KCG

COLLEGE OF TECHNOLOGY

AFFILIATED TO ANNA UNIVERSITY | AUTONOMOUS

REGULATIONS - 2023

CURRICULUM AND SYLLABI

(2023-2024)

B.E. COMPUTER SCIENCE AND ENGINEERING

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 COMPUTER SCIENCE AND ENGINEERING

The department of Computer Science and Engineering desires to become a prominent centre of excellence for producing competent IT professionals for providing software and software enabled solutions.

MISSION OF COMPUTER SCIENCE AND ENGINEERING

- Provide quality education in the field of computer science and engineering & related domains
- Facilitate socially responsive research and innovation
- Inculcate professional behaviour, a spirit of entrepreneurship and commitment to the progress of the nation
- Accommodate evolving software development tools and required implementation facilities

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

The graduates will:

PEO 1	Have successful career as software professional (or) entrepreneur (or) researcher in computer science and relevant disciplines.
PEO 2	Analyze, design, develop, test and deploy appropriate solutions for real world computing problems.
PEO 3	Apply software engineering principles at process, project and product levels.
PEO 4	Exhibit ethical attitude and social responsibility 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 software engineering principles, computer hardware and architecture, principles of algorithms & programming skills to analyze complex problems in computer science engineering and related domains.
PSO 02	Use compiler tool, CASE tool, graphic tool, app development tools, network simulator, security and analysis tools, cloud and grid tool kits, database management tools, web development frameworks for providing appropriate solutions.
PSO 03	Demonstrate professional & ethical behavior while providing IT based solutions.

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KCG COLLEGE OF TECHNOLOGY
AUTONOMOUS
REGULATIONS 2023
B.E. COMPUTER SCIENCE AND ENGINEERING
CHOICE BASED CREDIT SYSTEM
CURRICULA FOR SEMESTERS I TO VIII

SEMESTER–I

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
	23IP101	Induction Programme		-	-	-	-	-
THEORY								
1	23HS101	Essential Communication	HSMC	3	0	0	3	3
2	23MA101	Matrices and Calculus	BSC	3	0	0	3	3
3	23CS101	Programming in C	ESC	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	23CS121	C Programming Laboratory	ESC	0	0	4	4	2
8	23HS121	Communication Skills Laboratory	HSMC	0	0	2	2	1
9	23CS122	Computational Thinking	ESC	0	0	2	2	1
10	23HS122	General Clubs / Technical Clubs / NCC / NSS / Extension Activities	HSMC	0	0	2	2	1*
TOTAL				16	0	14	30	22

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

SEMESTER –II

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23HS201/ 23HS202	Professional English/ Foreign language	HSMC	3	0	0	3	3
2	23MA204	Probability and Statistics	BSC	3	1	0	4	4
3	23PH205	Physics for Information Science	BSC	3	0	0	3	3
4	23CS201	Data Structures using C	PCC	3	0	0	3	3
5	23HS203	Tamils and Technology	HSMC	1	0	0	1	1
THEORY AND PRACTICALS								
6	23EE281	Basic Electrical and Electronics Engineering	ESC	2	0	2	4	3
7	23ME211	Engineering Graphics	ESC	3	0	2	5	4
PRACTICALS								
8	23ME221	Engineering Practices Laboratory	ESC	0	0	4	4	2
9	23CS221	Data Structures Using C 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 L	T	P	Total Contact Periods	Credits
THEORY								
1	23MA202	Discrete Mathematics	BSC	3	1	0	4	4
2	23CS301	Object Oriented Programming	PCC	3	0	0	3	3
3	23CS302	Database Management Systems	PCC	3	0	0	3	3
4	23HS301	Universal Human Values and Ethics	HSMC	3	0	0	3	3
THEORY AND PRACTICALS								
5	23CS311	Digital Principles and System Design	PCC	3	0	2	5	4
6	23CS312	Design and Analysis of Algorithms	PCC	3	0	2	5	4
PRACTICALS								
7	23CS321	Object Oriented Programming Laboratory	PCC	0	0	4	4	2
8	23CS322	Database Management Systems 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	23MA301	Linear Algebra	BSC	3	1	0	4	4
2	23CS401	Operating Systems	PCC	3	0	0	3	3
3	23CS402	Artificial Intelligence	PCC	3	0	0	3	3
4	23CS403	Theory of Computation	PCC	3	0	0	3	3
5	23CS404	Computer Architecture	PCC	3	0	0	3	3
THEORY AND PRACTICALS								
6	23CS411	Software Engineering	PCC	3	0	2	5	4
PRACTICALS								
7	23CS421	Operating Systems Laboratory	PCC	0	0	4	4	2
8	23CS422	Artificial Intelligence Laboratory	PCC	0	0	4	4	2
9	23ES491	Aptitude and Logical Reasoning – 1	EEC	0	0	2	2	1*
TOTAL				18	1	12	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 L	T	P	Total Contact Periods	Credits
THEORY								
1	23RE501	Research Methodology and Intellectual Property Rights	ESC	2	0	0	2	2
2	23CS501	Computer Networks	PCC	3	0	0	3	3
3		Department Elective – 1	DEC	-	-	-	-	3
4		Department Elective – 2	DEC	-	-	-	-	3
5		Open Elective – 1 (Emerging Technology)	OEC	3	0	0	3	3
THEORY AND PRACTICALS								
6	23CS511	Compiler Design	PCC	3	0	2	5	4
PRACTICALS								
7	23CS521	Computer Networks Laboratory	PCC	0	0	4	4	2
8	23CS522	Mini Project	EEC	0	0	3	3	2
9	23CS523	Summer Internship	EEC	0	0	0	0	1
10	23ES591	Aptitude and Logical Reasoning - 2	EEC	0	0	2	2	1*
TOTAL				-	-	-	-	23

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

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	credits
				L	T	P		
THEORY								
1	23CS601	Cryptography and Cyber Security	PCC	3	0	0	3	3
2		Department Elective – 3	DEC	-	-	-	-	3
3		Department Elective – 4	DEC	-	-	-	-	3
4		Open Elective – 2 (Management / Safety Courses)	OEC	3	0	0	3	3
THEORY AND PRACTICALS								
5	23CE611	Environmental Science and Engineering	ESC	3	0	2	5	4
6	23CS611	Internet Programming	PCC	3	0	2	5	4
PRACTICALS								
7	23CS621	Project Work - Phase 1	EEC	0	0	4	4	2
8	23CS622	Technical Training	EEC	0	0	2	2	1
9	23CS623	Technical Seminar – 1	ESC	0	0	2	2	1
TOTAL				-	-	-	-	24

SEMESTER -VII

Sl. No.	Course Code	Course Title	Cate Gory	periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1		Open Elective - 3 (Management Courses)	OEC	3	0	0	3	3
2		Department Elective – 5	DEC	-	-	-	-	3
3		Department Elective – 6	DEC	-	-	-	-	3
4	23CS701	Technical Comprehension	EEC	2	0	0	2	2
THEORY AND PRACTICALS								
5	23CS711	Machine Learning and its Applications	PCC	3	0	2	5	4
PRACTICALS								
6	23CS721	Project Work – Phase 2	EEC	0	0	6	6	3
7	23CS722	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	23CS821/ 23CS822	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: CLOUD COMPUTING

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23IT031	Distributed Computing	DEC	2	0	2	4	3
2	23IT032	Cloud Services Management	DEC	2	0	2	4	3
3	23IT033	Virtualization	DEC	2	0	2	4	3
4	23IT034	Cloud Database Management	DEC	2	0	2	4	3
5	23IT035	Storage Technologies	DEC	2	0	2	4	3
6	23IT036	Security and Privacy in Cloud	DEC	2	0	2	4	3
7	23IT037	Stream Processing	DEC	2	0	2	4	3
8	23IT038	Cloud Web Services	DEC	2	0	2	4	3

VERTICAL 2 : 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	23CS036	Web Application Security	DEC	2	0	2	4	3
7	23CS037	Advanced Java Programming	DEC	2	0	2	4	3
8	23CS038	Python Full Stack Development with Machine Learning (Industry Supported Course)	DEC	2	0	2	4	3

VERTICAL 3 : ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23AD040	Natural Language Processing	DEC	2	0	2	4	3
2	23AD045	Data Exploration and Visualization	DEC	2	`0	2	4	3
3	23AD046	Knowledge Engineering	DEC	3	0	0	3	3
4	23IT039	Data Science	DEC	2	0	2	4	3
5	23IT040	Deep Learning	DEC	2	0	2	4	3
6	23IT041	Cognitive Systems	DEC	2	0	2	4	3
7	23IT042	Big Data Analytics	DEC	2	0	2	4	3
8	23IT043	Data Mining and Warehousing	DEC	2	0	2	4	3

VERTICAL 4: NETWORK AND SECURITY

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23CB031	Ethical Hacking	DEC	2	0	2	4	3
2	23CB034	Security in Computing	DEC	2	0	2	4	3
3	23CS039	Crypto currency and Blockchain Technology	DEC	3	0	0	3	3
4	23EC049	Network Essentials	DEC	2	0	2	4	3
5	23EC050	Network Engineering	DEC	2	0	2	4	3
6	23EC051	Switching, Routing and Wireless Essentials	DEC	2	0	2	4	3
7	23EC052	Enterprise Networking, Security and Automation	DEC	2	0	2	4	3
8	23EC053	Network Design	DEC	3	0	0	3	3

VERTICAL 5 : EMERGING TECHNOLOGIES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23AD043	Intelligent Robots	DEC	3	0	0	3	3
2	23CS040	AR VR Technology	DEC	2	0	2	4	3
3	23CS041	Game Development	DEC	2	0	2	4	3
4	23CS042	IoT based Smart Systems	DEC	2	0	2	4	3
5	23CS043	Quantum Computing	DEC	3	0	0	3	3
6	23CS044	Explainable AI	DEC	3	0	0	3	3
7	23CS045	Autonomous Vehicles	DEC	3	0	0	3	3
8	23CS046	AI in Industry	DEC	3	0	0	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	23OCB971	Cyber Law	OEC	3	0	0	3	3
4	23OEC972	Fundamentals of Wearable Devices	OEC	3	0	0	3	3
5	23OED971	Introduction to Design Thinking	OEC	3	0	0	3	3
6	23OED972	Intellectual Property Law	OEC	3	0	0	3	3
7	23OEE971	Renewable Energy Technologies	OEC	3	0	0	3	3
8	23OEE973	Electric and Hybrid Vehicles	OEC	3	0	0	3	3
9	23OMA971	Resource Management Techniques	OEC	3	0	0	3	3
10	23OMA972	Graph Theory	OEC	3	0	0	3	3
11	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+1*	11	6					22
Semester II	4	7	9	5			1*	25
Semester III	3	4	0	18			1*	25
Semester IV		4		20			1*	24
Semester V			2	9	6	3	3+1*	23
Semester VI			5	7	6	3	3	24
Semester VII			2	4	6	3	5	20
Semester VIII							10	10
Total	**12**	**26**	**24**	**63**	**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**										

<table>
<tr><td rowspan="2">23MA101</td><td rowspan="2">MATRICES AND CALCULUS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">

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

</td></tr>
<tr><td>UNIT I</td><td colspan="4">MATRICES</td><td>9</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>UNIT II</td><td colspan="4">DIFFERENTIAL CALCULUS</td><td>9</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>UNIT III</td><td colspan="4">FUNCTIONS OF SEVERAL VARIABLES</td><td>9</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>UNIT IV</td><td colspan="4">INTEGRAL CALCULUS</td><td>9</td></tr>
<tr><td colspan="6">Definite and Indefinite integrals - Substitution rule - Techniques of</td></tr>
</table>

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	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23CS101	PROGRAMMING IN C	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic constructs of C Language.
- To develop C Programs using basic programming constructs.
- To develop C programs using arrays and strings.
- To develop modular applications in C using functions and pointers.
- To develop applications in C using structures and Unions.
- To understand file handling in C.

UNIT I	BASICS OF C PROGRAMMING	9

Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Preprocessor directives - Compilation process.

UNIT II	ARRAYS AND STRINGS	9

Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.

UNIT III	FUNCTIONS AND POINTERS	9

Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference.

UNIT IV	STRUCTURES AND UNION	9
Structure - Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility.		
UNIT V	**FILE PROCESSING**	**9**
Files- Types of file processing: Sequential access, Random Access- Sequential access file- Random access file- Command line arguments.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Describe the basic constructs of C Programming Language.
CO2:	Develop simple applications using C basic constructs.
CO3:	Construct and Implement applications using Arrays and Strings.
CO4:	Develop and Implement applications using Functions and pointers.
CO5:	Construct applications using structures and Unions.
CO6:	Demonstrate File handling concepts and Command line arguments.
TEXT BOOKS:	
1	Reema Thareja, "Programming in C", Oxford University press, Second Edition, 2016.
2	Kernighan B.W and Ritchie D.M, "The C Programming language", Second Edition, Pearson Education, 2015.
REFERENCES:	
1	Paul Deitel and Harvey Deitel, "C How to program with an introduction to C++", Eighth Edition, Pearson Education,2018.
2	Yashwant Kanetkar, "Let us C", seventeenth Edition, BPB Publications, 2020.

3	Anita Goel and Ajay Mittal, “Computer Fundamentals and programming in C”, First Edition, Pearson Education, 2013.
4	Byron S. Gotfried, “Schaum’s outline of Theory and Problems of Programming with C”, McGraw-Hill Education,1996.
5	PradipDey, ManasGhosh, “Computer Fundamentals and Programming in C” Second Edition, Oxford University Press, 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	3	1	-
2	3	2	1	1	1	-	-	-	1	1	1	1	3	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	2	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	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

<table>
<tr><td rowspan="2">23HS102</td><td rowspan="2">HERITAGE OF TAMILS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">• Explain the classical literature of Tamil and highlight notable Tamil poets.
• Explain the creation of traditional Tamil musical instruments.
• Explain the sports and games associated with Tamil heritage.
• Explore the education and literacy practices during the Sangam period.
• Explain the contributions of Tamils to the Indian freedom struggle.
• Explain the development and history of printing in Tamil Nadu.</td></tr>
<tr><td>UNIT I</td><td colspan="4">LANGUAGE AND LITERATURE</td><td>3</td></tr>
<tr><td colspan="6">Language Families in India – Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature – Management Principles in Thirukural – Tamil Epics and Impact of Buddhism & Jainism in Tamil Land – Bakthi Literature Azhwars and Nayanmars – Forms of minor Poetry – Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidhasan.</td></tr>
<tr><td>UNIT II</td><td colspan="4">HERITAGE – ROCK ART PAINTINGS TO MODERN ART – SCULPTURE</td><td>3</td></tr>
<tr><td colspan="6">Hero stone to modern sculpture – Bronze icons – Tribes and their handicrafts – Art of temple car making – – Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments – Mridhangam, Parai, Veenai, Yazh and Nadhaswaram – Role of Temples in Social and Economic Life of Tamils.</td></tr>
<tr><td>UNIT III</td><td colspan="4">FOLK AND MARTIAL ARTS</td><td>3</td></tr>
<tr><td colspan="6">Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu,</td></tr>
</table>

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	தமிழக வரலாறு-மக்களும் பண்பாடும்-கே.கேபிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

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	**26-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23CY111	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	1	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

23CS121	C PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To familiarize with C programming constructs.
- To develop programs in C using basic constructs.
- To develop programs in C using arrays.
- To develop applications in C using strings, pointers, functions.
- To develop applications in C using structures.
- To develop applications in C using file processing.

PRACTICALS :

1. I/O statements, operators, expressions.
2. Decision-making constructs: if-else, goto, switch-case, break-continue.
3. Loops: for, while, do-while.
4. Arrays: 1D and 2D, multi-dimensional arrays, traversal.
5. Strings: operations.
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7. Recursion.
8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers.
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
10. Files: reading and writing, File pointers, file operations, random access, processor directives.

TOTAL: 60 PERIODS

LABORATORY REQUIREMENT FOR BATCH OF 30 STUDENTS:

HARDWARE : Standalone desktops – 30 No's

SOFTWARE: : C / C++ / Equivalent Compiler

COURSE OUTCOMES:

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

CO1:	Demonstrate knowledge on C programming constructs.

CO2:	Develop programs in C using basic constructs.
CO3:	Develop programs in C using arrays and strings
CO4:	Develop applications in C using functions and pointers.
CO5:	Develop applications in C using structures and union.
CO6:	Develop applications in C using file processing.

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

23CS122	COMPUTATIONAL THINKING	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To formulate problems in a way that enables the use of a computer to solve them.
- To logically organize and analyze data.
- To automate solutions through algorithmic thinking.
- To identify and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources.
- To generalize and transfer this problem solving process to wide variety of problems

MODULE I	INTRODUCTION TO ALGORITHMS	10

Algorithmic thinking - Data abstraction and representation - Abstraction and translation of everyday data for use on a computer - Decomposing a complex problem.

Suggested Activities:

- Explore algorithm design by creating oral algorithms.
- Abstract the essential details of everyday objects.
- Translate the description of everyday objects into data types and variables.
- Decompose a complex problem into discrete steps.

Suggested Evaluation Methods:

- Evaluation of the oral algorithms and computer data.

MODULE II	PROGRAMMING	10

Strategies for decomposition and algorithm design - Divide and Conquer - Simple program implementations - Overall data representation, abstraction and algorithm design - Program implementations.

Suggested Activities: • Design a simple algorithm for solving the problem. • External learning: Study of different strategies for decomposition and algorithm design. • Examine sample input and expected output and develop strategies to decompose the problem. • Use decomposition to break the problem into smaller problems and algorithmic design to plan a solution strategy. • External learning: Simple program implementations. • Examples of Data representation, abstraction, analysis and algorithm design. **Suggested Evaluation Methods:** • Whiteboard presentations of the decomposition and algorithm. • Evaluation of the developed strategies. • Whiteboard presentations of the Data analysis and Algorithm design. • Demonstration of the implemented programs.		
MODULE III	**COMPUTATIONAL THINKING**	**10**
Application of computational thinking to simple real world problems - program implementation of decomposed modules. **Suggested Activities:** Application to simple real-world problems. **Suggested Evaluation Methods:** Evaluation of the solutions to the real world problems.		
		TOTAL: 30 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		

CO1:	Formulate problems in a way that enables the use of a computer to solve them.
CO2:	Identify, organize and analyze the data.
CO3:	Utilize algorithmic thinking to automate solutions.
CO4:	Identify and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources.
CO5:	Apply and transfer the problem solving process to wide variety of problems.
CO6:	Apply algorithmic strategies to real-world problems using basic programming techniques.
REFERENCES:	
1	Exploring Computational Thinking.
2	https://edu.google.com/resources/programs/exploring-computational-thinking/

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

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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	-	-	-

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

COURSE OBJECTIVES:

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

UNIT I	PROBABILITY AND RANDOM VARIABLES	9+3

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

UNIT II	TWO- DIMENSIONAL RANDOM VARIABLES	9+3

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

UNIT III	ESTIMATION THEORY	9+3

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

UNIT IV	NON- PARAMETRIC TESTS	9+3

Introduction - The Sign test - The Signed - Rank test - Rank - sum

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

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply the fundamental knowledge of the concepts of probability and one dimensional random variables in engineering.
CO2:	Apply standard probability distributions to real life phenomenon.
CO3:	Apply the basic concepts of two dimensional random variables in engineering applications.
CO4:	Apply the concept of estimation theory for small and large samples in real life problems.
CO5:	Apply the notion of sampling distributions and statistical techniques used in engineering and management problems.
CO6:	Apply the basic concepts of classifications of statistical quality control in the field of engineering.
TEXT BOOKS:	
1	Johnson. R.A., Miller. I.R and Freund. J.E, " Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
2	Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata Mc Graw Hill, 4th Edition, 2007.
REFERENCES:	
1	Dr.P. Sivaramakrishna Das, C. Vijayakumari, ―A text book of probability and statistics‖, Pearson Publications.
2	Gupta. S.C. and Kapoor. V. K., ―Fundamentals of Mathematical Statistics‖, Sultan Chand & Sons, New Delhi, 12th Edition, 2020.

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

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

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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**	**-**	**-**

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23CS201	DATA STRUCTURES USING C	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of ADTs.
- To learn linear data structures – lists, stacks, and queues.
- To understand non-linear data structures – trees and graphs.
- To understand sorting, searching and hashing algorithms.
- To apply Tree and Graph structures.

UNIT I	LISTS	9

Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists –Applications of lists – Polynomial ADT.

UNIT II	STACKS AND QUEUES	9

Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions- Infix to Postfix conversion – Queue ADT – Operations – Circular Queue –DeQueue – Applications of Queues.

UNIT III	TREE STRUCTURES	9

Tree ADT – Tree Traversals - Binary Tree ADT – Expression trees – Binary Search Tree ADT –Priority Queue (Heaps) – Binary Heap-Multiway Search Trees - B-Tree – B+ Tree.

UNIT IV	SORTING AND SEARCHING	9

Sorting – Bubble sort – Selection sort – Insertion sort –Merge Sort – Quick Sort –Shell sort —Radix sort. Searching – Linear Search – Binary Search.

UNIT V	GRAPH STRUCTURES	9

Graph Definition – Representation of Graphs – Types of Graph - Breadth-first traversal –Depth-first traversal –– Bi-connectivity – Topological Sort – Dijkstra's algorithm – Minimum Spanning Tree – Prim's algorithm – Kruskal's algorithm.

	TOTAL: 45 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Make use of various linked list operations to solve the given problems
CO2:	Apply linear data structures stack and queue for real time applications.
CO3:	Utilize the non-linear data structure tree for real world applications
CO4:	Apply various sorting algorithms for the given scenario
CO5:	Apply various searching algorithms for the given scenario
CO6:	Apply graph algorithms for graph applications
TEXT BOOKS:	
1	Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2	Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007
REFERENCES:	
1	Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition,Pearson Education, 2015.
2	Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.
3	Alfred V. Aho, Jeffrey D. Ullman,John E. Hopcroft ,Data Structures and Algorithms, 1st edition, Pearson, 2002.

