Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
Udumalai Road, Pollachi, Coimbatore District 642003
Estd. 1998 | AICTE Approved | Affiliated to Anna University
An Autonomous Institution
NAAC A++ GRADE
Cycle 3 (2023-2030)
The Highest Grade

Curriculum and Syllabi

B.E. Computer Science and Engineering

Semesters I to VIII

Regulations 2023

Dr.Mahalingam College of Engineering and Technology

Department of Computer Science and Engineering

Vision

To develop engineers with global employability, entrepreneurship capability, research focus and social responsibility

Mission

- To develop internationally competent engineers in dynamic IT field by providing state-of-art academic environment and industry driven curriculum
- To motivate and guide students to take up higher studies and establish entrepreneurial ventures
- To enrich the department through committed and technically sound faculty team with research focus in thrust areas
- To undertake societal problems and provide solutions through technical innovations and projects in association with the industry, society and professional bodies

Dr.Mahalingam College of Engineering and Technology

Programme: B.E. Computer Science and Engineering

Programme Educational Objectives (PEOs) - Regulations 2023

The graduates of Computer Science and Engineering will be able to :

PEO 1. Domain Expertise: Possess expertise and emerge as key players in IT integrated domains.

PEO 2. Computing Skills and Ethics: Employ computing skills to solve societal and environmental issues in an ethical manner.

PEO 3. Lifelong Learning and Research: Involve in lifelong learning and research to meet the demands of global technology.

Programme Outcomes (POs) - Regulations 2023

On successful completion of the programme the graduates will be able to:

PO1.Engineering Knowledge : Apply the knowledge of mathematics, science, engineering fundamentals and concepts of Computer Science to solve complex engineering problems.

PO2.Problem Analysis : Identify, review literature, formulate and analyse complex engineering problems using first principles of mathematics and engineering sciences.

PO3.Design and Development of Solutions : Design and develop computing solutions for complex engineering problems with societal and environmental awareness.

PO4.Complex problem Investigation : IInvestigate complex problems by employing research methods to arrive at valid conclusions.

PO5.Modern Tool Usage : Evaluate and use appropriate tools and techniques in engineering activities.

PO6.Societal contribution : Follow professional engineering practice by applying contextual knowledge to assess societal and legal issues.

PO7.Environment and Sustainability : Understand and provide professional engineering solutions taking into consideration environmental and economic sustainability.

PO8.Ethics : Follow ethical principles and norms in engineering practice.

PO9.Individual and Team work : Function effectively as an individual, team member or leader in diversified environments.

PO10.Communication : Communicate effectively through various modes for all engineering activities.

PO11.Project Management and Finance : Apply Engineering knowledge and management principles for effective project management in multi-disciplinary environments.

PO12.Life-long Learning: Engage in independent life-long learning and skill development for professional and social well being.

Programme Specific Outcomes (PSOs) - Regulations 2023

Our Graduates Will

PSO 1. Systems Engineering: Employ software engineering principles in the design and development of efficient systems.

PSO 2. Knowledge Engineering: Apply data analytics techniques for solving real world problems.

Programme: B.E. Computer Science and Engineering
2023 Regulations (For 2023 Batch Only)
Curriculum for Semesters I and II

Course Type	Course Code	Course Title	Duration	Credits	Marks
VAC	23VAL101	Induction Program	3 Weeks	-	100

Course Type	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
AEC	23ENI101	Communication Skills I	2	0	2	3	100	ALL
Minor	23MAI103	Linear Algebra and Infinite Series	3	0	2	4	100	AD,AM,CS,IT &SC
Major	23CST101	Problem Solving using C	3	0	0	3	100	AD,AM,CS,IT &SC
Multi Disciplinary	23EEI101	Basics of Electrical and Electronics Engineering	3	0	2	4	100	AD,AM,CS,IT &SC
Multi Disciplinary	23MEL001	Engineering Drawing	1	0	3	2.5	100	AD,AM,AU,CS,EA, EC,EE,EV,IT,ME, SC
SEC	23CSL101	Problem Solving using C Laboratory	0	0	3	1.5	100	AD,AM,CS,IT &SC
VAC	23VAL102	Wellness for Students	0	0	2	1	100	ALL
VAC	23VAT101	தமிழர்மரபு /Heritage of Tamils	1	0	0	1	100	ALL
AEC	23SAL101	Studio Activities	0	0	2	-	-	ALL
		Total	**13**	**0**	**16**	**20**	**800**	-

