KCG

COLLEGE OF TECHNOLOGY

AFFILIATED TO ANNA UNIVERSITY | AUTONOMOUS

REGULATIONS - 2023

CURRICULUM AND SYLLABI

(2023-2024)

B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

KCG College of Technology was founded in 1998 to fulfill the Founder-Chairman, Dr. KCG Verghese's vision of **"To Make Every Man a Success and No Man a Failure".** It is a Christian minority institution, affiliated to Anna University (Autonomous), Chennai and approved by AICTE, New Delhi.

VISION OF KCG

KCG College of Technology aspires to become a globally recognized centre of excellence for science, technology & engineering education, committed to quality teaching, learning and research while ensuring for every student a unique educational experience which will promote leadership, job creation, social commitment and service to nation building.

MISSION OF KCG

- Disseminate knowledge in a rigorous and intellectually stimulating environment.
- Facilitate socially responsive research, innovation and entrepreneurship.
- Foster holistic development and professional competency.
- Nurture the virtue of service and an ethical value system in the young minds.

VISION OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

The Department of Artificial Intelligence and Data Science desires to become a: prominent Centre of Excellence for producing competent Data Architect for providing quality education by using the latest tools.

MISSION OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Provide quality education in the field of Artificial Intelligence and Data Science related domains.

- Facilitate Skill based value added education.
- Inculcate professional performance, an essence of entrepreneurship and promise to the growth of the country.
- Providing varying software development tools and required implementation facilities.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

The graduates will:

PEO 1	To provide graduates with the proficiency to utilize the fundamental knowledge of basic sciences, mathematics, Artificial Intelligence, data science and statistics to build systems that require management and analysis of large volume of data.
PEO 2	To enrich graduates with necessary technical skills to pursue pioneering research in the field of AI and Data Science and create disruptive and sustainable solutions for the welfare of ecosystems.
PEO 3	To enable graduates to think logically, pursue lifelong learning and collaborate with an ethical attitude in a multidisciplinary team
PEO 4	To Prepare Personality Skills, Provoke Social Commitment and Instill Societal Responsibilities in their Profession.

PROGRAM OUTCOMES (POs)

Engineering graduates will be able to:

PO 01	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 02	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 03	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 04	Use research based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 05	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 06	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 07	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 08	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 09	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadcast context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 01	Apply knowledge pertaining to Data engineering, Data pipelining and Programming skills to analyze socially relevant problems by means of Artificial Intelligence and Data Science.
PSO 02	Use Machine Learning tools related to Data Management, Data Manipulation, Data Visualization, Big Data and Deep Learning to analyze and interpret complex data sets to drive decision making.
PSO 03	Uphold professional standards and ethical principles in the development and deployment of AI and Data Science solutions, ensuring fairness, transparency, and accountability while respecting privacy, mitigating bias, and complying with legal and regulatory frameworks.

INDEX

KCG COLLEGE OF TECHNOLOGY
AUTONOMOUS
REGULATIONS 2023
B. TECH ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
CHOICE BASED CREDIT SYSTEM
CURRICULUM 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	23AD101	Programming in Python	PCC	3	0	0	3	3
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	23AD121	Python Programming 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	21

*** 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	23AD201	C and Data Structures	ESC	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	PCC	0	0	4	4	2
9	23AD221	C and Data Structures 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	23MA301	Linear Algebra	BSC	3	1	0	4	4
2	23CS302	Database Management Systems	PCC	3	0	0	3	3
3	23AD301	Object Oriented Programming in C++ and Java	PCC	3	0	0	3	3
4	23HS301	Universal Human Values and Ethics	HSMC	3	0	0	3	3
THEORY AND PRACTICALS								
5	23AD311	Fundamentals of Data Science	PCC	3	0	2	5	4
6	23CB311	Digital Principles and Computer Organization	PCC	3	0	2	5	4
PRACTICALS								
7	23CS322	Database Management Systems Laboratory	PCC	0	0	4	4	2
8	23AD322	Object Oriented Programming in C++ and Java Laboratory	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	23AD401	Algorithm Design and Analysis	PCC	3	0	0	3	3
2	23CS401	Operating Systems	PCC	3	0	0	3	3
3	23AD402	Big Data Computing	PCC	3	0	0	3	3
4	23AD403	Data Warehousing and Data Mining	PCC	3	0	0	3	3
THEORY AND PRACTICALS								
5	23AD411	Fundamentals of Artificial Intelligence	PCC	3	0	2	5	4
6	23MA411	Mathematical Modeling for Data Science	BSC	3	0	2	5	4
PRACTICALS								
7	23CS421	Operating Systems Laboratory	PCC	0	0	4	4	2
8	23AD421	Big Data Computing 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	23AD501	Machine Learning	PCC	3	0	0	3	3
3		Department Elective 1	DEC	-	-	-	-	3
4		Department Elective 2	DEC	-	-	-	-	3
5		Open Elective – 1 (Emerging Technologies)	OEC	3	0	0	3	3
THEORY AND PRACTICALS								
6	23AD511	Statistics for AI and ML	PCC	3	0	2	5	4
PRACTICALS								
7	23AD521	Machine Learning 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				17	0	12	29	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 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	23AD611	Fundamentals of Deep Learning	PCC	3	0	2	5	4
6	23AD612	AI in IoT Applications	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	DEC	-	-	-	-	3
3		Department Elective	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	23AD821/ 23AD822	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	23AD031	Digital Image Processing	DEC	3	0	0	3	3
2	23AD032	Unified Modeling Language	DEC	2	0	2	4	3
3	23AD033	Web Essentials	DEC	2	0	2	4	3
4	23AD034	Software Engineering Principles	DEC	3	0	0	3	3
5	23AD035	Distributed Systems	DEC	3	0	0	3	3
6	23AD036	Cryptography and Network Security	DEC	2	0	2	4	3
7	23AD037	Data Communications and Networking	DEC	3	0	0	3	3
8	23AD038	Automata Theory and Compiler Design	DEC	3	0	0	3	3

VERTICAL 2 : ANALYTICAL SCIENCES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
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	23AD042	Data Analytics	DEC	3	0	0	3	3
5	23AD043	Intelligent Robots	DEC	3	0	0	3	3
6	23AD044	Reinforcement Learning	DEC	3	0	0	3	3
7	23AD045	Data Exploration and Visualization	DEC	2	0	2	4	3
8	23AD046	Knowledge Engineering	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	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	23AD047	Software Design Thinking	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	23AD048	Intelligent Agents	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	23AD051	Fundamental of Speech Processing	DEC	2	0	2	4	3
5	23AD052	Evolutionary Computation	DEC	3	0	0	3	3
6	23AD053	Computer Vision	DEC	2	0	2	4	3
7	23CB058	Cryptocurrency	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	23AD057	Information Security Analysis and Audit	DEC	3	0	0	3	3
5	23AD058	Steganography and Digital Watermarking	DEC	2	0	2	4	3
6	23AD059	Utility Computing	DEC	2	0	2	3	3
7	23AD060	Cloud Databases	DEC	2	0	2	4	3
8	23CB043	Security in Cloud Computing	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	23OAE971	Aviation Management	OEC	3	0	0	3	3
2	23OAS971	Space Engineering	OEC	3	0	0	3	3
3	23OEC972	Fundamentals of Wearable Devices	OEC	3	0	0	3	3
4	23OEE973	Electric and Hybrid Vehicles	OEC	3	0	0	3	3
5	23OMA971	Resource Management Techniques	OEC	3	0	0	3	3
6	23OMT971	Foundation of Robotics	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	**12**	**26**	**23**	**64**	**18**	**9**	**21**	**173**

SEMESTER –I

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

COURSE OBJECTIVES:

- This is a mandatory 2 weeks Programme 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**

23AD101	PROGRAMMING IN PYTHON	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	COMPUTATIONAL THINKING	9

Introduction to Computing and Problem Solving: Fundamentals of Computing –Computing Devices – Identification of Computational Problems – Pseudo Code and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).

UNIT II	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 III	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 IV	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 V	**OBJECT-ORIENTED AND FUNCTIONAL PROGRAMMING**	**9**
Object-Oriented Programming: Classes and Objects, Creating Classes in Python,Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance, Polymorphism. Functional Programming: Lambda. Iterators, Generators, List Comprehensions.		
		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 Programming Concept
CO6:	Construct a code related to Functional Programming.

TEXT BOOKS:	
1	Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, 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. Richard L. Halterman. Copyright © 2011
2	Python for Everybody, 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	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23HS102	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- 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.

UNIT I	LANGUAGE AND LITERATURE	3

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.

UNIT II	HERITAGE – ROCK ART PAINTINGS TO MODERN ART – SCULPTURE	3

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.

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- வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)**
2	பொருனை- ஆற்றங்கரை **நாகரிகம் (தொல்லியல் துறை வெளியீடு)**

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	9

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	2	-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**

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

23AD121	PYTHON PROGRAMMING LABORATORY	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							**28-07-2023**								
Approved							**1st ACM**			**Date**			**09-09-2023**		

23HS121	COMMUNICATION SKILLS LABORATORY	L	T	P	C
		0	0	2	1

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	**2nd 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**

23AD201	C AND DATA STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of C programming language.
- To learn the concepts of advanced features of C.
- To learn the concepts of linear data structure.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

UNIT I	C PROGRAMMING FUNDAMENTALS	9

Data Types – Variables – Operations – Expressions and Statements – Conditional Statements – Functions – Recursive Functions – Arrays – Single and Multi- Dimensional Arrays.

UNIT II	C PROGRAMMING - ADVANCED FEATURES	9

Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – File Handling – Preprocessor Directives.

UNIT III	LINEAR DATA STRUCTURES	9

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – Doubly- Linked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue ADT – Priority Queues – Queue Implementation – Applications.

UNIT IV	NON-LINEAR DATA STRUCTURES	9

Trees – Binary Trees – Tree Traversals – Expression Trees – Binary Search Tree – Hashing - Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing – Double Hashing – Rehashing.

UNIT V	SORTING AND SEARCHING TECHNIQUES	9
Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Develop C programs for any real world/technical application.
CO2:	Apply advanced features of C in solving problems.
CO3:	Utilize functions to implement linear data structure operations.
CO4:	Make use of appropriate non–linear data structure operations.
CO5:	Apply sort algorithms for a given application.
CO6:	Utilize search algorithms for a given application

TEXT BOOKS:	
1	Reema Thareja, ―Programming in C‖, Second Edition, Oxford University Press, 2016.
2	Mark Allen Weiss, ―Data Structures and Algorithm Analysis in C‖, Second Edition, Pearson Education, 1997.
3	Gilberg and Forouzan: ―Data Structure- A Pseudo code approach with C‖ by Thomson publication
4	Data structure in C‖ by Tanenbaum, PHI publication / Pearson publication

REFERENCES:	
1	Brian W. Kernighan, Rob Pike, ―The Practice of Programming‖, Pearson Education, 1999.
2	Paul J. Deitel, Harvey Deitel, ―C How to Program‖, Seventh Edition, Pearson Education, 2013.
3	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, ―Data Structures and Algorithms‖, Pearson Education,1983.

4	Ellis Horowitz, SartajSahni and Susan Anderson, ―Fundamentals of Data Structures‖, Galgotia, 2008.

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	1
2	3	2	1	1	1	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	1	-	-	-	-	-	-	-	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	1	-	-	-	-	-	-	-	3	1	-
6	3	2	1	1	1	-	-	-	1	-	1	1	3	1	-
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**-**	**1**	**1**	**-**	**1**	**1**	**3**	**1**	**1**

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

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**		

23AD221	C AND DATA STRUCTURES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To write basic level programming in C
- Developing applications in C
- To implement linear and non-linear data structures
- To understand the different operations of search trees
- To get familiarized with sorting and searching algorithms

PRACTICALS:

1. Practice of C programming using statements, expressions, decision making and iterative statements.
2. Practice of C programming using Functions and Arrays
3. Implement C programs using Pointers and Structures
4. Implement C programs using Files
5. Development of real-time applications
6. Array implementation of List ADT
7. Array implementation of Stack and Queue ADTs
8. Linked list implementation of List, Stack and Queue ADTs
9. Applications for List, Stack and Queue ADTs
10. Implementation of Binary Trees and operations of Binary Trees
11. Implementation of Binary Search Trees
12. Implementation of searching techniques
13. Implementation of Sorting algorithms: Insertion Sort, Quick Sort, Merge Sort
14. Implementation of Hashing – any two collision techniques

TOTAL : 60 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Make Use of different constructs of C and develop applications.
CO2:	Build functions to implement linear data structure operations.
CO3:	Construct appropriate non-linear data structure operations.
CO4:	Choose appropriate Sorting and searching algorithms for a given application.
CO5:	Apply appropriate hash functions that result in a collision free scenario for data storage and Retrieval.
CO6:	Choose appropriate searching algorithms for a given application.

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	1
2	3	2	1	1	1	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	1	-	-	-	-	-	-	-	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	1	-	-	-	-	-	-	-	3	1	-
6	3	2	1	1	1	-	-		1	-	1	1	3	1	-
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**-**	**1**	**1**	**-**	**1**	**1**	**3**	**1**	**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:	
1	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

23MA301	LINEAR ALGEBRA	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To test the consistency and solve system of linear equations
- To find the basis and dimension of vector space
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors
- To find orthonormal basis of inner product space
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

UNIT I	MATRICES AND SYSTEM OF LINEAR EQUATIONS	9+3

Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordon method – Gauss Seidel Method

UNIT II	VECTOR SPACES	9+3

Vector spaces - Subspace - Linear independence and dependence – Linear Span - Basis and dimension – Maximal Linearly Independent Subsets.

