F1 score metrics.
6. Model Prediction API: Develop a Flask API to serve predictions from a trained ML model.
7. Prediction Logging: Set up basic logging to track incoming requests and analyze prediction patterns.
8. Deploying Flask API on Render: Deploy a Flask-based API on Render, including environment configuration and monitoring setup.
9. CI/CD Setup with GitHub Actions: Automate deployment of the API with CI/CD, ensuring consistent updates on each code commit

Mini Projects

1. Book Recommendation API: Build an API using Flask that provides book recommendations based on genre and author. Integrate data validation to ensure API requests have the required fields.
2. User Profile API with JWT and Redis: Create a Flask API where users can view and update their profiles. Implement JWT-based authentication and use Redis to cache user data for improved performance.
3. Movie Rating Predictor: Develop a regression model to predict user ratings for movies based on genre, director, and other features. Tune the model using cross-validation to optimize accuracy.
4. Spam Detection API: Develop an API using a pre-trained spam detection model to classify messages. Implement logging to track prediction accuracy over time.
5. Sentiment Analysis API with CI/CD on Render: Develop and deploy a sentiment analysis API, set up CI/CD on Render to automate redeployment, and implement monitoring.

TOTAL: 30 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Design and implement RESTful APIs using Python and Flask framework.
CO2:	Apply authentication, authorization, and caching mechanisms to secure and optimize backend applications.
CO3:	Preprocess data and build machine learning models using Scikit-Learn for regression and classification tasks.
CO4:	Integrate trained machine learning models into Flask APIs for real-time prediction and analysis.

CO5:	Monitor and log backend systems to ensure robustness and performance in API services.
CO6:	Deploy full-stack machine learning applications using Render and GitHub Actions with CI/CD practices
TEXT BOOKS:	
1	Miguel Grinberg, Flask Web Development, 2nd Edition, O'Reilly Media, 2018.
2	Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly, 2019.
3	Sebastian Raschka, Python Machine Learning, 3rd Edition, Packt Publishing, 2019.
REFERENCES:	
1	Mark Bates, Programming Flask, Pragmatic Bookshelf, 2022.
2	Jason Brownlee, Machine Learning Mastery With Scikit-Learn, 2021.
3	GitHub Docs: https://docs.github.com/
4	Flask Docs: https://flask.palletsprojects.com/
5	Render Docs: https://render.com/docs

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-		-	-	-	-	-	-	2	-	-
2	3	2	1	1	1	-	-	1	-	1	-	1	3	1	1
3	3	2	1	1	1	-	-	1	-	1	-	1	3	1	1
4	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
6	3	2	1	1	1	-	-	1	-	1	-	1	3	1	1
Overall Correlation	3	2	1	1	1	-	-	1	-	1	-	1	3	1	1

23AM039	AI AND MACHINE LEARNING INTEGRATION IN WEB APPS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the architecture and workflow of web applications integrating AI and ML models.
- To learn how to build, deploy, and manage machine learning models as APIs.
- To explore techniques for integrating AI models into frontend and backend web systems.
- To implement scalable AI-driven web solutions with cloud and container technologies.
- To evaluate the performance, security, and ethical aspects of AI-integrated web applications.

UNIT I	INTRODUCTION TO AI IN WEB APPLICATIONS	9

Introduction to AI and ML in Web Technologies – Web Application Architecture: Client, Server, and Database Layers – Role of AI/ML in Enhancing Web Functionality – ML Lifecycle in Web Context: Data Collection, Model Training, Deployment – REST and GraphQL APIs for AI Model Access – Overview of Frontend and Backend Integration – Case Studies: Chatbots, Recommendation Systems, and Predictive Dashboards.

UNIT II	MACHINE LEARNING MODEL DEPLOYMENT	9

Model Serialization and Packaging: Pickle, Joblib, ONNX – Building and Exposing ML Models as APIs using Flask and FastAPI – TensorFlow Serving and TorchServe – Deployment Pipelines for Scikit-learn Models – Testing and Monitoring ML APIs – Integrating APIs with Web Applications – Model Versioning and Continuous Integration.

UNIT III	FRONTEND INTEGRATION AND INTERACTIVE AI	9

Frontend Technologies: HTML5, CSS3, JavaScript, React –

Connecting Frontend with AI APIs using Fetch/Axios – In-browser AI using TensorFlow.js and ONNX.js – Developing Explainability Dashboards – Visualizing Model Predictions and Metrics – Real-time Data Streaming using WebSockets – Case Study: Interactive AI-driven Web Application.		
UNIT IV	**CLOUD AND CONTAINERIZED AI DEPLOYMENT**	**9**
Cloud Platforms for AI Integration: AWS, Azure, Google Cloud – Docker and Kubernetes for Model Deployment – Managing Scalable AI APIs – Serverless AI using AWS Lambda and Google Cloud Functions – CI/CD Pipelines for Automated AI Deployment – Security, Privacy, and Authentication for Deployed Models – Logging and Monitoring Cloud-based ML Services.		
UNIT V	**PERFORMANCE, ETHICAL AND SOCIAL CONSIDERATIONS**	**9**
Evaluating AI Web Applications: Latency, Throughput, and User Experience – Bias, Fairness, and Explainability in AI Systems – Data Privacy, Security, and Legal Compliance – Ethical Deployment and Responsible AI Use – Model Governance and Transparency – Real-world Use Cases and Best Practices – Future Trends in Web-integrated AI Systems.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the architecture and role of AI and ML models in web applications.
CO2:	Develop and deploy machine learning models as APIs using Flask or FastAPI.
CO3:	Integrate AI/ML functionalities into frontend and backend web systems.
CO4:	Implement scalable and containerized ML services using cloud technologies.
CO5:	Evaluate AI-integrated web applications based on

	performance and ethical parameters.
CO6:	Design and deploy complete AI-powered web applications for real-world use cases.
TEXT BOOKS:	
1	Denis Rothman, Hands-On Artificial Intelligence for Web Applications: Deploying and Integrating ML Models, Packt Publishing, 2023.
2	Flávio Santos, Machine Learning Engineering with Python: Deploy and Scale AI Models, Apress, 2022.
REFERENCES:	
1	Uday Kamath, John Liu, Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning, 2021.
2	Emmanuel Ameisen, Building Machine Learning Powered Applications: Going from Idea to Product, O'Reilly, 2020.
3	Leonida Gianfagna, Antonio Di Cecco, Explainable AI with Python, Springer, 2021.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
2	2	1	1	1	-	-	-	1	-	1	-	1	3	-	1
3	3	2	1	1	-	-	-	1	-	1	-	1	3	-	1
4	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
5	3	2	1	1	-	-	-	1	-	1	-	-	3	-	1
6	3	2	1	1	-	-	-	1	-	1	-	1	3	-	1
Overall Correlation	3	2	1	1	-	-	-	1	-	1	-	1	3	-	1

23CS044	EXPLAINABLE AI	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of Explainable AI (XAI)
- To learn to interpret various machine learning models.
- To explore model-agnostic XAI techniques for generating explanations across different models
- To apply XAI methods to deep learning models.
- To evaluate XAI methods and address ethical considerations.

UNIT I	INTRODUCTION TO XAI	9

Introduction to Explainable AI: Motivation, Importance - Challenges and limitations of black box models - Types of Explainability – taxonomy of explanations - Interpretability – Importance of Interpretability - Taxonomy of Interpretability Methods - Scope of Interpretability - Evaluation of Interpretability - Properties of Explanations - Human-friendly Explanations

UNIT II	INTERPRETABLE MACHINE LEARNING MODELS	9

Overview of Interpretable Machine Learning – Decision Trees, Random Forests – principles, interpretation techniques, Rule based Models – Rule induction, Decision list, rule-based classifiers, Linear models – Interpreting Coefficients, regularization techniques, feature selection.

UNIT III	MODEL AGNOSTIC XAI TECHNIQUES	9

Overview of model Agnostic systems – LIME – local feature importance explanations – SHAP – individual predictions and feature importance – Partial Dependence Plot – Individual Conditional Expectation Plot - Counterfactual explanations.

UNIT IV	XAI FOR DEEP LEARNING	9

XAI for deep learning models - Gradient-based methods: Grad-CAM, Integrated gradients, Saliency Maps – Layer wise relevance

propagation (LRP)– feature visualization- Deep Dream – Activation Maximization		
UNIT V	**EVALUATION AND ETHICAL CONSIDERATIONS**	**9**
Evaluating XAI Methods - Metrics and criteria for evaluating explanation - Human-in-the-loop evaluation - User studies and feedback - Ethical Considerations in XAI - Bias, fairness, and transparency - Privacy and security concerns - Social and legal aspects of XAI – Applications		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the Taxonomy of explanations.
CO2:	Explain interpretable machine learning principles of decision tree, rule based and linear models.
CO3:	Apply Model Agnostic XAI techniques, interpret and explain predictions of machine learning models.
CO4:	Apply XAI techniques for deep learning models
CO5:	Identify XAI methods and Propose innovative solutions to address ethical considerations.
CO6:	Apply XAI techniques in practical scenarios, for real-world datasets and problems.
TEXT BOOKS:	
1	Christoph Molnar, “Interpretable Machine Learning: A Guide for Making Black Box Models Explainable”, Springer, 2022.
REFERENCES:	
1	Uday Kamath, John Liu, “Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning”, 2021
2	Leonida Gianfagna, Antonio Di Cecco, Explainable AI with Python, Springer, 2021.