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

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<table>
<tr><td rowspan="2">23HS203</td><td colspan="2" rowspan="2">TAMILS AND TECHNOLOGY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">• 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</td></tr>
<tr><td>UNIT I</td><td colspan="5">WEAVING AND CERAMIC TECHNOLOGY</td><td>3</td></tr>
<tr><td colspan="7">Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.</td></tr>
<tr><td>UNIT II</td><td colspan="5">DESIGN AND CONSTRUCTION TECHNOLOGY</td><td>3</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT III</td><td colspan="5">MANUFACTURING TECHNOLOGY</td><td>3</td></tr>
<tr><td colspan="7">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.</td></tr>
</table>

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:	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**

<table>
<tr><td rowspan="2">23ME211</td><td rowspan="2">ENGINEERING GRAPHICS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
</table>

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	**26-07-2023**														
Approved	**1st ACM**			**Date**				**09-09-2023**							

23CS221	DATA STRUCTURES USING C LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To demonstrate array implementation of linear data structure algorithms.
- To implement the applications using Stack.
- To implement the applications using Linked list
- To implement Binary search tree algorithms.
- To implement the Heap algorithm.
- To implement Dijkstras algorithm.
- To implement Prims algorithm
- To implement Sorting, Searching algorithms.

PRACTICALS:

1. Array implementation of Stack, Queue and Circular Queue ADTs.
2. Implementation of Singly Linked List.
3. Linked list implementation of Stack and Linear Queue ADTs.
4. Implementation of Polynomial Manipulation using Linked list.
5. Implementation of Evaluating Postfix Expressions, Infix to Postfix conversion.
6. Implementation of Heaps using Priority Queues.
7. Implementation of Linear Search and Binary Search.
8. Implementation of Insertion Sort and Selection Sort.
9. Implementation of Quick Sort.
10. Implementation of Binary Search Trees.
11. Implementation of Dijkstra‘s Algorithm.
12. Implementation of Prim‘s Algorithm.

TOTAL : 60 PERIODS

LABORATORY REQUIREMENT FOR BATCH OF 30 STUDENTS:

HARDWARE: Standalone desktops – 30 No's **SOFTWARE:** C / C++ / Equivalent Compiler

COURSE OUTCOMES:

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

CO1:	Construct linear data structure algorithms.
CO2:	Develop applications using Stacks and Queue.
CO3:	Develop applications using Linked lists.
CO4:	Construct binary search tree algorithm.
CO5:	Construct Prim's and Dijkstra's graph algorithms.
CO6:	Analyze the various searching and sorting algorithms.

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

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

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

COURSE OBJECTIVES:

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

UNIT I	INTERPERSONAL COMMUNICATION	6

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	6

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	6

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	6

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	6
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: 30 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

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	-	-
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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**

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3</td><td>T
0</td><td>P
0</td><td>C
3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">
• To understand Object Oriented Programming concepts and basics of Java Programming language
• To know the principles of packages, inheritance and interfaces
• To develop a Java application with threads and generics classes
• To define exceptions and use I/O streams
• To design and build Graphical User Interface Application using JAVAFX
</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION TO OOP AND JAVA</td><td>9</td></tr>
<tr><td colspan="7">Overview of OOP – Object Oriented Programming paradigms – Features of Object Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java – Defining classes in Java – Constructors-Methods -Access specifiers - Static members- Java Doc comments</td></tr>
<tr><td>UNIT II</td><td colspan="5">INHERITANCE, PACKAGES AND INTERFACES</td><td>9</td></tr>
<tr><td colspan="7">Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces.</td></tr>
<tr><td>UNIT III</td><td colspan="5">EXCEPTION HANDLING AND MULTITHREADING</td><td>9</td></tr>
<tr><td colspan="7">Exception handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception.</td></tr>
</table>

Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication - Suspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.		
UNIT IV	**I/O, GENERICS, STRING HANDLING**	**9**
I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.		
UNIT V	**JAVAFX EVENT HANDLING, CONTROLS, COMPONENTS**	**9**
JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, ToggleButton – RadioButtons – ListView – ComboBox – ChoiceBox – Text Controls – ScrollPane. Layouts – FlowPane – HBox and VBox – BorderPane – StackPane – GridPane. Menus – Basics – Menu – Menu bars – MenuItem.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply the concepts of classes and objects to solve simple problems
CO2:	Develop programs using packages and interfaces
CO3:	Construct programs using inheritance concepts.
CO4:	Apply exception handling mechanisms and multithreaded model to solve real world problems
CO5:	Construct Java applications with I/O packages, string classes, Collections and generics concepts
CO6:	Apply the concepts of event handling and JavaFX components and controls for developing GUI based application

TEXT BOOKS:	
1	Herbert Schildt, “Java: The Complete Reference”, 11th Edition, McGraw Hill Education, New Delhi, 2019
2	Herbert Schildt, “Introducing JavaFX 8 Programming”, 1st Edition, McGraw Hill Education, New Delhi, 2015
REFERENCES:	
1	Cay S. Horstmann, “Core Java Fundamentals”, Volume 1, 11th Edition, Prentice Hall, 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	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	-	-	-	1	3	1	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	2	1	1	2	-	-	1	-	-	-	1	3	2	1

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

<table>
<tr><td rowspan="2">23CS302</td><td rowspan="2" colspan="2">DATABASE MANAGEMENT SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">
• 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.
</td></tr>
<tr><td>UNIT I</td><td colspan="5">RELATIONAL DATABASES</td><td>9</td></tr>
<tr><td colspan="7">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</td></tr>
<tr><td>UNIT II</td><td colspan="5">DATABASE DESIGN</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT III</td><td colspan="5">TRANSACTION MANAGEMENT</td><td>9</td></tr>
<tr><td colspan="7">Transaction Concepts – ACID Properties – Serializability – Transaction Isolation Levels – Concurrency Control – Need for</td></tr>
</table>

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**

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

COURSE OBJECTIVES:

- To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- To understand (or developing clarity) the harmony in the human being, family, society and nature/existence.
- To strengthen the self-reflection.
- To develop 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:	Explain the need of value education.	
CO2:	Interpret the difference between self and body.	

CO3:	Demonstrate the need to exist as a unit of Family and society.
CO4:	Classify Harmony at all levels.
CO5:	Apply the values acquired in the professional front.
CO6:	Identify appropriate technologies for ecofriendly production systems.
TEXT BOOKS:	
1	R R Gaur, R Sangal, G P Bagaria,Human Values and Professional Ethics, 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**

23CS311	DIGITAL PRINCIPLES AND SYSTEM DESIGN	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To design digital circuits using simplified Boolean functions
- To analyze and design combinational circuits
- To analyze and design synchronous and asynchronous sequential circuits
- To understand Programmable Logic Devices
- To write HDL code for combinational and sequential circuits

UNIT I	BOOLEAN ALGEBRA AND LOGIC GATES	9

Number Systems - Arithmetic Operations - Binary Codes- Boolean Algebra and Logic Gates - Theorems and Properties of Boolean Algebra - Boolean Functions - Canonical and Standard Forms - Simplification of Boolean Functions using Karnaugh Map - Logic Gates – NAND and NOR Implementations.

UNIT II	COMBINATIONAL LOGIC	9

Combinational Circuits – Analysis and Design Procedures - Binary Adder-Subtractor - Decimal Adder - Binary Multiplier - Magnitude Comparator - Decoders – Encoders – Multiplexers - Introduction to HDL – HDL Models of Combinational circuits.

UNIT III	SYNCHRONOUS SEQUENTIAL LOGIC	9

Sequential Circuits - Storage Elements: Latches , Flip-Flops - Analysis of Clocked Sequential Circuits - State Reduction and Assignment - Design Procedure - Registers and Counters - HDL Models of Sequential Circuits.

UNIT IV	ASYNCHRONOUS SEQUENTIAL LOGIC	9

Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-free State Assignment – Hazards.

UNIT V	MEMORY AND PROGRAMMABLE LOGIC	9

RAM – Memory Decoding – Error Detection and Correction - ROM

- Programmable Logic Array – Programmable Array Logic – Sequential Programmable Devices.

TOTAL: 45 PERIODS

PRACTICAL EXERCISES : 30 PERIODS

1. Design of adders and subtractors.
2. Design of code converters.
3. Design of Multiplexers & Demultiplexers.
4. Design of Encoders and Decoders.
5. Design of Magnitude Comparators
6. Design and implementation of counters using flip-flops
7. Design and implementation of shift registers.

TOTAL: 45 +30 =75 PERIODS

COURSE OUTCOMES:

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

CO1:	Solve K-map functions, Boolean algebra functions and simplification, procedures relevant to digital logic
CO2:	Analyse the combinational Logic circuit with adders and subtractors
CO3:	Examine the combinational Logic circuit with multiplexer, demultiplexer, encoder and decoder
CO4:	Infer a Synchronous Sequential Circuit
CO5:	Develop an Asynchronous Sequential Circuit
CO6:	Outline a logic gates using various memory and PLD’s

TEXT BOOKS:

1	M. Morris R. Mano, Michael D. Ciletti, “Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog”, 6th Edition, Pearson Education, 2017.
2	G. K. Kharate, “Digital Electronics”, Oxford University Press, 2010

REFERENCES:

1	John F. Wakerly, “Digital Design Principles and Practices”, Fifth Edition, Pearson Education, 2017.

2	Charles H. Roth Jr, Larry L. Kinney, "Fundamentals of Logic Design", Sixth Edition, CENGAGE Learning, 2013.
3	Donald D. Givone, "Digital Principles and Design", Tata Mc Graw Hill, 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	1	-
2	3	2	1	1	1	-	-	-	-	1	-	-	3	1	-
3	3	2	1	1	2	-	-	-	2	1	-	-	3	1	-
4	3	2	1	1	2	-	-	-	2	1	-	-	3	1	-
5	2	1	-	-	1	-	-	-	2	1	-	-	2	1	-
6	2	1	-	-	1	-	-	-	-	1	-	-	2	1	-
Overall Correlation	**3**	**2**	**1**	**1**	**2**	-	-	-	**2**	**2**	-	-	**3**	**2**	-

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

23CS312	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand and apply the algorithm analysis techniques on searching and sorting algorithms
- To critically analyze the efficiency of graph algorithms
- To understand different algorithm design techniques
- To solve programming problems using state space tree
- To understand the concepts behind NP Completeness, Approximation algorithms and randomized algorithms

UNIT I	INTRODUCTION	9

Time and space complexity - Asymptotic Notations – Solving Recurrences: substitution method - Lower bounds - hash function - searching: linear search, binary search and Interpolation Search, String Matching: The naïve string - matching algorithm - Rabin-Karp algorithm - Sorting: Insertion sort, heap sort

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 DESIGN AND ANALYSIS TECHNIQUES	9

Divide and Conquer methodology: Merge sort - Quick sort- Dynamic programming: Elements of dynamic programming - Matrix-chain multiplication - Multi stage graphs. Greedy Technique: Elements of the greedy strategy - Activity-selection problem - Huffman Trees

UNIT IV	STATE SPACE SEARCH ALGORITHMS	9

Backtracking: n-Queens problem - Hamiltonian Circuit Problem - Subset Sum Problem - Graph colouring problem Branch and

Bound : Solving 15-Puzzle problem - Assignment problem - Knapsack Problem - Travelling Salesman Problem.		
UNIT V	**NP-COMPLETE AND APPROXIMATION ALGORITHM**	**9**
Tractable and intractable problems: Polynomial time algorithms - Venn diagram representation – Non Deterministic algorithms - NP-hardness and NP-completeness - Problem reduction: TSP - 3 CNF problem. Approximation Algorithms: Bin Packing problem - Randomized Algorithms: concept and application - primality testing - randomized quick sort.		
		TOTAL: 45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Sort a given set of elements using the Quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted. The elements can be read from a file or can be generated using the random number generator.
2. Implement a Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted. The elements can be read from a file or can be generated using the random number generator.
3. (A) Obtain the Topological ordering of vertices in a given digraph. (B) Compute the transitive closure of a given directed graph using Warshall's algorithm.
4. Implement 0/1 Knapsack problem using Dynamic Programming.
5. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijikstra's algorithm
6. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.

7. (A) Print all the nodes reachable from a given starting node in a digraph using BFS method. (B) Check whether a given graph is connected or not using DFS method.
8. Find a subset of a given set S = {s1, s2,….., sN} of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions {1,2,6}and{1,8}.A suitable message is to be displayed if the given problem instance doesn't have a solution.
9. Implement any scheme to find the optimal solution for the Traveling Salesperson problem and then solve the same problem instance using any approximation algorithm and determine the error in the approximation.
10. Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.
11. Implement All-Pairs Shortest Paths Problem using Floyd's algorithm.
12. Implement N Queen's problem using Back Tracking.

COURSE OUTCOMES:

	After completion of the course, the students will be able to:
CO1:	Apply recursive and non-recursive algorithms to solve problem.
CO2:	Apply appropriate framework to meet algorithm's efficiency.
CO3:	Apply graph algorithms to solve problems and analyze their efficiency.
CO4:	Solve problems using algorithm design techniques like divide and conquer, dynamic programming and greedy techniques.
CO5:	Apply State Space Tree Analysis for Problem-Solving.
CO6:	Solve problems using approximation algorithms and randomized algorithms

TEXT BOOKS:	
1	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, 3rd Edition, Prentice Hall of India, 2009.
2	Ellis Horowitz, SartajSahni, SanguthevarRajasekaran Computer Algorithms/C++ Orient Blackswan, 2nd Edition, 2019.
REFERENCES:	
1	Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, 3rd Edition, Pearson Education, 2012.
2	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.
3	S. Sridhar, “Design and Analysis of Algorithms”, Oxford university 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	2	-	-	-	-	-	-	-	3	2	-
2	3	2	1	1	2	-	-	-	-	-	-	1	3	2	-
3	3	2	1	1	2	-	-	-	-	-	-	-	3	2	-
4	3	2	1	1	2	-	-	-	-	-	-	1	3	2	-
5	3	2	1	1	2	-	-	-	-	-	-	-	3	2	-
6	3	2	1	1	2	-	-	-	-	-	-	-	3	2	-
Overall Correlation	3	2	1	1	2	-	-	-	-	-	-	1	3	2	-

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

23CS321	OBJECT ORIENTED PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, inheritance, exception handling and file processing.
- To develop applications using generic programming and event handling

LIST OF EXPERIMENTS:

1. Solve problems by using sequential search, binary search, and quadratic sorting algorithms (selection, insertion)
2. Develop stack and queue data structures using classes and objects.
3. Develop a java application with an 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 funds. Generate pay slips for the employees with their gross and net salary.
4. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named printArea(). 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 printArea( ) that prints the area of the given shape.
5. Solve the above problem using an interface.

6. Implement exception handling and creation of user defined exceptions. 7. Write a java program that implements a multi-threaded application that has three threads. 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 the cube of the number. 8. Write a program to perform file operations. 9. Develop applications to demonstrate the features of generics classes. 10. Develop applications using JavaFX controls, layouts and menus. 11. Develop a mini project for any application using Java concepts.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Develop java programs using object oriented programming concepts
CO2:	Construct the java program in inheritance concepts.
CO3:	Develop simple applications using object oriented concepts such as package, exceptions
CO4:	Solve multithreading, and generics concepts in Java programming
CO5:	Create GUIs and event driven programming applications for real world problems
CO6:	Construct and deploy web applications using Java

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		

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**

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**		
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SEMESTER –IV

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	EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION	9+3

Eigen value 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	-	-

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<table>
<tr><td rowspan="2">23CS401</td><td rowspan="2" colspan="2">OPERATING SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">
• 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.
</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION</td><td>10</td></tr>
<tr><td colspan="7">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 - Structuring methods; Processes - Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication – Shared Memory Systems, Message Passing Systems, Threads - Multithread Models.</td></tr>
<tr><td>UNIT II</td><td colspan="5">PROCESS MANAGEMENT</td><td>9</td></tr>
<tr><td colspan="7">CPU Scheduling – Basic Concepts, Scheduling criteria - Scheduling algorithms; Process Synchronization - The Critical-Section problem, Synchronization hardware, Mutex Locks, Semaphores, Monitors, Classic problems of synchronization; Deadlock – Deadlock Characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.</td></tr>
<tr><td>UNIT III</td><td colspan="5">MEMORY MANAGEMENT</td><td>9</td></tr>
<tr><td colspan="7">Main Memory – Address Binding, Logical and Physical Address</td></tr>
</table>

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**

23CS402	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the various characteristics of intelligent agents.
- To learn the different search strategies in AI.
- To learn to represent knowledge in solving AI problems.
- To understand the different ways of designing software agents.

UNIT I	INTRODUCTION	6

Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

UNIT II	PROBLEM SOLVING METHODS	12

Search Strategies: Uninformed search - Informed search - Heuristics Functions - Local Search Algorithms and Optimization Problems - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search

UNIT III	LOGICAL REASONING	10

First Order Predicate Logic: syntax and semantics – usage - knowledge representation - Inference in First order logic: Unification – Forward Chaining - Backward Chaining – Resolution.

UNIT IV	KNOWLEDE REPRESENTATION AND REASONING	9

Knowledge Representation: Ontological Engineering - Categories and Objects – Events - Mental Events and Mental Objects. Reasoning Systems for Categories - Reasoning with Default Information.

UNIT V	MULTI AGENT SYSTEMS	8

Architecture for Intelligent Agents - Agent communication –

Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.	
	TOTAL: 45 PERIODS
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Analyze the typical AI problems to identify the suitable Intelligent agents and apply the problem-solving approach on them.
CO2:	Implement and compare different search strategies to solve AI problems.
CO3:	Design and apply local search algorithms and constraint satisfaction techniques.
CO4:	Interpret the problem and represent it using first order predicate logic.
CO5:	Describe the ontological engineering and reasoning systems.
CO6:	Illustrate the architecture of Intelligent agents, agent communication and Multi agent systems.
TEXT BOOKS:	
1	S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.
2	Gerhard Weiss, "Multi Agent Systems", Second Edition, MIT Press, 2013.
3	Michael Wooldridge, "An Introduction to MultiAgent Systems". Second Edition, Chichester: Wiley, 2009.
4	Gerhard Weiss, "Multiagent Systems: A Modern Approach to Distributed Artificial Intelligence". Cambridge: MIT Press, 1999.
REFERENCES:	
1	Bratko, "Prolog: Programming for Artificial Intelligence", Fourth edition, Addison Wesley Educational Publishers Inc., 2011.

2	M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)",Jones and Bartlett Publishers, Inc.; First Edition, 2008.
3	Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.
4	William F. Clocksin and Christopher S. Mellish, "Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003.
5	David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, 2010.

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

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

23CS403	THEORY OF COMPUTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the language hierarchy
- To construct automata for any given pattern and find its equivalent regular expressions
- To design a context free grammar for any given language
- To understand Turing machines and their capability
- To understand undecidable problems and NP class problems

UNIT I	AUTOMATA FUNDAMENTALS	9

Introduction to formal proof – Additional forms of Proof – Inductive Proofs –Finite Automata – Deterministic Finite Automata – Non-deterministic Finite Automata – Equivalence of NFA and DFA - Finite Automata with Epsilon Transitions.

UNIT II	REGULAR EXPRESSIONS AND LANGUAGES	9

Regular Expressions – FA and Regular Expressions – Proving Languages not to be regular – Closure Properties of Regular Languages – Equivalence and Minimization of Automata.

UNIT III	CONTEXT FREE GRAMMAR AND LANGUAGES	9

CFG – Parse Trees – Ambiguity in Grammars and Languages – Definition of the Pushdown Automata – Languages of a Pushdown Automata – Equivalence of Pushdown Automata and CFG, Deterministic Pushdown Automata.

UNIT IV	PROPERTIES OF CONTEXT FREE LANGUAGES	9

Normal Forms for CFG – Pumping Lemma for CFL – Closure Properties of CFL – Turing Machines– Programming Techniques for TM.

UNIT V	UNDECIDABILITY	9

Non-Recursive Enumerable (RE) Language – Undecidable

Problem with RE – Undecidable Problems about TM – Post's Correspondence Problem, The Class P and NP.	
	TOTAL: 45 PERIODS
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply mathematical proofs such as deductive proof, proof by contradiction and proof by induction.
CO2:	Construct a finite state automaton for a given regular language.
CO3:	Develop a normalized context free grammar for a given context free language.
CO4:	Construct a pushdown automaton for a given context-free language
CO5:	Construct a Turing machine for deciding a given problem.
CO6:	Explain the decidability or undecidability of various problems.
TEXT BOOKS:	
1	J.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory", Languages and Computations, Third Edition, Pearson Education, 2008.
2	John C Martin, "Introduction to languages and the Theory of Computation", 4th Edition, Tata McGraw Hill, 2011.
REFERENCES:	
1	H.R.Lewis and C.H.Papadimitriou, "Elements of the theory of Computation", Second Edition,PHI, 2015.
2	Peter Linz, "An Introduction to Formal Language and Automata", 6th Edition, Jones & Bartlett, 2016.
3	K.L.P. Mishra and N Chandrasekaran, "Theory of Computer Science: Automata Languages and Computation", 3rd Edition, Prentice Hall of India, 2006.
4	Micheal Sipser, "Introduction of the Theory and Computation", Thomson Brokecole, 1997.

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	3	-	-
2	3	2	1	1	-	-	-	-	2	2	2	2	3	-	-
3	3	2	1	1	-	-	-	-	2	2	1	2	3	-	-
4	3	2	1	1	-	-	-	-	2	2	2	2	3	-	-
5	3	2	2	2	-	-	-	-	2	1	1	2	3	-	-
6	2	1	1	1	-	-	-	-	1	1	1	2	2	-	-
Overall Correlation	3	2	2	2	-	-	-	-	2	2	2	2	3	-	-
Recommended by Board of Studies							08-04-2024								
Approved							2nd ACM			Date			25-05-2024		

23CS404	COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the basic structure and operations of a computer.
- To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.
- To learn the basics of pipelined execution.
- To understand the memory hierarchies, cache memories and virtual memories.
- To introduce the parallel processing technique.

UNIT I	**BASIC STRUCTURE OF A COMPUTER SYSTEM**	**9**

Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations decision making – MIPS Addressing.

UNIT II	**ARITHMETIC FOR COMPUTERS**	**9**

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations

UNIT III	**PROCESSOR AND CONTROL UNIT**	**9**

Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Pipelining – Pipelined datapath and control – Handling Data Hazards & Control Hazards Exceptions

UNIT IV	**MEMORY AND I/O ORGANIZATION**	**9**

Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, Serial Bus Architectures, Mass storage, Input and Output Devices.