UNIT III	LINEAR TRANSFORMATION	9+3

Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem - Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation – Invertibility and Isomorphisms – Dual Spaces.

UNIT IV	INNER PRODUCT SPACES	9+3

Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process – Adjoint of Linear operator – Normal and self adjoint operators – Unitary and orthogonal operators and their Matrices

UNIT V	EIGENVALUE PROBLEMS AND MATRIX DECOMPOSITION	9+3

Eigenvalue Problems - Power method, Jacobi rotation method - Singular value decomposition - QR decomposition – Generalized Inverse - Least square solution

TOTAL: 60 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Solve the system of linear equations.
CO2:	Find the basis and dimension of vector space.
CO3:	Find the matrix of linear transformation and its eigenvalues and eigenvectors.
CO4:	Find orthonormal basis of inner product space.
CO5:	Find eigenvalues of a matrix using numerical techniques
CO6:	Find Matrix Decomposition using different techniques
TEXT BOOKS:	
1	Friedberg A.H, Insel A.J. and Spence L, "Linear Algebra", Prentice Hall of India, New Delhi, 2004.
2	Faires J.D. and Burden R., "Numerical Methods", Brooks/Cole (Thomson Publications), New Delhi, 2002.
REFERENCES:	
1	Kumaresan S, "Linear Algebra - A geometric approach", Prentice Hall of India, New Delhi, Reprint, 2010.
2	P.S.Das – "Numerical Analysis", Pearson Educations, New Delhi, 2002
3	Richard Branson, "Matrix Operations", Schaum's outline series, 1989.

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	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

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

23AD301	OBJECT ORIENTED PROGRAMMING IN C++ AND JAVA	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the concepts of Object-oriented Programming and discuss the important elements of C++.
- 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	OBJECT ORIENTED PROGRAMMING AND C++	12

Basic Concepts of Objects Oriented Programming - Operators - Control Structures Functions in C++ - Function Overloading - Class - Member Function - Nesting of Member function - Constructors - Destructors - Array with Class - Static Data Member - Friend functions - Returning Objects - Operator Overloading - Type Conversion - Basic type to Class – Class to Basic - Class to Class.

UNIT II	OVERVIEW OF JAVA AND EXCEPTION HANDLING	9

An overview of Java, data types, variables and arrays, operators, control statements, classes, objects, methods – Inheritance. Exceptions – exception hierarchy – throwing and catching exceptions – built-in exceptions, creating own exceptions.

UNIT III	JAVA PROGRAMMING	6

Packages and Interfaces, Multithreaded programming, Strings, Input /Output, Generic Programming – Generic classes – generic methods.

UNIT IV	EVENT DRIVEN PROGRAMMING	9
Graphics programming – Frame – Components – working with 2D shapes – Using color, fonts, and images – Basics of event handling – event handlers – adapter classes – actions – mouse events – AWT event hierarchy.		
UNIT V	**JAVA PROGRAMMING USING SWING**	**9**
Introduction to Swing – layout management – Swing Components – Text Fields, Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Develop C++ programs using OOP principles.
CO2:	Develop Java programs with the concepts of inheritance and interfaces.
CO3:	Build Java applications using exceptions, threads and generics classes.
CO4:	Develop Java applications with event driven program.
CO5:	Develop interactive Java programs using swings.
CO6:	Develop and understand exception handling, multithreaded applications with synchronization.

TEXT BOOKS:	
1	K.R. Venugopal, Rajkumar Buyya, Ravishankar, "Mastering Develop interactive Java programs using swings++", TMH, 2017. (Unit I)
2	Herbert Schildt, "The Java 2: Complete Reference", Eighth Edition, TMH, 2018. (Unit II, Unit III, Unit IV, and Unit-V)

REFERENCES:	
1	Ira Pohl, "Object oriented programming using C++", Pearson Education Asia,2003.
2	Bjarne Stroustrup, "The C++ programming language" Addison Wesley, 2000

3	John Hubbard, "Programming with C++", Schaums outline series, TMH, 2003.
4	H.M. Deitel, P.J. Deitel, "Java: how to program", Fifth edition, Prentice Hall of India private limited.
5	E. Balagurusamy "Object Oriented Programming with C++", TMH 2/e.

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	1	1	1	3	1	1
2	3	2	1	1	1	-	-	-	1	-	1	1	3	1	-
3	3	2	1	1	1	-	-	-	1	-	1	1	3	1	-
4	3	2	1	1	1	-	-	-	1	-	1	1	3	1	-
5	3	2	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	1	1	1	3	1	1

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

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**

23AD311	FUNDAMENTALS OF DATA SCIENCE	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Will gain knowledge in the basic concepts of Data Science.
- To acquire skills in data preparatory and pre-processing steps.
- To learn the tools and packages in Python for data science.
- To acquire knowledge in data interpretation and visualization techniques.
- To understand the ethics for data science.

UNIT I	INTRODUCTION	9

Need for data science –benefits and uses –facets of data –data science process –setting the research goal –retrieving data – cleansing, integrating, and transforming data –exploratory data analysis –build the models –presenting and building applications

UNIT II	DATA HANDLING – PART I	9

Understanding Data Types in Python - Basics of NumPy arrays – Computation on NumPy Arrays: Universal Functions - Aggregations: Min, Max, and Everything in Between - Computation on Arrays: Broadcasting – Comparisons, Masks, and Boolean Logic –fancy indexing – Sorting Arrays - Structured Data

UNIT III	DATA HANDLING – PART II	9

Introducing Pandas Objects: Data manipulation with Pandas –data indexing and selection –operating on data –missing data – hierarchical indexing – Combining Datasets: Concat and Append - Merge and Join –aggregation and grouping –pivot tables - Working with Time Series.

UNIT IV	DATA VISUALIZATION	9

Visualization with matplotlib –line plots –scatter plots –visualizing errors –density and contour plots –histograms, binning's, and

density –three-dimensional plotting –geographic data –data analysis using stat models and seaborn –graph plotting using Plotline –interactive data visualization using Bokeh.		
UNIT V	**ETHICS AND DATA SCIENCE**	**9**
Data Ownership, The Five Cs, Implementing the Five Cs, Ethics and Security Training, Developing Guiding Principles, Building Ethics into a Data-Driven Culture, Regulation, Building Our Future, Case Study.		
TOTAL: 45 PERIODS		

PRACTICAL EXERCISES : 30 PERIODS

1. Install the data Analysis and Visualization tool: R/ Python.
2. Perform exploratory data analysis (EDA) on with datasets like email data set. Export all your emails as a dataset, import them inside a panda's data frame, visualize them and get different insights from the data.
3. Working with NumPy arrays, Panda's data frames, Basic plots using Matplotlib.
4. Explore various variable and row filters in R for cleaning data. Apply various plot features in R on sample data sets and visualize.
5. Perform Time Series Analysis and apply the various visualization techniques
6. Perform EDA on Wine Quality Data Set.
7. Use a case study on a data set and apply the various EDA and visualization techniques and present an analysis report.

TOTAL: 45 +30 =75 PERIODS

COURSE OUTCOMES:

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

CO1:	Compare the concepts of Big Data and Data Science
CO2:	Outline the basic concepts of Data Science
CO3:	Make use of data handling techniques using numpy package

CO4:	Apply pandas package using Python for data science applications.
CO5:	Utilize knowledge in Data Interpretation and Visualization techniques
CO6:	Infer the ethics of Data Science.
TEXT BOOKS:	
1	David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2	Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.
3	Mike Loukides, Hilary Mason and D J Patil "Ethics and Data Science", O'Reilly, 1st edition, 2018.
REFERENCES:	
1	Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.

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	1	1	2	1	1
2	2	1	-	-	1	1	1	1	-	-	-	1	2	1	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	-	-	-	-	-	3	-	-	-	1	3	-	3
Overall Correlation	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1

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

23CB311	DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To analyse and design combinational circuits.
- To analyse and design sequential circuits.
- To learn the basic structure and operation of a digital computer.
- To study the design of data path unit, control unit for processor and hazards.
- To learn the concept of various memories and I/O interfacing.

UNIT I	COMBINATIONAL LOGIC	9

Combinational Circuits – Karnaugh Map – Half and full Adder – Subtractors – Binary parallel adder - Magnitude Comparator – Decoder – Encoder – Multiplexers – Demultiplexers, Code converters

UNIT II	SYNCHRONOUS SEQUENTIAL LOGIC	9

Flip-Flops – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, - Registers – Counters- Ripple counters

UNIT III	COMPUTER FUNDAMENTALS	9

Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA):– Instruction and Instruction Sequencing – Addressing Modes, Encoding of Machine Instruction – Interaction between Assembly and High Level Language.

UNIT IV	PROCESSOR	9

Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control, Microprogrammed Control –

Pipelining – Data Hazard – Control Hazards.		
UNIT V	**MEMORY AND PROGRAMMABLE LOGIC**	**9**
Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – ROM-Programmable Logic Array-Programmable Array logic.		
		TOTAL: 45 PERIODS
PRACTICAL EXERCISES: 30 PERIODS		
1. Verification of Boolean theorems using logic gates. 2. Design and implementation of combinational circuits using gates for arbitrary functions. 3. Implementation of 4-bit binary adder/subtractor circuits. 4. Implementation of code converters. 5. Implementation of BCD adder, encoder and decoder circuits. 6. Implementation of functions using Multiplexers. 7. Implementation of the synchronous counters. 8. Implementation of a Universal Shift register. 9. Simulator based study of Computer Architecture		
		TOTAL: 45 +30 =75 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Develop digital fundamentals using number systems, logic gates, Boolean algebra and Karnaugh map.	
CO2:	Build various combinational circuits using logic gates.	
CO3:	Construct sequential circuits such as flip flops, counters and registers.	
CO4:	Analyse the functional units of computers, instruction set and addressing modes	
CO5:	Apply the various functional units of processor, pipelining and hazards.	
CO6:	Identify the various memory concepts of the processor and programmable logic devices.	

TEXT BOOKS:	
1	M. Morris Mano, Michael D. Ciletti, "Digital Design : With an Introduction to the Verilog HDL, VHDL, and System Verilog", Sixth Edition, Pearson Education, 2018.
2	David A. Patterson, John L. Hennessy, "Computer Organization and Design, The Hardware/Software Interface", Sixth Edition, Morgan Kaufmann/Elsevier, 2020.
REFERENCES:	
1	Floyd T.L., "Digital Fundamentals", Charles E., Eleventh edition Pearson,2019.
2	Charles H. Roth, Jr, 'Fundamentals of Logic Design', Jaico Books, 7th Edition, 2021.
3	M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016.
4	Carl Hamacher, ZvonkoVranesic, SafwatZaky, NaraigManjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw-Hill, 2012.
5	William Stallings, "Computer Organization and Architecture – Designing for Performance", Tenth Edition, 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	1	-	2	3	1	-
2	3	2	1	1	1	-	-	-	2	1	-	-	3	1	-
3	3	2	1	1	1	-	-	-	2	1	-	2	3	1	-
4	3	3	2	2	1	1	-	-	3	2	-	2	3	1	-
5	3	2	1	1	1	-	1	-	2	1	-	-	3	1	-
6	3	2	1	1	1	1	-	-	2	1	-	2	3	1	-
Overall Correlation	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**3**	**2**	**-**	**2**	**3**	**1**	**-**

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

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**

23AD322	OBJECT ORIENTED PROGRAMMING IN C++ AND JAVA LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To strengthen problem solving ability by using the characteristics of an object-oriented approach.
- To design applications using object-oriented features.
- To handle Exceptions in programs.
- The students will be expected to write, compile, run and debug the programs to demonstrate the usage of object-oriented concepts both in C++ and JAVA.
- Design event driven GUI and web related applications which mimic the real word scenarios.

LIST OF EXPERIMENTS:

1. Programs to demonstrate the usage of Class, Operator Overloading and Friend Functions.
2. Write a C++ program to display Names, Roll No., and grade of 3 students who have appeared in the examination. Declare the class of name, roll no., and grade. Create an array of class objects. Read and display the contents of the array.
3. Write a Program using copy constructor to copy data of an object to another object.
4. Write a program to design a class representing complex numbers and having the functionality of performing addition & multiplication of two complex numbers using operator overloading.
5. Write a Program to design a class complex to represent complex numbers. The complex class should use an external function (use it as a friend function) to add two complex numbers. The function should return an object of type complex representing the sum of two complex numbers.

II. Basics of Java and Exception Handling

6. 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.
7. 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.
8. Write a Java program to implement user defined exception handling.
9. 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.

III. The usage of Packages and Interfaces, Multithreaded programming, Generic Programming

10. 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.

11. 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.
12. 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.
13. Write a java program to find the maximum value from the given type of elements using a generic function.

IV. The usage of Event Driven Programming

14. Write a java program to draw lines, arcs, figures, images and text in different Fonts, styles and colors.
15. Write a java program to create Frames using swing
16. Design a calculator using event-driven programming paradigm of Java with the following options.
17. Decimal manipulations
18. Scientific manipulations
19. 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:	Demonstrate the problems using the characteristics of an object-oriented approach.
CO2:	Construct applications using object-oriented features.
CO3:	Develop and implement Java programs that make use of classes, packages and interfaces.
CO4:	Develop and implement Java programs with exception handling and multithreading.
CO5:	Construct applications using file processing, generic programming and event handling.
CO6:	Build an understanding of client/ server interactions.