Semester II

Course Type	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
AEC	23ENI201/	Communication Skills II	2	0	2	3	100	ALL
	23FLT201/	Foreign Language-Japanese	3	0	0			
	23FLT202	Foreign Language-German						
Minor	23MAI203	Calculus and Transforms	3	0	2	4	100	AD,AM,CS,IT&SC
Minor	23PHT001	Physics for Information Sciences	3	0	0	3	100	AD,AM,CS,IT&SC
Major	23ITT201	Data Structures	3	0	0	3	100	AD,AM,CS,IT&SC
Multi Disciplinary	23EEI201	Digital System Design	2	0	2	3	100	AD,AM,CS,IT&SC
Minor	23PHL001	Physics for Information Sciences Laboratory	0	0	3	1.5	100	AD,AM,CS,IT&SC
SEC	23ITL201	Data Structures Laboratory	0	0	3	1.5	100	AD,AM,CS,IT&SC
SEC	23CSL201	IT Practices Laboratory	0	0	4	2	100	AD,AM,CS,IT&SC
SEC	23ESL201	Professional Skills 1:Problem solving skills & Logical Thinking 1	0	0	2	1	100	ALL
VAC	23VAT201	தமிழரும்தொழில்நுட்பமும் / Tamils and Technology	1	0	0	1	100	ALL
Multi Disciplinary	23CHT202	Environmental Sciences	1	0	0	-	100	ALL
AEC	23SAL201	Studio Activities	0	0	2	-	-	ALL
		Total	**15**	**0**	**20**	**23**	**1100**	

Programme: B.E. Computer Science and Engineering
2023 Regulations (For 2024 Batch Onwards)
Curriculum for Semesters I to VIII

Course Type	Course Code	Course Title	Duration	Credits	Marks
VAC	23VAL101	Induction Program	3 Weeks	-	100

Course Type	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
AEC	23ENI101	Communication Skills I	2	0	2	3	100	ALL
Minor	23MAI103	Linear Algebra and Infinite Series	3	0	2	4	100	AD,AM,CS,IT &SC
Major	23CST101	Problem Solving using C	3	0	0	3	100	AD,AM,CS,IT &SC
Multi Disciplinary	23EEI101	Introduction to Electrical and Electronics Engineering	3	0	2	4	100	AD,AM,CS,IT &SC
Multi Disciplinary	23MEL001	Engineering Drawing	1	0	3	2.5	100	AD,AM,AU,CS,EA, EC,EE,EV,IT,ME, SC
SEC	23CSL101	Problem Solving using C Laboratory	0	0	3	1.5	100	AD,AM,CS,IT &SC
VAC	23VAL102	Wellness for Students	0	0	2	1	100	ALL
VAC	23VAT101	தமிழர்மரபு /Heritage of Tamils	1	0	0	1	100	ALL
AEC	23SAL101	Studio Activities	0	0	2	-	-	ALL
		Total	**13**	**0**	**16**	**20**	**800**	-

Semester II

Course Type	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
AEC	23ENI201/	Communication Skills II	2	0	2	3	100	ALL
	23FLT201/	Foreign Language-Japanese	3	0	0			
	23FLT202	Foreign Language-German						
Minor	23MAI203	Calculus and Transforms	3	0	2	4	100	AD,AM,CS,IT&SC
Minor	23PHT001	Physics for Information Sciences	3	0	0	3	100	AD,AM,CS,IT&SC
Major	23ITT201	Data Structures	3	0	0	3	100	AD,AM,CS,IT&SC
Multi Disciplinary	23EEI201	Digital System Design	2	0	2	3	100	AD,AM,CS,IT&SC
Minor	23PHL001	Physics for Information Sciences Laboratory	0	0	3	1.5	100	AD,AM,CS,IT&SC
SEC	23ITL201	Data Structures Laboratory	0	0	3	1.5	100	AD,AM,CS,IT&SC
SEC	23CSL201	IT Practices Laboratory	0	0	4	2	100	AD,AM,CS,IT&SC
SEC	23ESL201	Professional Skills 1:Problem solving skills & Logical Thinking 1	0	0	2	1	100	ALL
VAC	23VAT201	தமிழரும்தொழில்நுட்பமும் / Tamils and Technology	1	0	0	1	100	ALL
Multi Disciplinary	23CHT202	Environmental Sciences	1	0	0	-	100	ALL
AEC	23SAL201	Studio Activities	0	0	2	-	-	ALL
		Total	**15**	**0**	**20**	**23**	**1100**	