UNIT V	**ADVANCED COMPUTER ARCHITECTURE**	**9**

Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors,

Introduction to Graphics Processing Units, Clusters and Warehouse scale computers, Introduction to Multiprocessor network topologies.	
	TOTAL: 45 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Apply the basics structure of computers, operations and instructions.
CO2:	Apply arithmetic and logic unit.
CO3:	Explain pipelined execution and control unit.
CO4:	Identify the various memory systems and I/O communication.
CO5:	Apply parallel processing architectures.
CO6:	Apply the hardware interface for real time applications.
TEXT BOOKS:	
1	David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.
2	Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.
REFERENCES:	
1	William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition, Pearson Education, 2010.
2	John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.
3	Govindarajalu, "Computer Architecture and Organization, Design Principles and Applications", Second edition, McGraw-Hill Education India Pvt Ltd, 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	1	1	2	3	-	-
2	3	2	1	1	-	-	-	-	2	2	2	2	3	-	-
3	2	1	-	-	-	-	-	-	2	2	1	2	2	-	-
4	3	2	1	1	-	-	-	-	2	2	2	2	3	-	-
5	3	3	2	2	-	-	-	-	2	1	1	2	3	-	-
6	3	2	-	1	-	-	-	-	1	1	1	2	2	-	-
Overall Correlation	3	2	1	2	-	-	-	-	2	2	2	2	3	-	-
Recommended by Board of Studies							**08-04-2024**								
Approved							**2^{nd} ACM**			**Date**			**25-05-2024**		

23CS411	SOFTWARE ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To make the student understand the software process with different models.
- To familiarize the student with requirements engineering and software design concepts.
- To impart knowledge to the student in various software testing techniques and product metrics.
- To make the student recognize the significance of software quality and project management.
- To acquaint the student with the software maintenance and reengineering process

UNIT I	SOFTWARE PROCESS	9

Introduction to software engineering – Layers in software engineering – Generic process framework – Software general principles and myths – Process models: Waterfall model, Incremental process model, Evolutionary process models, Concurrent models, Specialized process models, Unified process, Personal and Team process models – Process assessment and improvement approaches – Agile process models.

UNIT II	REQUIREMENTS AND SOFTWARE DESIGN	9

Introduction to Requirements engineering: Functional and Nonfunctional requirements – Requirement specification template – Eliciting requirements – Requirements analysis – Requirements modeling: Class-based modeling, Flow-oriented model, Behavioral model – Design process – Design concepts – Design model dimensions – Software architecture – Architectural styles – Architectural mapping using data flow – User interface analysis and design.

UNIT III	SOFTWARE TESTING AND METRICS	9
Testing strategies for: Conventional software, Object-oriented software, Web-apps – Strategic issues – Software testing fundamentals – Validation testing – System testing – White-box testing – Black-box testing – Debugging – SCM process – Metrics for requirements model – Metrics for design model: Architectural design metrics, Lorenz and Kidd OO Metrics, Component-level design metrics – Metrics for source code – Metrics for testing and maintenance.		
UNIT IV	**SOFTWARE QUALITY AND PROJECT MANAGEMENT**	**9**
Elements of SQA – SQA Tasks, Goals, Metrics – Statistical SQA – Software Reliability – ISO 9000 Quality Standards – SQA Plan – Project management spectrum – People – Product- Process – Project – W^5HH Principle – Critical Practices.		
UNIT V	**MAINTENANCE AND REENGINEERING**	**9**
Software Maintenance – Software Supportability - Reengineering – Business process reengineering – Software Reengineering - Reverse Engineering – Restructuring – Forward Engineering – Economics of Reengineering.		
		TOTAL: 45 PERIODS
PRACTICAL EXERCISES:		**TOTAL: 30 PERIODS**

1. Identify the problem statement to define a given project within the bounded scope of the project.
2. Select relevant process model to define activities and related tasks set for an assigned project.
3. Gather application specific requirements to assimilate into requirements engineering model.
4. Prepare a broad SRS for a given project.
5. Develop DFD model (level-0, level-1 DFD and data dictionary) for a given project.

6. Write test cases to validate requirements of an assigned project from a SRS document.
7. Evaluate size of the project using function point metric for an assigned project.
8. Prepare SQA plan that facilitates various attributes of quality of a product.
9. Estimate the cost of a given project by using the COCOMO model.
10. Use CPM/PERT for scheduling an assigned project.

	TOTAL: 45+30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Make use of the appropriate process model to develop a project.
CO2:	Analyze the software requirements specification document and software design.
CO3:	Develop various testing strategies and techniques and their role in testing phase.
CO4:	Analyze different product metrics of SCM.
CO5:	Apply the role of SQA in software engineering and the benefits of project management.
CO6:	Apply different concepts and aspects of software maintenance and reengineering methods.
TEXT BOOKS:	
1	Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill Education, 7th Edition, New Delhi, 2009.
2	Ian Sommerville, "Software Engineering", Pearson Education, 10th Edition, India, 2017.
REFERENCES:	
1	James F. Peters, Witold Pedrycz, "Software Engineering, and Engineering Approach", John Wiley, New Delhi, 2000.

2	K. K. Aggarwal, Yogesh Singh, "Software Engineering", New Age International Publishers, 3rd Edition, New Delhi, 2007.
3	Rajib Mall, "Fundamentals of Software Engineering", PHI Learning Private Limited, 4th Edition, New Delhi, 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	1	1	1	1	1	1	1	3	1	1
2	3	2	1	1	2	1	1	1	2	2	2	1	3	2	1
3	3	2	1	1	2	1	1	1	2	2	1	1	3	2	1
4	3	2	1	1	2	1	1	1	2	2	2	1	3	2	1
5	3	2	1	1	2	1	1	1	2	1	1	1	3	2	1
6	3	2	1	1	2	1	1	1	1	1	1	1	3	2	1
Overall Correlation	3	2	1	1	2	1	1	1	2	2	2	1	3	2	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**

23CS422	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- Develop descriptions and specifications for the behavior of intelligent agents across various AI tasks, enabling agents to make decisions and interact with their environment autonomously.
- Apply and implement basic search strategies such as breadth-first search (BFS) and depth-first search (DFS), as well as heuristic search techniques like A* and its memory-bounded variants, to efficiently explore problem spaces.
- Implement and apply genetic algorithms and simulated annealing techniques to solve optimization problems
- Design and implement backtracking algorithms and local search strategies to solve CSPs, enabling students to navigate large solution spaces and handle constraints efficiently.
- Implement propositional and first-order logic-based inference techniques, including resolution methods, to enable machines to draw conclusions and make decisions based on a set of given facts.

LIST OF EXPERIMENTS:

1. Construct descriptions of agent behavior for various AI tasks
2. Implement basic search strategies for selected AI applications
3. Implement A* and memory bounded A* algorithms
4. Implement genetic algorithms for AI tasks
5. Implement simulated annealing algorithms for AI tasks
6. Implement alpha-beta tree search
7. Implement backtracking algorithms for CSP
8. Implement local search algorithms for CSP
9. Implement propositional logic inferences for AI tasks
10. Implement resolution based first order logic inferences for AI tasks

TOTAL:45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Develop clear descriptions and behavior for intelligent agents
CO2:	Demonstrate the ability to solve problems using searching and backtracking.
CO3:	Develop programs to implement simulated annealing and genetic Algorithm
CO4:	Implement Backtracking and Local Search Algorithm for Constraint Satisfaction Problem(CSP)
CO5:	Implement propositional logic-based inference engines that facilitate reason and decision-making in AI applications
CO6:	Apply resolution-based inference in first-order logic, enabling the automation of reasoning tasks

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

<table>
<tr><td rowspan="2">23CS501</td><td rowspan="2" colspan="2">COMPUTER NETWORKS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">• 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 understand the components required to build different types of networks.
• To learn concepts related to network addressing and Routing.</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION AND APPLICATION LAYER</td><td>9</td></tr>
<tr><td colspan="7">Building network – Network Edge and Core – Layered Architecture – OSI Model – Internet Architecture (TCP/IP) Networking Devices: Hubs, Bridges, Switches, Routers, and Gateways – Performance Metrics – Introduction to Sockets – Application Layer protocols – HTTP – FTP Email Protocols – DNS.</td></tr>
<tr><td>UNIT II</td><td colspan="5">TRANSPORT LAYER</td><td>9</td></tr>
<tr><td colspan="7">Transport Layer functions – Multiplexing and Demultiplexing – User Datagram Protocol – Transmission Control Protocol – Flow Control – Retransmission Strategies – Congestion Control.</td></tr>
<tr><td>UNIT III</td><td colspan="5">NETWORK LAYER</td><td>9</td></tr>
<tr><td colspan="7">Switching concepts – Internet Protocol – IPV4 Packet Format – IP Addressing – Subnetting – Classless Inter Domain Routing (CIDR) – Variable Length Subnet Mask (VLSM) – DHCP – ARP – Network Address Translation (NAT) – ICMP – Concept of SDN.</td></tr>
<tr><td>UNIT IV</td><td colspan="5">ROUTING</td><td>9</td></tr>
<tr><td colspan="7">Routing Principles – Distance Vector Routing – Link State Routing – RIP – OSPF – BGP – IPV6 – Introduction to Quality of Service (QoS).</td></tr>
</table>

UNIT V	DATA LINK LAYER AND PHYSICAL LAYER	9
Data Link Layer – Framing – Flow control – Error control – Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) **– Physical layer** – Signals – Bandwidth and Data Rate – Encoding – Multiplexing – Transmission Media.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the introduction about the computer networks.
CO2:	Identify the devices and protocols to design a network and implement it.
CO3:	Build network applications using the right set of protocols and estimate their performances.
CO4:	Explain trace packet flows and interpret packet formats.
CO5:	Apply addressing principles such as subnetting and VLSM for efficient routing.
CO6:	Explain media access and communication techniques.

TEXT BOOKS:

1	James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", Seventh Edition, Pearson Education, 2017.
2	Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.

REFERENCES:

1	William Stallings, "Data and Computer Communications", Tenth Edition, Pearson Education, 2013.
2	Nader F. Mir, "Computer and Communication Networks", Second Edition, Prentice Hall, 2014.
3	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2012.

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

<table>
<tr><td rowspan="2">23CS511</td><td rowspan="2" colspan="2">COMPILER DESIGN</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">To learn the various phases of compiler.
To learn the various parsing techniques.
To understand intermediate code generation and run-time environment.
To learn to implement front-end of the compiler.
To learn to implement code generator.</td></tr>
<tr><td>UNIT I</td><td colspan="5">FUNDAMENTALS OF COMPILATION</td><td>9</td></tr>
<tr><td colspan="7">Introduction: Modules and Interfaces - Tools and Software - Data structures for Tree Languages. The Phases of Compiler: Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens. Lex: Lex- Finite Automata – Regular Expressions to Automata NFA, DFA – Minimizing DFA.</td></tr>
<tr><td>UNIT II</td><td colspan="5">SYNTAX ANALYSIS</td><td>12</td></tr>
<tr><td colspan="7">Parser: Role of Parser – Grammars – Error Handling – Context-free grammars – Writing a grammar – Top Down Parsing. General Strategies: Recursive Descent Parser Predictive Parser - LL(1) Parser - Shift Reduce Parser - LR Parser - LR(0) Item. Construction of SLR Parsing Table - Introduction to LALR Parser – Error Handling and Recovery in Syntax Analyzer – YACC.</td></tr>
<tr><td>UNIT III</td><td colspan="5">INTERMEDIATE CODE GENERATION</td><td>8</td></tr>
<tr><td colspan="7">Syntax Directed Definitions: Syntax Directed Definitions-Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Intermediate Languages - Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking.</td></tr>
<tr><td>UNIT IV</td><td colspan="5">RUN-TIME ENVIRONMENT AND CODE GENERATION</td><td>8</td></tr>
<tr><td colspan="7">Runtime Environments: Source language issues – Storage</td></tr>
</table>

<table>
<tr><td colspan="3">organization – Storage Allocation Strategies: Static, Stack and Heap allocation - Parameter Passing-Symbol Tables – Dynamic Storage Allocation - Code Generation: Issues in the Design of a code generator – Basic Blocks and Flow graphs -Design of a simple Code Generator - Optimal Code Generation for Expressions– Dynamic Programming Code Generation.</td></tr>
<tr><td>UNIT V</td><td>CODE OPTIMIZATION</td><td>8</td></tr>
<tr><td colspan="3">Principal Sources of Optimization – Peep-hole optimization - DAG- Optimization of Basic Blocks - Global Data Flow Analysis - Efficient Data Flow Algorithm – Recent trends in Compiler Design.</td></tr>
<tr><td colspan="3" align="right">TOTAL: 45 PERIODS</td></tr>
<tr><td colspan="3">PRACTICALS: TOTAL: 30 PERIODS</td></tr>
<tr><td colspan="3">1. Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.). Create a symbol table, while recognizing identifiers.
2. Implement a Lexical Analyzer using Lex Tool
3. Implement an Arithmetic Calculator using LEX and YACC
4. Generate three-address code for a simple program using LEX and YACC.
5. Implement simple code optimization techniques (Constant folding, Strength reduction and Algebraic transformation)
6. Implement back-end of the compiler for which the three address code is given as input and the 8086 assembly language code is produced as output.</td></tr>
<tr><td colspan="3" align="right">TOTAL: 45+30 PERIODS</td></tr>
<tr><td colspan="3">COURSE OUTCOMES:</td></tr>
<tr><td colspan="3">After completion of the course, the students will be able to:</td></tr>
<tr><td>CO1:</td><td colspan="2">Apply front end and back end phases of compilation process and passes of compiler.</td></tr>
<tr><td>CO2:</td><td colspan="2">Construct a lexical analyzer for a sample language using LEX tool.</td></tr>
<tr><td>CO3:</td><td colspan="2">Develop a Parser using different parsing algorithms.</td></tr>
<tr><td>CO4:</td><td colspan="2">Construct Syntax Directed Translation Scheme (SDT) for semantic rules and apply intermediate code generation algorithm to generate code sequence.</td></tr>
</table>

CO5:	Solve run time environment and issues in code generation.
CO6:	Apply the Code Optimization Techniques to improve the performance of the code.
TEXT BOOKS:	
1	Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Sornav Bansal, "Compilers: Principles, Techniques and Tools", Second Edition, Pearson Education, 2023.
REFERENCES:	
1	Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence based Approach", Morgan Kaufmann Publishers, 2002
2	Steven S. Muchnick, "Advanced Compiler Design and Implementation‖", Morgan Kaufmann Publishers – Elsevier Science, India, Indian Reprint 2003.
3	Keith D Cooper and Linda Torczon, "Engineering a Compiler", Morgan Kaufmann Publishers Elsevier Science, 2004.
4	V. Raghavan, "Principles of Compiler Design", Tata McGraw Hill Education Publishers, 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	2	-	-	3	3	-	1
2	3	2	1	1	3	-	-	2	3	-	-	2	3	3	2
3	3	2	1	1	3	1	-	1	3	1	1	2	3	3	1
4	3	2	1	1	3	-	-	2	3	1	1	2	3	3	2
5	3	2	1	1	-	-	-	1	2	-	-	1	3	-	1
6	3	2	1	1	3	1	-	1	3	1	1	1	3	3	1
Overall Correlation	3	2	1	1	2	1	-	2	3	1	1	2	3	2	2

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

23CS521	COMPUTER NETWORKS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To learn and use network commands
- To learn socket programming
- To implement and analyze various network protocols.
- To learn and use simulation tools.
- To use simulation tools to analyze the performance of various network protocols.

PRACTICALS

1. Learn to use networking commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping, trace route PDUs using a network protocol analyzer, and examine.
2. Write a HTTP web client program to download a web page using TCP sockets.
3. Applications using TCP sockets like: a) Echo client and echo server b) Chat.
4. Simulation of DNS using UDP sockets.
5. Use a tool like Wireshark to capture packets and examine the packets.
6. Write a code simulating ARP /RARP protocols.
7. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.
8. Study of TCP/UDP performance using Simulation tool.
9. Simulation of Distance Vector/ Link State Routing algorithm.
10. Simulation of an error correction code (like CRC).

TOTAL: 30 PERIODS

LABORATORY REQUIREMENT FOR BATCH OF 30 STUDENTS:

HARDWARE: Standalone desktops – 30 No's

SOFTWARE : C / C++ / Java / Python / Equivalent Compiler | Network simulator like NS2/Glomosim/OPNET/ Packet Tracer/Equivalent

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Demonstrate the basic layers and its functions in computer networks.
CO2:	Construct data flow from one node to another node in a network.
CO3:	Demonstrate routing algorithms.
CO4:	Apply the various functions of protocols in computer networks.
CO5:	Demonstrate the working of various application layer protocols.
CO6:	Apply Error Correction and Detection Technique

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

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

<table>
<tr><td rowspan="2">23ES591</td><td rowspan="2">APTITUDE AND LOGICAL REASONING –2</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">• 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</td></tr>
<tr><td>UNIT I</td><td colspan="4"></td><td>4</td></tr>
<tr><td colspan="6">Probability, Permutation & Combination, Algebra, Problems on ages</td></tr>
<tr><td>UNIT II</td><td colspan="4"></td><td>4</td></tr>
<tr><td colspan="6">Mensuration, Logarithms, inequalities and modulus, Syllogism</td></tr>
<tr><td>UNIT III</td><td colspan="4"></td><td>4</td></tr>
<tr><td colspan="6">Directions, logical sequence words, number series, Analytical Reasoning</td></tr>
<tr><td>UNIT IV</td><td colspan="4"></td><td>4</td></tr>
<tr><td colspan="6">Blood relation, Clock and Calendar, Picture puzzles</td></tr>
<tr><td>UNIT V</td><td colspan="4"></td><td>4</td></tr>
<tr><td colspan="6">Data sufficiency, cube and cuboids, odd man out</td></tr>
<tr><td colspan="6" align="right">TOTAL: 20 PERIODS</td></tr>
<tr><td colspan="6">COURSE OUTCOMES:</td></tr>
<tr><td colspan="6">After completion of the course, the students will be able to:</td></tr>
<tr><td>CO1:</td><td colspan="5">Apply concepts of probability, permutation, and combination to solve real-world problems.</td></tr>
<tr><td>CO2:</td><td colspan="5">Solve algebraic problems and age-related problems using logical approaches and techniques.</td></tr>
<tr><td>CO3:</td><td colspan="5">Analyze and solve problems in mensuration, logarithms, and inequalities.</td></tr>
<tr><td>CO4:</td><td colspan="5">Interpret and solve problems related to directions, logical sequence, and number series.</td></tr>
<tr><td>CO5:</td><td colspan="5">Identify and solve problems in logical reasoning such as syllogism, blood relations, clock and calendar.</td></tr>
<tr><td>CO6:</td><td colspan="5">Identify and solve problems in logical reasoning such as syllogism, blood relations, clock and calendar.</td></tr>
</table>

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

23CS601	CRYPTOGRAPHY AND CYBER SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn to analyze the security of in-built cryptosystems.
- To know the fundamental mathematical concepts related to security.
- To develop cryptographic algorithms for information security.
- To comprehend the various types of data integrity and authentication schemes
- To understand cyber-crimes and cyber security.

UNIT I	INTRODUCTION TO SECURITY	9

Computer Security Concepts – The OSI Security Architecture – Security Attacks – Security Services and Mechanisms – A Model for Network Security – Classical encryption techniques: Substitution techniques, Transposition techniques, Steganography – Foundations of modern cryptography: Perfect security – Information Theory – Product Cryptosystem – Cryptanalysis.

UNIT II	SYMMETRIC CIPHERS	9

Number theory – Algebraic Structures – Modular Arithmetic - Euclid's algorithm – Congruence and matrices – Group, Rings, Fields, Finite Fields, Symmetric Key Ciphers: SDES – Block Ciphers – DES, Strength of DES – Differential and linear cryptanalysis – Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Pseudorandom Number Generators – RC4 – Key distribution.

UNIT III	ASYMMETRIC CRYPTOGRAPHY	9

Mathematics of Asymmetric Key Cryptography: Primes – Primality Testing – Factorization – Euler's totient function, Fermat's and Euler's Theorem – Chinese Remainder Theorem – Exponentiation and logarithm. Asymmetric Key Ciphers: RSA

cryptosystem – Key distribution – Key management – Diffie Hellman key exchange -– Elliptic curve arithmetic – Elliptic curve cryptography.		
UNIT IV	**INTEGRITY AND AUTHENTICATION ALGORITHMS**	**9**
Authentication requirement – Authentication function – MAC – Hash function – Security of hash function: HMAC, CMAC – SHA – Digital signature and authentication protocols – DSS – Schnorr Digital Signature Scheme – ElGamal cryptosystem – Entity Authentication: Biometrics, Passwords, Challenge Response protocols – Authentication applications – Kerberos, Mutual Trust: Key management and distribution – Symmetric key distribution using symmetric and asymmetric encryption – Distribution of public keys – X.509 Certificates.		
UNIT V	**CYBER CRIMES AND CYBER SECURITY**	**9**
Cyber Crime and Information Security – Classifications of Cyber Crimes – Tools and Methods – Password Cracking, Keyloggers, Spywares, SQL Injection – Network Access Control – Cloud Security – Web Security – Wireless Security		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the fundamentals of networks security, security architecture, threats and vulnerabilities.
CO2:	Explain different cryptographic operations of symmetric cryptographic algorithms.
CO3:	Apply the different cryptographic operations of public key cryptography.
CO4:	Apply the various Authentication schemes to simulate different applications.
CO5:	Apply various signature scheme using Digital signature standard.

CO6:	Explain various types of cyber-crimes and cyber security features.
TEXT BOOKS:	
1	William Stallings, "Cryptography and Network Security - Principles and Practice", Seventh Edition, Pearson Education, 2017.
2	Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber crimes, Computer Forensics and Legal Perspectives”, First Edition, Wiley India, 2011.
REFERENCES:	
1	Behrouz A. Ferouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata Mc Graw Hill, 2015.
2	Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.

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

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: 45 PERIODS
LIST OF EXPERIMENTS:		**TOTAL: 30 PERIODS**
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.		
		TOTAL: 45+30 PERIODS
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**

23CS611	INTERNET PROGRAMMING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand different Internet Technologies.
- To learn java-specific web services architecture
- To construct a basic website using HTML and Cascading Style Sheets.
- To build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
- To develop server side programs using Servlets and JSP.