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

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

23AD401	ALGORITHM DESIGN AND ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To analyze the efficiency of algorithmic solutions.
- To illustrate graph algorithms using various techniques.
- To explain divide and conquer, dynamic programming and greedy techniques for solving various problems.
- To apply the concept of iterative technique to solve optimization problems and backtracking.
- To familiarize the concept of the limitations of algorithmic power and handling it in different problems

UNIT I	INTRODUCTION	9

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving –Fundamentals of the Analysis of Algorithm Efficiency – Analysis Framework - Asymptotic Notations and their properties – Solving Recurrences : substitution method - Lower bounds - hash function- String Matching : The naïve string - matching algorithm - Rabin-Karp algorithm

UNIT II	GRAPH ALGORITHMS	9

Representations of graphs - Graph Traversal: DFS - BFS - Minimum spanning tree: Kruskal's and Prim's algorithm - Shortest Path: Bellman - Ford algorithm - Dijkstra's algorithm - Maximum flow: Flow networks - Ford-Fulkerson method - Maximum bipartite matching.

UNIT III	ADVANCED ANALYSIS TECHNIQUES	9

Divide and Conquer Methodology – Merge Sort - Multiplication of Large Integers and Strassen's Matrix Multiplication – Closest-Pair and Convex - Hull Problems.

Dynamic programming – Principle of optimality - Coin changing problem – Warshall's and Floyd's algorithms – Optimal Binary Search Trees - Multistage graph - Knapsack Problem and Memory

functions. **Greedy Technique –** Dijkstra's algorithm - Huffman Trees and codes.		
UNIT IV	**OPTIMIATION AND BACKTRACKING TECHNIQUES**	**9**
Branch and Bound : Assignment problem - Knapsack Problem - Travelling Salesman Problem - LIFO Search and FIFO Search **Backtracking –** N Queens problem - Hamiltonian Circuit Problem – Subset Sum Problem.		
UNIT V	**NP COMPLETE AND APPROXIMATION ALGORITHM**	**9**
Lower - Bound Arguments - P, NP, NP- Complete and NP Hard Problems - NP-completeness - Problem reduction: TSP - 3 CNF problem - Approximation Algorithms for NP-Hard Problems – Traveling Salesman problem – Cook's Theorem – Bin Packing problem		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Infer the efficiency of various algorithms mathematically.
CO2:	Apply graph algorithms to solve problems and analyze their efficiency
CO3:	Build the problems using divide and conquer, dynamic programming techniques.
CO4:	Develop problems using greedy algorithmic techniques.
CO5:	Solve the problems using optimization and backtracking techniques
CO6:	Utilize the limitations of algorithmic power and solve the problems using branch and bound techniques.

TEXT BOOKS:	
1	Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012

REFERENCES:	
1	Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran," Computer Algorithms/ C++", Second Edition, Universities Press, 2019.
2	Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.
3	S. Sridhar, "Design and Analysis of Algorithms", Oxford university press, 2014.
4	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.

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

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

23CS401	OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

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**	**8**
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
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	2	1	-	1	-	-	-	-	-	-	-	-	2	-	-
2	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
4	2	1	-	1	-	-	-	-	-	-	-	-	2	-	-
5	2	1	-	1	-	-	-	-	-	-	-	-	2	-	-
6	2	1	-	1	-	-	-	-	-	-	-	-	2	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-

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

23AD402	BIG DATA COMPUTING	L	T	P	C
		3	0	0	3

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	HADOOP RELATED TOOLS	9

Hbase – data model and implementations – Hbase clients-Thrift implementation – Hbase examples – Pig - Pig Latin scripts – Hive-HiveQL queries.

UNIT V	MAPREDUCE APPLICATIONS	9

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	
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							08-04-2024								
Approved							2nd ACM			Date			25-05-2024		

23AD403	DATA WAREHOUSING AND DATA MINING	L	T	P	C
		3	0	0	3

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**	**9**
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

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	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23AD411	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE	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:

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.	
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							08-04-2024								
Approved							2nd ACM			Date			25-05-2024		

23MA411	MATHEMATICAL MODELING FOR DATA SCIENCE	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Gain knowledge in basics of R language for computation.
- Utilize the looping concepts in R language to manipulate the data.
- Create and manipulate data frames and work with files using R.
- Understand the problem that a machine learning algorithm is designed to solve.
- To develop designing skills for modeling non-deterministic problems.
- To educate students in predicting future results according to the parameters.

UNIT I	INTRODUCTION TO R PROGRAMMING	9

Introduction-How to run R-Basic features of R- R Sessions and Functions- Basic Math- Variables- Data Types - Advanced Data Structures – Lists, Matrices, Arrays, Factors ,Data Frames, Functions , Vectors , Atomic Vectors, Character vectors - Operations on the logical vectors - Calculating with R.

UNIT II	LOOPING AND CONTROL STRUCTURES	9

Programming Structures, Different types of loops such as: for(), while() loops, Control Statements, Looping Over Non Vector Sets,- If-Else, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return-Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion

UNIT III	WORKING WITH DATA FRAMES AND FILE OPERATIONS	9

Data Frames, making data frames - Working with data frames- Data Reshaping- Melting and Casting of data – Merging Data Frames - Editing and Reading Data from Files –Reading and Writing Files

UNIT IV	DATA MODELS AND LINEAR REGRESSION	9
Data, Models, and Learning - Empirical Risk Minimization - Parameter Estimation - Maximum Likelihood Estimation - Bayesian Estimation Methods - Directed Graphical Models - Model Selections - Linear Regression - Problem Formulation		
UNIT V	**DIMENSIONALITY REDUCTION AND SUPPORT VECTOR MACHINES**	**9**
Dimensionality Reduction with Principal Component Analysis, Maximum Variance Perspective, Projection Perspective - PCA in High Dimensions, Key Steps of PCA in Practice, Latent Variable Perspective - SVM - Separating Hyperplanes, Primal Support Vector Machine		
TOTAL: 45 PERIODS		
PRACTICAL EXERCISES: 30 PERIODS		
1. Basic Operations In R 2. Data Structures In R 3. Working With Looping & Function In R 4. Implementation of Vector Recycling, Apply Family & Recursion 5. R Code for Data Frame Manipulation Including Extraction, Transformation And Loading of Data 6. Parameter Estimation Using R 7. Linear Algebra – Solving Linear Equations 8. Dimensionality Reduction using R		
TOTAL: 45 +30 =75 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Demonstrate the basic computations using R	
CO2:	Identify looping and recursion concepts in R to manipulate the data	
CO3:	Construct R code to manipulate the Data Frames	
CO4:	Utilize probabilistic modeling and inferences to data	
CO5:	Apply linear models and regression for classification.	

CO6:	Choose appropriate Dimensionality reduction algorithm and SVM for machine learning.
TEXT BOOKS:	
1	Tilman M. Davies, "The Book of R - A First Programming And Statistics" Library of Congress Cataloging-in-Publication Data,2016.
2	Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
REFERENCES:	
1	Matthias Dehmer, Salissou Moutari, Frank Emmert-Streib, Mathematical Foundations of Data Science Using R, De Gruyter Oldenbourg, 2020.
2	Norman Matloff, Probability and Statistics for Data Science: Math + R + Data, CRC Data Science Series, 2019.

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	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	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23CS421	OPERATING SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To install windows operating systems.
- To understand the basics of Unix command and shell programming.
- To implement various CPU scheduling algorithms.
- To implement Deadlock Avoidance Algorithms.
- To be familiar with File Organization and File Allocation Strategies.
- To understand the working of virtual machines.

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 a C program to implement the concept of threading.
9. Write a C program to implement single level and two-level directory structure.
10. Write C programs to implement the following Memory Allocation Methods a. First Fit b. Worst Fit c. Best Fit
11. Write C programs to implement the various Page Replacement Algorithms.
12. Implement various disk scheduling algorithms.
13. Install any guest operating system like Linux using VMware

TOTAL : 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply basic UNIX commands and shell programming
CO2:	Construct various CPU Scheduling Algorithms.
CO3:	Construct the concept of interprocess communication.
CO4:	Build various page replacement algorithms.
CO5:	Interpret operations on directories.
CO6:	Build Linux OS using VMware.

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	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23AD421	BIG DATA COMPUTING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To install and configure Hadoop.
- To implement and use NoSQL big data management.
- To implement MapReduce analytics using Hadoop and related tools.
- To understand the usage of Hadoop related tools for Big Data Analytics
- To Integrate Big Data Concepts with Practical Applications

LIST OF EXPERIMENTS:

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 data bases 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 PERIODS

COURSE OUTCOMES:

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

CO1:	Demonstrate to Install, configure, and run Hadoop and HDFS.
CO2:	Build applications using NoSQL big data management.
CO3:	Construct map-reduce analytics using Hadoop.

CO4:	Construct map-reduce program with dataset.
CO5:	Utilize Hadoop-related tools such as HBase, Cassandra, Pig, and Hive
CO6:	Develop Big Data Applications

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	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

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	**4**
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	2	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	1	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

23RE501	RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- 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

UNIT I	INTRODUCTION TO RESEARCH FORMULATION	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

UNIT II	LITERATURE REVIEW	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

UNIT III	DATA ANALYSIS	6

Execution of the research - Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Generalization and Interpretation

UNIT IV	REPORT, THESIS PAPER, AND RESEARCH PROPASAL WRITING	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 –

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**

23AD501	MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Classify the types of machine learning models and infer the terminologies used.
- Apply the neural network modeling technique to data classification
- Utilize learning algorithms to build machine learning models on a supervised dataset
- Identify the appropriate ensemble method to boost the classifier accuracy
- Utilize learning algorithms to build machine learning models on a unsupervised dataset
- Apply knowledge mining to various machine learning application

UNIT I	INTRODUCTION	9

Machine Learning – Types of Machine Learning – Supervised Learning – Unsupervised Learning –Machine Learning Process – Terminologies used in Machine learning – Testing Machine Learning Algorithms - Training, Testing, and Validation Sets - The Confusion Matrix - Accuracy Metrics - The Receiver Operator Characteristic (ROC) Curve - Unbalanced Datasets - Measurement Precision–- Turning Data into Probabilities

UNIT II	NEURAL NETWORKS	9

Neurons, Neural Networks, and Linear Discriminants - The Brain and the Neuron - Neural Networks - The Perceptron - Linear Separability - Linear Regression - The Multi-Layer Perceptron Going Forwards Going Backwards: Back-Propagation of Error - The Multi-Layer Perceptron in Practice - Examples of Using the MLP - Deriving Back-Propagation

UNIT III	LEARNING MODELS – SUPERVISED	11

Evolutionary Learning : The Genetic Algorithm (GA) - Generating Offspring: Genetic Operators - Using Genetic Algorithms - Genetic Programming

Reinforcement Learning: Example: Getting Lost - Markov Decision Processes- Values - Using Reinforcement Learning Ensemble Learning: Boosting – Bagging - Random Forests - Different Ways To Combine Classifiers		
UNIT IV	**LEARNING MODELS - UNSUPERVISED**	**9**
The K-Means Algorithm - Vector Quantisation- The Self-Organising Feature - Map Markov Chain Monte Carlo (MCMC) Methods - Sampling - Monte Carlo Or Bust - The Proposal Distribution- Markov Chain Monte Carlo - Graphical Models		
UNIT V	**CASE STUDY**	**7**
Customer Churn , Galaxy Classification, Multivariate Time Series Forecasting, Financial Fraud at Scale With Decision Trees - Business Understanding - Data Understanding - Data Preparation - Modeling - Evaluation – Deployment		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Summarize the basic concepts of machine learning techniques and terminologies
CO2:	Develop classification models using neural networks
CO3:	Apply different learning models to various supervised datasets
CO4:	Illustrate the methods to enhance the efficiency of learning models
CO5:	Apply different learning models to various unsupervised datasets
CO6:	Identify the appropriate data modelling techniques for various applications.

TEXT BOOKS:	
1	Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2015.

2	Tom. M. Mitchell, "Machine Learning", McGraw Hill International Edition 1017
REFERENCES:	
1	Ethem Alpaydin, —Introduction to Machine Learning‖, Third Edition, Prentice Hall of India, 2015
2	Christopher Bishop, —Pattern Recognition and Machine Learning‖, Springer, 2006.
3	Kevin P. Murphy, —Machine Learning: A Probabilistic Perspective‖, MIT Press, 2012.