3	Denis Rothman, “Hands-On Explainable AI (XAI) with Python: Interpret, Visualize, Explain, and Integrate Reliable AI for Fair, Secure, and Trustworthy AI Apps”, Packt Publishing Ltd, 2020.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-		-	-	-	-	-	-	2	-	-
2	2	1	1	1	-	-	-	1	-	1	-	1	3	-	1
3	3	2	1	1	-	-	-	1	-	1	-	1	3	-	1
4	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
5	3	2	1	1	-	-	-	1	-	1	-	-	3	-	1
6	3	2	1	1	-	-	-	1	-	1	-	1	3	-	1
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**3**	**-**	**1**

VERTICAL – 4 : COMPUTATIONAL INTELLIGENCE

23AM040	EMBEDDED AI	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
• Understand the fundamentals of AI deployment in embedded systems. • Identify challenges and constraints in edge/embedded AI systems. • Learn model optimization techniques for deploying ML models on low-resource devices. • Explore TinyML frameworks and software tools used in embedded AI. • Understand hardware accelerators and hardware-software co-design for embedded AI.					
UNIT I	**INTRODUCTION TO EMBEDDED AI**				9
Overview of Embedded AI vs. Cloud AI, use cases (healthcare, automotive, IoT), challenges: limited compute, memory, power; embedded devices: MCUs, SoCs.					
UNIT II	**MODEL OPTIMIZATION**				9
Pruning, quantization (8-bit, fixed-point), knowledge distillation, low-rank factorization, model compression case studies.					
UNIT III	**EMBEDDED AI FRAMEWORKS**				9
TinyML, TensorFlow Lite Micro, CMSIS-NN, ONNX Runtime, Edge Impulse; inference engines and memory management strategies					
UNIT IV	**SYSTEM INTEGRATION & DEPLOYMENT**				9
Sensor data acquisition, preprocessing on embedded devices, real-time constraints, firmware considerations, edge AI pipeline design.					
UNIT V	**HARDWARE ACCELERATION & CO-DESIGN**				9
Introduction to DSPs, NPUs, FPGAs, ASICs; hardware/software co-design principles; benchmarking tools and metrics: latency,					

throughput, energy.	
	TOTAL: 45 PERIODS
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Understanding the constraints such as memory, compute, and power in embedded AI systems.
CO2:	Apply model compression techniques like pruning and quantization to optimize AI models..
CO3:	Compare various TinyML frameworks and runtimes for embedded AI deployment.
CO4:	Describe the integration of sensor input with embedded AI models and their deployment flow..
CO5:	Evaluate embedded AI models based on accuracy, latency, and power efficiency.
CO6:	Discuss hardware accelerators and hardware-software co-design strategies for embedded AI.
TEXT BOOKS:	
1	Pete Warden, Daniel Situnayake, TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers, O'Reilly Media, 2020
2	Vivienne Sze, Yu-Hsin Chen, Joel Emer, et al. Efficient Processing of Deep Neural Networks, Morgan & Claypool / MIT Press,2020
REFERENCES:	
1	Shashank Gupta, Embedded Machine Learning, BPB Publications, 2022
2	Daniel Situnayake, Pete Warden, AI at the Edge: Solving Real Problems with Embedded Machine Learning,O'Reilly Media,2022

Cos	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	1	1	1	1	1	1	3	2	3	3
2	3	3	3	2	2	1	1	1	1	1	1	3	3	3	3
3	3	3	3	2	2	1	1	1	1	1	1	3	3	3	3
4	2	3	3	2	2	1	1	1	2	2	2	3	3	2	3
5	3	3	2	2	3	1	1	1	2	2	2	3	3	3	3
6	3	3	2	2	3	1	1	1	1	1	1	3	3	3	3
Overall Correlation	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3

23AD049	IMMERSIVE TECHNOLOGIES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Understand the fundamentals of immersive technologies, including VR, AR, MR, and XR.
- Explore hardware and software tools for creating immersive experiences.
- Develop design principles for immersive applications across industries.
- Examine emerging trends and the ethical implications of immersive technologies.
- Gain hands-on experience in developing simple immersive solutions.

UNIT I	INTRODUCTION TO IMMERSIVE TECHNOLOGIES	6

Overview of immersive Technologies: Augmented Reality,Virtual Reality,Mixed Reality- Evolution of AR/VR Systems – Components: Hardware and Software – Application in various domains - **Case Studies**: Iconic immersive applications and their impact.

UNIT II	FOUNDATIONS OF VIRTUAL REALITY AND AUGMENTED REALITY	6

Virtual Reality: Immersion, Interaction, and Presence -Augmented Reality: Overlays, Tracking and Spatial Mapping - Basics of 3D Graphics: Rendering, Shading and Transformations - Technology Stack:Sensors, Displays, Tracking Systems, and Input Devices - Tools and Frameworks - Current Limitations and Challenges.

UNIT III	DESIGNING FOR IMMERSIVE EXPERIENCE	6

Principles for Immersive Environments - Narrative Techniques and Interactivity - Ergonomics and Accessibility(UI & UX) - Prototyping and Testing Immersive application

UNIT IV	DEVELOPMENT TOOLS AND FRAMEWORKS	6

Overview of VR/AR development platforms: Unity, Unreal

Engine, WebXR - Working with Basic Workflows and Scripting - Introduction to ARKit, ARCore, and Microsoft Mixed Reality Toolkit - Exploring WebXR for Browser-Based Immersive Experiences.

UNIT V	PIONEERING FRONTIERS AND EMERGING HORIZONS	6

Immersive AI - Case Study: AI-Driven Personalization in Virtual and Augmented Reality, Natural Language Processing for Conversational Agents in Immersive Environments, Generative AI for Content Creation in Immersive Technologies – Social VR - Ethical Considerations and Accessibility in Immersive Technologies - Emerging Horions: Haptics, Brain-Computer Interfaces and Holography.

TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1. Install AR/VR Framework: Unity
2. Creating a Basic AR Scene
3. Use the primitive objects and apply various projection types by handling camera.
4. Download objects from asset store and apply various lighting and shading effects.
5. Model three dimensional objects using various modelling techniques and apply textures over them
6. Develop Augmented Reality with Marker-Based Tracking. dd audio and text special effects to the developed application
7. Creating a Browser-Based AR Experience
8. Building a 3D Environment with Unity

TOTAL:30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Explain the concepts of immersive technologies.
CO2:	Summarize the technical building blocks of VR and AR.
CO3:	Apply design principles to create user-friendly immersive applications.

CO4:	Build basic VR/AR applications using software tools.
CO5:	Infer advanced technologies shaping the future of immersive tech.
CO6:	Illustrate ethical implications and societal impact.

TEXT BOOKS:

1	Tony Parisi, "Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile", O'Reilly Media, December 2015.
2	Dieter Schmalstieg and Tobias Hollerer,"Augmented Reality: Principles and Practice", Addison-Wesley Professional, 2016.

REFERENCES:

1	Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2017.
2	Gerard Jounghyun Kim, "Designing Virtual Reality Systems: The Structured Approach", Springer, 2005.
3	Steve Mann, "Mixed Reality: A New Era of Interaction", Springer, 2018.
4	Jason Jerald, "The VR Book: Human-Centered Design for Virtual Reality", ACM Books, 2016.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	-	-	2	1	2	3	2	1	-
2	2	1	-	-	1	-	-	-	2	1	2	3	2	1	-
3	3	2	1	1	3	-	-	1	3	3	3	3	3	3	1
4	3	2	1	1	3	-	-	1	3	3	3	3	3	3	1
5	2	1	-	-	3	-	-	1	3	3	3	3	2	3	1
6	2	1	-	-	1	-	-	-	2	1	2	3	2	1	-
Overall Correlation	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**1**	**3**	**2**	**3**	**3**	**3**	**2**	**1**

<table>
<tr><td>23AD050</td><td colspan="2">ETHICS OF AI</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td></td><td colspan="2"></td><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">• To understand the need for ensuring ethics in AI
• To understand ethical issues with the development of AI agents
• To apply the ethical considerations in different AI applications
• To evaluate the relation of ethics with nature
• To overcome the risk for Human rights and other fundamental values.</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION</td><td>6</td></tr>
<tr><td colspan="7">Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust</td></tr>
<tr><td>UNIT II</td><td colspan="5">ETHICAL INITIATIVES IN AI</td><td>6</td></tr>
<tr><td colspan="7">International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponization.</td></tr>
<tr><td>UNIT III</td><td colspan="5">AI STANDARDS AND REGULATION</td><td>6</td></tr>
<tr><td colspan="7">Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems</td></tr>
<tr><td>UNIT IV</td><td colspan="5">ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS</td><td>6</td></tr>
<tr><td colspan="7">Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility Roboethics Taxonomy.</td></tr>
</table>

UNIT V	AI AND ETHICS- CHALLENGES AND OPPORTUNITIES	6
Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries- National and International Strategies on AI.		
TOTAL: 30 PERIODS		
PRACTICAL EXERCISES:		
1. Case study on ethical initiatives in healthcare, autonomous vehicles and defense 2. Exploratory data analysis on a 2-variable linear regression model 3. Experiment the regression model without a bias and with bias 4. Classification of a dataset from UCI repository using a perceptron with and without bias 5. Case study on ontology where ethics is at stake. 6. Identification on optimization in AI affecting ethics		
TOTAL:30 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Summarize about morality and ethics in AI	
CO2:	Apply the knowledge of real time application ethics, issues and its challenges.	
CO3:	Explain the ethical harms and ethical initiatives in AI	
CO4:	Demonstrate about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems	
CO5:	Explain the concepts of Roboethics and Morality with professional responsibilities.	
CO6:	Classify the societal issues in AI with National and International Strategies on AI.	