UNIT I	WEBSITE BASICS, HTML 5, CSS 3, WEB 2.0	9

Web Essentials: Clients, Servers and Communication – The Internet – Basic Internet protocols – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements – Semantic elements – Drag and Drop – Audio – Video controls – CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations.

UNIT II	CLIENT SIDE PROGRAMMING	9

Java Script: An introduction to JavaScript–JavaScript DOM Model-Date and Objects,-Regular Expressions- Exception Handling-Validation-Built-in objects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – Function Files – Http Request – SQL.

UNIT III	SERVER SIDE PROGRAMMING	9

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

Installing and Configuring Apache Tomcat Web Server- Database Connectivity: JDBC perspectives, JDBC program example – JSP: Understanding Java Server Pages-JSP Standard Tag Library (JSTL)-Creating HTML forms by embedding JSP code.		
UNIT IV	**PHP and XML**	**9**
An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation- Regular Expressions – File handling – Cookies – Connecting to Database. XML: Basic XML- Document Type Definition- XML Schema DOM and Presenting XML, XML Parsers and Validation, XSL and XSLT Transformation, News Feed (RSS and ATOM).		
UNIT V	**INTRODUCTION TO AJAX and WEB SERVICES**	**9**
AJAX: Ajax Client Server Architecture-XML Http Request Object-Call Back Methods; Web Services: Introduction- Java web services Basics – Creating, Publishing, Testing and Describing a Web services (WSDL)-Consuming a web service, Database Driven web service from an application –SOAP.		
		TOTAL: 45 PERIODS
PRACTICALS:		**TOTAL: 30 PERIODS**

1. Create a web page with the following using HTML (A) to embed a map in a web page (B) To fix the hot spots in that map (C) Show all the related Information when the hot spots are clicked.
2. Create a web page with the following. a. Cascading style sheets. b. Embedded style sheets. c. Inline style sheets. Use our college information for the web pages
2. Validate the Registration, user login, user profile and payment by credit card pages using JavaScript.

	3. Write programs in Java using Servlets: (A) To invoke servlets from HTML forms (B) Session tracking using hidden form fields and Session tracking for a hit count. **4.** Write programs in Java to create three-tier applications using servlets for conducting online examination for displaying student mark list. Assume that student information is available in a database which has been stored in a database server. **5.** Install TOMCAT web server. Convert the static web pages of programs into dynamic web pages using servlets (or JSP) and cookies. Hint: Users information (user id, password, credit card number) would be stored in web.xml. Each user should have a separate Shopping Cart. **6.** Redo the previous task using JSP by converting the static web pages into dynamic web pages. Create a database with user information and books information. The books catalogue should be dynamically loaded from the database. **7.** Create and save an XML document at the server, which contains 10 users Information. Write a Program, which takes user Id as an input and returns the User details by taking the user information from the XML document. **8.** i. Validate the form using PHP regular expression. ii. Store the form data into database using PHP. **9.** Write a web service for finding what people think by asking 500 people's opinion for any consumer product.
	TOTAL:45+30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Construct a basic website using HTML and Cascading Style Sheets.
CO2:	Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.

CO3:	Develop server side programs using Servlets and JSP.
CO4:	Construct simple web pages in PHP and to represent data in XML format.
CO5:	Develop an XML schemas, parsers and XSL
CO6:	Make use of AJAX and web services to develop interactive web applications
TEXT BOOKS:	
1	Deitel and Deitel and Nieto, "Internet and World Wide Web - How to Program", Prentice Hall, 5th Edition, 2011
REFERENCES:	
1	Stephen Wynkoop and John Burke "Running a Perfect Website", QUE, 2nd Edition,1999.
2	Chris Bates, "Web Programming – Building Intranet Applications", 3rd Edition Wiley Publications, 2009.
3	Jeffrey C and Jackson, "Web Technologies A Computer Science Perspective", Pearson Education, 2011.
4	Gopalan N.P. and Akilandeswari J., "Web Technology", Prentice Hall of India, 2011.
5	UttamK.Roy, "Web Technologies", Oxford University Press, 2011.

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	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	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	1	1	1	3	2	1
6	3	2	1	1	2	-	-	1	1	1	1	1	3	2	1
Overall Correlation	3	2	1	1	2	-	-	1	1	1	1	1	3	2	1

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

23CS621	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	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**

23CS622	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**

23CS623	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

<table>
<tr><td rowspan="2">23CS701</td><td rowspan="2">TECHNICAL COMPREHENSION</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td colspan="6">PURPOSE:</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td colspan="6">COURSE OUTCOMES:</td></tr>
<tr><td colspan="6">After completion of the course, the students will be able to:</td></tr>
<tr><td>CO1:</td><td colspan="5">Analyse the phenomena involved in the concerned problem and solve them.</td></tr>
<tr><td>CO2:</td><td colspan="5">Apply principles to new and unique circumstances.</td></tr>
<tr><td>CO3:</td><td colspan="5">Estimate concepts and principles of concerned branch of engineering.</td></tr>
<tr><td>CO4:</td><td colspan="5">Distinguish between facts and opinion in the engineering field.</td></tr>
<tr><td>CO5:</td><td colspan="5">Deduct cause-and-effect relationships of any relationship.</td></tr>
<tr><td>CO6:</td><td colspan="5">Interpret data from charts and graphs and judge the relevance of information.</td></tr>
<tr><td colspan="6">GUIDELINES:</td></tr>
<tr><td colspan="6">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.</td></tr>
</table>

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**			

<table>
<tr><td rowspan="2">23CS711</td><td rowspan="2">MACHINE LEARNING AND ITS APPLICATIONS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">• To understand the concepts of machine learning
• To appreciate supervised learning and their applications.
• To understand unsupervised learning like clustering and EM algorithms.
• To provide foundational knowledge of neural networks, including their biological inspiration, architecture, and components such as neurons, layers, weights, and biases.
• To learn about Specialized Neural Network Architectures.</td></tr>
<tr><td>UNIT I</td><td colspan="4">INTRODUCTION TO MACHINE LEARNING</td><td>9</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>UNIT II</td><td colspan="4">SUPERVISED LEARNING</td><td>9</td></tr>
<tr><td colspan="6">Linear Models for Regression – Linear Basis Function Models – The Bias-Variance Decomposition – Bayesian Linear Regression – Common Regression Algorithms – Simple and Multiple Linear Regression – Linear Models for Classification – Discriminant Functions – Probabilistic Generative Models – Probabilistic Discriminative Models – Bayesian Logistic Regression – Common Classification Algorithms – k-Nearest Neighbors – Decision Trees – Random Forest model – Support Vector Machines.</td></tr>
<tr><td>UNIT III</td><td colspan="4">UNSUPERVISED LEARNING</td><td>9</td></tr>
<tr><td colspan="6">Mixture Models and Expectation Maximization –Clustering Techniques - K-Means Clustering – Dirichlet Process Mixture Models – Spectral Clustering – Hierarchical Clustering – Dimensionality Reduction - The Curse of Dimensionality –</td></tr>
</table>

Dimensionality Reduction Technique – Principal Component Analysis – Latent Variable Models(LVM) – Latent Dirichlet Allocation (LDA).		
UNIT IV	**FUNDAMENTALS OF NEURAL NETWORKS**	**9**
Introduction – Architecture - Single-layer vs. Multi-layer Neural Networks - Feedforward Neural Networks (FNNs) - Activation Functions – Sigmoid – ReLU – Tanh - Learning in Neural Networks - Forward Propagation – Backpropagation - Loss Functions - Optimization Techniques - Challenges in Training Neural Networks - Simple Neural Network Implementation.		
UNIT V	**CLASSICAL NEURAL NETWORKS AND THEIR APPLICATIONSIN MACHINE LEARNING**	**9**
Perceptrons and Multilayer Perceptrons (MLP) - Radial Basis Function (RBF) Networks - Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART) - Hopfield Networks and Recurrent Networks - Competitive Neural Networks - Fuzzy Neural Networks - Reinforcement Learning in Traditional Neural Networks- Genetic Algorithms for Neural Network Optimization.		
		TOTAL: 45 PERIODS
PRACTICALS:		**TOTAL: 30 PERIODS**

1. Implement a simple linear regression model using Python
2. Build a classification model using the k-NN algorithm and understand its working mechanism.
3. Implement a decision tree algorithm for classification tasks and understand the decision-making process.
4. Understand the concept of support vector machines and implement them for classification tasks.
5. Implement the K-Means clustering algorithm to group similar data points and understand unsupervised learning.
6. Build a basic feed forward neural network and implement the back propagation algorithm to adjust weights.

	7. Use CNNs to classify images and learn about convolution operations, pooling, and feature extraction 8. Implement an RNN to process sequential data such as time series or text data. 9. Apply PCA for dimensionality reduction to simplify data without losing significant information.
	TOTAL: 45+30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the basics of machine learning.
CO2:	Apply Supervised Learning Algorithms to Real-World Problems.
CO3:	Build Unsupervised-learning models for K-means, KNN.
CO4:	Apply the basics and fundamentals of Neural Networks.
CO5:	Build the basics of classical neural network.
CO6:	Analyze the Neural Networks and Deep Learning models.
TEXT BOOKS:	
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	Simon Haykin, "Neural Networks and Learning Machines", Pearson Education, 2009
REFERENCES:	
1	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
2	Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, CRC Press, 2014.
3	Tom Mitchell, "Machine Learning", McGraw-Hill, 2017.
4	Fabio Nelli,"Python Data Analytics with Pandas, Numpy, and Matplotlib", Second Edition, 2018.
5	S. Rajasekaran, G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", Prentice Hall of India, 2010.
6	J.S.R. Jang, C.T. Sun, E. Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson Education, 2004.

7	Kevin Gurney, "Artificial Neural Networks: An Introduction", CRC Press, 1997
8	B. Yegnanarayana, "Artificial Neural Networks, Prentice Hall India", 2009
9	Christopher M. Bishop,"Neural Networks for Pattern Recognition", Oxford University Press, 1995
10	Raúl Rojas, "Introduction to Artificial Neural Networks", Springer, 1996
11	S. Sumathi, S. N. Sivanandam, "Fuzzy Neural Networks: Fundamentals and Applications", Springer, 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	2	2	3	2	-	2
2	3	2	1	1	1	-	-	2	1	2	1	3	3	1	2
3	3	2	1	1	1	-	-	1	2	1	1	3	3	1	1
4	3	2	2	1	1	-	-	2	2	1	2	1	3	1	2
5	3	2	1	1	2	-	-	2	2	1	2	3	3	2	2
6	3	3	2	2	1	-	-	2	2	1	1	1	3	1	2
Overall Correlation	3	2	2	1	1	-	-	2	2	2	2	2	3	1	2

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

23CS721	PROJECT WORK PHASE-2	L	T	P	C
		0	0	4	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**

23CS722	TECHNICAL SEMINAR – 2	L	T	P	C
		0	0	2	1

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

23CS821	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
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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	**07-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

VERTICAL 1: CLOUD COMPUTING

<table>
<tr><td rowspan="2">23IT031</td><td rowspan="2">DISTRIBUTED COMPUTING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">• To 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 implement security Mechanisms for Distributed Systems</td></tr>
<tr><td>UNIT I</td><td colspan="4">INTRODUCTION</td><td>6</td></tr>
<tr><td colspan="6">Introduction: Relation to Computer System Components – Message -Passing Systems versus Shared Memory Systems – Primitives for Distributed Communication – Synchronous versus Asynchronous Executions –A Model of Distributed Computations and Communication Networks - Logical Clocks – Scalar Time and Vector Time - Message Ordering and Group Communication - Causal Order and Total Order - Global State and Snapshot Recording Algorithms.</td></tr>
<tr><td>UNIT II</td><td colspan="4">LOGICAL TIME AND GLOBAL STATE</td><td>6</td></tr>
<tr><td colspan="6">Logical Time: Physical Clock Synchronization: NTP – A Framework for a System of Logical Clocks - 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.</td></tr>
</table>

UNIT III	DISTRIBUTED MUTEX AND DEADLOCK	6
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	**CONSENSUS AND RECOVERY**	**6**
Consensus and Agreement Algorithms: Problem Definition – Overview of Results – Agreement in a Failure-Free System(Synchronous and Asynchronous) – Agreement in Synchronous Systems with Failures; Checkpointing and Rollback Recovery: Introduction – Background and Definitions – Issues in Failure Recovery – Checkpoint-based Recovery – Coordinated Checkpointing Algorithm - Algorithm for Asynchronous Checkpointing and Recovery		
UNIT V	**FAULT TOLERANCE AND SECURITY**	**6**
Types of Faults and Failure Models - Fault Detection and Failure Recovery Techniques - Byzantine Fault Tolerance (BFT) - Replication Strategies for Fault Tolerance - Network Partitioning and Partition Tolerance - Security Mechanisms - Intrusion Detection and Prevention - Data Privacy and Confidentiality - Checkpointing and Logging - Self-Stabilization and Resilient Algorithms - Partition Tolerance and CAP Theorem - Blockchain Security.		
		TOTAL: 30 PERIODS

PRACTICALS:	
	1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS. 2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs. 3. Install Google App Engine. Create hello world app and other simple web applications using python/java. 4. Use GAE launcher to launch the web applications. 5. Use fault injection techniques (e.g., Chaos Monkey) to simulate failures in a distributed environment. 6. Develop a small-scale MapReduce application (e.g., word count, log processing). 7. Implement a mini version of a distributed file system (similar to HDFS or GFS). **8.** Simulate load-balancing techniques (e.g., round robin, least connections) across multiple servers.
	TOTAL: 30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Apply the concept of computation and communication models of distributed systems.
CO2:	Apply the issues of synchronization.
CO3:	Experiment with virtualization of hardware resources and Docker.
CO4:	Develop the concept of distributed mutual exclusion and distributed deadlock detection techniques.
CO5:	Develop fault detection and failure recovery techniques.
CO6:	Apply security mechanisms.
TEXT BOOKS:	
1	George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, “Distributed Systems: Concepts and Design”, Pearson Publishers, 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	Sukumar Ghosh, "Distributed Systems: An Algorithmic Approach", 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	-	-	-	2	3	1	3	3	1	-
2	3	2	1	1	1	-	-	-	1	2	1	3	3	2	-
3	3	2	1	1	1	-	-	-	3	1	1	3	3	1	-
4	3	2	1	1	3	-	-	-	3	3	1	2	3	3	-
5	3	2	1	1	3	-	-	-	2	2	1	2	3	2	-
6	2	1	-	-	3	-	-	-	2	2	1	2	3	3	-
Overall Correlation	3	2	1	1	2	-	-	-	3	3	2	3	3	2	-

23IT032	CLOUD SERVICES MANAGEMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the principles of cloud architecture, models and infrastructure.
- To explore and experiment with various Cloud deployment environments.
- To learn about the security issues in the cloud environment.
- To Introduce Cloud Service Management terminology, definition & concepts
- Compare and contrast cloud service management with traditional IT service management
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services

UNIT I	CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE	6

Cloud Architecture: System Models for 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	CLOUD DEPLOYMENT ENVIRONMENT	6

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.

UNIT III	CLOUD SERVICE MANAGEMENT FUNDAMENTALS	6

Cloud Ecosystem, Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models.

UNIT IV	CLOUD SERVICES STRATEGY	6
Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture		
UNIT V	**CLOUD SERVICE MANAGEMENT**	**6**
Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

LIST OF EXPERIMENTS

1. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
2. Find a procedure to transfer the files from one virtual machine to another virtual machine.
3. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
4. Install Hadoop single node cluster and run simple applications like word count.
5. Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloud softwares like Openstack, Eucalyptus, OpenNebula with Role-based access control
6. Create a Cost-model for a web application using various services and do Cost-benefit analysis
7. Create alerts for usage of Cloud resources
8. Create Billing alerts for your Cloud Organization
9. Compare Cloud cost for a simple web application across AWS, Azure and GCP and suggest the best one.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the design challenges in the cloud.
CO2:	Develop and deploy services on the cloud and set up a cloud environment.
CO3:	Build and automate business solutions using cloud technologies.
CO4:	Explain the cloud service strategies including management framework and cloud policies.
CO5:	Solve the real world problems using Cloud services and technologies
CO6:	Explain security challenges in the cloud environment.

TEXT BOOKS:

1. Enamul Haque, "Cloud Service Management and Governance: Smart Service Management in Cloud Era", Enel Publications, 2017.
2. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall, 2013.

REFERENCES:

1. Praveen Ayyappa, "Economics of Cloud Computing" LAP Lambert Academic Publishing, 2013.
2. Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi, "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	3	2	1	1	3	-	-	-	2	2	3	1	3	3	-
2	3	2	1	1	2	-	-	-	2	2	3	3	2	3	-
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4	2	1	-	-	3	-	-	-	2	2	3	2	3	3	-
5	3	2	1	1	3	-	-	-	3	1	3	2	3	2	-
6	2	1	-	-	3				3	1	3	2	3	2	
Overall Correlation	3	2	1	1	3	-	-	-	3	2	3	2	3	3	-

23IT033	VIRTUALIZATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the basic concepts of networks.
- To explore various technologies in the wireless domain.
- To study about 4G and 5G cellular networks.
- To learn about Network Function Virtualization.
- To understand the paradigm of Software defined networks.

UNIT I	INTRODUCTION TO VIRTUALIZATION	6

Virtualization and cloud computing – Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization – partial virtualization – Paravirtualization-Types of Hypervisors.

UNIT II	SERVER AND DESKTOP VIRTUALIZATION	6

Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform-Desktop Virtualization-Types of Desktop Virtualization.

UNIT III	NETWORK FUNCTIONS VIRTUALIZATION	6

Virtual Machines –NFV benefits-requirements – architecture-NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration- NFV Use Cases- NFV and SDN –Network virtualization – VLAN and VPN.

UNIT IV	STORAGE VIRTUALIZATION	6

Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risks of Storage Virtualization-SAN-NAS-RAID.

UNIT V	VIRTUALIZATION TOOLS	6
VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box – IBM PowerVM- Google Virtualization- Case study.		
		TOTAL: 30 PERIODS

PRACTICALS EXCERCISES:

1. Create type 2 virtualization in VMWARE or any equivalent Open Source Tool. Allocate memory and storage space as per requirement. Install Guest OS on that VMWARE
2. Create, Manage, Configure and schedule snapshots.
3. Desktop Virtualization using Chrome Remote Desktop.
4. Create type 2 virtualization on ESXI 6.5 server.
5. Create a VLAN in CISCO packet tracer.
6. Install KVM in Linux.
7. Create Nested Virtual Machine (VM under another VM)

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Build a Virtualization network.
CO2:	Apply the virtualization techniques.
CO3:	Illustrate the Network function Virtualization.
CO4:	Develop SDN based applications.
CO5:	Explain the concepts of storage virtualization.
CO6:	Build a Nested VM and explain about Virtualization tools.

TEXT BOOKS:

1	Cloud computing a practical approach – Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
2	Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011

REFERENCES:

1	P Chris Wolf, Erick M. Halter. "Virtualization: From the Desktop to the Enterprise". APress, 2005.

2	P James E. Smith, Ravi Nair. “Virtual Machines: Versatile Platforms for Systems and Processes”.Elsevier/Morgan Kaufmann, 2005.
3	David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.

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

23IT034	CLOUD DATABASE MANAGEMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Understand the fundamental concepts of cloud database management.
- Explore various cloud database services and their features.
- Learn to design, deploy, and manage databases in the cloud.
- Gain insights into security and compliance aspects of cloud databases.
- Develop skills to optimize and troubleshoot cloud databases.

UNIT I	INTRODUCTION TO CLOUD DATABASE MANAGEMENT	6

Basics of cloud computing-Cloud database architecture-Types of cloud databases (SQL, NoSQL, NewSQL)-Cloud database service models (DBaaS)- Benefits and challenges of cloud databases.

UNIT II	CLOUD DATABASE SERVICES	6

Overview of major cloud database providers (AWS, Azure, Google Cloud)- Comparing cloud database services (Amazon RDS, Azure SQL Database, Google Cloud SQL)-Features and pricing models-Use cases for different cloud database services-cloud database platforms.

UNIT III	DESIGNING AND DEPLOYING CLOUD DATABASES	6

Database design principles for the cloud-Data modelling and schema design-Deployment strategies and automation-Backup and recovery in cloud databases-High availability and disaster recovery.

UNIT IV	SECURITY AND COMPLIANCE IN CLOUD DATABASES	6

Security principles for cloud databases-Data encryption (at rest and in transit)-Identity and access management-Compliance standards (GDPR, HIPAA, etc.)-Auditing and monitoring

UNIT V	OPTIMIZATION AND TROUBLESHOOTING OF CLOUD DATA	6
Performance tuning techniques-Indexing and query optimization-Scaling databases (vertical and horizontal scaling)-Monitoring and diagnostics tools-Common troubleshooting scenarios and solutions		
		TOTAL: 30 PERIODS

PRACTICALS EXPERIMENTS:

1. Create Amazon AWS EC2 Linux instance with conceptual understanding of SSH client software protocol and keys.
2. Create Amazon AWS EC2 Windows server instance with conceptual understanding of RDP (Remote Desktop Protocol).
3. Create cloud storage Bucket using Amazon Simple Storage Service (S3). Perform the following operations:
4. Create a folder within a S3 Bucket.
5. Upload content to S3
6. Create a cloud storage Bucket using Amazon Simple Storage Service (S3). Perform the following operations:
7. Change permissions to allow public access of contents.
8. Set MetaData on an S3 Bucket.
9. Delete an S3 Bucket and its content.
10. Launch and connect to an Amazon Relational DataBase (RDS) Service using MySQL
11. Launch and connect to an Amazon Relational DataBase (RDS) Service using Oracle.
12. Launch and connect to an Amazon Relational DataBase (RDS) Service using postgre SQL DataBase engines.
13. Launch and connect to an Amazon Relational DataBase (RDS) Service using SQL Server.