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	2	1	-	-	-	-	-	-	-	-	1	-	2	-	-
5	3	2	1	1	-	-	-	-	-	-	1	-	3	-	-
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	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23AD511	STATISTICS FOR AI AND ML	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To use univariate analysis on various applications
- To perform bivariate analysis on any given dataset
- To apply Inferential statistics to various datasets
- To apply variance and draw inferences from the outcome
- To develop regression models to correlate the attributes
- To build time series analysis

UNIT I	DESCRIBING DATA I	9

Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs – averages – mode – median – mean – averages for qualitative and ranked data – describing variability – range – variance – standard deviation – degrees of freedom – interquartile range – variability for qualitative and ranked data

UNIT II	REGRESSION ANALYSIS AND TIME SERIES	9

Relationship between attributes using Covariance and Correlation - Relationship between multiple variables: Regression (Linear, Multivariate) in prediction - Residual Analysis - Forecasting models - Trend analysis - Cyclical and Seasonal analysis - Smoothing; Moving averages; Box-Jenkins, Holt-winters, Auto-correlation; ARIMA

UNIT III	DESCRIBING DATA II	9

Normal distributions – z scores – normal curve problems – finding proportions – finding scores – more about z scores – correlation – scatter plots – correlation coefficient for quantitative data – computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean

UNIT IV	INFERENTIAL STATISTICS	9
Populations – samples – random sampling – Sampling distribution- standard error of the mean - Hypothesis testing – z-test – z-test procedure –decision rule – calculations – decisions – interpretations - one-tailed and two-tailed tests – Estimation – point estimate – confidence interval – level of confidence – effect of sample size		
UNIT V	**ANALYSIS OF VARIANCE**	**9**
t-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance – t-test for two related samples. F-test – ANOVA – Two-factor experiments – three f-tests – two-factor ANOVA – Introduction to chi-square tests		
TOTAL: 30 PERIODS		
PRACTICAL EXERCISES:		
1. Frequency distributions for Quantitative data and Qualitative data 2. Describing Data with Averages, Measures of variability 3. Normal Distributions, Correlation coefficient and scatter plots 4. Regression 5. Implementation of Z-Test – One Sample Z-Test and Two Sample Z-Test 6. Implementation of Z-Test – using Titanic case study 7. Implementation of T-Test – one sample t-test 8. Implementation of T-Test – Two sample t-test and Paired T-Test 9. Implementation of VARIANCE ANALYSIS (ANNOVA) 10. Demonstration of Linear Regression 11. Implementation of Time Series Analysis		
TOTAL:30 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		

CO1:	Outline various univariate techniques to analyse the data
CO2:	Utilize bivariate analysis to explore the data
CO3:	Apply statistical methods to draw inferences from data.
CO4:	Apply ANOVA method to draw inference from data
CO5:	Build models for predictive analytics
CO6:	Construct time series analysis
TEXT BOOKS:	
1	Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.
2	Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.
REFERENCES:	
1	Gupta, S.C. and Kapoor, V.K. (1997) "Fundamentals of Mathematical Statistics" Sultan Chand and Sons
2	Pratap Dangeti, "Statistics for Machine Learning",Packt Publishing Ltd, 21 Jul 2017

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	3	2	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	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23AD521	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

PRACTICALS

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 clustering for Euclidean distance metric
8. k-Nearest Neighbor 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	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

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**

23AD611	FUNDAMENTALS OF DEEP LEARNING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the basic ideas and principles of neural networks.
- To understand the basic concepts of deep learning.
- To appreciate the use of deep learning applications.
- To know the applications of Deep learning techniques to NLP
- To build solutions for real world problems.

UNIT I	FUNDAMENTALS OF DEEP NETWORKS	9

Introduction-Linear Algebra-Probability and Information Theory-Numerical Computation Machine Learning Basics.

UNIT II	DEEP NETWORKS: MODERN PRACTICES	9

Deep Feedforward Networks: Simple Deep Neural Network-Generic Deep Neural Network Computations in Deep Neural Network-Gradient-Based Learning. -Regularization for deep learning: L2 regularization-L1 Regularization-Entropy Regularization-Dropout-Data augmentation. Optimization for Training deep models: Learning Differs from Pure Optimization Challenges in Neural Network Optimization-Stochastic Gradient Descent.

UNIT III	CONVOLUTIONAL AND RECURRENT NEURAL NETWORKS	9

Introduction-Convolutional Operation-Pooling-Data Types-Convolution Algorithms

Convolutional Networks with Deep Learning. Sequence Modeling: Recurrent and Recursive Nets: Introduction-Auto-Completion-Unfolding Computational Graphs-Recurrent Neural Networks. Types of RNNs-Bidirectional RNNs-Sequence-to-Sequence Architectures-Deep Recurrent Networks-Long-Term Dependencies; Gated Architecture: LSTM

UNIT IV	DEEP LEARNING RESEARCH	9
Linear Factor Models-Auto encoders: Undercomplete Autoencoders-Regularized Autoencoders Stochastic Encoders and Decoders-Denoising Autoencoders-Learning with Autoencoders; Deep Generative Models; Variational autoencoders-Generative adversarial networks.		
UNIT V	**APPLICATIONS OF DEEP LEARNING TO NLP**	**9**
Introduction to NLP and Vector Space Model of Semantics - Word Vector Representations: Continuous Skip-Gram Model - Continuous Bag-of-Words model (CBOW) - Glove - Evaluations and Applications in word similarity		
TOTAL: 30 PERIODS		

PRACTICAL EXERCISES:

1. Solving XOR problem using DNN.
2. Classification of MNIST Dataset using CNN.
3. Character recognition using CNN.
4. Face recognition using CNN.
5. Language modeling using RNN.
6. Sentiment analysis using LSTM.
7. Parts of speech tagging using Sequence to Sequence architecture.
8. Machine Translation using Encoder-Decoder model.
9. Image augmentation using GANs.
10. Mini-project on real world applications.

TOTAL:30 PERIODS

COURSE OUTCOMES:

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

CO1:	Illustrate the role of deep learning in machine learning applications.
CO2:	Design and implement deep learning applications.
CO3:	Analyze different deep learning models in image related projects.
CO4:	Design and implement convolutional neural networks.
CO5:	Summarize the applications of deep learning in NLP and image processing

CO6:	Design and implement LSTM concepts to build solutions for real world problems.
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	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23AD612	AI IN IOT APPLICATIONS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To study the fundamentals of IoT
- To study various communication principles for IoT
- To study the fundamentals of AI in IoT.
- To study different AI algorithms used for IoT.
- To study the applications of AI in IoT.

UNIT I	INTRODUCTION TO IoT	9

Introduction to Internet of Things (IoT), Functional Characteristics, Recent Trends in the Adoption of IoT, Role of cloud in IoT, Societal Benefits of IoT:- Health Care, Machine to Machine (M2M), Smart Transportation, Smart Living, Smart Cities, Smart Grid

UNIT II	COMMUNICATION PRINCIPLES AND TRANSDUCERS	9

RFID, ZigBEE, Bluetooth, Internet Communication- IP Addresses - MAC Addresses , IEEE 802 Family of Protocols , I/O interfaces Software Components – Definition of Sensor, Sensor features, Resolution, Classes, Different types of sensors, Actuator, Different types of Actuators, purpose of Sensors and Actuators in IoT

UNIT III	PRINCIPLES AND FOUNDATIONS OF IOT AND AI	9

loT reference model, loT platforms, loT verticals, Big data and lot, Infusion of Al- data science in IoT, Cross-industry standard process for data mining Al platforms and loT platforms and Tools, TensorFlow, Keras, Datasets, The combined cycle power plant dataset Wine quality dataset, Air quality data.

UNIT IV	ALGORITHMS FOR IoT	9

Classification using support vector machines, Maximum margin hyperplane, Kernel trick - Naive Bayes - Decision trees - Deterministic and analytic methods - Gradient descent method

Newton-Raphson method - Natural optimization methods Simulated annealing - Genetic algorithm for CNN architecture- Genetic algorithm for LSTM optimization- Deep reinforcement learning-Q learning-Q Networks.

UNIT V	APPLICATIONS	9

Continuous glucose monitoring- Hypoglycemia prediction using CGM data- Heart monitor- Digital assistants- Human activity recognition- HAR using wearable sensors- Smart home automation- Predictive maintenance using Al- Predictive maintenance using Long Short-Term Memory- Predictive maintenance advantages and disadvantages-Electrical load forecasting in industry-STLF using LSTM- Components of a smart city-Smart traffic management-Smart parking- Smart waste management-Smart policing-Smart lighting-Smart governance-Cities with open data-Adapting lot for smart cities and the necessary steps.

TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1. Explore and analyze various IoT platforms, including data handling techniques, using example datasets like air quality and power plant datasets.
2. Use the wine quality dataset to classify wine quality using logistic regression and evaluate performance.
3. Implement an SVM classifier for the wine dataset, using the kernel trick to improve classification.
4. Implement ensemble techniques on IoT-related data (e.g., air quality) and evaluate model performance improvements.
5. Implement a genetic algorithm to optimize hyperparameters in a CNN model for IoT data.
6. Implement Q-learning to control a simple IoT system, such as temperature control in a smart home.
7. Implement a vanilla GAN in TensorFlow to generate synthetic images based on IoT image data (e.g., human activity from wearable sensors).

8. Use LSTM to predict maintenance needs based on equipment data from IoT sensors. 9. Create a model that uses IoT sensor data to predict and manage traffic in a smart city. 10. Project: Develop a comprehensive IoT-based solution for monitoring and managing environmental conditions in smart cities, focusing on air quality, traffic congestion, and waste management.	
TOTAL:30 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Illustrate the basic architecture of Internet of Things based Devices
CO2:	Illustrate wireless communication systems.
CO3:	Summarize IoT reference models, data science integration, and AI platforms relevant to IoT
CO4:	Develop models based on classification algorithms
CO5:	Develop algorithms for IoT tasks, optimizing complex processes like CNN and LSTM models.
CO6:	Apply AI-based solutions for various real time IoT applications
TEXT BOOKS:	
1	Adrian Mcewen, Hakin Cassimally, "Designing The Internet of Things", First Edition, Wiley, 2014.
2	Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.
REFERENCES:	
1	Vijay Madisetti, Arshdeep Bahga," Internet of Things A Hands-On- Approach",2014,
2	Raj Kamal , " Internet of Things: Architecture and Design", McGraw Hill.2nd edition June 2022 2. Pethuru Raj, Anupama C. Raman ," The Internet of Things Enabling Technologies, Platforms, and Use Cases", Taylor and Francis

	group. February 2017
3	Peter Waher, "Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3", First Edition, Packt Publishing, 2018
4	Vijay Madisetti, Arshdeep Bahga," Internet of Things A Hands-On- Approach",2014,

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**

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

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**

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

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**

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

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

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

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

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**

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

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**

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

SEMESTER -VIII

23AD821	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

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

VERTICAL 1: GENERIC COMPUTER ENGINEERING

23AD031	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand digital image processing basics and apply transformations, operations, and enhancements.
- Apply image enhancement techniques in spatial and frequency domains to improve image quality.
- Apply image restoration and multi-resolution analysis, including noise modeling and wavelet transforms.
- Explore image segmentation and feature extraction using edge detection, region-based segmentation, and methods like SIFT and SURF.
- Understand machine learning in image processing, focusing on classification and clustering techniques like SVM and unsupervised learning.

UNIT I	FUNDAMENTALS OF IMAGE PROCESSING	9

Introduction to Image Processing – Applications – Digital Imaging System – Sampling and Quantization – Pixel Connectivity – Colour Models – Image Operations.

UNIT II	IMAGE ENHANCEMENT	9

Image Transforms – Fourier Transform – Cosine Transform – Image Enhancement in Spatial and Frequency Domains – Grey Level Transformations – Histogram Processing – Spatial Filtering.

UNIT III	IMAGE RESTORATION AND MULTI-RESOLUTION ANALYSIS	9

Multi-resolution Analysis – Wavelet Transforms – Image Restoration – Noise and Blur – Image Restoration Algorithms – Basic Degradation Models – Image Filtering.

UNIT IV	IMAGE SEGMENTATION AND FEATURE EXTRACTION	9
Image Segmentation – Edge Detection – Thresholding – Region-based Segmentation – Feature Extraction – SIFT, SURF – Feature Reduction – Blob Detection – Segmentation Evaluation Metrics.		
UNIT V	**IMAGE PROCESSING APPLICATIONS**	**9**
Image Classifiers – Support Vector Machines – Image Clustering – Hierarchical Clustering – EM Algorithm – Face Recognition – Medical Image Processing.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Outline the basics of image processing, including how images are created, processed, and analyzed.
CO2:	Make use of techniques to enhance image quality in both spatial and frequency domains.
CO3:	Apply image restoration techniques using multi-resolution analysis.
CO4:	Utilize different image segmentation techniques, such as edge detection and region-based segmentation.
CO5:	Apply feature extraction methods (e.g., SIFT, SURF) and understand the importance of feature reduction in image processing tasks.
CO6:	Interpret image classification and clustering algorithms for various image processing applications, such as object recognition and image analysis.

TEXT BOOKS:	
1	Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Third Edition,2010.
2	Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.

REFERENCES:	
1	Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
2	Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
3	D,E. Dudgeon and RM. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4	William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002 5. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

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	-	-
2	3	2	1	1	1	2	-	-	-	1	3	-	3	1	-
3	3	2	1	1	1	2	-	-	-	1	3	-	3	1	-
4	3	2	1	1	1	2	-	-	-	1	3	-	3	1	-
5	3	2	1	1	1	2	-	-	-	1	3	-	3	1	-
6	2	1	-	-	-	1	-	1	-	1	2	1	2	-	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**2**	**-**	**1**	**1**	**1**	**3**	**1**	**3**	**1**	**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 serverDevelop 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

23AD034	SOFTWARE ENGINEERING PRINCIPLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- The aim of the course is to provide
- To Understand the basics of software engineering process
- To understand the requirements of the software
- To understand the design engineering
- To understand the testing strategies
- To understand the metric for process
- To understand the metric for product

UNIT I	INTRODUCTION TO SOFTWARE ENGINEERING	9

The evolving role of software, changing nature of software, software myths. A Generic view of process: Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI), process patterns, process assessment, personal and team process models. Process models: The waterfall model, incremental process models, evolutionary process models, the unified process.