Semester III

Course Type	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Minor	23MAT305	Discrete Mathematics	3	1	0	4	100	AM,CS,IT&SC
Major	23CST301	Design and Analysis of Algorithms	3	1	0	4	100	CS & AD
Minor	23CST302	Computer Architecture	3	0	0	3	100	CS & AD
Major	23CSI301	Database Systems	3	0	2	4	100	CS & AD
Major	23CST303	Java Programming	3	0	0	3	100	-
Major	23CSL301	Java Programming Laboratory	0	0	3	1.5	100	-
SEC	23ESL301	Professional Skills 2: Problem solving skills & Logical Thinking 2	0	0	2	1	100	ALL
VAC	23VAT301	Universal Human Values 2 :Understanding Harmony	2	1	0	3	100	ALL
AEC	23SAL301	Studio Activities	0	0	2	-	-	ALL
		Total	**17**	**3**	**9**	**23.5**	**800**	

Semester IV

Course Type	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Minor	23MAT401	Probability and Statistics	3	1	0	4	100	AM,AU,CS,EC ,EE,ME,IT & SC
Major	23CSI401	Computer Network Technology	3	0	2	4	100	-
Major	23CST401	Operating Systems	3	0	0	3	100	-
Major	23CST402	Data Warehousing and Mining	3	0	0	3	100	-
Minor	23EEI401	Microcontrollers and IoT	3	0	2	4	100	-
Major	23CSL401	Python Programming Laboratory	1	0	3	2.5	100	-
SEC	23ESL401	Professional Skills 3: Professional Development and Etiquette	0	0	2	1	100	ALL
AEC	23SAL401	Studio Activities	0	0	2	-	-	ALL
		Total	**16**	**1**	**11**	**21.5**	**700**	

Course Category	Course Code	CourseTitle	Duration	Credits	Marks
SEC	XXXXXXXX	Internship - I / Community Internship /Skill Development	2 Weeks	1	100

Semester V

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23CST501	Formal Languages and Automata Theory	3	1	0	4	100	-
Major	23CSI501	Object Oriented Software Engineering	3	0	2	4	100	-
Major	23CST502	Cyber and Digital Forensics	3	0	0	3	100	-
Major	23XXXXXX	Professional Elective – I	2	0	2	3	100	-
Major	23XXXXXX	Professional Elective – II	2	0	2	3	100	-
Major	23CSL501	Internet Programming Laboratory	1	0	3	2.5	100	-
Project	23CSP501	Reverse Engineering Project	0	0	6	3	100	-
SEC	23ESL501	Professional Skills 4: Communication Skills and Interview Essentials	0	0	2	1	100	-
AEC	23SAL501	Studio Activities	0	0	2	-	-	ALL
		Total	**14**	**1**	**19**	**23.5**	**800**	

Semester VI

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23CSI601	Compiler Design	3	0	2	4	100	-
Major	23CST601	Artificial Intelligence	3	0	0	3	100	-
Major	23XXXXXX	Professional Elective – III	2	0	2	3	100	-
Major	23XXXXXX	Professional Elective – IV	2	0	2	3	100	-
Minor	23XXXXXX	Open Elective – I	3	0	0	3	100	-
Major	23CSL601	Artificial Intelligence Laboratory	0	0	3	1.5	100	-
SEC	23ESL601	Professional Skills 5: Ace and Elevate: Aptitude and Soft Skills	0	0	2	1	100	-
AEC	23SAL601	Studio Activities	0	0	2	-	-	ALL
		Total	**13**	**0**	**13**	**18.5**	**700**	

Course Category	Course Code	Course Title	Duration	Credits	Marks
SEC	23XXXXXX	Internship - 2 / Research Internship / Skill Development	2 Weeks-4Weeks	1	100