TOTAL: 30 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Apply the fundamental concepts and architecture of cloud databases.
CO2:	Explain the features and benefits of different cloud database services.
CO3:	Summarize the process of designing and deploying databases in the cloud.
CO4:	Explain the security and compliance considerations for cloud databases.
CO5:	Illustrate the techniques for optimizing cloud database performance.
CO6:	Interpret common troubleshooting methods for cloud database issues.
TEXT BOOKS:	
1	Thomas Erl . "Cloud Computing: Concepts, Technology & Architecture.", Prentice Hall, 1st Edition, 2013.
2	Carlos Coronel, Steven Morris. "Database Systems: Design, Implementation, and Management (with Cloud Computing and Data Storage Integration).", Cengage Learning, 2020.
REFERENCES:	
1	Michael J. Kavis, "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)", Wiley, 1st Edition, 2014.
2	Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", O'Reilly Media, 1st Edition, 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	-	-	1	-	1	1	1	2	1	1
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3	2	1	-	-	1	-	-	1	-	1	1	1	3	1	1
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5	2	1	-	-	1	-	-	1	-	1	1	1	3	1	1
6	2	1	-	-	1	-	-	1	-	1	1	1	3	1	1
Overall Correlation	3	2	1	1	2	-	-	2	-	2	2	2	3	2	2

23IT035	STORAGE TECHNOLOGIES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Characterize the functionalities of logical and physical components of storage
- Describe various storage networking technologies
- Identify different storage virtualization technologies
- Discuss the different backup and recovery strategies
- Understand common storage management activities and solutions

UNIT I	STORAGE SYSTEMS	6

Introduction to Information Storage: Digital data and its types - Information storage - Key characteristics of data center and Evolution of computing platforms - Information Lifecycle Management - Third Platform Technologies: Cloud computing and its essential characteristics - Cloud services and cloud deployment models - Big data analytics - Social networking and mobile computing - Characteristics of third platform infrastructure and Imperatives for third platform transformation - Data Center Environment: Building blocks of a data center - Compute systems and compute virtualization and Software-defined data center.

UNIT II	INTELLIGENT STORAGE SYSTEMS AND RAID	6

Components of an intelligent storage system, - Components, addressing, and performance of hard disk drives and solid-state drives – RAID - Types of intelligent storage systems - Scale-up and scale-out storage Architecture.

UNIT III	STORAGE NETWORKING TECHNOLOGIES	6

Block-Based Storage System - File-Based Storage System - Object-Based and Unified Storage - Fibre Channel SAN: Software-defined networking - FC SAN components and architecture - FC SAN

topologies - link aggregation, and zoning - Fibre Channel over Ethernet SAN: Components of FCoE SAN - FCoE SAN connectivity - Converged Enhanced Ethernet - FCoE architecture.		
UNIT IV	**BACKUP, ARCHIVE AND REPLICATION**	**6**
Introduction to Business Continuity - Backup architecture - Data deduplication - Cloud-based and mobile device backup - Data archive - Compute based, storage-based, and network-based replication - Data migration, - Disaster Recovery as a Service (DRaaS).		
UNIT V	**SECURING STORAGE INFRASTRUCTURE**	**6**
Information security goals - Storage security domains - Threats to a storage infrastructure - Security controls to protect a storage infrastructure - Governance, risk, and compliance - Storage infrastructure management functions - Storage infrastructure management processes.		
		TOTAL: 30 PERIODS
PRACTICALS:		

LIST OF EXPERIMENTS

1. For any storage documentation, plan storage requirements based on performance and cost considerations such as Fibre Channel.
2. Install the iSCSI target feature and create/configure an iSCSI target.
3. Self-directed remote lab for advanced HPE storage solutions.
4. Design backup, recovery, and archive strategies for various customer scenarios.
5. Create a persistent disk and attach it to a virtual machine.
6. Create a storage bucket and upload objects to the bucket using google cloud console.
7. Create folders and subfolders in the bucket using google cloud console.
8. Make objects in a storage bucket publicly accessible using google cloud console.
9. Create an Image-backed Dataset from a Node-local Dataset.

10.	Create a Remote Dataset and use it on a Single Node.
	TOTAL: 30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the fundamentals of information storage management and various models of Cloud infrastructure services and deployment
CO2:	Illustrate the usage of advanced intelligent storage systems and RAID
CO3:	Interpret various storage networking architectures - SAN, including storage subsystems and virtualization
CO4:	Examine the different role in providing disaster recovery and remote replication technologies
CO5:	Utilize the security needs and security measures to be employed in information storage management
CO6:	Model the backup, archiving with regard to recovery and business continuity.
TEXT BOOKS:	
1	EMC Corporation, "Information Storage and Management", Wiley, India,2012
2	Jon Tate., Pall Beck., Hector Hugo Ibarra., Shanmuganathan Kumaravel and Libor Miklas, "Introduction to Storage Area Networks", Ninth Edition, IBM - Redbooks, 2017.
REFERENCES:	
1	Hubbert Smith , "Data Center Storage", First Edition, Auerbach Publications, 2019

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

<table>
<tr><td rowspan="2">23IT036</td><td rowspan="2">SECURITY AND PRIVACY IN CLOUD</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">

To introduce Cloud Computing terminology, definition & concepts
To understand the security design and architectural considerations for Cloud
To understand the Identity, Access control in Cloud
To follow best practices for Cloud security using various design patterns
To be able to monitor and audit cloud applications for security

</td></tr>
<tr><td>UNIT I</td><td colspan="4">FUNDAMENTALS OF CLOUD SECURITY CONCEPTS</td><td>6</td></tr>
<tr><td colspan="6">Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Non- repudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.</td></tr>
<tr><td>UNIT II</td><td colspan="4">SECURITY DESIGN AND ARCHITECTURE FOR CLOUD</td><td>6</td></tr>
<tr><td colspan="6">Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies – Data Protection strategies: Data retention, deletion and archiing procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key.</td></tr>
<tr><td>UNIT III</td><td colspan="4">ACCESS CONTROL AND IDENTITY MANAGEMENT</td><td>6</td></tr>
<tr><td colspan="6">Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based</td></tr>
</table>

Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention.		
UNIT IV	**CLOUD SECURITY DESIGN PATTERNS**	**6**
Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud.		
UNIT V	**MONITORING, AUDITING AND MANAGEMENT**	**6**
Proactive activity monitoring - Incident Response, monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management		
		TOTAL: 30 PERIODS
PRACTICALS EXERCISES:		

LIST OF EXPERIMENTS

1. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in Cloud Sim
2. Simulate resource management using cloud sim
3. Simulate log forensics using cloud sim
4. Simulate a secure file sharing using a cloud sim
5. Implement data anonymization techniques over the simple dataset (masking, k- anonymization, etc)
6. Implement any encryption algorithm to protect the images
7. Implement any image obfuscation mechanism
8. Implement a role-based access control mechanism in a specific scenario.
9. Implement an attribute-based access control mechanism based on a particular scenario
10. Develop a log monitoring system with incident management in the cloud.

	TOTAL: 30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Utilize the cloud concepts and fundamentals.
CO2:	Explain the security challenges in the cloud.
CO3:	Make use of cloud policy and Identity and Access Management.
CO4:	Experiment with various risks and audit and monitoring mechanisms in the cloud.
CO5:	Analyze the various architectural and considerations for security in the cloud.
CO6:	Illustrate the privacy issues in cloud environment
TEXT BOOKS:	
1	Raj Kumar Buyya, James Broberg, Andrzej Goscinski, "Cloud Computing", Wiley, 2013.
2	Dave shackleford, "Virtualization Security: Protecting Virtualized Environments", Sybex, 2013.
REFERENCES:	
1	Mark C. Chu-Carroll, "Code in the Cloud", CRC Press, 2011.
2	Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi, "Mastering Cloud Computing Foundations and Applications Programming", McGraw-Hill Education, 2013.

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

23IT037	STREAM PROCESSING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To Introduce Data Processing terminology, definition & concepts
- To Define different types of Data Processing
- To Explain the concepts of Real-time Data processing
- To Select appropriate structures for designing and running real-time data services in a business environment
- To Illustrate the benefits and drive the adoption of real-time data services to solve real world problems

UNIT I	FOUNDATIONS OF DATA SYSTEMS	6

Introduction to Data Processing - Stages of Data processing - Data Analytics, Batch Processing - Stream processing - Data Migration - Transactional Data processing, Data Mining - Data Management Strategy - Storage, Processing - Integration - Analytics - Benefits of Data as a Service – Challenges.

UNIT II	REAL-TIME DATA PROCESSING	6

Introduction to Big data - Big data infrastructure - Real-time Analytics - Near real-time solution - Lambda architecture - Kappa Architecture - Stream Processing, Understanding Data Streams - Message Broker - Stream Processor - Batch & Real-time ETL tools - Streaming Data Storage.

UNIT III	DATA MODELS AND QUERY LANGUAGES	6

Relational Model - Document Model - Key-Value Pairs - NoSQL - Object-Relational Mismatch - Many to-One and Many-to-Many Relationships - Network data models, Schema Flexibility - Structured Query Language - Data Locality for Queries - Declarative Queries - Graph Data models - Cypher Query Language - Graph Queries in SQL, The Semantic Web - CODASYL, SPARQL.

UNIT IV	EVENT PROCESSING WITH APACHE KAFKA	6
Apache Kafka - Kafka as Event Streaming platform - Events, Producers - Consumers, Topics - Partitions, Brokers - Kafka APIs - Admin API - Producer API - Consumer API - Kafka Streams API - Kafka Connect API.		
UNIT V	**REAL-TIME PROCESSING USING SPARK STREAMING**	**6**
Structured Streaming - Basic Concepts, Handling Event-time and Late Data - Fault-tolerant Semantics - Exactly-once Semantics - Creating Streaming Datasets - Schema Inference - Partitioning of Streaming datasets - Operations on Streaming Data - Selection, Aggregation - Projection - Watermarking - Window operations - Types of Time windows - Join Operations – Deduplication.		
		TOTAL: 30 PERIODS

PRACTICALS EXERCISES:

1. Install MongoDB
2. Design and Implement Simple application using MongoDB
3. Query the designed system using MongoDB
4. Create a Event Stream with Apache Kafka
5. Create a Real-time Stream processing application using Spark Streaming
6. Build a Micro-batch application
7. Real-time Fraud and Anomaly Detection
8. Real-time personalization, Marketing, Advertising

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Apply the applicability and utility of different streaming algorithms.
CO2:	Apply current research trends in data-stream processing.
CO3:	Analyze the suitability of stream mining algorithms for data stream systems.

CO4:	Build stream processing systems, services and applications.
CO5:	Solve problems in real-world applications that process data streams.
CO6:	Solve problems in Event Processing with Apache Kafka
TEXT BOOKS:	
1	Karau, Holden, and Matei Zaharia. "Learning Spark: Lightning-Fast Data Analytics." 2nd Edition. O'Reilly Media, 2023.
2	Wampler, Dean, and Jason Decremer. "Programming Scala: Scalability = Functional Programming + Objects." 3rd Edition. O'Reilly Media, 2023.
REFERENCES:	
1	Gualtieri, Mike, et al. "Streaming Data: Understanding the Real-Time Pipeline." 1st Edition. O'Reilly Media, 2023.
2	Shukla, Bhavuk, and Pradeep Pujari. "Stream Processing with Apache Kafka." Apress, 2023.
3	Akidau, Tyler, Slava Chernyak, and Reuven Lax. "Streaming Systems: The What, Where, When, and How of Large-Scale Data Processing." 1st Edition. O'Reilly Media, 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	2	1	3	2	2	1	1
2	3	2	1	1	2	-	-	1	1	2	3	1	2	2	1
3	3	3	2	2	3	-	-	1	3	3	1	1	3	2	1
4	3	2	1	1	3	-	-	1	2	3	3	1	1	1	1
5	3	2	1	1	2	-	-	1	1	3	1	2	1	3	1
6	3	2	1	1	1	-	-	1	1	1	1	1	1	1	1
Overall Correlation	3	3	2	2	2	-	-	2	2	2	2	2	2	2	2

23IT038	CLOUD WEB SERVICES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Introduction to cloud computing and Amazon web services.
- Understanding and using EC2 instances.
- Deploying and managing applications on AWS cloud.
- Using AWS security services.
- Implementing the networking concepts on AWS cloud.
- Analyze the requirements for developing and migrating applications to Web and Cloud Services.

UNIT I	INTRODUCTION TO CLOUD COMPUTING AND AMAZON WEB SERVICES	6

Introduction to Cloud Computing - Cloud Service Delivery Models (IAAS, PAAS, SAAS) - Cloud Deployment Models (Private, Public, Hybrid and Community) - Introduction to Amazon Web Services - Why Amazon? Use Cases - AWS Storage Options - AWS Compute Options - AWS Database Options - AWS Workflow Automation and Orchestration Options - AWS Systems Management and Monitoring Options - AWS Virtual Private Cloud Introduction, Pricing Concepts.

UNIT II	INTRODUCTION TO EC2	6

Introduction To EC2 - Instance Types And Uses - Auto scaling Instances - Amazon Machine Images (AMIS) - Modifying Existing Images - Creating New Images of Running Instances - Converting An Instance Store AMI To An EBS AMI - Instances Backed By Storage Types - Elastic IPS - Elastic Load Balancing.

UNIT III	WEB APPLICATIONS AND SECURITY	6

Introduction to Elastic Beanstalk - Deploying Scalable Application On AWS - Selecting And Launching An Application Environment - Provisioning Application Resources with Cloud formation - Introduction to Cloud Lookout - Describe Amazon Cloud Watch metrics and alarms - AWS Messaging Services Introduction to

AWS Security - Describe Amazon Identity and Access Management (IAM) - AWS Directory Service - AWS Key Management Service.		
UNIT IV	**STORAGE**	**6**
Amazon Storage - S3 Storage Basics - Buckets and Objects - Creating A Web Server Using S3 Endpoints - Managing Voluminous Information with EBS - Glacier Storage Service - Describe Amazon Dynamo - Understand key aspects of Amazon RDS - Launch an Amazon RDS instance		
UNIT V	**NETWORKING**	**6**
Introduction to AWS Networking - Access Control Lists (ACLs) - Setting Up a Security Group- Setting Up VPC And Internet Gateway- Setting Up A VPN- Setting Up A Customer Gateway For VPN- Setting Up Dedicated Hardware For VPC-Route53 for DNS System - Cloud front.		
		TOTAL: 30 PERIODS

PRACTICALS EXERCISES:

1. Study of CloudSim, set up CloudSim environment.
2. Virtual Machine (VM) creation, Running VMs on CloudSim.
3. Allocate different Cloudlets to VMs and Data Centers using different Cloud based scheduling algorithms
4. Create different Data Centers, VM allocation and provisioning on Data Centers, and analysis of outcomes
5. Assigning cloudlets and analysing the scheduling parameters for various scenarios
6. Apply and evaluate the performance of various Cloud based Web Services

COURSE OUTCOMES:

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

CO1:	Explain the process of cloud computing and Amazon web services.
CO2:	Summarize the concept of EC2
CO3:	Apply knowledge on Deploying and managing applications

	on AWS
CO4:	Interpret the use of AWS security service
CO5:	Explain the networking concepts on AWS
CO6:	Interpret the migrate applications to Web and Cloud Services.
TEXT BOOKS:	
1	Joe Baron, Hisham Baz , Tim Bixler , Biff Gaut , Kevin E. Kelly , Sean Senior , John Stamper , "AWS Certified Solutions Architect Official Study Guide: Associate Exam, John Wiley and Sons Publications, 2017
2	Cloud Computing: A Hands-On Approach Book by Arshdeep Bahga and Vijay K. Madisetti,CreateSpace Independent Publishing Platform,2013
REFERENCES:	
1	Yohan Wadia , "AWS Certified Solutions Architect Official Study Guide: Associate Exam, John Packt Publishing, 2016
2	Bernald Golden, "Amazon Web Services for Dummies", John Wiley & Sons, 2013

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

VERTICAL 2: FULL STACK DEVELOPMENT

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

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

UNIT I	INTRODUCTION TO JAVA SCRIPT	6

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

UNIT II	INTRODUCTION TO NOSQL DATABASE WITH MONGODB	6

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

UNIT III	FRONTEND DEVELOPMENT WITH REACT JS	6

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

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

PRACTICAL EXERCISES:

LIST OF EXPERIMENTS

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

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain concepts of JavaScript and its environment.
CO2:	Apply NoSQL databases and develop deeper into it using MongoDB and performing basic database operations in it.

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

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

<table>
<tr><td rowspan="2">23CS032</td><td colspan="2" rowspan="2">MOBILE APP DEVELOPMENT</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">• To understand the need and characteristics of mobile applications
• To design the right user interface for mobile applications.
• To understand the design issues in the development of mobile applications
• To understand the development procedure for mobile applications forms
• To develop mobile applications using various tools and platform</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION TO ANDROID OS</td><td>6</td></tr>
<tr><td colspan="7">Android: An Open Platform for Mobile Development- Introducing the Open Handset Alliance- Introducing the Development Framework- Developing for Android-Developing for Mobile and Embedded Devices- Android Development Tools-Introducing the Application Manifest File -The Android Application Lifecycle.</td></tr>
<tr><td>UNIT II</td><td colspan="5">BUILDING USER INTERFACE AND INTENT CREATIONS</td><td>6</td></tr>
<tr><td colspan="7">Fundamental Android UI Design- Android User Interface Fundamentals- Introducing Layouts- The Android Widget Toolbox- Introducing Intents- Creating Intent Filters and Broadcast Receivers- Using Internet Services-Connecting to Google App Engine.</td></tr>
<tr><td>UNIT III</td><td colspan="5">DATABASES AND CONTENT PROVIDERS</td><td>6</td></tr>
<tr><td colspan="7">Introduction on SQLite- Working with SQLite Databases- Creating Content Providers Native Android Content Providers- Introducing Services -Using Background Threads- Using Alarms- Creating and Using Menus and Action Bar Action Items.</td></tr>
</table>

UNIT IV	**LOCATION-BASED SERVICES AND WIRELESS SERVICES**	**6**
Using Location-Based Services-Using the Emulator with Location-Based Services-Selecting a Location Provider- Finding Your Current Location- Using Bluetooth-Managing Network and Internet Connectivity- Managing Wi-Fi.		
UNIT V	**TELEPHONY AND SMS, PUBLISHING APPLICATIONS**	**6**
Using Telephony - Introducing SMS and MMS - Distributing Applications-Introducing the Google Play - Getting Started with Google Play-Publishing Applications.		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		
LIST OF EXPERIMENTS 1. Develop an application that uses GUI components, Font and Colours 2. Develop an application that uses Layout Managers and event listeners. 3. Write an application that draws basic graphical primitives on the screen. 4. Develop an application that makes use of databases 5. Develop an application that makes use of Notification Manager 6. Implement an application that uses Multi-threading 7. Develop a native application that uses GPS location information 8. Implement an application that writes data to the SD card 9. Implement an application that creates an alert upon receiving a message 10. Write a mobile application that makes use of RSS feed		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Develop an application using Android development environment
CO2:	Develop mobile application development frameworks and tools
CO3:	Build a mobile application that manages Database operations
CO4:	Develop location based services and wireless environments
CO5:	Develop Telephony Applications for introducing SMS and MMS
CO6:	Develop applications based on Android OS

TEXT BOOKS:

1	Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011)

REFERENCES:

1	Reto Meier, "Professional Android 4 Application Development", Wiley, First Edition, 2012
2	Zigurd Mednieks, Laird Dornin, G. Blake Mike, Masumi Nakamura, "Programming Android", O'Reilly, 2ndEdition, 2012.
3	Alasdair Allan, "iPhone Programming", O'Reilly, First Edition, 2010.