UNIT II	SOFTWARE REQUIREMENTS	9

Functional and non-functional requirements, user requirements, system requirements, interface specification, the software requirements document. Requirements engineering process: Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management. System models: Context models, behavioral models, data models, object models, structured methods.

UNIT III	DESIGN ENGINEERING	9

Design process and design quality, design concepts, the design model. Creating an architectural design: software architecture,

data design, architectural styles and patterns, architectural design, conceptual model of UML, basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams.		
UNIT IV	**TESTING STRATEGIES**	**9**
A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging. Product metrics: Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance.		
UNIT V	**METRICS FOR PROCESS AND PRODUCTS**	**9**
Software measurement, metrics for software quality. Risk management: Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan. Quality Management: Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability, the ISO 9000 quality standards.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Illustrate the software engineering process and framework.
CO2:	Identify the end-user requirements into system and software requirements.
CO3:	Identify and apply appropriate software architectures and patterns to carry out high level design of a system and be able to critically compare alternative choices.
CO4:	Outline the awareness of testing problems and will be able to develop a simple testing report
CO5:	Demonstrate the metrics for process
CO6:	Demonstrate the metrics for products

TEXT BOOKS:	
1	Software Engineering, "A practitioner's Approach- Roger S. Pressman", 6th edition, Mc Graw Hill International Edition,2004.
2	Ian Sommerville , "Software Engineering", 7th edition, Pearson Education,2004.
REFERENCES:	
1	James Rambaugh, Ivar Jacobson "The unified modeling language user guide Grady Booch" , Pearson Education. 1999
2	James F. Peters, Witold Pedrycz, John Wiley, "Software Engineering, an Engineering approach" John Wiley and Sons, 1999
3	Waman S Jawadekar , "Software Engineering principles and practice", The Mc Graw-Hill, 2004
4	Meiler page-Jones, "Fundamentals of object-oriented design using UML",Pearson Education, 1999

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	3	-	1
2	3	2	1	1	-	-	-	-	-	-	1	-	3	-	-
3	3	2	1	1	1	-	-	-	1	1	1	1	3	1	-
4	2	1	-	-	1	1	1	-	-	-	1	1	2	1	-
5	2	1	-	-	1	1	1	-	-	-	1	1	2	1	-
6	2	1	-	-	1	1	1	-	-	-	1	1	2	1	-
Overall Correlation	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1

23AD035	DISTRIBUTED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the legacy systems of distributed systems
- To introduce the computation and communication models of distributed systems
- To illustrate the issues of synchronization and collection of information in distributed systems
- To describe distributed mutual exclusion and distributed deadlock detection techniques
- To elucidate agreement protocols and fault tolerance mechanisms in distributed systems
- To explain the cloud computing models and the underlying concepts

UNIT I	INTRODUCTION	9

Introduction: Definition-Relation to Computer System Components – Motivation – Message - Passing Systems versus Shared Memory Systems – Primitives for Distributed Communication – Synchronous versus Asynchronous Executions – Design Issues and Challenges; A Model of Distributed Computations: A Distributed Program – A Model of Distributed Executions – Models of Communication Networks – Global State of a Distributed System

UNIT II	LOGICAL TIME AND GLOBAL STATE	9

Time – Vector Time; Message Ordering and Group Communication: Message Ordering Paradigms – Asynchronous Execution with Synchronous Communication – Synchronous Program Order on Asynchronous System – Group Communication – Causal Order – Total Order; Global State and Snapshot Recording Algorithms: Introduction – System Model and Definitions – Snapshot Algorithms for FIFO Channels.

UNIT III	DISTRIBUTED MUTEX AND DEADLOCK	9

Distributed Mutual exclusion Algorithms: Introduction –

Preliminaries – Lamport's algorithm – Ricart- Agrawala's Algorithm –– Token-Based Algorithms – Suzuki-Kasami's Broadcast Algorithm; Deadlock Detection in Distributed Systems: Introduction – System Model – Preliminaries – Models of Deadlocks – Chandy-Misra-Haas Algorithm for the AND model and OR Model.		
UNIT IV	**RECOVERY AND CONSENSUS**	**9**
Checkpointing and Rollback Recovery: Introduction – Background and Definitions – Issues in Failure Recovery – Checkpoint-based Recovery – Coordinated Checkpointing Algorithm- Algorithm for Asynchronous Checkpointing and Recovery - Consensus and Agreement Algorithms: Problem Definition – Overview of Results		
UNIT V	**CLOUD COMPUTING**	**9**
The Evolution of Cloud Computing - Comparison between Cluster, Grid and Cloud Computing - Benefits and Challenges - Cloud Computing Model- Cloud Computing Services - Elements of Cloud Security Model - Cloud Security Reference Model- Virtualizing Physical Computing Resources - Machine or Server Level Virtualization- Advantages of Virtualization		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the foundations of distributed systems.	
CO2:	Interpret various models of computations	
CO3:	Solve synchronization and state consistency problems.	
CO4:	Apply resource sharing techniques in distributed systems.	
CO5:	Apply working model of consensus and reliability of distributed systems.	
CO6:	Explain the fundamentals of cloud computing.	
TEXT BOOKS:		
1	Kshemkalyani Ajay D, Mukesh Singhal, "Distributed Computing: Principles, Algorithms and Systems",	

	Cambridge Press, 2011.
2	Sandeep Bhowmik, "Cloud Computing" Cambridge Press, 2017
REFERENCES:	
1	George Coulouris, Jean Dollimore, Time Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.
2	Pradeep L Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
3	Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, 2003.
4	Arshdeep Bagga, Vijay Madisetti, " Cloud Computing: A Hands-On Approach", Universities Press, 2014.Bernard Kolman, David R. Hill, "Introductory Linear Educations", New Delhi, First Reprint, 2009. Algebra, Pearson.

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	2	2	2	2	3	-	1
4	3	2	1	1	-	-	-	1	3	2	1	1	3	-	1
5	3	2	1	1	1	1	-	1	3	3	2	1	3	-	1
6	2	1	-	-	-	-	-	-	3	3	3	1	2	-	-
Overall Correlation	3	2	1	1	1	1	-	1	3	2	3	2	3	-	1

23AD036	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- 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

UNIT I	INTRODUCTION	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

UNIT II	SYMMETRIC KEY CRYPTOGRAPHY	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.

UNIT III	PUBLIC KEY CRYPTOGRAPHY	6

Asymmetric Key Ciphers: Rsa Cryptosystem – Key Distribution – Key Management – Diffie Hellman Key Exchange -Elgamal Cryptosystem – Elliptic Curve Arithmetic-Elliptic Curve Cryptography.

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

23AD037	DATA COMMUNICATIONS AND NETWORKING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of layering in networks.
- To know the functions of protocols of each layer of TCP/IP protocol suite.
- To visualize the end-to-end flow of information.
- To learn the functions of network layer and the various routing protocols
- To familiarize the functions and protocols of the Transport layer

UNIT I	INTRODUCTION AND APPLICATION LAYER	9

Data Communication - Networks - Network Types - Protocol Layering - TCP/IP Protocol Suite - OSI Model - Introduction to Sockets; Application Layer Protocols: HTTP - FTP - Email Protocols (SMTP - POP3 - IMAP - MIME) - DNS - SNMP

UNIT II	TRANSPORT LAYER	9

Introduction - Transport Layer Protocols: UDP - TCP: Connection Management - Flow Control - Congestion Control - Congestion Avoidance (DECbit - RED) - SCTP - Quality of Service

UNIT III	NETWORK LAYER	9

Switching: Packet Switching - Internet Protocol - IPv4 - IP Addressing - Subnetting - IPv6 - ARP - RARP - ICMP - DHCP

UNIT IV	ROUTING	9

Routing Protocols: Unicast Routing - Distance Vector Routing - RIP - Link State Routing - OSPF - Path Vector Routing – BGP; Multicast Routing: DVMRP - PIM

UNIT V	DATA LINK AND PHYSICAL LAYERS	9

Data Link Layer - Framing - Flow Control - Error Control - Data Link Layer Protocols - HDLC - PPP - Media Access Control - Ethernet Basics - CSMA/CD - Virtual LAN - Wireless LAN (802.11); Physical Layer: Data and Signals - Performance - Transmission Media - Switching - Circuit Switching

TOTAL : 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain application-layer protocols and their practical functions in facilitating communication between networked systems.
CO2:	Apply transport-layer protocols to manage data flow, congestion, and connection reliability in networking scenarios.
CO3:	Develop network-layer protocols for addressing and packet-switching operations
CO4:	Make use of routing protocols for various applications.
CO5:	Identify key concepts of data link layer to improve signal performance.
CO6:	Identify key concepts of physical layer to improve reliability in network design
TEXT BOOKS:	
1	James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021.
2	Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite,Sixth Edition TMH, 2022
REFERENCES:	
1	Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012
2	William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.

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	3	2	1	1	3	-	-	2	1	2	2	3	3	3	2
4	3	2	1	1	3	-	-	2	1	2	2	3	3	3	2
5	3	2	1	1	3	-	-	2	1	2	2	3	3	3	2
6	3	2	1	1	3	-	-	2	1	2	2	3	3	3	2
Overall Correlation	3	2	1	1	3	-	-	2	1	2	2	3	3	3	2

23AD038	AUTOMATA THEORY AND COMPILER DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To establish a strong foundation in the principles of automata theory.
- To undertand the formulation and application of regular expressions and regular languages.
- To analyze the structure and functionality of context-free grammars (CFG) and pushdown automata (PDA).
- To explore the standard normal forms of context-free grammars and their applications.
- To illustrate the architecture and operational phases of a compiler.
- To intrepret methods for intermediate code generation and optimization strategies to enhance computational efficiency.

UNIT I	AUTOMATA AND REGULAR EXPRESSIONS	9

Introduction to Automata Theory: Need for automata theory, formal proof basics. Finite Automata (FA): Deterministic Finite Automata (DFA), Non-deterministic Finite Automata (NFA). Finite Automata with Epsilon Transitions: Epsilon moves, conversion of NFA to DFA

UNIT II	REGULAR EXPRESSIONS AND REGULAR LANGUAGES	10

Regular Expressions: Definition, constructing regular expressions, applications. Regular Languages: Properties and examples, equivalence of finite automata and regular expressions.

UNIT III	CONTEXT-FREE GRAMMAR AND PUSHDOWN AUTOMATA	9

Grammar Types and Chomsky Hierarchy: Classification of grammars, Chomsky's hierarchy. Context-Free Grammar (CFG): Definition, derivations, parse trees, ambiguity.

Pushdown Automata (PDA): Definition, language acceptance, conversion between CFG and PDA

UNIT IV	NORMAL FORMS AND TURING MACHINES	9
Normal Forms for CFG: Simplification, Chomsky Normal Form (CNF), Greibach Normal Form (GNF). Turing Machines (TM): Definition, language acceptance, TM as integer function computer		
UNIT V	**COMPILATION AND CODE OPTIMIZATION**	**9**
Syntax Analysis: Token specification, regular expressions to DFA, parsing (LL(1), SLR, CLR, LALR parsers). Semantic Analysis and Intermediate Code Generation: Syntax-directed translation, three-address code, code generation issues. Code Optimization: Loop and basic block optimization, DAG representation of basic blocks		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Demonstrate knowledge of automata theory and its role in language recognition, including working with finite automata (DFA/NFA) for construction, conversion, and minimization.
CO2:	Apply regular expressions and language properties to pattern recognition, and use the pumping lemma to identify non-regular languages.
CO3:	Construct and interpret context-free grammars (CFG) and pushdown automata (PDA), demonstrating their equivalence in language processing.
CO4:	Analyze and simplify CFGs using normal forms and explain the computational role of Turing machines in language acceptance and computation.
CO5:	Design and implement lexical analyzers and parsers, understanding their components and using parsing techniques like top-down and bottom-up methods.
CO6:	Develop strategies for intermediate code generation and apply optimization techniques, such as loop and data flow analysis, to enhance compiler performance.

TEXT BOOKS:	
1	Hopcroft J.E., Motwani R. and Ullman J.D., "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education, 2008..
2	John C Martin , "Introduction to Languages and the Theory of Computation", 4th Edition, Tata McGraw Hill, 2011.
REFERENCES:	
1	A. V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, Compilers: Principles, techniques, and tools, Second Edition, Pearson Education, 2007.
2	Harry R Lewis and Christos H Papadimitriou , "Elements of the Theory of Computation", 2nd Edition, Prentice Hall of India, 2015.
3	Peter Linz, "An Introduction to Formal Language and Automata", 6th Edition, Jones and Bartlett, 2016.
4	K.L.P.Mishra and N.Chandrasekaran, "Theory of Computer Science: Automata Languages and Computation", 3rd Edition, Prentice Hall of India, 2006..
5	Andrew A.Appel , Modern Compiler Implementation in Java, Cambridge University Press; 2nd edition, 2002.
6	Allen Holub, Compiler Design in C, Prentice Hall, 1990

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

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

23AD042	DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Provide basic knowledge of business intelligence and decision support systems.
- Explain about how to model decision support systems and analyze decisions under certainty, uncertainty, and risk.
- Explore healthcare data analytics and machine learning basics for healthcare.
- Discuss the use of IoT and smart sensors in healthcare.
- Explain data security methods for protecting patient information in healthcare analytics.
- Investigate deep learning techniques.