TEXT BOOKS:	
1	Virginia Dignum, "Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way", Springer, 2019.
2	Mark Coeckelbergh, "AI Ethics", The MIT Press, 2020.
REFERENCES:	
1	Paula Boddington , “Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms)” November 2017
2	Mark Coeckelbergh,” AI Ethics”, The MIT Press Essential Knowledge series, April 2020

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	1	-	-	1	-	1	1	1	2	1	1
2	3	2	1	1	3	-	-	2	1	2	2	3	3	3	2
3	2	1	-	-	1	-	-	2	-	2	1	2	2	1	2
4	2	1	-	-	2	-	-	2	1	2	2	2	2	2	2
5	2	1	-	-	1	-	-	2	-	2	1	2	2	1	2
6	2	1	-	-	1	3	-	2	-	2	1	2	2	1	2
Overall Correlation	3	2	1	1	1	1	-	2	1	2	2	2	3	1	2

23AM041	KERNEL METHODS FOR PATTERN ANALYSIS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Understand the mathematical foundations of kernel methods including RKHS and Mercer's theorem.
- Formulate and solve machine learning problems using kernel-based approaches like SVMs and kernel regression.
- Design or select appropriate kernel functions for different types of data and applications.
- Implement kernel algorithms for classification, regression, and dimensionality reduction tasks.
- Analyze the performance and limitations of kernel methods in real-world scenarios.

UNIT I	INTRODUCTION TO KERNEL METHODS FOR PATTERN ANALYSIS	6

Overview of Pattern Recognition and Machine Learning-Need for Nonlinear Models-Feature Mapping and the Kernel Trick-Inner Product Spaces and Hilbert Spaces-Reproducing Kernel Hilbert Space (RKHS)

UNIT II	SUPPORT VECTOR MACHINES (SVMS) AND REGULARIZATION	6

Linear SVM: Primal and Dual Formulation-Hard Margin and Soft Margin Classifiers- Nonlinear SVMs using Kernels- Lagrangian Duality, KKT Conditions-Regularization in RKHS-Representer Theorem

UNIT III	KERNEL METHODS FOR REGRESSION AND DIMENSIONALITY REDUCTION	6

Kernel Ridge Regression-Regularized Least Squares-Kernel PCA (Principal Component Analysis)- Kernel CCA (Canonical Correlation Analysis)-Kernel LDA (Linear Discriminant Analysis)

UNIT IV	STRUCTURED DATA KERNELS AND LEARNING KERNELS	6
String Kernels (e.g., Spectrum Kernel, Subsequence Kernel)- Tree Kernels and Graph Kernels-Convolution Kernels- Multiple Kernel Learning (MKL)-Kernel Selection Techniques- Combining Kernels		
UNIT V	**ADVANCED APPLICATIONS AND SCALABLE KERNEL METHODS**	**6**
Kernel K-Means and Spectral Clustering- One-Class SVM for Novelty/Anomaly Detection- Large-Scale Kernel Learning-Kernel Approximations (Nyström Method, Random Fourier Features)- Deep Kernel Learning.		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		
1. Implement Kernel Function Validation (Check PSD properties, Gram Matrix) 2. Train a Linear SVM and RBF Kernel SVM on a real dataset 3. Visualize decision boundaries for linear vs nonlinear SVMs 4. Implement Kernel PCA and visualize transformed data 5. Text Classification using String Kernels 6. Graph Classification using Graph Kernels 7. Mini Project: Build a kernel-based classifier for image/text/graph data		
		TOTAL:30 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the concept of kernels, feature mapping, and RKHS, and prove representer theorem and basic generalization bounds.	
CO2:	Formulate and solve optimization problems underlying SVMs, kernel regression, and eigen-decomposition–based kernel algorithms.	
CO3:	Choose or design kernels suited for various data modalities (e.g. RBF, polynomial, string kernels, graph kernels).	

CO4:	Implement kernel-based algorithms and conduct experiments to compare performance (accuracy, computation time, overfitting).
CO5:	Handle large-scale data challenges (approximate kernels, sparse methods, kernel approximation techniques).
CO6:	Apply kernel methods to structured data such as sequences, trees, and graphs.
TEXT BOOKS:	
1	John Shawe-Taylor & Nello Cristianini, Kernel Methods for Pattern Analysis (Cambridge, 2004) — the canonical reference.
2	Bernhard Schölkopf & Alexander J. Smola, Learning with Kernels: Support Vector Machines, Regularization, Optimization, and Beyond (MIT Press)
REFERENCES:	
1	Cristianini, N. & Shawe-Taylor, J., An Introduction to Support Vector Machines and Other Kernel-based Methods.
2	C. M. Bishop, Pattern Recognition and Machine Learning (for broader ML context) Vapnik, V., Statistical Learning Theory

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	2	1	1	1	1	1	1	2	3	2	2
2	3	3	3	2	2	1	1	1	1	1	1	2	3	3	2
3	3	3	2	2	3	1	1	1	1	1	1	2	3	3	3
4	2	3	3	2	3	1	1	1	2	2	2	3	3	3	2
5	3	3	2	2	3	1	1	1	2	2	2	3	3	3	3
6	3	3	2	2	3	1	1	1	1	1	1	2	3	3	3
Overall Correlation	**3**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**3**

<table>
<tr><td rowspan="2">23AM042</td><td rowspan="2" colspan="2">MLOps</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">Introduce students to MLOps concepts, tools, and practices for deploying ML models in production.
Teach best practices for versioning, testing, monitoring, and scaling ML systems.
Provide hands-on exposure to DevOps tools integrated with ML pipelines.
Enable students to manage end-to-end ML lifecycle in real-world projects.</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION TO MLOps</td><td>9</td></tr>
<tr><td colspan="7">Definition and importance of MLOps in AI & ML-Challenges in deploying ML models to production-Differences between traditional DevOps and MLOps-MLOps lifecycle stages: Development, Deployment, Monitoring</td></tr>
<tr><td>UNIT II</td><td colspan="5">ML MODEL DEVELOPMENT LIFECYCLE</td><td>9</td></tr>
<tr><td colspan="7">Data collection, cleaning, preprocessing, and feature engineering-Model training and evaluation- Experiment tracking and reproducibility-Versioning datasets, models, and code</td></tr>
<tr><td>UNIT III</td><td colspan="5">MODEL DEPLOYMENT AND SERVING</td><td>9</td></tr>
<tr><td colspan="7">Deployment strategies: batch, online, streaming-REST APIs for ML models (Flask, FastAPI, TensorFlow Serving)-Containerization with Docker-Orchestration with Kubernetes</td></tr>
<tr><td>UNIT IV</td><td colspan="5">CONTINUOUS INTEGRATION & CONTINUOUS DEPLOYMENT (CI/CD) FOR ML</td><td>9</td></tr>
<tr><td colspan="7">CI/CD pipelines for ML systems-Automated testing: unit tests, integration tests for ML-Monitoring model performance and detecting drift-Retraining pipelines and rollback strategies</td></tr>
<tr><td>UNIT V</td><td colspan="5">ADVANCED TOPICS IN MLOps</td><td></td></tr>
<tr><td colspan="7">Scaling ML workloads: distributed training and inference-Model</td></tr>
</table>

explainability and fairness in production- Logging, observability, and alerting for ML systems-Security and compliance considerations for ML models- Emerging trends: Feature stores, Serverless ML, Edge deployment

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Understand the MLOps lifecycle and its components.
CO2:	Implement ML pipelines for training, testing, and deployment.
CO3:	Use version control, containerization, and orchestration tools for ML.
CO4:	Monitor ML models in production for performance and drift.
CO5:	Apply CI/CD practices to ML workflows.
CO6:	Manage scalable ML systems in cloud environments.