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

<table>
<tr><td rowspan="2">23CS033</td><td rowspan="2" colspan="2">UI AND UX DESIGN</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">• 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.</td></tr>
<tr><td>UNIT I</td><td colspan="5">FOUNDATIONS OF DESIGN</td><td>6</td></tr>
<tr><td colspan="7">UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy.</td></tr>
<tr><td>UNIT II</td><td colspan="5">FOUNDATIONS OF UI DESIGN</td><td>6</td></tr>
<tr><td colspan="7">Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides.</td></tr>
<tr><td>UNIT III</td><td colspan="5">FOUNDATIONS OF UX DESIGN</td><td>6</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT IV</td><td colspan="5">WIREFRAMING, PROTOTYPING AND TESTING</td><td>6</td></tr>
<tr><td colspan="7">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.</td></tr>
</table>

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
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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

<table>
<tr><td rowspan="2">23CS035</td><td rowspan="2" colspan="2">DEVOPS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">

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

</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION TO DEVOPS</td><td>6</td></tr>
<tr><td colspan="7">Devops Essentials - Introduction to AWS, GCP, Azure - Version control systems: Git and Github.</td></tr>
<tr><td>UNIT II</td><td colspan="5">COMPILE AND BUILD USING MAVEN & GRADLE</td><td>6</td></tr>
<tr><td colspan="7">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</td></tr>
<tr><td>UNIT III</td><td colspan="5">CONTINUOUS INTEGRATION USING JENKINS</td><td>6</td></tr>
<tr><td colspan="7">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.</td></tr>
</table>

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

<table>
<tr><td rowspan="2">23CS036</td><td colspan="2" rowspan="2">WEB APPLICATION SECURITY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">To understand the fundamentals of web application security.
To focus on wide aspects of secure development and deployment of web applications.
To learn how to build secure APIs.
To learn the basics of vulnerability assessment and penetration testing.
To get an insight about Hacking techniques and Tools.</td></tr>
<tr><td>UNIT I</td><td colspan="5">FUNDAMENTALS OF WEB APPLICATION SECURITY</td><td>6</td></tr>
<tr><td colspan="7">The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation.</td></tr>
<tr><td>UNIT II</td><td colspan="5">SECURE DEVELOPMENT AND DEPLOYMENT</td><td>6</td></tr>
<tr><td colspan="7">Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM).</td></tr>
<tr><td>UNIT III</td><td colspan="5">SECURE API DEVELOPMENT</td><td>6</td></tr>
<tr><td colspan="7">API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.</td></tr>
</table>

<table>
<tr><td>UNIT IV</td><td>VULNERABILITY ASSESSMENT AND PENETRATION TESTING</td><td>6</td></tr>
<tr><td colspan="3">Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database- based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.</td></tr>
<tr><td>UNIT V</td><td>HACKING TECHNIQUES AND TOOLS</td><td>6</td></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td colspan="3" align="right">TOTAL: 30 PERIODS</td></tr>
<tr><td colspan="3">PRACTICAL EXERCISES:</td></tr>
<tr><td colspan="3">LIST OF EXPERIMENTS
1. Install wireshark and explore the various protocols
a) Analyze the difference between HTTP vs HTTPS
b) Analyze the various security mechanisms embedded with different protocols.
2. Identify the vulnerabilities using OWASP ZAP tool
3. Create simple REST API using python for following operation
a) GET
b) PUSH
c) POST
d) DELETE
4. Install Burp Suite to do following vulnerabilities:
a) SQL injection
b) cross-site scripting (XSS)
5. Attack the website using Social Engineering method</td></tr>
<tr><td colspan="3" align="right">TOTAL :30 PERIODS</td></tr>
</table>

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the basic concepts of web application security
CO2:	Identify the process for secure development and deployment of web applications
CO3:	Develop and design Secure Web Applications that uses secure APIs
CO4:	Apply vulnerability assessment and penetration testing methods using various tools and its types.
CO5:	Experiment with hacking techniques for secure social engineering
CO6:	Apply hacking Tools like Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.
TEXT BOOKS:	
1	Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc
2	Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.
3	Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.
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 & 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”, The McGraw-Hill Companies,Third Edition, 2011,

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

<table>
<tr><td rowspan="2">23CS037</td><td colspan="2" rowspan="2">ADVANCED JAVA PROGRAMMING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">• To learn the advanced concepts in J2SE.
• To understand server side programming using Servlet.
• To learn the Java server pages and implementation.
• To understand the Model View Controller Architecture.
• To learn to develop web-based applications using struts hibernate Frameworks.</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCING JAVA ENTERPRISE EDITION</td><td>6</td></tr>
<tr><td colspan="7">Enterprise Java, Basic Application Structure, Using Web Containers, Creating Servlets, Configuring Servlets, Understanding HTTP methods, Using Parameters and Accepting Form Submissions, Using Init parameters, File Uploading, JDBC.</td></tr>
<tr><td>UNIT II</td><td colspan="5">JAVA SERVER PAGES</td><td>6</td></tr>
<tr><td colspan="7">Creating JSPs, Using Java within JSP, Combining Servlets and JSPs, maintaining State using Sessions, JSP Custom Tag Library, Integrating Servlets and JSP: Model View Controller Architecture.</td></tr>
<tr><td>UNIT III</td><td colspan="5">STRUTS FRAMEWORK</td><td>6</td></tr>
<tr><td colspan="7">Introduction to Struts – Building a Simple Struts Application – Understanding Model, View and Controller Layer- Overview of Tiles.</td></tr>
<tr><td>UNIT IV</td><td colspan="5">JAVA SERVER FACES (JSF)</td><td>6</td></tr>
<tr><td colspan="7">Introduction to Java Server Faces (JSF)- JSF Application Architecture – Building a simple JSF Application – JSF Request Processing Lifecycle – The Facelets View Declaration Language – User Interface Component Model- JSF Event Model.</td></tr>
<tr><td>UNIT V</td><td colspan="5">SPRING FRAMEWORK AND HIBERNATE</td><td>6</td></tr>
<tr><td colspan="7">MVC pattern for Web Applications, Spring Framework, Understanding Application Context, Bootstrapping Spring</td></tr>
</table>

framework, Configuring Spring framework, Data Persistence, Object/relational Mapping, Hibernate ORM, Mapping Entities to Tables.
TOTAL: 30 PERIODS
PRACTICAL EXERCISES:
LIST OF EXPERIMENTS 1. Deploy a basic web application on a web container like Apache Tomcat. 2. Develop a servlet to handle file uploads. 3. Implement a simple application combining servlets and JSPs. 4. Implement session management in JSP. 5. Develop a simple form-based application using Struts. 6. Develop JSP pages as the view layer in Struts. 7. Develop a simple form-based application using JSF. 8. Develop JSF views using Facelets. 9. Implement the MVC pattern using Spring MVC. 10. Implement database operations using spring and Hibernate.
TOTAL: 30 PERIODS
COURSE OUTCOMES:
After completion of the course, the students will be able to:

CO1:	Apply the advanced Java concepts to solve complex problems.
CO2:	Develop server side programs using Servlets and JSP.
CO3:	Develop an application using Java Server Faces and Struts Framework.
CO4:	Apply cutting-edge frameworks in web application development.
CO5:	Develop a web application using Hibernates.
CO6:	Develop a web application using Spring framework.

TEXT BOOKS:	
1	Anil Hemrajani, “Agile Java Development with Spring, Hibernate and Eclipse”, Sams Publishing, 2006.
2	Herbert Schildt, “The Complete Reference-Java”, Tata Mcgraw- Hill Edition, 2022.
REFERENCES:	
1	Christian Bauer, Gavin King, Gary Gregory, “Java Persistence with Hibernate”, Manning Publications, 2015.
2	Craig Walls, “Spring in Action”, Manning Publications, 2014.
3	Ed Burns, Chris Schalk, “JavaServer Faces 2.0, The Complete Reference”, McGraw-Hill Publishers, 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	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	3	2	1
5	3	2	1	1	2	1	-	1	1	1	1	1	3	2	1
6	3	2	1	1	2	1	-	1	1	1	1	1	3	2	1
Overall Correlation	3	3	1	1	3	1	-	1	1	1	1	1	3	3	1

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

VERTICAL 3: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

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**

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**

23IT039	DATA SCIENCE	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the data science fundamentals and process.
- To learn to describe the data for the data science process.
- To learn to describe the relationship between data.
- To utilize the Python libraries for Data Wrangling.
- To present and interpret data using visualization libraries in Python

UNIT I	INTRODUCTION	6

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model– presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data.

UNIT II	DESCRIBING DATA	6

Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores

UNIT III	DESCRIBING RELATIONSHIPS	6

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 towards the mean.

UNIT IV	PYTHON LIBRARIES FOR DATA WRANGLING	6

Basics of Numpy arrays –aggregations –computations on arrays – comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables.

UNIT V	DATA VISUALIZATION	6
Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		

LIST OF EXPERIMENTS

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages.
2. Working with Numpy arrays.
3. Working with Pandas data frames.
4. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.
5. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:
    a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
    b. Bivariate analysis: Linear and logistic regression modeling
    c. Multiple Regression analysis
    d. Also compare the results of the above analysis for the two data sets.
    6. Apply and explore various plotting functions on UCI data sets.
    a. Normal curves
    b. Density and contour plots
    c. Correlation and scatter plots
    b. Histograms
    c. Three dimensional plotting
7. Visualizing Geographic Data with Basemap.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the data science process
CO2:	Compare different types of data description for data science process
CO3:	Apply knowledge on relationships between data
CO4:	Make use of the Python Libraries for Data Wrangling
CO5:	Apply Visualization Libraries in Python to interpret and explore data
CO6:	Analyze different plots for basic exploratory data analysis

TEXT BOOKS:

1	David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2	Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.

REFERENCES:

1	Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.
2	Newell, Allen. "Unified Theories of Cognition." Harvard University Press, 1990.

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

23IT040	DEEP LEARNING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the basics of deep neural networks
- To understand CNN of architectures of deep neural networks
- To understand the concepts of Artificial Neural Networks
- To learn the basics of Data science in Deep learning
- To learn about applications of deep learning in AI and Data Science.

UNIT I	DEEP NETWORKS BASICS	6

Probability Distributions – Gradient based Optimization - Linear Algebra: Scalars -- Vectors -- Matrices and tensors – Machine Learning Basics: Capacity -- Overfitting and underfitting -- Hyperparameters and validation sets -- Estimators -- Bias and variance -- Stochastic gradient descent -- Challenges motivating deep learning; Deep Networks: Deep feedforward networks.

UNIT II	CONVOLUTIONAL NEURAL NETWORKS	6

Convolution Operation -- Sparse Interactions -- Parameter Sharing -- Equivariance -- Pooling -- Convolution Variants: Strided -- Tiled -- Transposed and dilated convolutions; CNN Learning: Nonlinearity Functions -- Loss Functions -- Regularization -- Optimizers -- Gradient Computation.

UNIT III	DEEP LEARNING ALGORITHMS FOR AI	6

Artificial Neural Networks – Linear Associative Networks – Perceptrons -The Backpropagation Algorithm - Hopfield Nets - Boltzmann Machines - Deep RBMs - Variational Autoencoders - Deep Backprop Networks- Autoencoders.

UNIT IV	DATA SCIENCE AND DEEP LEARNING	6

Fundamentals of Data science and responsibilities of a data scientist - life cycle of data science – Data science tools - Data

modeling, and featurization - How to work with data variables and data science tools - How to visualize the data.		
UNIT V	**APPLICATIONS OF DEEP LEARNING**	**6**
Object detection and classification -RGB and depth image fusion - NLP tasks - dimensionality estimation - time series forecasting - building electric power grid for controllable energy resources - guiding charities in maximizing donations and robotic control in industrial environments.		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		

LIST OF EXPERIMENTS

1. Design a single unit perceptron for classification of a linearly separable binary dataset without using pre-defined models. Use the Perceptron() from sklearn.

a. Identify the problem with single unit Perceptron. Classify using Or-, And- and Xor-ed data and analyze the result.

2. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets. Vary the activation functions used and compare the results.
3. Build a Deep Feed Forward ANN by implementing the Backpropagation algorithm and test the same using appropriate data sets. Use the number of hidden layers >=4.
4. Design and implement an Image classification model to classify a dataset of images using Deep Feed Forward NN. Record the accuracy corresponding to the number of epochs. Use the MNIST, CIFAR-10 datasets.
5. Design and implement a CNN model (with 2 layers of convolutions) to classify multi category image datasets. Record the accuracy corresponding to the number of epochs. Use the MNIST, CIFAR-10 datasets.

6. Design and implement a CNN model (with 4+ layers of convolutions) to classify multi category image datasets. Use the MNIST, Fashion MNIST, CIFAR-10 datasets. Set the No. of Epoch as 5, 10 and 20. Make the necessary changes whenever required. Record the accuracy corresponding to the number of epochs. Record the time required to run the program, using CPU as well as using GPU in Colab.
7. Design and implement a CNN model (with 2+ layers of convolutions) to classify multi category image datasets. Use the concept of padding and Batch Normalization while designing the CNN model. Record the accuracy corresponding to the number of epochs. Use the Fashion MNIST/MNIST/CIFAR10 datasets.
8. Design and implement a CNN model (with 4+ layers of convolutions) to classify multi category image datasets. Use the concept of regularization and dropout while designing the CNN model. Use the Fashion MNIST datasets. Record the Training accuracy and Test accuracy corresponding to the following architectures:
    a. Base Model
    b. Model with L1 Regularization
    c. Model with L2 Regularization
    d. Model with Dropout
    e. Model with both L2 (or L1) and Dropout
9. Use the concept of Data Augmentation to increase the data size from a single image.
10. Design and implement a CNN model to classify CIFAR10 image dataset. Use the concept of Data Augmentation while designing the CNN model. Record the accuracy corresponding to the number of epochs.

	TOTAL: 30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the basics in deep neural networks.
CO2:	Apply Convolution Neural Network for image processing.
CO3:	Explain the basics of Artificial Intelligence using deep learning.
CO4:	Apply deep learning algorithms for data science.
CO5:	Apply deep learning algorithms for variety applications.
CO6:	Discuss a real world application using suitable deep neural networks.
TEXT BOOKS:	
1	Ian Goodfellow, Yoshua Bengio, Aaron Courville. "Deep Learning.", MIT Press, 2016.
2	Stone, James. "Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning", Sebtel Press, United States, 2019.
REFERENCES:	
1	Vance, William. "Data Science: A Comprehensive Beginners Guide to Learn the Realms of Data Science.",2019.
2	Wani, M.A., Raj, B., Luo, F., Dou."Deep Learning Applications.", Volume 3, Springer Publications,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	2	1	1
2	3	2	1	1	2	-	-	1	1	1	1	1	2	2	1
3	3	2	1	1	1	-	-	1	1	1	1	1	2	1	1
4	3	2	1	1	1	-	-	1	1	1	1	1	2	1	1
5	3	2	1	1	1	-	-	1	1	1	1	1	3	1	1
6	2	1	-	-	2	-	-	1	-	-	-	1	2	2	1
Overall Correlation	3	2	1	1	2	-	-	2	1	1	1	2	3	2	2

23IT041	COGNITIVE SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To familiarize Use the Innovation Canvas to justify potentially successful products.
- To learn various ways in which to develop a product idea.
- To understand about how Big Data can play vital role in Cognitive Computing.
- To know about the business applications of Cognitive Computing.
- To get into all applications of Cognitive Computing

UNIT I	FOUNDATION OF COGNITIVE COMPUTING	6

Foundation of Cognitive Computing: cognitive computing as a new generation - the uses of cognitive systems - system cognitive - understanding cognition Design Principles for Cognitive Systems: Components of a cognitive system - building the corpus - bringing data into cognitive system - machine learning - hypotheses generation and scoring - presentation and visualization services.

UNIT II	NATURAL LANGUAGE PROCESSING IN COGNITIVE SYSTEMS	6

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

UNIT III	BIG DATA AND COGNITIVE COMPUTING	6

Relationship between Big Data and Cognitive Computing: Dealing with human-generated Big data - analytical data warehouses,

Hadoop, data in motion and streaming data - integration of big data with traditional data Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing - using advanced analytics to create value - Impact of open source tools on advanced analytics.		
UNIT IV	**BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING**	**6**
Knowledge meaning to business - Difference with a cognitive systems approach - Meshing data together differently - Using business knowledge to plan for the future - Answering business questions in new ways - Building business specific solutions , Making cognitive computing a reality - Cognitive application changing the market - The process of building a cognitive application: defining the objective and domain - Understanding the intended users and their attributes - questions and exploring insights - Training and testing.		
UNIT V	**APPLICATION OF COGNITIVE COMPUTING**	**6**
Building a cognitive health care application: Foundations of cognitive computing for healthcare - Building on a foundation of big data analytics - Cognitive applications across the health care eco system - Using a cognitive application to enhance the electronic medical record Using cognitive application to improve clinical teaching		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		
LIST OF EXPERIMENTS 1. Build a simple cognitive system that can process text input and generate insights. Use Watson's Natural Language Understanding (NLU) API to analyze text data. 2. Create a basic neural network to classify images or text. Experiment with training the model and observe how it learns from data.		

	3. Set up a Hadoop cluster, upload a large dataset, and perform basic Map Reduce operations to analyze the data. 4. Perform advanced data analysis on a big dataset using Spark. Implement machine learning algorithms to predict trends or classify data. 5. Analyze a case study where cognitive computing disrupted a traditional business model. Discuss the benefits and challenges faced during the implementation 6. Develop a cognitive customer support chatbot that can understand and respond to customer queries using Watson Assistant. 7. Create user personas, define the domain, and design the application interface. 8. Create a cognitive simulation tool that presents medical scenarios to trainees and provides feedback based on data patterns and best practices.
	TOTAL: 30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain applications in Cognitive Computing.
CO2:	Implement Natural language API.
CO3:	Develop a Hadoop Cluster to Perform Map Reduce operations.
CO4:	Apply the process of taking a product to market.
CO5:	Build an application involved in cognitive domain.
CO6:	Summarize the foundation of big data analytics.
TEXT BOOKS:	
1	Vijay V Raghavan, Venkat N.Gudivada, VenuGovindaraju, C.R. Rao. "Cognitive Computing: Theory and Applications: (Handbook of Statistics 35).", Elsevier publications, 2016

2	Judith Hurwitz, Marcia Kaufman, Adrian Bowles. “Cognitive Computing and Big Data Analytics.”, Wiley Publications, 2015
REFERENCES:	
1	Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences.”, The MIT Press, 1999.
2	Noah D. Goodman, Joshua B. Tenenbaum. “Probabilistic Models of Cognition.”, The ProbMods Contributors, Second Edition, 2016.

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

23IT042	BIG DATA ANALYTICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Understand the fundamental concepts of Big Data.
- Apply MapReduce algorithms to distributed file systems
- Explore various Big Data technologies and understand workflow management
- Implement streaming analytics techniques for processing and analyzing stream data
- Analyze recommender systems and social network mining techniques

UNIT I	INTRODUCTION TO BIG DATA	6

Introduction to Big Data - Need for processing Big Data – Need for analytics- Characteristics of big data, Domain-specific examples of big data, Big Data Stack – Introduction to Hadoop – Setting up of Hadoop.

UNIT II	MAPREDUCE AND NEW SOFTWARE STACK	6

Distributed File System – MapReduce, algorithms using MapReduce - Extensions to MapReduce – Communication-cost model – Complexity Theory for MapReduce -Overview of Spark.

UNIT III	BIG-DATA TECHNOLOGY OVERVIEW	6

Big Data Collection Systems – Apache Flume – Big data Storage – HDFS Systems – Pig and Hadoop – Grunt – Data Model – pig Latin – Hive Overview – Hive QL – Overview of HBase - Overview of Workflow – Workflow and Scheduling using Apache Oozie - Introduction to NoSQL Databases – Basics of MongoDB.

UNIT IV	STREAMING ANALYTICS AND LINK ANALYSIS	6

Introduction to Stream analytics – Stream data model – Sampling Data – filtering streams – Count distinct elements in a stream,

Counting ones, Estimating moments – Decaying windows – Link Analysis – PageRank Computation – Market Basket model – Limited pass algorithms for Frequent Item sets.		
UNIT V	**RECOMMENDER SYSTEMS AND SOCIAL NETWORK MINING**	**6**
Advertising on the Web – Online Algorithms – Matching problem – Adwords problem and Implementation – recommendation systems – Collaborative filtering – Dimensionality reduction – Mining Social Network graphs – Clustering of social network graphs – Partitioning of graphs – Simrank – Counting Triangles – Neighborhoods properties of Graphs.		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		

LIST OF EXPERIMENTS

1. Study : Installation and Setting up Hadoop
2. Write a map reduce program to compute and measure the runtime and study its scaling behaviour for the following:
   a. Compute descriptive statistics such as mean, median, mode, standard deviation from a large dataset.
   b. Compute box-plots and histograms of all the numerical variables in a large multi -variate dataset.
   c. Compute correlation metrics between pairs of all the numerical variables in a large multi - variate dataset.
   d. Perform clustering of a large multi-variate dataset.
   e. Perform classification of a large multi-variate dataset into two or more classes.
3. Write a spark program to compute and measure the runtime and study its scaling behaviour for the following:

a. Box-plots and histograms of all the numerical variables in a large dataset.
b. Perform classification in a large dataset.
c. Perform regression in a large dataset.

4. Write, run and debug Map reduce programs
    a. To analyse and build models from streaming data efficiently using systems like Apache Spark.
    b. To analyse and build models from non-streaming data efficiently using systems like Apache Spark.
5. Use graph dataset and perform the following:
    a. Perform basic analysis such as calculating node degree centrality, identifying important nodes using between-ness centrality.
    b. Find communities by using graph clustering.

TOTAL: 30 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the basics of Big Data.
CO2:	Develop MapReduce program to compute and measure the runtime and
CO3:	Apply HDFS concepts and interfacing with HDFS.
CO4:	Apply Big Data Technology, Tools, and Algorithms.
CO5:	Analyze the stream data and Link analysis.
CO6:	Apply big data in Recommender systems.

TEXT BOOKS:	
1	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Third Edition, Cambridge University Press, New Delhi.2014
2	Arshdeep Bagha and Vijay Madisetti, "Big Data Science & Analytics - A Hands-on Approach", New Delhi, 2016.

REFERENCES:	
1	Sadalage, Pramod J. "NoSQL distilled", 2013
2	E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
3	Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
4	Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
5	Alan Gates, "Programming Pig", O'Reilley, 2011.

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

23IT043	DATA MINING AND WAREHOUSING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand data warehouse concepts, architecture, business analysis and tools.
- To understand data pre-processing and data visualization techniques.
- To study algorithms for finding hidden and interesting patterns in data.
- To understand and apply various classification and clustering techniques using tools.
- Apply data mining techniques for real-world problem solving.

UNIT I	BUSINESS ANALYSIS AND ON-LINE ANALYTICAL PROCESSING	6

Basic Concepts - Data Warehousing Components – Building a Data Warehouse – Database Architectures for Parallel Processing – Parallel DBMS Vendors - Multidimensional Data Model – Data Warehouse Schemas for Decision Support, Concept Hierarchies - Characteristics of OLAP Systems – Typical OLAP Operations, OLAP and OLTP.

UNIT II	DATA MINING INTRODUCTION	6

Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques Issues –applications- Data Objects and attribute types, Statistical description of data, Data Pre-processing – Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures.

UNIT III	DATA MINING - FREQUENT PATTERN ANALYSIS	6

Mining Frequent Patterns, Associations and Correlations – Mining

Methods- Pattern - Evaluation Method –Pattern Mining in Multilevel, Multi-Dimensional Space –Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns - Mining associations in real time data sets using WEKA / R.		
UNIT IV	**CLASSIFICATION**	**6**
Decision Tree Induction - Bayesian Classification – Rule Based Classification Classification by Backpropagation – Support Vector Machines –– Lazy Learners – Model Evaluation and Selection-Techniques to improve Classification Accuracy - Classification of real time data sets using WEKA / R.		
UNIT V	**CLUSTERING**	**6**
Clustering Techniques – Cluster analysis-Partitioning Methods - Hierarchical Methods – Density Based Methods - Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering with constraints, Outlier analysis-outlier detection methods – Clustering real time data sets using WEKA / R.		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

LIST OF EXPERIMENTS

1. Experiments: Build Data Warehouse and Explore WEKA
   a. Build a Data Warehouse/Data Mart (using open source tools like Pentaho Data Integration tool, Pentoaho Business Analytics; or other data warehouse tools like Microsoft-SSIS, Informatica, Business Objects, etc.).
   b. Identify source tables and populate sample data
   c. Design multi-dimensional data models namely Star, snowflake and Fact constellation schemas for any one enterprise (ex. Banking, Insurance, Finance, Healthcare, Manufacturing, Automobile, etc.).
   d. Write ETL scripts and implement using data warehouse tools

e. Perform various OLAP operations such slice, dice, roll up, drill up and pivot

f. Explore visualization features of the tool for analysis like identifying trends etc.

g. List the attribute names and they types

h. Number of records in each dataset

i. Identify the class attribute (if any)

j. Plot Histogram

k. Determine the number of records for each class.

l. Visualize the data in various dimensions

2. Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets

   a. Explore various options available in Weka for preprocessing data and apply (like Discretization Filters, Resample filter, etc.) on each dataset

   b. Load each dataset into Weka and run Aprori algorithm with different support and confidence values. Study the rules generated.

   c. Apply different discretization filters on numerical attributes and run the Apriori association rule algorithm.

   d. Study the rules generated. Derive interesting insights and observe the effect of discretization in the rule generation process.