UNIT I	AN OVERVIEW OF BUSINESS INTELLIGENCE, ANALYTICS, AND DECISION SUPPORT	9

Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems, A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics.

UNIT II	MODEL-BASED DECISION MAKING	9

Decision Support Systems modeling, Structure of mathematical models for decision support, Certainty, Uncertainty, and Risk, Decision modeling with spreadsheets, Mathematical programming optimization, Decision Analysis with Decision Tables and Decision Trees, Multi-Criteria Decision Making With Pairwise Comparisons.

UNIT III	INTRODUCTION TO HEALTHCARE ANALYSIS	9

Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy- Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning, Probabilistic reasoning and Bayes Theorem, Weighted sum approach.

UNIT IV	HEALTH CARE MANAGEMENT	9
IOT- Smart Sensors – Migration of Healthcare Relational database to NoSQL Cloud Database – Decision Support System – Matrix block Cipher System – Semantic Framework Analysis – Histogram bin Shifting and Rc6 Encryption – Clinical Prediction Models – Visual Analytics for Healthcare.		
UNIT V	**HEALTHCARE AND DEEP LEARNING**	**9**
Introduction on Deep Learning – DFF network CNN- RNN for Sequences – Biomedical Image and Signal Analysis – Natural Language Processing and Data Mining for Clinical Data – Mobile Imaging and Analytics – Clinical Decision Support System.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Demonstrate business intelligence and decision support systems and their applications.
CO2:	Develop model decision support systems and analyze decisions in scenarios of certainty, uncertainty, and risk.
CO3:	Apply knowledge of healthcare data analytics and machine learning to address healthcare challenges.
CO4:	Identify the role of IoT and smart sensors in improving healthcare management and operations.
CO5:	Build and Implement data security methods to ensure the protection of patient information in healthcare analytics.
CO6:	Utilize deep learning techniques for healthcare applications such as clinical decision support and biomedical imaging.

TEXT BOOKS:	
1	Ramesh Sharda, Dursun Delen, EfraimTurban, J.E.Aronson,Ting-Peng Liang, David King, "Business Intelligence and Analytics: System for Decision Support", 10th Edition, Pearson Global Edition, 2013.
2	Efraim Turban, Ramesh Sharda, Dursun Delen, and David King "Decision Support and Business Intelligence Systems", 9th Edition, Pearson, 2011
3	Trevor L. Strome "Healthcare Analytics for Quality and Performance Improvement", 1st Edition, Wiley, 2013

4	Chandan K. Reddy and Charu C. Aggarwal "Healthcare Data Analytics", 1st Edition, Chapman & Hall/CRC, 2015
REFERENCES:	
1	Bharath Ramsundar, Peter Eastman, Patrick Walters, and Vijay Pande "Deep Learning for the Life Sciences: Applying Deep Learning to Genomics, Microscopy, Drug Discovery, and More", 1st Edition, O'Reilly Media, 2019
2	Paul Goodwin and George Wright "Decision Analysis for Management Judgment", 5th Edition, Wiley, 2014
3	Cliff Ragsdale "Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Business Analytics", 9th Edition, Cengage Learning, 2021
4	Nathan Marz and James Warren "Big Data: Principles and Best Practices of Scalable Real-Time Data Systems", 1st Edition, Manning Publications, 2015
5	Farrokh Alemi "Big Data in Healthcare: Statistical Analysis and Predictive Modeling", 1st Edition, Auerbach Publications,2019
6	Deepak K. Gupta and Nilanjan Dey "Practical Machine Learning for Healthcare", 1st Edition, Academic Press, 2022

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	1	2	2	1	1
2	3	2	1	1	1	1	1	1	1	2	2	2	3	1	1
3	3	2	1	1	1	1	1	1	2	1	1	2	3	1	1
4	3	2	1	1	1	1	1	1	1	3	1	2	3	1	1
5	3	2	1	1	1	2	2	2	3	3	3	3	3	1	2
6	3	2	1	1	1	3	3	3	3	3	3	3	3	1	3
Overall Correlation	3	2	1	1	2	2	2	2	2	3	2	3	3	1	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**

23AD044	REINFORCEMENT LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce a range of topics related to Reinforcement Learning and probability concepts.
- To gain knowledge on the Markov Decision Process.
- To understand the Q-Learning and SARSA methods.
- To know about Deep Learning in Reinforcement Learning.
- To gain knowledge on Policy Gradient Methods.

UNIT I	BASICS OF REINFORCEMENTLEARNING	9

Introduction to Reinforcement Learning–Elements of Reinforcement Learning– Scope – History of Reinforcement Learning– The Agent-Environment Interface – Examples of Reinforcement Learning – Why Study Reinforcement Learning – Challenges in Reinforcement Learning – Multi-arm Bandit Problem.

UNIT II	MARKOV DECISION PROCESSES AND DYNAMIC PROGRAMMING	9

Overview of Markov Chain - Overview of Markov Decision Process – Model Reinforcement Learning Problem using MDP – Markov Process – Markov Chain – Markov Decision Process – Alternative Bellman Equations for value functions – Optimal policy and optimal value functions – Using Dynamic programming to solve RL problems– Policy Evaluation – Policy Improvement – Policy Iteration – Value Iteration.

UNIT III	MONTE CARLO AND TEMPORAL DIFFERENCING	9

Monte Carlo Introduction – Policy Evaluation – Incremental Update – Exploration Vs Exploitation – Policy Improvement – Temporal Differencing Learning – TD Policy Evaluation – Epilon-Greedy policy – On-policy Vs Off-policy – Q-

Learning – SARSA Learning – Double Q-Learning – Applications of Q-Learning – Grid Problems - N-Step Bootstrapping.		
UNIT IV	**VALUE FUNCTION APPROXIMATION**	**9**
Linear value function approximation – Challenge of Large-scale MDP – Value Function approximations – Stochastic Gradient Descent – Linear value and non-linear value approximation – Deep neural nets – Naïve Deep-Q Learning – Experience Replay – DQN for Games – DQN with Double-Q learning – Prioritized experience Replay – Advantage Function and Duelling Network Architecture.		
UNIT V	**ADVANCED DEEP REINFORCEMENT LEARNING**	**9**
Policy Gradient Methods – Policy-Based methods – Policy Gradient – REINFORCE – Baseline – Actor-Critic Methods - Problems with Continuous Action space – Problems with Standard Methods – Policy Performance Bounds – Proximal Policy Optimization - Latest Trends – Distributed Reinforcement Learning – Curiosity Driven Exploration –Random network Distillation – Planning with AlphaZero.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Intepret different terminologies of RL and Concepts of Probability.	
CO2:	Illustrate the Markov Decision Process and Bellman Equation for learning.	
CO3:	Apply dynamic programming techniques to the Markov decision process and Monte Carlo methods	
CO4:	Build and Implement Time difference learning for real-world problems	
CO5:	Apply Approximation methods of learning and Q-learning technique.	

CO6:	Apply advanced policy gradient methods in reinforcement learning
TEXT BOOKS:	
1	Richard S.Sutton and Andrew G.Barto "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019.
2	Michael Hu, "The Art of Reinforcement Learning – Fundamentals, Mathematics and Implementations with Python", 1st Edition APress, 2024.
REFERENCES:	
1	Sudharsan Ravichandiran, Deep Reinforcement Learning with Python, SecondEdition, Packet Publishing, Birmingham, 2020.
2	Csaba Szepesvari, Algorithms for Reinforcement Learning (Synthesis Lectures on Artificial Intelligence & Machine Learning)", 1st Edition, Morgan & Claypool Publishers, 2010.
3	Laura Graesser and Wah Loon Keng,"Foundations of Deep Reinforcement learning: theory and Practice in Python", 1st Edition, Pearson India, New Delhi, 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	-	1	2	-	2
2	2	1	-	-	1	2	-	3	-	1	-	-	2	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	2	1	1	-	3	3	3	3	3	3	-	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**	**1**	**1**	**3**	**1**	**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**

23AD046	KNOWLEDGE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understanding Fundamental Concepts Knowledge Engineering.
- Develop Logical Reasoning Skills
- Explore Semantic Networks and Ontologies
- Apply Advanced Reasoning Techniques
- Integrate Knowledge Representation with AI Systems

UNIT I	INTRODUCTION	9

Introduction: Definition and Importance, Types of Knowledge: Declarative Knowledge, Procedural Knowledge, Meta-Knowledge, Historical Background: Evolution of Knowledge Representation in AI, Key Concepts: Ontology, Epistemology, and the Role of Logic in Knowledge Representation, Applications: Real-world Examples and Applications in AI Systems.

UNIT II	LOGIC-BASED REPRESENTATION	9

Propositional Logic: Syntax, Semantics, and Inference, First-Order Logic (FOL): Syntax and Semantics, Quantifiers, and Inference Mechanisms, Resolution and Unification: Techniques and Algorithms, Knowledge Bases: Structure, Creation, and Querying, Automated Reasoning: Tools and Techniques for Logical Inference.

UNIT III	SEMANTIC NETWORKS AND FRAMES	9

Semantic Networks: Concepts, Nodes, Arcs, and Types of Relationships, Frame-Based Systems: Definition, Structure, and Examples, Inheritance: Types, Mechanisms, and Issues, Conceptual Graphs: Basics and Usage in Representing Knowledge, Applications: Use Cases in Natural Language Processing and Expert Systems

UNIT IV	ONTOLOGIES AND DESCRIPTION LOGICS	9
Ontologies: Definition, Components, and Development Processes, Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation, Description Logics: Basics, Syntax, Semantics, and Reasoning, Ontology Engineering: Tools, Methodologies, and Best Practices, Case Studies: Real-world Applications and Success Stories.		
UNIT V	**ADVANCE TOPICS IN KNOWLEDGE REPRESENTATION**	**9**
Probabilistic Reasoning: Bayesian Networks and Markov Models, Temporal and Spatial Representation: Methods and Applications, Non-Monotonic Reasoning: Default Logic, Circumscription, and Belief Revision, learning from Knowledge: Integrating Machine Learning with Knowledge Representation, Ethical and Practical Considerations: Challenges, Limitations, and Future Trends in Knowledge Representation in AI		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain Knowledge Representation Techniques.
CO2:	Solve complex AI problems through logical inference.
CO3:	Identify uncertainty in AI systems effectively.
CO4:	Develop Ontologies and represent domain-specific knowledge in AI applications.
CO5:	Construct Knowledge Representation in AI Systems.
CO6:	Apply Ethical and Practical Considerations to develop AI systems.
TEXT BOOKS:	
1	Stuart Russell, Peter Norvig. Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2021.

2	John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000
3	Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
4	Michael Genesereth, Nils J. Nilsson. Logical Foundations of Artificial Intelligence. Morgan Kaufmann, 1987.
REFERENCES:	
1	Dean Allemang, James Hendler. Semantic Web for the Working Ontologist, 2nd Edition, Morgan Kaufmann, 2011.
2	Judea Pearl. Probabilistic Reasoning in Intelligent Systems, 2nd Edition, Morgan Kaufmann, 1988.

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	3	-	1
3	3	2	1	1	-	-	-	1	-	-	-	1	3	-	1
4	3	2	1	1	-	2	3	1	2	1	1	2	3	-	1
5	3	2	1	1	-	1	-	2	-	-	-	2	3	-	2
6	3	2	1	1	-	1	2	3	-	-	-	2	3	-	3
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**2**	**1**	**1**	**1**	**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

23CS032	MOBILE APP DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- 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

UNIT I	INTRODUCTION TO ANDROID OS	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.

UNIT II	BUILDING USER INTERFACE AND INTENT CREATIONS	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.

UNIT III	DATABASES AND CONTENT PROVIDERS	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.

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	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	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

23AD047	SOFTWARE DESIGN THINKING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the phases, importance, and methods of design thinking
- Learn to identify, clarify, and analyze problems, and use empathetic design to understand user needs.
- Explore techniques for brainstorming, ideation, and prototyping and learn to create value propositions.
- Understand agile principles, compare them with design thinking, and learn how to use both in software development and business.
- Learn how to plan and conduct user tests, use feedback for improvement

UNIT I	INTRODUCTION TO DESIGN THINKING	9

Importance of Design Thinking – Design thinking and business- Design thinking and product-Phases in design thinking process - Empathize –Define – Ideate – Prototype – Steps in immersion activity- Explanation on Moccasin walk- Flow charts and handouts- Software Development Methodology – Waterfall model – V –model -Customer Example.

UNIT II	UNDERSTAND, OBSERVE AND DEFINE THE PROBLEM	9

Search field determination - Problem clarification - Understanding of the problem –Problem analysis - Reformulation of the problem - Observation Phase - Empathetic desig- Tips for observing - Methods for Empathetic Design - Point-of-View Phase - Characterization of the target group - Description of customer needs.