TEXT BOOKS:

1	Mark Treveil & Alok Shukla, Practical MLOps, O'Reilly Media, 2022
2	**Emmanuel Ameisen**, *Building Machine Learning Powered Applications*, O'Reilly Media, 2020

REFERENCES:

1	Hannes Hapke & Catherine Nelson, Deep Learning Projects with MLOps, Packt, 2021
2	**Valliappa Lakshmanan, Martin Görner, and Michael Katzenellenbogen**, *Machine Learning Design Patterns*, O'Reilly, 2020

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	1	1	1	2	1	1	1	3	1	1
2	3	3	2	2	3	1	1	1	1	1	1	1	3	3	2
3	3	1	3	2	3	1	1	1	1	1	1	1	2	3	3
4	3	1	3	2	3	1	1	1	1	1	1	1	2	3	3
5	3	2	3	2	3	2	2	1	1	1	2	1	2	3	3
6	3	2	3	2	3	2	2	1	1	2	2	2	2	3	3
Overall Correlation	3	2	3	2	3	2	1	1	1	1	1	2	2	3	3

23AD053	COMPUTER VISION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature-based alignment and motion estimation
- To develop skills on 3D reconstruction
- To examine practical applications of computer vision across diverse fields

UNIT I	INTRODUCTION TO IMAGE FORMATION AND PROCESSING	6

Image Processing, Computer Vision, What is Computer Vision - Low-level, Mid-level, High-level ; Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

UNIT II	FEATURE DETECTION, MATCHING AND SEGMENTATION	6

Feature Extraction -Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram - Points and patches - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts

UNIT III	FEATURE-BASED ALIGNMENT & MOTION ESTIMATION	

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT IV	3D RECONSTRUCTION	6
Shape from X - Active rangefinding - Surface representations - Point-based representations - Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.		
UNIT V	**APPLICATIONS**	**6**
Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Virtual Reality and Augmented Reality.		
TOTAL: 30 PERIODS		

PRACTICAL EXERCISES:

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 Image features, Feature matching, cloning, Feature matching based image alignment
5. Image segmentation using Graphcut / Grabcut
6. 3D Reconstruction – Creating Depth map from stereo images
7. Object Detection and Tracking using Kalman Filter, Camshift

TOTAL:30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Explain the fundamental concepts of image formation, transformation, and processing techniques
CO2:	Apply feature detection and segmentation techniques
CO3:	Develop algorithms for feature-based alignment, pose

	estimation, and motion estimation in both 2D and 3D environments.
CO4:	Apply 3D reconstruction techniques.
CO5:	Explain computer vision applications like object recognition, medical image analysis, and content-based image retrieval.
CO6:	Apply computer vision techniques into practical applications, including video processing, virtual reality, and augmented reality, considering industry trends and future developments.
TEXT BOOKS:	
1	D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", , Pearson Education, Second Edition, 2015.
2	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
REFERENCES:	
1	Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", Second Edition, Cambridge University Press, March 2004.
2	Christopher M. Bishop; "Pattern Recognition and Machine Learning", Springer, 2006
3	E. R. Davies, "Computer and Machine Vision", Fourth Edition, Academic Press, 2012.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	2	1	2	2	2	1	3	2	1	2
2	3	2	1	1	1	2	2	3	2	2	2	3	3	1	3
3	3	2	1	1	1	2	2	3	3	3	2	2	3	1	2
4	3	2	1	1	1	1	1	2	2	2	3	3	3	1	2
5	2	1	-	-	1	2	2	3	2	3	2	3	2	1	3
6	3	2	1	1	1	2	3	3	3	3	3	3	3	1	3
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**3**

23AM043	ROBOTIC PROCESS AUTOMATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the concepts, architecture, and components of Robotic Process Automation (RPA).
- To learn various RPA tools and their real-world applications across industries.
- To develop skills in designing, building, and deploying software bots.
- To explore integration of RPA with AI, ML, and data analytics for intelligent automation.
- To evaluate governance, ethics, and future trends in automation.

UNIT I	INTRODUCTION TO ROBOTIC PROCESS AUTOMATION	6

Introduction to Automation and RPA – Definition, Scope, and Evolution; Difference between RPA and Traditional Automation; Key Components of RPA – Bots, Recorder, Workflow Designer; RPA Architecture and Process Lifecycle; Benefits and Limitations of RPA; Applications of RPA in Banking, Healthcare, Education, and Manufacturing.

UNIT II	RPA TOOLS AND PLATFORMS	6

Overview of Leading RPA Tools – UiPath, Automation Anywhere, Blue Prism; Installation and Interface Overview; Features and Capabilities Comparison; Recorder Functions, Activities, and Workflows; Bot Development Environments; Creating and Executing Simple Automation Tasks; Case Study – Automating Invoice Processing.

UNIT III	BOT DESIGN, DEVELOPMENT, AND DEPLOYMENT	6

RPA Process Flow – Identifying Tasks for Automation, Process Mapping, and Bot Design Principles; Developing Software Bots – Data Input/Output Operations, Loops, Conditions, and Exception Handling; Reusable Components and Modular Design; Debugging and Testing Bots; Bot Deployment and Orchestration; Scheduling and Monitoring Bot Execution.

UNIT IV	INTELLIGENT AUTOMATION AND INTEGRATION	6
Integration of RPA with Artificial Intelligence (AI) and Machine Learning (ML); Intelligent Document Processing (IDP); Cognitive Automation – Image Recognition, NLP, and Chatbots; Using APIs for System Integration; RPA in Cloud and Edge Environments; Use Cases – Smart Data Extraction, Automated Report Generation, Predictive Automation.		
UNIT V	**GOVERNANCE, ETHICS, AND FUTURE OF AUTOMATION**	**6**
RPA Governance Framework – Security, Compliance, and Audit Considerations; Role-Based Access Control (RBAC) in RPA; Ethical Issues in Automation – Workforce Impact and Responsible AI; Metrics for Measuring RPA Performance; Future Trends – Hyperautomation, Intelligent Process Automation (IPA), and Human-Bot Collaboration; Case Studies on RPATransformation.		
TOTAL: 30 PERIODS		
PRACTICAL EXERCISES:		
1. Install and explore any one RPA tool (UiPath / Automation Anywhere / Blue Prism). 2. Create a simple bot to automate form filling or data entry from Excel to Web. 3. Develop a workflow to read and process emails automatically. 4. Implement a bot for data extraction and report generation using UiPath. 5. Design an automation process for file and folder operations (copy, move, rename). 6. Build a bot for automating invoice processing or purchase order approval. 7. Integrate a chatbot with an RPA process to handle user requests.		

8. Develop a process that combines RPA with OCR for document scanning and data capture. 9. Implement a simple AI-driven bot using NLP to classify support tickets. 10. Prepare a report analyzing RPA's business benefits, ROI, and ethical considerations in an organization.	
	TOTAL: 30 PERIODS
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the fundamental concepts, architecture, and lifecycle of Robotic Process Automation.
CO2:	Identify and apply suitable RPA tools for automating repetitive business processes.
CO3:	Design, develop, and deploy software bots using standard RPA platforms.
CO4:	Integrate RPA with AI and ML for intelligent automation solutions.
CO5:	Evaluate ethical, governance, and security aspects of automation.
CO6:	Analyze real-world RPA applications and emerging trends in intelligent process automation.
TEXT BOOKS:	
1	Alok Mani Tripathi, *Learning Robotic Process Automation*, Packt Publishing, 2018.
2	Pascal Bornet, Ian Barkin, and Jochen Wirtz, Intelligent Automation: Welcome to the World of Hyperautomation, World Scientific Publishing, 2021.
REFERENCES:	
1	Mary C. Lacity and Leslie P. Willcocks, Robotic Process Automation and Cognitive Automation: The Next Phase, SB Publishing, 2018.
2	Lim Mei Ying, UiPath Studio Guide: Learn RPA with Real-Time Examples, Apress, 2020.
3	Leslie Willcocks, Service Automation: Robots and the Future of Work, Steve Brookes Publishing, 2016.

Cos	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	1	-	-	3	2	-	-	3	2	-
2	3	2	1	3	-	-	-	-	-	-	-	-	3	3	-
3	3	3	2	3	1	-	-	-	-	-	-	-	3	3	-
4	3	2	1	3	2	1	-	-	-	-	-	-	2	2	1
5	3	2	2	1	2	-	-	-	-	-	-	-	3	2	1
6	3	2	2	3	2	-	-	-	-	1	-	-	3	2	2
Overall Correlation	**3**	**3**	**3**	**2**	**3**	**2**	**1**	**-**	**-**	**1**	**2**	**1**	**1**	**3**	**2**

23CS041	GAME DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of a game engine.
- To survey the gaming development environment and tool kits.
- To learn and develop simple games using Unity

UNIT I	3D GRAPHICS FOR GAME DESIGN	6

Introduction Genres of games, Basics of 2D and 3D graphics for game avatar, Game components – 2D and 3D Transformations – Projections – Color models – Illumination and Shader models – Animation – Controller based animation.

UNIT II	GAME DESIGN PRINCIPLES	6

Character development, Storyboard development for gaming – Script design – Script narration, Game balancing, Core mechanics, Principles of level design – Proposals – Writing for preproduction, Production and Post-production.

UNIT III	GAME ENGINE DESIGN	6

Rendering concept – Software rendering – Hardware rendering – Spatial sorting algorithms – Algorithms for game engine – Collision detection – Game logic – Game AI – Pathfinding

UNIT IV	OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS	6

Pygame game development – Unity – Unity scripts – Mobile gaming, Game studio, Unity single player and multi-player games

UNIT V	GAME DEVELOPMENT USING UNITY ENGINE	6
Exporting assets from 3D software – Different types of camera in Unity – Character navigation – Third person camera movement – Creating enemy characters runtime – Animation control in Unity – Graphic user interface in Unity – Assigning properties and methods for player		
TOTAL: 30 PERIODS		

PRACTICAL EXERCISES:

LIST OF EXPERIMENTS

1. Installation of a game engine, e.g., Unity, Unreal Engine.
2. Character design, sprites, movement, and character control.
3. Level design: design of the world in the form of tiles along with interactive and collectible objects.
4. Design of interaction between the player and the world, optionally using the physics engine.
5. Developing a 2D interactive using Unity.
6. Design of menus and user interaction in mobile platforms.
7. Developing a 3D game using Unreal.
8. Developing a multiplayer game using Unity.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Apply the basic concepts of 2D graphics.
CO2:	Apply the fundamentals of 3D graphics.
CO3:	Design games based on the principles.
CO4:	Make use game engines effectively.
CO5:	Analyse gaming environments and frameworks.
CO6:	Develop a simple game in Unity.