3. Demonstrate performing classification on data sets

   a. Load each dataset into Weka and run Id3, J48 classification algorithm. Study the classifier output. Compute entropy values, Kappa statistic.

   b. Extract if-then rules from the decision tree generated by the classifier, Observe the confusion matrix and derive Accuracy, F-measure, TPrate, FPrate, Precision and Recall values. Apply cross-validation strategy with various fold levels and compare the accuracy results.

4. Demonstrate performing clustering on data sets
    a. Load each dataset into Weka and run simple k-means clustering algorithm with different values of k (number of desired clusters). Study the clusters formed. Observe the sum of squared errors and centroids, and derive insights.
    b. Load each dataset into Weka and perform Naïve-bayes classification and k-Nearest Neighbour classification. Interpret the results obtained.
    c. Plot RoC Curves
5. Demonstrate performing Regression on data sets
    a. Load each dataset into Weka and build Linear Regression model. Study the clusters formed. Use Training set option. Interpret the regression model and derive patterns and conclusions from the regression results.
    b. Use options cross-validation and percentage split and repeats running the Linear Regression Model. Observe the results and derive meaningful results.
    c. Explore Simple linear regression technique that only looks at one variable.

TOTAL: 30 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Build a Data warehouse system and perform business analysis with OLAP tools.
CO2:	Apply suitable pre-processing and visualization techniques for data analysis.
CO3:	Apply frequent pattern for data analysis.
CO4:	Apply appropriate classification for data analysis.
CO5:	Apply appropriate clustering techniques for data analysis.
CO6:	Apply Data mining techniques for association rule mining techniques

TEXT BOOKS:	
1	Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012.
2	Inmon W H, Krishnan K, "Building the Data Lakehouse", Morgan Kaufmann Publishers, Boston, 2023.

REFERENCES:	
1	Tan P N, Steinbach M, Kumar V, "Introduction to Data Mining", Pearson Education, London, 2024.
2	Han J, Kamber M, Pei J, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, San Francisco, 2023.
3	Kimball R, Ross M, "The Data Warehouse Toolkit", John Wiley & Sons, New York, 2023
4	Aggarwal C C, "Data Mining: The Textbook", Springer International, Switzerland, 2022
5	Inmon W H, "Building the Data Warehouse", John Wiley & Sons, New Jersey, 2015

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

VERTICAL 4: NETWORK AND SECURITY

23CB031	ETHICAL HACKING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the basics of computer based vulnerabilities.
- To explore different foot printing, reconnaissance and scanning methods.
- To expose the enumeration and vulnerability analysis methods.
- To understand hacking options available in Web and wireless applications.
- To explore the options for network protection.
- To practice tools to perform ethical hacking to expose the vulnerabilities.

UNIT I	INTRODUCTION	6

Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware - Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security

UNIT II	FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS	6

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall

UNIT III	ENUMERATION AND VULNERABILITY ANALYSIS	6

Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP,

NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded OS.		
UNIT IV	**SYSTEM HACKING**	**6**
Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade.		
UNIT V	**NETWORK PROTECTION SYSTEMS**	**6**
Access Control Lists - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network- Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		

LIST OF EXPERIMENTS

1. Install Kali or Backtrack Linux / Metasploitable/ Windows XP
2. Practice the basics of reconnaissance.
3. Using FOCA / SearchDiggity tools, extract metadata and expanding the target list.
4. Aggregates information from public databases using online free tools like Paterva'sMaltego.
5. Information gathering using tools like Robtex
6. Scan the target using tools like Nessus
7. View and capture network traffic using Wireshark.
8. Automate dig for vulnerabilities and match exploits using Armitage
   - FOCA : http://www.informatica64.com/foca.aspx.
   - Nessus: http://www.tenable.com/products/nessus.
   - Wireshark : http://www.wireshark.org.
   - Armitage : http://www.fastandeasyhacking.com.
   - Kali or Backtrack Linux, Metasploitable, Windows XP

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the basic concepts of computer based vulnerabilities.
CO2:	Make use of the tools for foot printing, reconnaissance and scanning methods.
CO3:	Experiment with the enumeration and vulnerability analysis methods.
CO4:	Explain the hacking options available in Web and wireless applications.
CO5:	Analyze and choose the options for network protection.
CO6:	Make use of tools to perform ethical hacking to expose the vulnerabilities.

TEXT BOOKS:

1. Simpson, Michael T., Kent Backman, and James E. Corley. "Hands-On Ethical Hacking and Network Defense." Course Technology, Delmar Cengage Learning, 2010.
2. Engebretson, Patrick. "The Basics of Hacking and Penetration Testing." SYNGRESS, Elsevier, 2013.

REFERENCES:

1. Stuttard, Dafydd, and Marcus Pinto. "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws." 2011.
2. Seitz, Justin. "Black Hat Python: Python Programming for Hackers and Pentesters." 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	1	2	2	1	-
2	3	2	1	1	2	-	-	-	3	2	2	2	3	2	-
3	3	2	1	1	2	-	-	-	1	1	1	3	3	2	-
4	2	1	-	-	3	-	-	-	3	2	1	2	2	3	-
5	3	3	2	2	3	-	-	-	3	1	1	1	3	3	-
6	3	2	1	1	2	-	-	-	2	1	1	2	3	2	-
Overall Correlation	3	2	1	1	3	-	-	-	3	2	2	2	3	3	-

23CB034	SECURITY IN COMPUTING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand security design principles.
- To learn secure programming techniques.
- To know the standard algorithms used to provide confidentiality, integrity and authenticity in web application.
- To understand the security requirements in operating systems.
- To learn about the emerging security applications.

UNIT I	SECURITY DESIGN PRINCIPLES	6

Security Goals – Secure System Design – Understanding Threats – Designing in Security –Convenience and Security – Security in Software Requirements – Security by Obscurity – Secure Design Principles – Defense in Depth – Diversity in Defense – Securing the Weakest Link – Failsafe Stance.

UNIT II	SECURE PROGRAMMING TECHNIQUES	6

Worms and Other Malware – Buffer Overflows – Client State Manipulation – SQL Injection Password Security – Cross Domain Security in Web Applications – Attack Patterns – Preventing XSRF – Preventing XSSI - Preventing XSS.

UNIT III	WEB APPLICATIONS SECURITY	6

Introduction - Security Testing - Security Incident Response Planning - Microsoft Security Development Lifecycle (SDL) - OWASP Comprehensive Lightweight Application Security Process (CLASP) - The Software Assurance Maturity Model (SAMM).

UNIT IV	SECURITY IN OPERATING SYSTEMS	6

Introduction - Security in the Design of OS – Rootkit- Windows Security – Windows Protection System – Windows Authorization

– Windows Security Analysis – Windows Vulnerabilities – Address Space Layout Randomizations.		
UNIT V	**EMERGING TOPICS IN SECURITY**	**6**
Internet of Things- Medical Devices - Mobile Phones- Security in the Internet of Things-Economics-Making a Business Case - Quantifying Security -Current Research and Future Directions- Electronic Voting Fair Election - Critical Issues - Cyber Warfare - Examples of Cyber Warfare		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

LIST OF EXPERIMENTS

1. Implement the SQL injection attack.
2. Implement the Buffer Overflow attack
3. Implement Cross Site Scripting and Prevent XSS.
4. Understanding Malwares working and detection
5. Implement Hacking windows - Windows login password.
6. Implement Hacking windows - Accessing restricted drives.
7. Install wire shark and explore the various protocols
    a. Analyze the difference between HTTP vs HTTPS.
    b. Analyze the various security mechanisms embedded with different protocols.
8. Identify the vulnerabilities using OWASP ZAP tool
9. Installation of rootkits and study about the variety of options

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain fundamental security goals and principles in system design.
CO2:	Identify and mitigate risks from malware, including worms

	and buffer overflows.
CO3:	Develop skills in conducting security audits and managing vulnerabilities in web applications.
CO4:	Apply best practices for password security and cross-domain security in web applications.
CO5:	Develop a secure operating system.
CO6:	Analyze case studies and examples of cyber warfare to understand its impact and strategies.
TEXT BOOKS:	
1	Charles P. Pfleeger, Shari Lawrence P fleeger and Jonathan Margulies, "Security in Computing", Fifth Edition, Pearson Education, 2015.
2	William Stallings, "Cryptography and Network Security: Principles and Practices", Sixth Edition, Pearson Education, 2014.
REFERENCES:	
1	Neil Daswani, Christoph Kern, and Anita Kesavan, "Foundations of Security: What Every Programmer Needs to Know", Frist Edition, A press, 2007.
2	Bruce Schneier, "Applied Cryptography Protocols, Algorithms and Source Code in C", Second Edition, John Wiley and Sons Inc., 2006.
3	Matt Bishop, "Computer Security: Art and Science", First Edition, Addison Wesley, 2002.
4	Georgia Weidman, "Penetration Testing: A Hands-on Introduction to Hacking", 2nd edition, 2014.
5	N. Asokan, Lucas Davi, Alexandra Dmitrienko, Stephan Heuser, Kari Kostianen, Elena Reshetova, Ahmad-Reza Sadeghi, "Mobile Platform Security", First Edition, Morgan and Claypool Publishers Series, 2014.

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

23CS039	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of Blockchain
- To learn Different protocols and bitcoin consensus algorithms in Blockchain
- To learn the Blockchain implementation frameworks
- To understand the Blockchain Applications
- To experiment the Hyperledger Fabric, Ethereum networks

UNIT I	INTRODUCTION TO BLOCKCHAIN	9

Blockchain- Public Ledgers-Blockchain as Public Ledgers - Block in a Blockchain, Transactions-The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree.

UNIT II	BITCOIN AND CRYPTOCURRENCY	9

A basic crypto currency-Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.

UNIT III	BITCOIN CONSENSUS	9

Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,Monopoly Problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.

UNIT IV	HYPERLEDGER FABRIC & ETHEREUM	9

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT V	**BLOCKCHAIN APPLICATIONS**	**9**
Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Demonstrate the emerging abstract models for Blockchain Technology.	
CO2:	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.	
CO3:	Explain the conceptual understanding of the function of Blockchain as a method of securing distributed ledgers.	
CO4:	Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application.	
CO5:	Apply transactions and requests against blockchain networks.	
CO6:	Develop applications in supply chain management,small cities,banking etc.	
TEXT BOOKS:		
1	Bashir and Imran, “Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks”, 3^{rd} edition Packt Publishing, 2020,	
2	Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, 3^{rd} edition, O’Reilly, 2015.	
REFERENCES:		
1	Daniel Drescher, “Blockchain Basics”, First Edition, Apress, 2017.	
2	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder,”Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction” Princeton University Press, 2016.	

3	Melanie Swan, "Blockchain: Blueprint for a New Economy", 3rd edition, O'Reilly, 2015
4	Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packet Publishing,2018
5	Saravanan Krishnan , Valentina Emilia Balas," Handbook of Research on Blockchain Technology",Elsevier Inc. ISBN: 9780128198162, 2020.

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

23EC049	NETWORK ESSENTIALS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Concept of network communication
- Importance of standards and protocols in network communications
- Configuration of an integrated wireless router and wireless client to connect securely to the internet.
- Connecting wireless PC clients to a wireless router
- Concept to build a simple computer network using Cisco devices and troubleshoot basic network connectivity issues.

UNIT I	BASICS OF NETWORKING	6

The Fundamentals of Internet Connectivity - PC Basics - Overview of High-Speed and Dialup Connectivity - Web Browsers and Plug-Ins - Networking Terminology - Analogies That Describe Digital Bandwidth.

UNIT II	INTRODUCTION TO NETWORK SIMULATION AND COMMUNICATION	6

Network Simulation using Packet Tracer: Packet Tracer Network Simulator - Networking Models - Network Topologies - Wireless Communications.

UNIT III	INTRODUCTION TO NETWORK ADDRESSING	6

Introduction to TCP/IP: Comparing the OSI Reference Model Layers and the TCP/IP Reference Model Layers, Internet Architecture - IP Addresses: IPv4 Addressing, IP Address Classes, Reserved IP Addresses, Public and Private Addresses, Introduction to Subnetting, IPv4 Versus IPv6 - IP Address Assignment, Acquisition, and Hierarchy: Obtaining an Internet Address, Static Assignment of an IP Address, Address Resolution Protocol, RARP IP Address Assignment

UNIT IV	INTRODUCTION TO TRANSPORT LAYER	6
Transport Layer Services - Understanding the TCP/IP Transport Layer: Flow Control, Session Establishment, Maintenance, and Termination Overview, Three-Way Handshake. Windowing: Acknowledgment, TCP, UDP, TCP and UDP Port Numbers.		
UNIT V	**INTRODUCTION ROUTER TROUBLESHOOTING**	**6**
Introduction to Network Testing - Troubleshooting Router Issues Using the show interface and show interfaces Commands - Troubleshooting Routing Issues Using the show CDP neighbors Command - Troubleshooting Routing Issues Using show IP route and show IP protocol - Troubleshooting Router Connections Using the show controllers serial Command.		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

LIST OF EXPERIMENTS

1. Making of cross cable and straight cable.
2. Configuration of switches and routers
3. Creation of different Topologies using switches and Routers for Connecting Computers
4. Transferring data in an established Computer Network using addressing schemes.
5. Creation of a simple Local Area Network.
6. Routing Protocols.
7. Simulation of unicast and multicast routing protocols

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the Basic concepts of Networking
CO2:	Illustrate about the various types of cabling used in the networking
CO3:	Interpret the various addressing scheme used in networking
CO4:	Explain the basic of Transport Layer

CO5:	Summarize the basic of Network Security
CO6:	Make use of the configuration to troubleshoot the devices
TEXT BOOKS:	
1	Cisco Networking Academy Program CCNA 1 and 2 Companion Guide, third Edition by CISCO Press
2	Cisco Certified Network Associate Study Guide Seventh Edition, Todd Lammle, SYBEX
REFERENCES:	
1	Beasley, J.S. and Nilkaew, P., 2018. Networking Essentials: A CompTIA Network+ N10-007 Textbook. Pearson IT Certification
2	McMillan, T., 2015. Cisco networking essentials. John Wiley & Sons, 2nd Edition

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

<table>
<tr><td rowspan="2">23EC050</td><td colspan="2" rowspan="2">NETWORK ENGINEERING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">• To learn the Network Models and datalink layer functions.
• To understand routing in the Network Layer.
• To explore methods of communication and congestion control by the Transport Layer.
• To study the Network Security Mechanisms.
• To learn various hardware security attacks and their countermeasures.</td></tr>
<tr><td>UNIT I</td><td colspan="5">NETWORKING TODAY</td><td>6</td></tr>
<tr><td colspan="7">Networking – Components, types, Internet Connections, Requirements of a reliable network, Network Components, Network Representations and Topologies, Common Types of Networks, Internet Connections, Reliable Networks, Network Trends, Network Security.</td></tr>
<tr><td>UNIT II</td><td colspan="5">BASIC SWITCH AND END DEVICE CONFIGURATION</td><td>6</td></tr>
<tr><td colspan="7">Cisco IOS Access, IOS Navigation, The Command Structure, Basic Device Configuration, Save Configurations, Ports and Addresses, Configure IP Addressing, Verify Connectivity.</td></tr>
<tr><td>UNIT III</td><td colspan="5">PROTOCOLS AND MODELS</td><td>6</td></tr>
<tr><td colspan="7">The Rules, Protocols, Protocol Suites, Standards Organizations, Reference Models, Data Encapsulation, Data access.</td></tr>
<tr><td>UNIT IV</td><td colspan="5">ETHERNET SWITCHING</td><td>6</td></tr>
<tr><td colspan="7">Ethernet Frames, Ethernet MAC Address, The MAC Address Table, Switch Speeds and Forwarding Methods.</td></tr>
<tr><td>UNIT V</td><td colspan="5">ADDRESS RESOLUTION</td><td>6</td></tr>
<tr><td colspan="7">Introduction, MAC and IP, Packet Tracer—Identify MAC and IP Addresses, ARP, Video—ARP Request, Video—ARP Role in Remote Communications, IPv6 Neighbor Discovery, IPv6 Neighbor Discovery—Address Resolution.</td></tr>
</table>

TOTAL: 30 PERIODS
PRACTICAL EXERCISES:
LIST OF EXPERIMENTS 1. Basic Switch and End Device Configuration and examine the ARP Table - ILM 2. Create network and assign Static IP address to the host using Supernetting and subnetting. 3. Design a network using VLANs, Wireless LANs and InterVLAN routing. 4. Design a simple firewall for host and network. 5. Configure and troubleshoot redundancy on a switched network using EtherChannel. 6. Simulation of Transport Layer Protocols and analysis of congestion control techniques in network.
TOTAL: 30 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the basic of IOS Commands to configure the devices using CLI
CO2:	Interpret the usage of various transmission medium used in the connectivity
CO3:	Make use of the IP Addressing scheme to implement the VLSM Scheme, Subnetting to interconnect various active ports of routers
CO4:	Summarize the various protocols used in transport layer
CO5:	Interpret the protocols used in the Application Layer.
CO6:	Make use of the security features to configure the devise to enhance the security as well to protect from the threats.

TEXT BOOKS:	
1	Introduction to Networks Companion Guide (CCNAv7), CISCO Press
2	Juniper, ‘Distinguished Network Engineering Book SET’, Wiley, 2011

REFERENCES:	
1	CCNA 200-301, Volume 1 Official Cert Guide, WENDELL ODOM, CCIE No. 1624 Emeritus, CISCO Press
2	Keshav, 'An Engineering Approach To Computer Networking: ATM Networks, The Internet, And The Telephone Network', Pearson Education, 1997
3	Jason Edelman, Scott S. Lowe, Matt Oswalt, 'Network Programmability and Automation Skills for the Next-Generation Network Engineer', O'Reilly Media, 2018
4	Stallings, 'Computer Networking With Internet Protocols And Technology', Pearson Education, 2003

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

23EC051	SWITCHING, ROUTING AND WIRELESS ESSENTIALS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Student will understand a switch functionality and able to configure VLANs.
- Students will gain knowledge of dynamic host configuration protocols, understand LAN security concepts.
- Students will study switch security issues and methods to address them. Understand Wireless LAN concepts and providing wireless security.
- Students will study routing concepts and perform static routing configurations.

UNIT I	BASIC DEVICE CONFIGURATION	6
Configure a Switch with Initial Settings, Configure Switch Ports, Secure Remote Access, Basic Router Configuration, Verify Directly Connected Networks.		
UNIT II	**SWITCHING CONCEPTS**	**6**
Frame Forwarding, Collision and Broadcast Domains, Overview of VLANs, VLANs in a Multi-Switched Environment, VLAN Configuration, VLAN Trunks.		
UNIT III	**SWITCH SECURITY CONFIGURATION**	**6**
Implement Port Security, Mitigate VLAN Attacks, Mitigate DHCP Attacks, Mitigate ARP Attacks, Mitigate STP Attacks		
UNIT IV	**ROUTING CONCEPTS**	**6**
Path Determination, Packet Forwarding, IP Routing Table, Static and Dynamic Routing.		
UNIT V	**WIRELESS LAN**	**6**
Introduction to Wireless, WLAN Components, WLAN Operation, CAPWAP Operation, WLAN Threats, Secure WLANs.		
		TOTAL : 30 PERIODS

PRACTICAL EXERCISES:	
LIST OF EXPERIMENTS 1. Basic Switch and Router Configuration using console mode 2. Configure VLANs and Trunking 3. Implementation of VLANs and Trunking 4. Configure Router-on-a-Stick Inter-VLAN Routing 5. Troubleshoot Inter-VLAN Routing 6. Implement the Inter VLAN Routing	
	TOTAL: 30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain how Layer 2 switches forward data
CO2:	Explain how STP enables redundancy in a Layer 2 network.
CO3:	Make use of DHCPv4 to operate across multiple LANs
CO4:	Explain how to configure DTP and native VLAN to mitigate VLAN attacks
CO5:	Summarize the operation of SLAAC.
CO6:	Interpret how a router processes packets when a static route is configured
TEXT BOOKS:	
1	Switching, Routing, and Wireless Essentials v7.0 (SRWE) Companion Guide, Cisco Press
2	James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021
REFERENCES:	
1	CCNA 200-301, Volume 1 Official Cert Guide, WENDELL ODOM, CCIE No. 1624 Emeritus, CISCO Press
2	Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022
3	Wendell Odom, CCNA Routing and Switching 200-125 Official Cert Guide, CISCO press, 1st edition

4	Bruce Hartpence, 'Packet Guide to Routing and Switching', O'Reilly Media, Inc. 2011

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

23EC052	ENTERPRISE NETWORKING, SECURITY AND AUTOMATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Work with routers and switches using OSPF in point-to-point and multi-access networks.
- Mitigate threats and enhance network security using access control lists and security
- Develop critical thinking and problem-solving skills using real equipment and Cisco Packet Tracer.
- Understand virtualization, SDN, and how APIs and configuration management tools enable network automation.

UNIT I	SINGLE-AREA OSPFV2	6

OSPF Features and Characteristics- OSPF Packet- OSPF Operations- OSPF Router ID- Point-to-Point OSPF Networks- Multi access OSPF Networks- Modify Single-Area OSPFv2- Default Route Propagation- Verify Single-Area OSPFv2.

UNIT II	NETWORK SECURITY CONCEPTS	6

Current State of Cyber security- Threat Actors- Threat Actors Tool- Malware- Common Network Attacks- IP Vulnerabilities and Threats- TCP and UDP Vulnerabilities- IP Services- Network Security Best Practices- Cryptography.

UNIT III	ACL CONCEPTS	6

Purpose of ACLs- Wildcard Masks in ACLs- Guidelines for ACL Creation- Types of IPv4 ACLs- ACLs for IPv4 Configuration- Configure Standard IPv4 ACLs-Modify IPv4 ACLs- Secure VTY Ports with a Standard IPv4 AC- Configure Extended IPv4 ACLs NAT for IPv4.

UNIT IV	WAN, VPN, IPSEC AND QOS	6

Wan Concepts- Purpose of WANs- VPN Technology- Types of VPNs- IPsec- Network Transmission Quality- Traffic Characteristics- QoS Models.