UNIT III	IDEATION AND PROTOTYPING	9
Ideate Phase –Need, Uses, methods of ideation - Creativity techniques - Brainstorming - Mind maps - Ideation - Prototype Phase -Types and Guidelines of prototyping– Story telling- Importance of prototyping in design thinking – Value proposition - Guidelines to write value proposition -Lean Startup Method for Prototype Development – Visualization and presentation techniques.		
UNIT IV	**AGILITY AND DESIGN THINKING**	**9**
Agile principles- Agile Methodology Overview-Design thinking and coding – Agile Methodology – Differences between agile and design thinking - Complementing agile with design thinking Extreme Programming –Software Development using Scrum Framework –Sprints – Design Thinking related to science and art-Design Thinking in Business-Linking Design Thinking Solution to Business Challenges		
UNIT V	**TESTING AND IMPLEMENTATION**	**9**
Test Phase - Need to test –User feedback - Conducting a user test – Guidelines for planning a test – How to test - Desirable, feasible and viable solutions – Iterate phase- Tips for interviews - Tips for surveys - Kano Model - Desirability Testing - Conduct of workshops - Requirements for the space - Material requirements.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Apply design thinking concepts to give solution for the problems identified
CO2:	Choose appropriate Agile software methodology for faster development of quality software
CO3:	Describe how to improve collaboration between development

CO4:	Build and Implement Automated Installations and Deployments.
CO5:	Make use of different transformations of a product or a service through brainstorming and incremental approach, etc.
CO6:	Construct user testing processes to gather actionable feedback.
TEXT BOOKS:	
1	Robert Stachowiak and Tracey Kelly "Design Thinking in Software and AI Projects"Apress, 2020.
2	Michael Lerwick "Mindful Digital Transformation of Teams Products, Services, Businesses, and Ecosystems" Wiley Apress, 2020.
REFERENCES:	
1	Christian Mueller-Roterberg, "Handbook of Design Thinking - Tips & Tools for how to design thinking", 2018
2	Jeanne Liedtka and Tim Ogilvie "A design thinking tool kit for managers", Columbia university press, 2011.
3	Tim Brown, Harper Collins "How Design Thinking Transforms Organizations and Inspires Innovation", publisher, 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	1	1	-	-	-	1	3	-	1
3	2	1	-	-	-	2	1	2	1	1	-	2	2	-	2
4	3	2	1	1	-	2	2	2	1	1	1	2	3	-	2
5	3	2	1	1	-	1	1	2	-	-	-	2	3	-	2
6	3	2	1	1	-	1	1	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	2	1	2	1	1	1	2	3	-	2

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

23AD048	INTELLIGENT AGENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand Agent development
- Gain Knowledge in Multi agent and Intelligent agents
- Understanding Agents and security
- Gain Knowledge in Agent Applications
- Apply the principles and methods of intelligent agents to a small-scale practical problem.

UNIT I	FOUNDATIONS OF INTELLIGENT AGENTS	9

Agent Definition, Agent Programming Paradigms, Agent Vs Object, Aglet, Mobile Agents, Agent Frameworks, Agent Reasoning. Processes, Threads, Daemons, Components, Java Beans, ActiveX, Sockets, RPCs, Distributed Computing, Aglets Programming, Jini Architecture, Actors and Agents, Typed and Proactive Messages.

UNIT II	APPLICATIONS CLASSES	9

Theoretical approaches and NASA applications – Agent based control for multi-UAV information collection- Agent based decision support system for Glider pilots, Multi agent system in E- Health Territorial Emergencies

UNIT III	MULTI AGENT SYSTEMS CLASSES	9

Software Agents for computer network security- Multi-Agent Systems, Ontologies and Negotiation for Dynamic Service Composition in Multi- Organizational Environmental Management.

UNIT IV	INTELLIGENT SOFTWARE AGENTS CLASSES	9

Interface Agents – Agent Communication Languages – Agent Knowledge Representation – Agent Adaptability – Belief Desire Intension – Mobile Agent Applications

UNIT V	AGENTS AND SECURITY CLASSES	9

Agent Security Issues – Mobile Agents Security – Protecting Agents

against Malicious Hosts –Untrusted Agent – Black Box Security – Authentication for Agents – Security Issues for Aglets	
TOTAL: 45 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Outline the development of software agents
CO2:	Apply agents in real-world applications, such as UAV control and decision support systems.
CO3:	Develop multi-agent systems for tasks like network security and service composition.
CO4:	Demonstrate how intelligent agents communicate, represent knowledge, and adapt to different situations.
CO5:	Identify security issues in mobile agents and implement protective measures.
CO6:	Explain agent security techniques, including authentication and protection against malicious hosts.
TEXT BOOKS:	
1	Jeffrey M. Bradshaw, "Software Agents", AAAI Press , 1997
2	Richard Murch, Tony Johnson, "Intelligent Software Agents", Prentice Hall , 1999
REFERENCES:	
1	Gerhard Weiss, Multi Agent Systems, "A Modern Approach to Distributed Artificial Intelligence", MIT Press , 2016
2	Mohammad Essaaidi, Maria Ganzha, and Marcin Paprzycki, "Software Agents, Agent Systems and Their Applications", IOS Press , 2012

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	-	1
2	3	2	1	1	-	-	-	2	1	2	2	3	3	-	2
3	3	2	1	1	-	-	-	2	1	2	2	3	3	-	2
4	2	1	-	-	-	-	-	2	1	2	2	2	2	-	2
5	3	2	1	1	-	-	-	2	1	2	2	3	3	-	2
6	2	1	-	-	-	3	-	2	-	2	1	2	2	-	2
Overall Correlation	3	2	1	1	-	1	-	2	1	2	2	3	3	-	2

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**

23AD050	ETHICS OF AI	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- 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.

UNIT I	INTRODUCTION	6

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

UNIT II	ETHICAL INITIATIVES IN AI	6

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponization.

UNIT III	AI STANDARDS AND REGULATION	6

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

UNIT IV	ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS	6

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.

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

23AD051	FUNDAMENTAL OF SPEECH PROCESSING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To introduce the fundamental concepts of speech processing and its applications.
- To equip students with the skills to analyze and process speech signals using time and frequency domain techniques.
- To explore various speech enhancement methods for noise reduction and quality improvement.
- To provide insights into the development of automatic speech recognition and speaker recognition systems.
- To teach the principles and techniques behind speech synthesis and text-to-speech conversion.

UNIT I	INTRODUCTION TO SPEECH PROCESSING	6

Overview of speech processing, Applications in speech recognition, synthesis, and speaker identification, Basics of human speech production and perception

UNIT II	SPEECH SIGNAL REPRESENTATION AND ANALYSIS	6

Time-domain methods (waveform, short-time energy, zero-crossing rate), Frequency-domain methods (Fourier Transform, Spectrogram), Cepstral analysis, Mel-frequency cepstral coefficients (MFCC)

UNIT III	SPEECH ENHANCEMENT AND NOISE REDUCTION	6

Techniques for noise reduction, Spectral subtraction, Wiener filtering, Adaptive filtering, Echo cancellation, Voice activity detection (VAD)

UNIT IV	SPEECH RECOGNITION	6

Fundamentals of automatic speech recognition (ASR), Feature extraction, Acoustic modeling, Language modeling, Hidden

Markov Models (HMM), Gaussian Mixture Models (GMM), Deep learning approaches in ASR		
UNIT V	**SPEAKER RECOGNITION AND SYNTHESIS**	**6**
Speaker identification and verification, Feature extraction for speaker recognition, Text-to-speech (TTS) synthesis, Formant synthesis, Concatenative synthesis, Statistical parametric synthesis, Neural network-based synthesis (e.g., WaveNet)		
TOTAL: 30 PERIODS		

PRACTICAL EXERCISES:

1. Speech Signal Analysis
2. Spectrogram Analysis
3. Feature Extraction Using MFCC
4. Speech Enhancement Using Spectral Subtraction
5. Voice Activity Detection (VAD)
6. Basic Automatic Speech Recognition (ASR)
7. Speaker Recognition
8. Text-to-Speech (TTS) Synthesis

TOTAL:30 PERIODS

COURSE OUTCOMES:

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

CO1:	Outline the basic concepts and components of speech processing systems, including human speech production and perception
CO2:	Analyze speech signals using time-domain and frequency-domain methods, including cepstral analysis and MFCCs
CO3:	Apply speech enhancement techniques such as spectral subtraction and adaptive filtering to improve speech quality
CO4:	Develop automatic speech recognition systems using feature extraction, acoustic modeling, and language modeling techniques
CO5:	Make use of speaker recognition systems for identification and verification purposes using relevant feature extraction methods
CO6:	Model text-to-speech systems using various synthesis techniques, including formant, concatenative, and neural network-based synthesis

TEXT BOOKS:	
1	Shaila D. Apte, Speech and Audio Processing, Wiley India (P) Ltd, New Delhi, 2012
2	Philipos C. Loizou, Speech Enhancement Theory and Practice, Second Edition, CRC Press, Inc., United States, 2013
3	Lawrence Rabiner and Biing-Hwang Juang, Fundamentals of Speech Recognition, 1st Edition, Prentice Hall International, 1993.
4	Dong Yu and Li Deng, *Automatic Speech Recognition: A Deep Learning Approach*, 1st Edition, Springer, 2015.
REFERENCES:	
1	Christian Müller "*Speaker Classification I: Fundamentals, Features, and Methods"*, 1st Edition, Springer, 2007.
2	Paul Taylor, "*Text-to-Speech Synthesis"*, 1st Edition, Cambridge University Press, 2009.
3	A.M. Kondoz, "*Digital Speech: Coding for Low Bit Rate Communication Systems"*, 2nd Edition, Wiley, 2004.

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	3	2	2	1	2	-	3	-	1	3	-	3	1	3
3	3	2	1	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	-	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**

23AD052	EVOLUTIONARY COMPUTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand Evolutionary Computation Principles
- To develop a deep understanding of Genetic Algorithms
- To explore various advanced evolutionary algorithms
- To solve multi-criteria decision-making problems.
- To analyze the integration of evolutionary algorithms with other techniques

UNIT I	INTRODUCTION TO EVOLUTIONARY COMPUTATION	9

Definition and overview of evolutionary computation- Key concepts: population, fitness, selection, mutation, crossover - Historical background and inspiration from natural evolution - Types of evolutionary algorithms: Genetic Algorithms, Genetic Programming, and Evolutionary Strategies. Applications of evolutionary computation.

UNIT II	GENETIC ALGORITHMS	9

Structure and working of Genetic Algorithms- Selection methods such as roulette wheel, tournament, rank-based selection - Crossover techniques like one-point, two-point, uniform crossover - Mutation operators: bit-flip, swap, scramble -Fitness function and problem representation- Case studies and applications of Gas

UNIT III	ADVANCED EVOLUTIONARY ALGORITHMS	9

Evolutionary Programming and Evolutionary Strategies - Genetic Programming: representation and operators - Differential Evolution: principles and working - Particle Swarm Optimization (PSO): swarm behavior, velocity, and position updates - Comparative analysis of various evolutionary algorithms

UNIT IV	MULTI-OBJECTIVE EVOLUTIONARY ALGORITHMS	9

Introduction to multi-objective optimization problems - Pareto

optimality and dominance concepts - NSGA-II (Non-dominated Sorting Genetic Algorithm) - SPEA2 (Strength Pareto Evolutionary Algorithm) - Applications of MOEAs in engineering and optimization		
UNIT V	**HYBRID EVOLUTIONARY ALGORITHMS AND APPLICATIONS**	**9**
Hybridization with local search methods (memetic algorithms) - Fuzzy logic and evolutionary algorithms - Applications in machine learning and data mining - Real-world problem-solving using hybrid algorithms - Recent trends and future directions in evolutionary computation		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the core principles of evolutionary computation
CO2:	Apply genetic algorithms for optimization problems
CO3:	Build and Implement advanced algorithms such as Genetic Programming
CO4:	Apply the concept of multi-objective evolutionary algorithms
CO5:	Solve the problems using Hybrid techniques
CO6:	Apply ethical and Practical Considerations in evolutionary computation.

TEXT BOOKS:	
1	Eiben, A.E., & Smith, J.E. "Introduction to Evolutionary Computing", 2nd Edition, Springer, 2015.
2	Goldberg, D.E. "Genetic Algorithms in Search, Optimization, and Machine Learning", 1st Edition, Addison-Wesley, 1989.
3	De Jong, K.A. "Evolutionary Computation: A Unified Approach", 1st Edition, MIT Press, 2006.
4	Deb, K." Multi-Objective Optimization Using Evolutionary Algorithms", 1st Edition, Wiley, 2001.

REFERENCES:	
1	Price, K.V., Storn, R.M., & Lampinen, J.A. "Differential Evolution: A Practical Approach to Global Optimization", 1st Edition, Springer, 2005.
2	Bonabeau, E., Dorigo, M., & Theraulaz, G. "Swarm Intelligence: From Natural to Artificial Systems", 1st Edition, Oxford University Press, 1999.
3	Blum, C., Ochoa, G., & Alba, E. "Hybrid Metaheuristics: Research and Applications", 1st Edition, Springer, 2011.
4	Langdon, W.B., & Cantú-Paz, E. "Fuzzy Evolutionary Computation: Recent Advances and Applications", 1st Edition, Springer, 2002.