TEXT BOOKS:	
1	Patrick Felicia, "Unity from Zero to Proficiency (Proficient): A step-by-step guide to creating your first 3D Role-Playing Game", LPF Publishing, 1st Edition, New Delhi, 2019. (Unit 1)
2	Ernest Adams, "Fundamentals of Game Design", Pearson Education India, 3rd Edition, India, 2015. (Unit 2 & 3)
REFERENCES:	
1	Franz Lanzinger, "3D Game Development with Unity", CRC Press, 1st edition, New Delhi, 2022.
2	Franz Lanzinger, "2D Game Development with Unity", CRC Press, 1st Edition, New Delhi, 2020.
3	Adam Kramarzewski, Ennio De Nucci, "Practical Game Design: A modern and comprehensive guide to video game design", Packt Publishing Limited, 2nd Edition, New Delhi, 2023.
4	Rachel Cordone, "Unreal Engine 4 Game Development Quick Start Guide", Packt Publishing Limited, 1st Edition, New Delhi, 2019.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	1	3	1	2	3	3	2	1
2	3	2	1	1	2	-	-	1	3	1	2	3	3	2	1
3	3	2	1	1	2	-	-	1	2	2	3	2	3	2	1
4	3	2	1	1	1	-	-	1	1	1	1	1	3	1	1
5	3	2	1	1	1	-	-	1	2	2	1	1	3	1	1
6	3	2	1	1	1	-	-	1	1	3	2	1	3	1	1
Overall Correlation	3	2	1	1	2	-	-	1	2	2	2	2	3	2	1

VERTICAL 5: CYBER SECURITY AND CLOUD COMPUTING

<table>
<tr><td rowspan="2">23AD054</td><td rowspan="2">WEB SECURITY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">• To understand the fundamentals of web application security
• To focus on wide aspects of secure development and deployment of web applications
• To learn how to build secure APIs
• To learn the basics of vulnerability assessment and penetration testing
• To get an insight about Hacking techniques and Tools</td></tr>
<tr><td>UNIT I</td><td colspan="4">FUNDAMENTALS OF WEB APPLICATION SECURITY</td><td>6</td></tr>
<tr><td colspan="6">The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation</td></tr>
<tr><td>UNIT II</td><td colspan="4">SECURE DEVELOPMENT AND DEPLOYMENT</td><td>9</td></tr>
<tr><td colspan="6">Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)</td></tr>
<tr><td>UNIT III</td><td colspan="4">SECURE API DEVELOPMENT</td><td>9</td></tr>
<tr><td colspan="6">API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.</td></tr>
</table>

UNIT IV	API SECURITY ESSENTIALS	9
API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.		
UNIT V	**HACKING TECHNIQUES AND TOOLS**	**9**
Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		

1. Installing and configuring Metasploit
2. Perform a reconnaissance on a test application
3. Enumerate open ports and web services using Metasploit's auxiliary modules (e.g., http_version, http_title)
4. Vulnerability Scanning
   a. Perform an Nmap scan using Metasploit
   b. Use vulnerability scanning modules such as auxiliary/scanner/http/http_login
   c. Identify and analyze vulnerabilities found in the scan
5. Demonstrate a Remote Code Execution (RCE) exploit on a vulnerable application
6. Use privilege escalation techniques to elevate user privileges
7. Exploiting Web Application Vulnerabilities
   a. Exploit an XSS vulnerability using Metasploit
   b. Perform session hijacking and cookie manipulation
8. Reporting and Remediation
   a. Prepare a sample report documenting

	vulnerabilities, exploits, and mitigation strategies. b. Review security best practices and recommend fixes based on findings
	TOTAL:30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Outline the basic concepts of web application security and the need for it
CO2:	Develop proficiency in the methods and best practices for securely building and deploying web applications, ensuring protection against security risks and vulnerabilities.
CO3:	Apply the skill to design and develop Secure Web Applications that use Secure APIs
CO4:	Understand the significance of conducting vulnerability assessments and penetration testing to identify and mitigate security risks, ensuring system robustness and protection against potential threats.
CO5:	Apply the skill to think like a hacker and to use hackers tool sets
CO6:	Develop security frameworks, tools, and methodologies to ensure continuous security
TEXT BOOKS:	
1	Andrew Hoffman, "Web Application Security: Exploitation and Countermeasures for Modern Web Applications", First Edition, O'Reilly Media, Inc., 2020
2	Bryan Sullivan, Vincent Liu, "Web Application Security: A Beginners Guide", The McGraw-Hill Companies, 2012
REFERENCES:	
1	Michael Cross, "Developer's Guide to Web Application Security", Syngress Publishing, Inc., 2007.
2	Ravi Das and Greg Johnson, "Testing and Securing Web Applications", Taylor and Francis Group, LLC., 2021.
3	Prabath Siriwardena, "Advanced API Security", Apress Media LLC, USA,2020.

4	Malcom McDonald, “Web Security for Developers”, No Starch Press, Inc,2020.
5	Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams ,“Grey Hat Hacking: The Ethical Hacker’s Handbook”, Third Edition, The McGraw-Hill Companies, 2011.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
2	3	2	1	1	2	1	-	1	-	-	-	3	2	2	1
3	3	2	1	1	3	-	-	1	-	-	-	3	2	3	1
4	3	2	1	1	2	1	-	1	-	-	-	3	2	2	1
5	3	2	1	1	1	2	-	2	-	-	-	3	2	1	2
6	3	2	1	1	3	-	-	1	-	3	2	3	2	3	1
Overall Correlation	**3**	**2**	**1**	**1**	**2**	**1**	**-**	**1**	**-**	**3**	**2**	**3**	**3**	**2**	**2**

23AD055	AI FOR CYBER SECURITY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the Role of AI in Cyber Security
- To learn Key AI Algorithms and Techniques for Security
- To develop Skills in AI-driven Threat Detection and Mitigation
- To explore Ethical and Legal Implications of AI in Cyber Security
- To gain Insight into Future Trends and Emerging Technologies.

UNIT I	INTRODUCTION TO AI IN CYBER SECURITY	9

Overview of AI and Cyber Security-Definition and significance of AI in cyber security - Current cyber security challenges and how AI addresses them - AI Techniques in Cyber Security - Machine Learning (ML), Deep Learning (DL), and Natural Language Processing (NLP) basics - Applications of AI in Cyber Security- AI for threat detection, fraud prevention, and anomaly detection.

UNIT II	MACHINE LEARNING FOR CYBER THREAT DETECTION	6

Supervised and Unsupervised Learning for Security- Overview of ML techniques -Decision Trees, SVM, Neural Networks, Use of ML for anomaly detection and signature-based threat detection - Real-time Intrusion Detection Systems (IDS) , AI-based intrusion detection and prevention. Behavior-based vs signature-based approaches. Malware Detection Using ML.

UNIT III	DEEP LEARNING AND NLP FOR CYBER SECURITY	6

Deep Learning Techniques in Cyber Security- Neural networks, Convolutional Neural Networks (CNNs), and Recurrent Neural Networks (RNNs) for threat intelligence. Autoencoders for Anomaly Detection - Detecting network anomalies using

autoencoders. Natural Language Processing (NLP) Applications- NLP for log analysis, phishing detection, and processing threat intelligence feeds. Chatbots for Security Operations.		
UNIT IV	**AI FOR VULNERABILITY AND RISK MANAGEMENT**	**6**
API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.		
UNIT V	**ETHICAL IMPLICATIONS AND FUTURE TRENDS**	**6**
Adversarial AI and Attacks - AI's role in adversarial attacks - evasion, poisoning attacks. Ethics and Bias in AI Cyber Security Models - Legal and Regulatory Framework - Compliance, privacy laws, and regulations affecting AI in cyber security. Future Trends and case studies.		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1. Research and evaluate at least two AI-based cyber security tools (e.g., Darktrace, Cylance).
2. Prepare a report comparing their threat detection techniques and use of AI algorithms.
3. Analyze how AI helped detect and respond to the threat, focusing on the techniques employed.
4. Use a machine learning algorithm (e.g., Decision Tree or Random Forest) to detect network intrusions using the KDD Cup '99 dataset. Evaluate the performance using accuracy, precision, and recall metrics.
5. Implement a classification model using supervised learning (e.g., SVM or Naive Bayes) to detect and classify malware types based on their characteristics. Use an open-source malware dataset for training and testing.