UNIT V	NETWORK TROUBLESHOOTING AND VIRTUALIZATION	6
Network Documentation- Troubleshooting Process- Troubleshooting Tools- Cloud Computing – Virtualization.		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		
LIST OF EXPERIMENTS 1. Configure Single-Area OSPFv2 2. Explore DNS Traffic 3. Configure and Verify Extended IPv4 ACLs 4. Configure NAT for IPv4 5. Investigate the Broadband distribution and analyse the access options for the Scenarios.		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain how single-area OSPF operates in both point-to-point and broadcast multi access networks.
CO2:	Summarize network security concepts with respect to TCP and UDP vulnerabilities
CO3:	Illustrate the ACL and NAT and its types in IPv4
CO4:	Make use of NAT services on the edge router to provide IPv4 address scalability
CO5:	Interpret how VPNs and IPsec secure site-to-site and remote access connectivity
CO6:	Summarize how network automation is enabled through Restful APIs and configuration management tools.

TEXT BOOKS:

1	Enterprise Networking, Security, and Automation Course Booklet (CCNAv7), CISCO Press
2	Mike Shema, “Hacking Web Apps: Detecting and Preventing Web Application Security Problems”, First edition, Syngress Publishing, 2012

REFERENCES:	
1	CCNA 200-301, Volume 1 Official Cert Guide, WENDELL ODOM, CCIE No. 1624 Emeritus, CISCO Press
2	Pallapa Venkataram, Satish Babu, Wireless and Mobile Network Security, First Edition, Tata McGraw Hill, 2010
3	Markus Schumacher, Security Patterns: Integrating Security and Systems Engineering, Wiley Software Pattern Series, 2010
4	Angular 6 for Enterprise-Ready Web Applications, Doguhan Uluca, 1st edition, Packt Publishing

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

23EC053	NETWORK DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To inspire the students to learn the various switching technologies
- To design the networks for various categories
- To introduce the purpose of management of the network systems

UNIT I	SWITCHING TECHNOLOGIES	9

Switching technologies, multiplexing, circuit switching, packet switching X.25, frame relax, SMDs ATM, B-ISDN, traffic matrix, traffic pattern calculations, performance issues of packet networks, delay, availability and reliability.

UNIT II	NETWORK DESIGN FOR ACCESS	9

Network Design for Access: Campus network design, leased line and radio modems, DDR & ISDN Access Network design, X.25 remote access network design, Frame-relay interfaces & traffic shaping VSAT & WLAN network design.

UNIT III	NETWORK DESIGN FOR BACKBONE	9

Network Design for Backbone: Identification & selection of internetworking devices, CISCO routers & Nortel switches, EIGRP.

UNIT IV	NETWORK DESIGN FOR CONVERGENCE	9

Network Design for convergence: UDP broadcasts, IP Networks for Voice, Data, Video, Fax, Soft & hard design examples for IP Technology networks, network design for digital video broadcast.

UNIT V	DATA NETWORK MANAGEMENT SYSTEMS	9

Data Network Management Systems: Managing IP, ICMP, TCP, UDP, X.25 reporting Ethernet traffic, managing bridges & routers. Microsoft & HP, NMS Tools. Case Studies: selected from design, architecture & topology areas of internetworks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the various switching techniques use in the network design
CO2:	Interpret the network design for the access
CO3:	Summarize the network design process employed for the backbone system
CO4:	Explain the process involved in the design process for the convergence networks
CO5:	Interpret the Various data processing tools used in Network Design
CO6:	Explain the various managing schemes used in the Network Design
TEXT BOOKS:	
1	Data Network Design; D L Spolin, Mc-Graw Hill, 1993
2	Network Design & Case Studies "CISCO Systems Inc." CISCO Press, 1993
REFERENCES:	
1	Feit , 'SNMP GDE Networking Management', Mc-Graw Hill Inc., 1995
2	Jeff Doyle, Jennifer Dehaven Carroll 'Routing TCP/IP', CISCO systems, 2001
3	Designing Cisco Network Service Architectures (ARCH) Foundation Learning Guide: (CCDP ARCH 642-874) 3rd Edition
4	Tim Szigeti, Christina Hattingh, Al Gore, 'End-to-End QoS Network Design: Quality of Service in LANs, WANs, and VPNs (Networking Technology)', 1st Edition, Cisco Press

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

VERTICAL 5: EMERGING TECHNOLOGIES

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

23CS040	AR / VR TECHNOLOGY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To learn about the VR modeling techniques in detail.
- To gain knowledge about various applications of AR/VR.
- To know the basics of AR.
- To learn about the game engines involved in the development of AR/VR based applications.

UNIT I	INTRODUCTION	7

Introduction to virtual reality and augmented reality – Definition – Introduction to trajectories and hybrid space – Three I's of VR – VR Vs 3D computer graphics – Benefits of VR – Components of VR system – Introduction to AR – AR technologies – Input devices – 3D position trackers – Types of trackers – Navigation and manipulation interfaces – Gesture interfaces – Types of gesture input devices – Output devices – Graphics display – Human visual system – Personal graphics displays – Large volume displays – Sound displays – Human auditory system.

UNIT II	VR MODELING	6

Modeling – Geometric modeling – Virtual object shape – Object visual appearance – Kinematics modeling – Transformation matrices – Object position – Transformation invariants – Object hierarchies – Viewing the 3D world – Physical modeling – Collision detection – Surface deformation – Force computation – Force smoothing and mapping – Behavior modeling – Model management.

UNIT III	APPLICATIONS	6

Human factors in VR – VR health and safety issues – VR and society – Medical applications of VR – VR in education, arts, and entertainment – Military VR applications – Emerging

applications of VR – VR applications in manufacturing – Applications of VR in robotics – Information visualization – VR in business.		
UNIT IV	**AUGMENTED REALITY**	**6**
Introduction to augmented reality – Computer vision for AR – Interaction – Modeling and annotation – Navigation – Wearable devices.		
UNIT V	**AR/VR SOFTWARE TOOLS AND GAME ENGINE**	**5**
Fundamentals of Unity – Introduction to Vuforia – Basics of Unreal – Overview of Blender – Basics of Pygame.		
		TOTAL: 30 PERIODS
PRACTICAL EXERCISES:		

LIST OF EXPERIMENTS

1. Study of tools like Unity, Maya, 3DS Max, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection types by handling camera.
3. Download objects from asset store and apply various lighting and shading effects.
4. Model 3D objects using various modeling techniques and apply textures over them.
5. Create 3D realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop AR enabled applications with interactivity like E-learning environment, virtual walkthroughs, and visualization of historic places.

	8. Develop AR enabled simple applications like DNA structure visualization and human anatomy visualization.
	TOTAL: 30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Summarize the basic concepts of AR and VR.
CO2:	Identify different gesture interfaces used in AR/VR.
CO3:	Apply the concepts of VR modeling.
CO4:	Identify VR applications in different domains.
CO5:	Develop AR applications in different domains.
CO6:	Analyze the different types of game engines.
TEXT BOOKS:	
1	John Vince, "Introduction to Virtual Reality", Springer London, 1st Edition, India, 2011. (Units 1, 2 & 3)
2	Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 1st Edition, India, 2016. (Unit 1, 3 & 4)
3	a. https://docs.unity.com/ (Unity) b. https://developer.vuforia.com/library/(Vuforia) c. https://dev.epicgames.com/documentation/en-us/unreal-engine (Unreal) d. https://docs.blender.org/ (Blender) e. https://www.pygame.org/docs/ (Pygame) (Unit 5)
REFERENCES:	
1	Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publishing, 1st Edition, India, 2018.
2	William R. Sherman, Alan B. Craig, "Understanding Virtual Reality – Interface, Application, and Design", Morgan Kaufmann Publishers, 2nd Edition, New Delhi, 2018.

3	Justin Plowman, "3D Game Design with Unreal Engine 4 and Blender", Packt Publishing, 1st Edition, New Delhi, 2016.
4	Jonathan Linowes, Krystian Babilinski, "Augmented Reality for Developers: Build practical augmented reality applications with Unity, ARCore, ARKit and Vuforia", Packt Publishing, 1st Edition, New Delhi, 2017.

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

<table>
<tr><td rowspan="2">23CS041</td><td rowspan="2">GAME DEVELOPMENT</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">• To 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</td></tr>
<tr><td>UNIT I</td><td colspan="4">3D GRAPHICS FOR GAME DESIGN</td><td>6</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td>UNIT II</td><td colspan="4">GAME DESIGN PRINCIPLES</td><td>6</td></tr>
<tr><td colspan="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.</td></tr>
<tr><td>UNIT III</td><td colspan="4">GAME ENGINE DESIGN</td><td>6</td></tr>
<tr><td colspan="6">Rendering concept – Software rendering – Hardware rendering – Spatial sorting algorithms – Algorithms for game engine – Collision detection – Game logic – Game AI – Pathfinding</td></tr>
<tr><td>UNIT IV</td><td colspan="4">OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS</td><td>6</td></tr>
<tr><td colspan="6">Pygame game development – Unity – Unity scripts – Mobile gaming, Game studio, Unity single player and multi-player games</td></tr>
<tr><td>UNIT V</td><td colspan="4">GAME DEVELOPMENT USING UNITY ENGINE</td><td>6</td></tr>
<tr><td colspan="6">Exporting assets from 3D software – Different types of camera in</td></tr>
</table>

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)
3	Franz Lanzinger, “3D Game Development with Unity”, CRC Press, 1st edition, New Delhi, 2022. (Unit 4 & 5)
REFERENCES:	
1	Franz Lanzinger, “2D Game Development with Unity”, CRC Press, 1st Edition, New Delhi, 2020.
2	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.
3	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

23CS042	IoT BASED SMART SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To get familiar with IoT fundamentals.
- To know about essential wireless technologies for IoT.
- To understand about cloud infrastructure for IoT.
- To understand IoT Design Methodologies.
- To gain experience about Smart Systems for IoT

UNIT I	INTRODUCTION TO THE INTERNET OF THINGS	6

Introduction to IoT- Elements of an IoT- Technology drivers- Business drivers- Typical IoT applications- Trends and implications.

UNIT II	WIRELESS TECHNOLOGIES FOR THE IoT	6

Sensors and sensor nodes - Sensing devices- Sensor modules, nodes and systems- Network connectivity and protocols- Wireless sensor networks -Protocols - RFID , NFC, Zigbee, GSM, GPRS.

UNIT III	THE CLOUD FOR IOT	6

The Topology of the Cloud - Cloud-to-Device Connectivity - Device Ingress/Egress - Data Normalization and Protocol Translation- Infrastructure – APIs.

UNIT IV	IoT DESIGN METHODOLOGY	6

IoT systems management – IoT Design Methodology – Specifications Integration and Application Development, Arduino IDE – Programming – APIs.

UNIT V	IoT SMART SYSTEMS	6

Smart Home Automation -Smart Lighting -Smart Appliances - Intrusion Detection - Smoke/Gas Detectors - Smart cities – Smart waste management – Smart Agriculture – Future Trends: AI-enabled IoT.

TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

LIST OF EXPERIMENTS

1. Introduction to Arduino platform and programming
2. Interfacing Arduino with LED Blinking
3. Interfacing Arduino with LED Blinking with Push Button.
4. Build a simple smart home system
5. Interfacing Arduino with sound sensor.
6. Implement basic security using encryption in MQTT
7. Interfacing Arduino with Soil Moisture Sensor.
8. Build up automated irrigation monitoring

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Apply various concepts of the IoT and their technologies.
CO2:	Develop the IoT application using wireless technologies .
CO3:	Apply cloud integration for IoT.
CO4:	Develop applications using Arduino IDE.
CO5:	Develop Smart systems and IoT for Intrusion Detection.
CO6:	Develop Smart systems and AI-enabled IoT.

TEXT BOOKS:

1	Misra, Sudip, Anandarup Mukherjee, and Arijit Roy,"Introduction to IoT", Cambridge University Press, 2021.
2	Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.

REFERENCES:

1	Milan Milenkovic,"Internet of Things: Concepts and System Design" Springer 2020.
2	J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.

3	Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.
4	Charles Bell, "Beginning Sensor Networks with Arduino and Raspberry Pi", Apress, 2013

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	1	-
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	1	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	1	-	-	1	-	1	-	-	3	1	1
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**

23CS043	QUANTUM COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of quantum computing.
- To understand the background of Quantum Mechanics.
- To analyze the computation models.
- To understand quantum computation environments and frameworks.
- To understand quantum operations such as noise and error–correction.

UNIT I	QUANTUM COMPUTING BASIC CONCEPTS	9

Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum states in Hilbert space- Quantum Bits - Representations of Qubits - Superpositions.

UNIT II	QUANTUM GATES AND CIRCUITS	9

Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction - IBM Qiskit Platform.

UNIT III	QUANTUM ALGORITHMS AND PROTOCOLS	9

Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm –Simple quantum protocol: teleportation.

UNIT IV	QUANTUM INFORMATION THEORY	9

Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem - Classical information over noisy quantum channels.

UNIT V	QUANTUM CRYPTOGRAPHY	9

Classical cryptography basic concepts - Private key cryptography - Shor's Factoring Algorithm - Quantum Key Distribution - BB84 - Ekart 91.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the basics of quantum computing.
CO2:	Explain the concept of quantum Mechanics.
CO3:	Apply the quantum algorithms for computation models.
CO4:	Explain quantum computation environments and frameworks.
CO5:	Identify quantum operations such as noise and error–correction.
CO6:	Apply quantum cryptography algorithm.

TEXT BOOKS:

1	Parag K Lala, Mc Graw Hill Education, “Quantum Computing, A Beginners Introduction”, First edition (1 November 2020)
2	Michael A. Nielsen, Issac L. Chuang, “Quantum Computation and Quantum Information”, Tenth Edition, Cambridge University Press, 2010.

REFERENCES:

1	Chris Bernhardt, The MIT Press; Reprint edition,”Quantum Computing for Everyone” (8 September 2020).
2	Scott Aaronson, “Quantum Computing Since Democritus”, Cambridge University Press, 2013.
3	N. David Mermin, “Quantum Computer Science: An Introduction”, Cambridge University Press, 2007.

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

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

COURSE OBJECTIVES:

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

UNIT I	INTRODUCTION TO XAI	9

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

UNIT II	INTERPRETABLE MACHINE LEARNING MODELS	9

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

UNIT III	MODEL AGNOSTIC XAI TECHNIQUES	9

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

UNIT IV	XAI FOR DEEP LEARNING	9

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

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

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

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

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

23CS045	AUTONOMOUS VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Understand Autonomous Driving Basics
- To Study the role of control in autonomous systems
- To understand map databases, path planning techniques, and vehicle communication technologies for practical autonomous vehicle applications
- To learn about the use of deep learning in autonomous driving for perception, prediction, routing and reinforcement learning-based control.
- To explore AI algorithms, data management, cognitive decision-making, and the impact of autonomous vehicle technologies on industry and society.

UNIT I	INTRODUCTION TO AUTONOMOUS GROUND VEHICLES	9

Introduction to Autonomous Driving -Autonomous Driving Algorithms, Autonomous Driving Client System, Autonomous Driving Cloud Platform - Autonomous Vehicle Localization - Localization with GNSS, Localization with LiDAR and High-Definition Maps, Visual Odometry, Dead Reckoning and Wheel Odometry, Sensor Fusion - Perception in Autonomous Driving - Detection, Segmentation, Stereo, Optical and Scene Flow.

UNIT II	CONTROL IN AUTONOMOUS SYSTEMS	9

Role of Control in Autonomous Systems - Feedback, Autonomous Control - System Architecture and Hybrid System Modeling - System Architecture, Hybrid System Formulation, State Machines for Different Challenge Events - Sensors and Estimation - Vehicle Internal State Sensing, External World Sensing, Estimation, Situational Awareness.

UNIT III	PATH PLANNING AND APPLICATIONS	9

Maps and Path Planning - Map Databases - Raster, Vector and

Utilizing Map Data - Path Planning -Vehicle to Vehicle and Vehicle to Infrastructure Communication - V2V Communications, V2I Communications, Communication Technologies, 802.11p/WAVE DSRC Architecture, Applications in Autonomous, Vehicles - Examples of Autonomy - Cruise Control, Antilock-Brake Systems, Steering Control and Lane Following, Parking.		
UNIT IV	**DEEP LEARNING IN AUTONOMOUS DRIVING**	**9**
Deep Learning in Autonomous Driving Perception - Convolutional Neural Networks, Semantic Segmentation - Prediction and Routing - Planning and Control, Traffic Prediction, Lane Level Routing - Decision, Planning, and Control - Behavioral Decisions, Motion Planning, Feedback Control, Bicycle Model, PID Control - Reinforcement Learning-Based Planning and Control - Reinforcement Learning, Learning-Based Planning and Control in Autonomous Driving.		
UNIT V	**AI AND SOFTWARE ENABLERS FOR AGV**	**9**
Human-like reasoning - Hybrid , configurable AI algorithms - Data management environment for analyzing AI Algorithms - Dynamic Selection - Dynamic Integration - Cognitive decision making for Autonomous Driving - Autonomous Support - Automation and Autonomy - Advantages of AV Technologies - Adoptions scenarios for AVs -Industry 4.0 AVs - Major Pillars in the evolution of AVs - Spillovers and Impact of AVs.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Illustrate the fundamental concepts and algorithms used in autonomous ground vehicles.	
CO2:	Explain the principles of deep learning in autonomous driving.	

CO3:	Apply AI and software enablers in the context of autonomous ground vehicles and analyze the impact of autonomous vehicles in industry.
CO4:	Demonstrate the challenges and considerations related to control in autonomous systems.
CO5:	Apply path planning algorithms in the applications for autonomous vehicles to implement autonomy features.
CO6:	Identify the security vulnerabilities and risks associated with autonomous ground vehicle systems, including potential cyber-attacks, sensor spoofing, and system vulnerabilities.
TEXT BOOKS:	
1	Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot, “Creating Autonomous Vehicle Systems”, Morgan & Claypool, 2018.
2	Umit Ozguner, Tankut Acarman, Keith Redmill, “Autonomous Ground Vehicles”, Artech House, 2011.
REFERENCES:	
1	George Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos , ”Autonomous Vehicles Technologies, Regulations, and Societal Impacts” Elsevier,2021
2	George A. Berkey, “Autonomous Robots: From Biological Inspiration to Implementation and Control (Intelligent Robotics and Autonomous Agents series)” , MIT Press, 2005
3	Hong Cheng, “Autonomous Intelligent Vehicles Theory, Algorithms, and Implementation”, Springer, 2011.
4	Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone, “Global Navigation Satellite Systems, Inertial Navigation, and Integration”, Third Edition, John Wiley & Sons, 2013.
5	Karl Johan Astrom, Richard M. Muray, “Feedback System: An Introduction for scientist and Engineers”, Princeton University Press, 2021

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

23CS046	AI IN INDUSTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explore how Industrial AI is applied in various sectors
- To learn about Digital Twins, their characteristics, and how they impact predictive maintenance and data-driven decision-making.
- To explore the role of AI in decision-making, software systems, and software engineering processes.
- To study distributed computing, cloud computing, data storage solutions, and information security.
- To examine AI applications across various industries.

UNIT I	INDUSTRIAL AI	9

Industrial AI- Industrial AI in action- Applying industrial AI- The IMS architecture for industrial AI-Visible and Invisible issues-Building the future with AI- Killer Applications of Industrial AI.

UNIT II	DATA ANALYTICS IN INDUSTRY 4.0	9

Digital Twins(DT)- History of DT- Characteristics- Evolution- Data twin - physical world, digital world-Classifications- Level of integration- Characteristics- Modelling digital twins- Smart manufacturing and Applications- Uses of Digital Twin Technology- Digital twins maintenance - predictive maintenance-Planning the digital twin- Digital twin during operation phase-Hybrid analysis and Fleet data- Digital implementation- Digital twin impacts on industry 4.0.- Industry 4.0. Data Analytics - Data driven and model driven approaches-Types - descriptive analytics, diagnostics analytics, maintenance predictive analytics, prescriptive analytics- Data-Driven Decision making- Data quality- Data augmentation- Information logistics- Data driven challenges.

UNIT III	**AI AND SOFTWARE ENGINEERING**	**9**
Fundamentals in AI – Decision Making- Decision Support Systems- Business Intelligence- Database and Knowledge Base in Decision Support Systems- Inference Mechanisms in AI- Knowledge Interpretation- Data, Information Knowledge and Wisdom- AI and Software Engineering- Systems thinking and Systems Engineering- Software Engineering – Overview- System Software- Evolution- Paradigm- Architecture Models- Software Systems and Software Engineering Processes, Component based software engineering- Software maintenance overview- Applications of AI in classical software engineering.		
UNIT IV	**DATA STORAGE AND COMPUTING MODELS**	**9**
Distributed Computing, Cloud Computing, Fog and Edge Computing, Data Storage and Information Management, Data Fusion and Integration, Data Quality, Communication, Cognitive Computing, Distributed Ledger, Information Security, Cybersecurity, Block chain Security.		
UNIT V	**CASE STUDIES**	**9**
AI factory for Railway- AI Factory, Mining, Augmented Reality and Virtual Reality, Cybersecurity, AI Transformation Roadmap, AI in Healthcare, Education, Banking, Retail and E-commerce, Gaming and Entertainment, Chatbots.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the concepts, principles, and applications of industrial AI in various domains.	
CO2:	Apply digital twin technology for smart manufacturing and other industry-specific applications.	
CO3:	Demonstrate the impacts and challenges of AI in industry 4.0 and other specific domains.	

CO4:	Summarize about AI algorithms and methodologies in software engineering projects.
CO5:	Illustrate various computing models, data storage and management systems and their implications for distributed systems.
CO6:	Analyze real-world case studies to understand the practical implementation of AI in different industries.
TEXT BOOKS:	
1	Ramin Karim, Diego Galar and Uday Kumar,"AI Factory Theories, Applications and case Studies", CRC Press, 2023
2	Ella Hassanien, Jyotir Moy Chatterjee and Vishal Jain "Artificial Intelligence and Industry 4.0", Academic press, 2022.
REFERENCES:	
1	Stevan Lawrence Fernandes Tarun K.Sharma, "Artificial Intelligence in Industrial Applications", Springer, 2022.
2	Utpal Chakraborty, Amit banerjee, Jayanta Kumar Saha, Niloy Sarkar, Chinmay Chakraborty, "Artificial Intelligence and the Fourth Industrial Revolution", Jenny Stanford Publishing 2022.

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