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

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	6

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

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

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

23AD054	WEB SECURITY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- 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

UNIT I	FUNDAMENTALS OF WEB APPLICATION SECURITY	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

UNIT II	SECURE DEVELOPMENT AND DEPLOYMENT	9

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)

UNIT III	SECURE API DEVELOPMENT	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 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

23AD057	INFORMATION SECURITY ANALYSIS AND AUDIT	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	FUNDAMENTALS OF INFORMATION SECURITY	9

Information Security: Threats, Frauds, Thefts, Malicious Hackers, Malicious Code, Denial of Services Attacks, Social Engineering - Vulnerability – Risk: Risk definition, Types Risk – an introduction Business Requirements Information Security - Definitions Security Policies: Tier1 (Origination Level), Tier2 (Function Level), Tier3 (Application/Device Level), Procedures, Standards, Guidelines

UNIT II	SECURITY ARCHITECTURE AND DESIGN	9

Service – Oriented Architecture and Web Service Security – Analysis of Covert Channel – ISO Standards – Security Framework - BS 7799 and ISO 27000 Family - Federal Information Systems Management Act - Management Frameworks - Zachman Framework - Calder–Moir IT Governance Framework - Balanced Scorecard.

UNIT III	ACCESS CONTROL TECHNIQUES	9

Authentication Tokens – Roles of Tokens – Access Control Administration – Accountability – Need for Accountability – Requirements of accountability – Accountability Implementation

– Methods of Attack: Rootkits , types, installation – Rootkits and Security issues – Rootkit Prevention – other malicious software: Trickbot, FinFisher, Turla, DoublePulsar.		
UNIT IV	**CLOUD AND VIRTUALIZATION SECURITY**	**9**
Cloud Security Models: Iaas, Paas, Saas – Security Challenges in Cloud – Virtualization Security – Container Security: Docker, Kubernetes - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key		
UNIT V	**SECURITY AUDIT AND EMERGING TRENDS**	**9**
Security Auditing Techniques - Internal vs. External Audits - Compliance Checks: HIPAA, SOX - Auditing Tools: Wireshark, Snort **Emerging Trends and Future of Information Security:** AI and Machine Learning in Cybersecurity - Blockchain Security Applications - Quantum Computing Threats.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the fundamental concepts of information security.	
CO2:	Build and Implement security policies and frameworks.	
CO3:	Identify and analyze security risks and vulnerabilities in information systems.	
CO4:	Illustrate the application of cloud and virtualization security.	
CO5:	Make use of tools for penetration testing, vulnerability scanning, and security auditing	
CO6:	Make use of AI and ML and other recent technologies in information security.	
TEXT BOOKS:		
1	Harold F Tipton, Micki Krause, "Information Security Management handbook", 6th Edition, Auerbach Publications, 5 April 2012.	

2	Peter Kim, "The Hacker Playbook: Practical Guide to Penetration Testing", 13 March 2014
REFERENCES:	
1	Shon Harris and Fernando Maymi, "CISSP All-in-One Exam Guide", 7th Edition, McGrawHill Education, 1 June 2016.
2	Ronald L. Krutz, Russel Dean Vines, "The CISSP Prep Guide: Gold Edition", Gold Edition, Wiley Publication, 31 Oct 2002
3	Ed Tittel, Mike Chapple, James Michael Stewart, "Certified Information Systems Security Professional, Study Guide", 6th Edition, Sybex Publication, 06 July 2012 5. ISO/ IEC 27002: 2005.
4	RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi, "Mastering Cloud Computing Foundations and Applications Programming", Morgan Kaufmann publisher, 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	3	2	1	1	1	-	-	-	1	1	1	1	3	1	-
3	3	2	1	1	2	1	1	2	3	3	2	1	3	2	2
4	2	1	-	-	2	1	-	2	3	3	2	1	2	2	2
5	3	2	1	1	3	1	1	2	3	3	2	1	3	3	2
6	3	2	1	1	1	1	1	2	2	3	2	1	3	1	2
Overall Correlation	3	2	1	1	2	1	1	2	3	3	2	1	3	2	2

23AD058	STEGANOGRAPHY AND DIGITAL WATERMARKING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To develop an understanding of digital watermarking and steganography basics, various approaches, characteristics and application domains.
- To apply digital watermarking as an authentication tool for distribution of content over the Internet and Steganography techniques for covert communication.
- To understand the basics of the counter measures like steganalysis for assessing the data hiding methods.
- To enable to evaluate and choose appropriate data hiding technique based on a multitude of security factors.
- To explore the protocols designed for secure and anonymous digital watermarking in practical scenarios.

UNIT I	STEGANOGRAPHY	8

Introduction - Text Steganography _ Image Steganography: Data Hiding in Raw (BMP) Images - LSB (Least Significant Bit) Embedding - Data Hiding by Mimicking Device Noise (Stochastic Modulation). Data Hiding in Palette (GIF) Images - Palette Formats (GIF) - Hiding by Decreasing Colour Depth, Gifshuffle, - Optimal Palette Parity Assignment. Data Hiding in JPEG Images - JPEG Format - J-Steg Data Hiding Algorithm _ Hiding in Spatial Domain _ Hiding in Transform Domain _ Image Quality Metrics.

UNIT II	AUDIO STEGANOGRAPHY	8

Temporal Domain Techniques - Low-Bit Encoding - Echo Hiding - Hiding in Silence Intervals. Transform Domain Hiding Techniques - Magnitude Spectrum - Tone Insertion - Phase Coding - Amplitude Coding - Cepstral Domain _ Codecs Domain: Codebook Modification _ Bit stream Hiding _ Audio Quality Metrics

UNIT III	VIDEO STEGANOGRAPHY	6
Introduction _ Video Streams - Substitution-Based Techniques - Transform Domain Techniques - Adaptive Techniques - Format-Based Techniques - Cover Generation Techniques _ Video Quality Metrics - Perceptual Transparency Analysis - Robustness against Compression - Robustness against Manipulation.		
UNIT IV	**DATA HIDING**	**5**
Relationship between Watermarking and Steganography. Digital Watermarking Basics: Models of Watermarking, Basic Message Coding, Error Coding. Digital Watermarking Theoretic Aspects: Mutual Information and Channel Capacity, Designing a Good Digital Mark, Theoretical Analysis of Digital Watermarking _ Types of Watermarking _ Fragile, Semi-Fragile.		
UNIT V	**SPREAD SPECTRUM WATERMARKING**	**9**
Transform Domain Watermarking, Quantization Watermarking. Protocols: Buyer Seller Watermarking Protocols, Efficient and Anonymous Buyer-Seller Watermarking Protocol.		
TOTAL: 30 PERIODS		

PRACTICAL EXERCISES:

1. Perform steganography in text, image and audio.
2. Data hiding in different image types png, GIF, jpeg, bmp etc
3. Implement any steganography algorithm
4. Reversible data hiding in images
5. Steganography in encrypted images Two-layer security
6. Steganography in transform domain DCT, DWT, Curvelet etc.,
7. Case study on cover generation and cover detection technique.
8. Implement digital watermarking with difference between steganography and watermarking
9. Case study on attacks on watermarks
10. Case study on LSB embedding and LSB steganalysis.

TOTAL : 30 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Summarize watermarking and steganography fundamental concepts and principles
CO2:	Identify and assess different types of data hiding techniques in various image formats and various data hiding methods
CO3:	Explain the block code and its usage for covert communication
CO4:	Demonstrate the use of watermarking for copyright protection and steganography for secret communication in various digital media
CO5:	Construct and implement efficient data hiding methods
CO6:	Infer the strength of any data hiding algorithm against steganalysis techniques.
TEXT BOOKS:	
1	J. Fridrich, "Steganography in Digital Media: Principles, Algorithms, and Applications", Cambridge: Cambridge University Press, 2009.
2	I. J. Cox, M. L. Miller, J. A. Bloom, T. Kalker, and J. Fridrich, "Digital Watermarking and Steganography", 2nd Ed. Amsterdam: Morgan Kaufmann Publishers In, 2007.
REFERENCES:	
1	R. C. Gonzalez, R. E. Woods, D. J. Czitrom, and S. Armitage, "Digital Image Processing", 3rd Ed. United States: Prentice Hall, 2007.
2	P. Wayner, "Disappearing Cryptography: Information hiding: Steganography and Watermarking", 3rd ed. Amsterdam: Morgan Kaufmann Publishers In, 2008.
3	M. Arnold, M. Schmucker, and S. D. Wolthusen, "Techniques and applications of digital Watermarking and content protection", 2nd Ed. Boston, MA: Artech House Publishers, 2003.

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	2	1	-	-	2	1	-	1	-	-	-	2	2	2	1
3	2	1	-	-	1	-	-	-	-	-	-	3	2	1	-
4	2	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

23AD059	UTILITY COMPUTING	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

23AD060	CLOUD DATABASES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- 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

UNIT I	DISTRIBUTED AND CLOUD DATABASE	9

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.

UNIT II	CLOUD DATABASE SERVICE MODELS	9

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)

UNIT III	CLOUD DATA STORAGE AND MANAGEMENT	9

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

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

23CB043	SECURITY IN CLOUD COMPUTING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand cloud computing architecture and the shared responsibility model in security.
- To explore various security challenges specific to cloud environments.
- To learn techniques for securing data, applications, and networks in cloud platforms.
- To examine compliance, identity management, and access control for cloud security.
- To analyse incident response, risk management, and disaster recovery strategies in cloud computing.

UNIT I	INTRODUCTION TO CLOUD SECURITY FUNDAMENTALS	6

Overview of Cloud Computing: Cloud models (public, private, hybrid), and service models (IaaS, PaaS, SaaS). Security Challenges in Cloud: Multi-tenancy, data privacy, data location, data breaches, and insider threats. Shared Responsibility Model: Division of security responsibilities between cloud providers and customers. Cloud Security Architectures: Security architecture for AWS, Azure, and Google Cloud.

UNIT II	DATA SECURITY IN CLOUD	6

Data Security and Privacy: Data lifecycle, data classification, data protection mechanisms. **Encryption Techniques**: Symmetric and asymmetric encryption, key management. **Data Loss Prevention (DLP)**: Strategies to prevent data leakage. **Secure Data Storage**: Techniques and tools for secure storage in cloud environments.

UNIT III	APPLICATION AND NETWORK SECURITY IN CLOUD	6

Application Security: Secure software development for cloud applications, secure APIs. **Network Security in Cloud**: Firewalls, Intrusion Detection Systems (IDS), and Virtual Private Clouds

(VPCs). **Web Application Security**: Cloud-based web security, protecting against threats such as SQL injection and XSS. **Cloud Security Tools**: Introduction to cloud-native security tools and third-party solutions

UNIT IV	**COMPLIANCE, IDENTITY, AND ACCESS MANAGEMENT**	**6**

Compliance in Cloud: Standards like GDPR, HIPAA, and ISO/IEC 27017. Identity and Access Management (IAM): Role-based access control (RBAC), Single Sign-On (SSO), and Multi-Factor Authentication (MFA). Access Control Models: Role-based and attribute-based access control for cloud resources. Identity Federation: Integrating cloud identity with enterprise identity solutions.

UNIT V	**INCIDENT RESPONSE, RISK MANAGEMENT, AND DISASTER RECOVERY**	**6**

Incident Response in Cloud: Planning, monitoring, and responding to security incidents. **Risk Management**: Identifying, assessing, and mitigating risks in cloud environments. **Disaster Recovery**: Backup strategies, recovery models, and testing disaster recovery plans. **Cloud Security Standards**: Overview of standards and frameworks like CSA, NIST, and ENISA

TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1. Case study on shared responsibility models across major cloud providers.
2. Hands-on activity to review cloud infrastructure and identify potential security gaps.
3. Implementing encryption for data stored in the cloud.
4. Configuring and testing Data Loss Prevention (DLP) policies on a cloud platform.
5. Configuring firewalls and VPCs in a cloud environment.
6. Conducting a vulnerability assessment on a cloud-hosted web application.

7. Setting up IAM policies and roles for cloud resources. 8. Configuring SSO and MFA in a cloud environment. 9. Developing an incident response plan for a cloud infrastructure. 10. Configuring backup and disaster recovery settings in a cloud service.	
TOTAL:30 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Identify and describe the security challenges unique to cloud computing and evaluate the shared responsibility model.
CO2:	Apply techniques for data security, including encryption and secure data storage, in cloud environments.
CO3:	Examine various methods for ensuring application and network security in cloud services.
CO4:	Make use of the tools for compliance requirements, access control, and identity management systems for cloud security.
CO5:	Develop strategies for incident response and risk management specific to cloud infrastructures.
CO6:	Evaluate cloud security standards and implement disaster recovery strategies for cloud environments.
TEXT BOOKS:	
1	Mather, Tim, Subra Kumaraswamy, and Shahed Latif. "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance." 1st Edition, O'Reilly Media, 2009.
2	Winkler, Vic (J.R.). "Securing the Cloud: Cloud Computer Security Techniques and Tactics." 1st Edition, Syngress, 2011
REFERENCES:	
1	Samani, Raj, Jim Reavis, and Brian Honan. "CSA Guide to Cloud Computing: Implementing Cloud Privacy and Security." 1st Edition, Syngress, 2015.

2	Kumar, Saurabh. "Cloud Computing: Insights into New-Era Infrastructure." 1st Edition, Wiley India, 2011.
3	Winkler, J.R. (Vic). "Securing the Cloud: Cloud Computing Security Techniques and Tactics." 1st Edition, Syngress, 2011.
4	Krutz, Ronald L., and Russell Dean Vines. "Cloud Security: A Comprehensive Guide to Secure Cloud Computing." 1st Edition, Wiley, 2010

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