6. Build a deep learning autoencoder model to detect network anomalies in a dataset (e.g., UNSW-NB15). 7. Implement a Natural Language Processing (NLP) model to detect phishing emails. 8. Develop a vulnerability scanning tool that uses machine learning to predict potential weaknesses in a system based on system logs and configuration data. 9. Write a report discussing how bias can impact cyber security decisions.	
TOTAL:30 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain AI Techniques for Cyber Security
CO2:	Build and Implement AI Models for Threat Detection
CO3:	Apply AI for Vulnerability and Risk Management
CO4:	Build and Implement Natural Language Processing (NLP) for Cyber Intelligence
CO5:	Utilize Ethical and Legal Challenges in AI-driven Security
CO6:	Apply Future Trends and Innovations in AI-based Cyber Defense
TEXT BOOKS:	
1	Baeza-Yates R and Ribeiro-Neto B, “Modern Information Retrieval: The Concepts and Technology Behind Search”, 2nd ed., ACM Press Books, 2011.
2	Chio C., and Freeman D, “Deep Learning for Cybersecurity”, O'Reilly Media, 2019
REFERENCES:	
1	Mongeau S and Seplow A., “Cybersecurity Data Science: Machine Learning and Data Analytics for Cyber Risk Management”, Apress, 2021.
2	Joseph A. D and Nelson B., “Adversarial Machine Learning”, Cambridge University Press, 2018
3	Müller A. C., and Guido S, “Introduction to Machine Learning with Python: A Guide for Data Scientists”, O'Reilly Media, 2016

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	1	-	-	-	1	2	-	1
2	3	2	1	1	1	-	-	1	-	-	1	2	3	1	1
3	3	2	1	1	3	-	-	1	-	-	1	2	3	3	1
4	3	2	1	1	2	-	-	1	-	-	2	2	3	2	1
5	3	2	1	1	2	-	1	3	-	-	1	1	3	2	3
6	3	2	1	1	1	2	1	2	2	1	1	2	3	1	2
Overall Correlation	3	2	1	1	2	1	1	2	1	1	1	2	3	2	2

23AD056	CYBER THREAT INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide an understanding of the fundamental concepts of cyber threat intelligence and its role in cybersecurity.
- To equip students with the knowledge to collect, analyze, and disseminate cyber threat information.
- To teach students how to identify and classify cyber threats and assess the risks they pose.
- To explore various tools, techniques, and frameworks for threat detection and mitigation.
- To develop practical skills in generating actionable threat intelligence for real-world security environments.

UNIT I	INTRODUCTION TO CYBER THREAT INTELLIGENCE	9

Overview of Cyber Threat Intelligence (CTI) – Strategic, Tactical, Operational, and Technical Intelligence; Cyber Threat Intelligence Lifecycle – Collection, Analysis, Dissemination, Feedback; Cyber Threat Actors – Nation-states, Cybercriminals, Hacktivists, Insider Threats; Attack Vectors – Phishing, Malware, Denial of Service, Exploits; Intelligence Sources – Open-source, Commercial, and Internal Intelligence Feeds.

UNIT II	THREAT DATA COLLECTION AND ANALYSIS	9

Sources of Threat Data – OSINT (Open-Source Intelligence), Dark Web Monitoring, Vendor Feeds, ISACs (Information Sharing and Analysis Centers); Data Collection Methods – Automated Tools, Manual Collection, Web Scraping; Threat Intelligence Platforms (TIPs) – Integration, Enrichment, Correlation of Threat Data; Threat Data Analysis – Indicators of Compromise (IOCs), Threat Patterns, Trends; Data Enrichment – WHOIS Lookups, Geolocation, Domain Reputation.

UNIT III	**THREAT DETECTION AND ATTRIBUTION**	**9**
Threat Detection Techniques – Signature-Based, Anomaly-Based, Behavior-Based Detection; Threat Hunting – Proactive Threat Identification; Malware Analysis – Types of Malware, Basic Static and Dynamic Analysis; Attack Attribution – Attribution Challenges, Attribution Techniques (Forensic Artifacts, Malware Attribution, Intelligence Gathering).		
UNIT IV	**FRAMEWORKS AND TOOLS FOR CYBER THREAT INTELLIGENCE**	**9**
MITRE ATT and CK Framework – Adversarial Tactics, Techniques, Procedures (TTPs); Cyber Kill Chain – Stages of Cyber Attack and Defense Strategies; Threat Modeling – Risk Assessment and Defense through Threat Models; Threat Analysis Tools – Wireshark, Splunk, Snort; YARA Rules – Writing Custom Malware Detection Rules		
UNIT V	**THREAT INTELLIGENCE INTEGRATION AND RESPONSE**	**9**
Role of CTI in Incident Response – Enhancing Detection, Investigation, and Response; Intelligence-Driven Security Operations – Integration of CTI in SOCs (Security Operations Centers); Threat Intelligence Sharing – Methods and Platforms (MISP, STIX/TAXII); Threat Reporting – Writing Actionable Threat Reports; Case Studies – Real-World Examples of CTI in Cyber Incidents.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Outline the key concepts, types, and lifecycle of cyber threat intelligence
CO2:	Compare different types of cyber threats, attack vectors, and vulnerabilities.
CO3:	Analyze threat data from various sources to generate actionable intelligence.

CO4:	Apply frameworks like mitre attack and Cyber Kill Chain to assess and respond to cyber threats
CO5:	Utilize open-source and commercial tools for threat detection, monitoring, and analysis
CO6:	Apply cyber threat intelligence into incident response and defense strategies to enhance security posture
TEXT BOOKS:	
1	Henry Dalziel, “How to Define and Build an Effective Cyber Threat Intelligence Capability”, 1st Edition, Syngress, 2014..
2	Thomas J. Holt, Adam M. Bossler, and Kathryn C. Seigfried-Spellar, “Cybercrime and Digital Forensics: An Introduction”, 2nd Edition, Routledge, 2017.
REFERENCES:	
1	John Robertson, Ahmad Diab, and Rick Howard, “Intelligence-Driven Incident Response: Outwitting the Adversary”, 1st Edition, O'Reilly Media, 2018.
2	William Stallings, “Effective Cybersecurity: A Guide to Using Best Practices and Standards”, 1st Edition, Addison-Wesley Professional, 2018.
3	Scott J. Roberts and Rebekah Brown,”Intelligence-Driven Incident Response: Outwitting the Adversary”, 1st Edition, O'Reilly Media, 2017.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	2	-	1	2	1	2	-	2
2	2	1	-	-	1	2	-	3	-	1	3	-	2	1	3
3	3	3	2	2	1	2	-	3	-	1	3	-	3	1	3
4	3	2	1	1	1	2	-	3	-	1	3	-	3	1	3
5	3	2	1	1	-	3	3	3	3	3	2	-	3	-	3
6	3	2	1	1	-	3	3	3	3	2	3	-	3	-	3
Overall Correlation	3	2	1	1	1	3	1	3	1	2	3	1	3	1	3

23AM044	ETHICAL HACKING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the fundamentals, principles, and legal aspects of ethical hacking.
- To explore security vulnerabilities, attack vectors, and penetration-testing methodologies.
- To learn techniques for exploiting and securing systems, networks, and applications.
- To examine identity management, access control, and security compliance from an attacker–defender perspective.
- To analyse incident handling, reporting methods, and risk mitigation strategies used in ethical hacking.

UNIT I	INTRODUCTION TO ETHICAL HACKING	6

Fundamentals of Ethical Hacking: Ethical vs. unethical hacking, hacker types, phases of ethical hacking. Cybersecurity Concepts: Threats, vulnerabilities, exploits, attack surfaces.
Legal and Ethical Issues: Laws, regulations, responsible disclosure, cybercrime laws.
Hacking Methodology Overview: Reconnaissance, scanning, enumeration, gaining access, maintaining access, clearing tracks. Security Architectures: Overview of security models used in modern IT infrastructures.

UNIT II	INFORMATION GATHERING AND VULNERABILITY ANALYSIS	6

Reconnaissance Approaches: Passive and active information gathering, open-source intelligence (OSINT).Scanning Techniques: Network scanning, port scanning, service identification, OS fingerprinting. Vulnerability Assessment: Vulnerability classification, CVSS, vulnerability scanners. Footprinting Tools: Nmap, Whois, Shodan, recon-ng, OSINT frameworks. Security Controls: Defensive techniques to prevent reconnaissance.

UNIT III	**SYSTEM, APPLICATION, AND NETWORK EXPLOITATION**	**6**
System Hacking: Password cracking, privilege escalation, malware basics, backdoors, and rootkits. Application Security Testing: Web application attacks (SQL injection, XSS, CSRF, command injection).Network Exploits: MITM attacks, session hijacking, DNS attacks, ARP poisoning. Wireless Hacking: Wi-Fi attacks, WPA/WPA2 cracking, rogue access points. Penetration Testing Tools: Metasploit, Burp Suite, OWASP ZAP, Wireshark, Aircracking.		
UNIT IV	**ACCESS CONTROL, IDENTITY MANAGEMENT, AND SECURITY COMPLIANCE**	**6**
Access Control Models: RBAC, ABAC, MAC, DAC. Authentication Mechanisms: Password policies, biometrics, Multi-Factor Authentication (MFA). Identity Management: Identity federation concepts, SSO mechanisms, directory services. Compliance and Standards: GDPR, HIPAA, ISO 27001, PCI-DSS; relevance to ethical hacking. Exploitation Perspective: Bypassing authentication, session management attacks, privilege abuse.		
UNIT V	**INCIDENT HANDLING, REPORTING, AND RISK MANAGEMENT**	**6**
Incident Response: Detection, containment, eradication, recovery process. Attack and Forensic Analysis: Log analysis, evidence collection, and chain of custody. Risk Management: Identifying and assessing security risks, threat modeling, and mitigation strategies. Disaster Recovery: Backup strategies, business continuity concepts. Ethical Hacking Frameworks: NIST, MITRE ATT&CK, PTES, OSSTMM.		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		
1. Case study on ethical hacking methodologies and legal		

frameworks. 2. Performing reconnaissance and footprinting using OSINT tools. 3. Network scanning and enumeration using Nmap. 4. Conducting vulnerability assessment with automated tools. 5. Exploiting common web vulnerabilities (SQLi/XSS) in a controlled environment. 6. Wireless network auditing and Wi-Fi security testing. 7. Performing password cracking and privilege escalation in test systems. 8. Bypassing authentication and analysing session security. 9. Developing an incident response plan for a simulated cyberattack. **10.** Conducting a full penetration test and preparing a professional report.	
	TOTAL:30 PERIODS
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Describe ethical hacking fundamentals, legal frameworks, and core attack methodologies.
CO2:	Perform reconnaissance and vulnerability analysis using professional tools.
CO3:	Execute ethical exploitation of systems, applications, and networks.
CO4:	Apply identity management and access control concepts to assess security posture.
CO5:	Develop incident response strategies and perform forensic investigation tasks.
CO6:	Evaluate security risks and implement standard-based mitigation and recovery strategies.
TEXT BOOKS:	
1	Kevin Mitnick, William Simon. *The Art of Deception: Controlling the Human Element of Security*, Wiley.
2	EC-Council. *Ethical Hacking and Countermeasures*, EC-Council Press.

REFERENCES:

1	Dafydd Stuttard, Marcus Pinto. The Web Application Hacker's Handbook, Wiley.
2	Jon Erickson. Hacking: The Art of Exploitation, No Starch Press.
3	Georgia Weidman. *Penetration Testing: A Hands-on Introduction to Hacking*, No Starch Press.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	1	-	-	2	1	-	-	3	2	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	3	-
3	3	3	2	2	3	1	-	-	-	-	-	-	3	3	-
4	3	2	1	1	3	2	1	1	-	-	-	-	2	2	1
5	3	2	1	1	3	2	1	1	-	-	1	-	3	2	1
6	3	3	2	2	3	3	2	2	-	-	1	-	3	2	2
Overall Correlation	**3**	**3**	**2**	**2**	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**-**	**3**	**2**	**1**

23AM045	QUANTUM COMPUTING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Develop an understanding of the foundational concepts of quantum mechanics relevant to cryptography, including qubits, superposition, entanglement, and measurement.
- Study various quantum cryptographic models and protocols such as QKD, quantum secret sharing, and quantum authentication techniques.
- Understand the threat posed by quantum computers to classical cryptographic systems and explore post-quantum cryptography.
- Evaluate the performance, robustness, and security proofs of quantum cryptographic schemes.
- Explore practical implementations, quantum channels, noise models, and real-world constraints in quantum communication systems.

UNIT I	INTRODUCTION TO QUANTUM CRYPTOGRAPHY	6

Basics of Quantum Mechanics – Qubits – Superposition – Measurement – Entanglement – No-Cloning Theorem – Quantum Channels – Quantum vs Classical Cryptography – Security Principles – Quantum Randomness – Quantum Adversary Models – Overview of Quantum Attacks on Classical Cryptosystems (Shor's Algorithm).

UNIT II	QUANTUM KEY DISTRIBUTION	6

QKD Concepts – BB84 Protocol – E91 Protocol – B92 Protocol – SARG04 – Decoy-State QKD – Entanglement-Based QKD – QKD System Components (Sources, Detectors, Quantum Channel) – Error Rates in QKD – Quantum Bit Error Rate (QBER) – Eavesdropping Strategies – Security Proofs for QKD – Practical QKD Implementation Issues.

UNIT III	**QUANTUM COMMUNICATION PROTOCOLS & AUTHENTICATION**	**6**
Quantum Secure Direct Communication – Quantum Secret Sharing – Quantum Teleportation – Quantum Digital Signatures – Quantum Authentication Protocols – Quantum Coin Flipping – Quantum Oblivious Transfer – Device-Independent Cryptography – Measurement Device Independent QKD (MDI-QKD) – Quantum Network Architectures.		
UNIT IV	**POST-QUANTUM CRYPTOGRAPHY**	**6**
Introduction to Post-Quantum Cryptography – Need for PQC – Classes of PQC Algorithms: Lattice-Based, Code-Based, Multivariate Polynomial, Hash-Based, Isogeny-Based Systems – NIST PQC Standardization – Key Encapsulation Mechanisms (KEMs) – Quantum-Safe Signatures – Comparison of Quantum vs Post-Quantum Approaches – Security Models and Performance Metrics.		
UNIT V	**QUANTUM WATERMARKING & ADVANCED PROTOCOLS**	**6**
Quantum Data Hiding – Quantum Watermarking Techniques – Quantum Steganography Concepts – Transform Domain Quantum Watermarking – Entanglement-Assisted Watermarking – Quantum Spread Spectrum – Buyer-Seller Protocols in Quantum Domain – Anonymous Communication in Quantum Networks – Robustness Against Quantum Noise, Decoherence, and Quantum Attacks.		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		
1. Simulation of qubits, superposition, and measurement using Qiskit/QuTiP. 2. Implement BB84 QKD protocol in a quantum simulator. 3. Analyze eavesdropping attacks (intercept-resend) in QKD systems.		

4. Quantum key reconciliation and privacy amplification. 5. Implement quantum teleportation in simulation. 6. Simulation of post-quantum algorithms (e.g., Kyber). 7. Case study on quantum attacks on RSA and ECC. 8. Implement a simple quantum digital signature protocol. 9. Case study on quantum noise models and their impact on communication. 10. Demonstrate quantum random number generation (QRNG).	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Summarize the fundamental principles of quantum mechanics relevant to cryptography.
CO2:	Identify and describe various quantum cryptographic protocols and their security features.
CO3:	Explain QKD mechanisms and apply them for secure key exchange.
CO4:	Demonstrate post-quantum cryptographic algorithms and quantum-safe communication techniques.
CO5:	Design and implement basic quantum cryptographic schemes using simulators.
CO6:	Evaluate the robustness and security of quantum and post-quantum cryptographic systems against quantum attacks.
TEXT BOOKS:	
1	S. B. Goyal, Vidyapati Kumar, Sardar M. N. Islam and Deepika Ghai, "Quantum Computing, Cyber Security and Cryptography: Issues, Technologies, Algorithms, Programming and Strategies", Springer, 2025.
2	Kavita Saini, B. B. Gupta and Pethuru Raj (Eds.), "Post-Quantum Cryptography Algorithms and Approaches for IoT and Blockchain Security", Elsevier, 2025.
REFERENCES:	
1	Jonathan Katz, *Post-Quantum Cryptography*, Springer, 2014.

2	Mark M. Wilde, *Quantum Information Theory*, Cambridge University Press, 2017.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	-	-	1	-	-	1	-	-	-	2	3	2	1
2	3	2	1	-	2	1	-	2	-	-	-	2	3	2	1
3	3	2	1	-	2	-	-	1	-	-	-	3	3	2	-
4	3	2	1	1	3	1	1	-	-	-	-	3	3	3	2
5	3	3	2	1	3	2	1	2	-	-	-	3	3	3	3
6	3	2	1	-	3	1	-	1	-	3	2	3	3	3	2
Overall Correlation	3	2	1	1	2	1	1	1	-	1	1	3	3	2	1

23AM046	VIRTUALIZATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the principles of cloud architecture, models and infrastructure.
- To understand the concepts of virtualization and virtual machines.
- To gain knowledge about virtualization Infrastructure.
- To explore and experiment with various Cloud deployment environments.
- To learn about the security issues in the cloud environment.

UNIT I	CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE	6

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges

UNIT II	VIRTUALIZATION BASICS	6

Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.

UNIT III	VIRTUALIZATION INFRASTRUCTURE AND DOCKER	7

Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker

Images and Repositories.		
UNIT IV	**CLOUD DEPLOYMENT ENVIRONMENT**	**6**
Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.		
UNIT V	**CLOUD SECURITY**	**5**
Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice.		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1. Install VirtualBox/VMware/ Equivalent open-source cloud Workstation with different flavors of Linux or Windows OS on top of windows 8 and above.
2. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs
3. Install Google App Engine. Create a hello world app and other simple web applications using python/java.
4. Use the GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Install Hadoop single node cluster and run simple applications like wordcount.
8. Creating and Executing Your First Container Using Docker.
9. Run a Container from Docker Hub

TOTAL:30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Infer the design challenges in the cloud.
CO2:	Apply the concept of virtualization and its types.
CO3:	Experiment with virtualization of hardware resources and Docker.

CO4:	Develop services on the cloud and set up a cloud environment
CO5:	Build and deploy services on the cloud and set up a cloud environment
CO6:	Explain security challenges in the cloud environment
TEXT BOOKS:	
1	Kai Hwang, Geoffrey C Fox and Jack G Dongarra, "Distributed and Cloud Computing", Morgan Kaufmann, 2011.
2	James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.
REFERENCES:	
1	James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2	Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.
3	Thomas Erl, Ricardo Puttini, Zaigham Mahmood," Cloud Computing: Concepts, Technology and Architecture", Prentice Hall, 2013.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	-	1	-	-	-	2	2	1	1
2	3	2	1	1	2	1	-	1	-	-	-	2	3	2	1
3	3	2	1	1	1	-	-	-	-	-	-	3	2	1	-
4	3	2	1	1	1	1	1	-	-	-	-	2	2	1	-
5	3	2	1	1	3	2	1	2	-	-	-	2	3	3	2
6	2	1	-	-	3	-	-	1	-	3	2	2	2	3	1
Overall Correlation	3	2	1	1	2	1	1	1	-	1	1	3	3	2	1

<table>
<tr><td rowspan="2">23AD060</td><td rowspan="2">CLOUD DATABASES</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">

Understand the fundamentals of cloud computing and its impact on database systems.
Explore various cloud database models and services.
Learn how to design, implement, and manage databases in the cloud.
Familiarize with industry-leading cloud platforms like AWS, Google Cloud, and Azure.
Gain hands-on experience with cloud database tools and applications

</td></tr>
<tr><td>UNIT I</td><td colspan="4">DISTRIBUTED AND CLOUD DATABASE</td><td>9</td></tr>
<tr><td colspan="6">Basics of Cloud Computing: IaaS, PaaS, SaaS- Evolution of Cloud Databases from traditional databases - challenges of cloud-based databases - Cloud database architectures - Public, Private, and Hybrid clouds- Overview of popular cloud platforms - AWS, Azure, Google Cloud.</td></tr>
<tr><td>UNIT II</td><td colspan="4">CLOUD DATABASE SERVICE MODELS</td><td>9</td></tr>
<tr><td colspan="6">Database as a Service (DBaaS) overview - Relational databases in the cloud: Amazon RDS, Google Cloud SQL, Azure SQL. NoSQL databases in the cloud: Amazon DynamoDB, Google Bigtable, Azure Cosmos DB. Introduction to NewSQL databases and their role in cloud architecture - Database scalability, availability, and consistency (CAP theorem)</td></tr>
<tr><td>UNIT III</td><td colspan="4">CLOUD DATA STORAGE AND MANAGEMENT</td><td>9</td></tr>
<tr><td colspan="6">Cloud storage fundamentals : Blob storage, File storage, Block storage - Distributed data storage - Data replication and backup strategies in cloud databases - Data security in cloud environments - Monitoring and optimizing performance in cloud databases</td></tr>
</table>

UNIT IV	CLOUD DATABASE DESIGN AND INTEGRATION	9
Databases for cloud-native applications - multi-tenancy and resource isolation in cloud databases - Integration with cloud services - data lakes, big data platforms, machine learning - APIs for cloud databases - RESTful APIs, GraphQL- Serverless databases and event-driven architectures -AWS Aurora Serverless, Firebase		
UNIT V	**CLOUD DATABASE APPLICATIONS AND CASE STUDIES**	**9**
Real-world applications of cloud databases (e-commerce, IoT, social media) - Migrating on-premise databases to the cloud: processes and challenges - Case studies on cloud database use by large enterprises - Best practices for cloud database management and optimization - Emerging trends in cloud databases - AI integration, edge computing		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		
1. Setting Up a Relational Cloud Database 2. Deploying and Querying a NoSQL Database 3. Implementing Data Backup and Recovery 4. Securing a Cloud Database with Encryption 5. Integrating a Cloud Database with Serverless Architecture 6. Migrating an On-Premise Database to the Cloud 7. Exploring Data Partitioning and Sharding. 8. Monitoring and Optimizing Cloud Database Performance		
		TOTAL:30 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Compare cloud and on-premise database systems.	
CO2:	Explain how cloud databases handle scalability and availability.	
CO3:	Demonstrate between various cloud database services.	

CO4:	Apply data management best practices in cloud environments.
CO5:	Build scalable cloud database systems and Integrate cloud databases with other cloud services for holistic solutions.
CO6:	Analyze real-world scenarios of cloud database deployment
TEXT BOOKS:	
1	Lee Chao, "Cloud Database Development and Management", CRC Press, 1st Edition, 2013.
2	Liang Zhao, David Taniar, "Cloud Data Management" , Springer, 1st Edition, 2014
REFERENCES:	
1	Lee Chao, CRC Press, 1st Edition (2013) Cloud Data Management", Liang Zhao, David Taniar, Springer, 1st Edition ,2014
2	Valliappa Lakshmanan, Jordan Tigani, "Google BigQuery: The Definitive Guide", O'Reilly Media, 1st Edition, 2019.
3	Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", 1st Edition, 2013.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	2	1	-	1	-	2	2	-	1
2	2	1	-	-	-	1	2	2	-	1	-	2	2	-	2
3	2	1	-	-	-	1	2	2	-	1	-	2	2	-	2
4	3	2	1	1	2	2	2	2	1	1	1	2	3	2	2
5	3	2	1	1	2	2	2	2	1	2	2	2	3	2	2
6	3	3	2	2	2	3	2	2	2	3	2	3	3	2	2
Overall Correlation	3	2	1	1	1	2	2	2	1	2	1	3	3	1	2

23CB058	CRYPTO CURRENCY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the fundamental concepts of cryptocurrency, blockchain, and decentralized finance.
- To explore the technologies behind cryptocurrencies, including cryptography, consensus algorithms, and blockchain architectures.
- To analyze the risks and challenges associated with cryptocurrencies and blockchain technologies.
- To investigate the economic and legal implications of cryptocurrencies, including their impact on global financial systems.
- To develop practical skills in implementing and using cryptocurrency technologies, including wallets, exchanges, and smart contracts.

UNIT I	INTRODUCTION	6

Overview of Cryptocurrency - Blockchain Technology: Concept, Structure, and Functionality - Evolution of Cryptocurrencies - Types of Cryptocurrencies: Bitcoin, Ethereum, Litecoin, and Altcoins - Advantages and Challenges of Cryptocurrencies

UNIT II	CRYPTOGRAPHIC FOUNDATIONS OF CRYPTOCURRENCY	6

Basics of Cryptography: Symmetric and Asymmetric Encryption - Hash Functions and Public Key Infrastructure (PKI) - Digital Signatures and Certificates - Elliptic Curve Cryptography (ECC) - Security in Cryptocurrencies

UNIT III	CONSENSUS ALGORITHMS AND BLOCKCHAIN PROTOCOLS	6

Proof of Work (PoW) vs Proof of Stake (PoS) - Delegated Proof of Stake (DPoS) - Practical Byzantine Fault Tolerance (PBFT) - Consensus in Ethereum and Smart Contracts - Blockchain Protocols and Governance.

UNIT IV	CRYPTOCURRENCY ECONOMICS AND MARKETS	6
The Role of Cryptocurrencies in Modern Financial Systems - Cryptocurrency Markets: Exchanges, Trading, and Volatility - Cryptocurrency Mining and Proof of Work - Initial Coin Offerings (ICO) and Tokenomics - Economic Impacts and Challenges of Cryptocurrencies		
UNIT V	**LEGAL, REGULATORY, AND SECURITY ISSUES**	**6**
Legal Frameworks for Cryptocurrencies Globally - Anti-Money Laundering (AML) and Know Your Customer (KYC) - Security Issues in Cryptocurrency Transactions and Wallets - Regulatory Challenges: Taxation and Compliance - The Future of Cryptocurrencies in Legal and Economic Systems		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		

LIST OF EXPERIMENTS

1. Setting up a Cryptocurrency Wallet (Bitcoin, Ethereum)
2. Sending and Receiving Cryptocurrencies
3. Understanding and Using Blockchain Explorers
4. Cryptocurrency Mining: Setting Up a Mining Rig (Bitcoin, Ethereum)
5. Exploring Cryptocurrency Exchanges (Buying, Selling, and Trading)
6. Using and Interacting with Ethereum Smart Contracts
7. Analyzing the Bitcoin Blockchain Using Tools (e.g., Blockchair, Blockchain.info)
8. Setting up a Private Blockchain using Ethereum or Hyperledger
9. Simulating an ICO: Token Creation and Launch

	10. Security Testing of Cryptocurrency Transactions and Smart Contracts
	TOTAL: 30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the core concepts of cryptocurrency, blockchain, and decentralized networks.
CO2:	Analyze the underlying technologies and protocols that enable cryptocurrencies, including cryptographic algorithms and consensus mechanisms
CO3:	Examine the risks, vulnerabilities, and challenges of using cryptocurrencies in real-world scenarios.
CO4:	Apply the economic, legal, and regulatory implications of cryptocurrencies and blockchain technologies.
CO5:	Make use of cryptocurrency tools such as wallets, exchanges, and smart contracts.
CO6:	Analyze the future of cryptocurrency and blockchain in emerging markets, financial systems, and industries.
TEXT BOOKS:	
1	Nakamoto, Satoshi. Bitcoin: A Peer-to-Peer Electronic Cash System. Bitcoin.org, 2008.
2	Mougayar, William. The Business Blockchain: Promise, Practice, and the 4th Industrial Revolution. Wiley, 2016.
REFERENCES:	
1	Buterin, Vitalik. Ethereum," A Next-Generation Smart Contract and Decentralized Application Platform" Ethereum Foundation, 2013.
2	Crosby, Michael, et al.," Blockchain Technology: Beyond Bitcoin" Applied Innovation Review, 2016.
3	Narayanan, Arvind, et al." Bitcoin and Cryptocurrency Technologies"Princeton University Press, 2016.
4	Zohar, Aviv," Bitcoin and Cryptocurrencies" MIT Press, 2018.

5	Gans, Joshua S.," The Blockchain and the New Architecture of Trust."MIT Press, 2019.
6	Tapscott, Don, and Alex Tapscott. Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World. Penguin, 2016.
7	Antonopoulos, Andreas M. Mastering Bitcoin: Unlocking Digital Cryptocurrencies. O'Reilly Media, 2017.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	2	1	2	2	2	1	3	2	2	2
2	3	3	2	2	3	2	2	3	2	2	2	3	3	3	3
3	3	3	2	2	3	2	2	3	3	3	2	2	3	3	3
4	3	2	1	1	2	1	1	2	2	2	3	3	3	2	2
5	3	2	1	1	3	2	2	3	2	3	2	3	3	3	3
6	3	3	2	2	3	2	3	3	3	3	3	3	3	3	3
Overall Correlation	3	3	2	2	3	2	2	3	3	3	3	3	3	3	3