Semester VII

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23CSI701	Cloud Technology	2	0	2	3	100	-
Major	23CST702	Agile Methodologies	3	0	0	3	100	-
Major	23XXXXXX	Professional Elective – V	3	0	0	3	100	-
Major	23XXXXXX	Professional Elective – VI	3	0	0	3	100	-
Minor	23XXXXXX	Open Elective – II	3	0	0	3	100	-
Major	23CSL701	Open Source Software Development Laboratory	0	0	4	2	100	-
Project	23XXXXXX	Project Phase-I	0	0	8	4	100	-
		Total	**14**	**0**	**14**	**21**	**700**	

Semester VIII

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Project	23XXXXXX	Project Phase-II	0	0	12	6	200	-
SEC	23XXXXXX	Internship - 3 / Skill Development	8 Weeks			4	100	-
		Total	**0**	**0**	**12**	**10**	**300**	

Total Credits: 163

Vertical wise Electives

Vertical I Data Science							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
23CSE001	Data Science in Bioinformatics	3	0	0	3	100	-
23CSE002	Social Network Analytics	3	0	0	3	100	-
23CSE003	Information Retrieval Techniques	2	0	2	3	100	-
23CSE004	Big Data Analytics	2	0	2	3	100	-
23CSE005	Data Visualization	2	0	2	3	100	-
23CSE006	Data Analytics	2	0	2	3	100	-
23CSE007	Text and web Mining	2	0	2	3	100	-
23CSE008	Healthcare Analytics	2	0	2	3	100	-

Vertical II Artificial Intelligence & Machine Learning							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
23CSE009	Explainable AI	3	0	0	3	100	-
23CSE010	Bio Inspired Computing	3	0	0	3	100	-
23CSE011	Soft Computing Techniques	2	0	2	3	100	-
23CSE012	Deep Learning Methods	2	0	2	3	100	-
23CSE013	Generative AI	2	0	2	3	100	-
23CSE014	Machine Learning	2	0	2	3	100	-
23CSE015	Speech Processing	2	0	2	3	100	-
23CSE016	Prompt Engineering for AI	2	0	2	3	100	-

Vertical III Networks & Security							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
23CSE017	Distributed Systems	3	0	0	3	100	-
23CSE018	Information Security	3	0	0	3	100	-
23CSE019	Cryptographic Techniques	2	0	2	3	100	-
23CSE020	Embedded Systems	2	0	2	3	100	-
23CSE021	Malware Analysis	2	0	2	3	100	-
23CSE022	Block Chain Technology	2	0	2	3	100	-
23CSE023	Security in Quantum Computing	2	0	2	3	100	-
23CSE024	Edge Computing Practices	2	0	2	3	100	-

Vertical IV Software Development							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
23CSE025	Reliability Engineering	3	0	0	3	100	-
23CSE026	Software Quality Assurance and Testing	3	0	0	3	100	-
23CSE027	Design Patterns	2	0	2	3	100	-
23CSE028	Foundation Skills in Integrated Product Development	2	0	2	3	100	-
23CSE029	Full Stack Development	2	0	2	3	100	-
23CSE030	DevOps Technologies	2	0	2	3	100	-
23CSE031	Advanced Java Programming	2	0	2	3	100	-
23CSE032	Robotic Process Automation Design	2	0	2	3	100	-

Vertical V Human Computer Interaction							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
23CSE033	3D User Interface	3	0	0	3	100	-
23CSE034	Wearable Technology	3	0	0	3	100	-
23CSE035	Digital Image Processing Techniques	2	0	2	3	100	-
23CSE036	Graphics and Visualization	2	0	2	3	100	-
23CSE037	Game Design and Development	2	0	2	3	100	-
23CSE038	UI and UX Design Essentials	2	0	2	3	100	-
23CSE039	Multimedia System Techniques	2	0	2	3	100	-
23CSE040	Mixed Reality	2	0	2	3	100	-

Diversified Electives							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
23ITE043	Integrated Big Data Solutions	3	0	0	3	100	-
23ITE044	AWS Services with Devops Tools	2	0	2	3	100	-
23ITE047	Intellectual Property Rights	3	0	0	3	100	-
23AUE050	Entrepreneurship Development	3	0	0	3	100	-
23AUE051	Design Thinking and Innovation	3	0	0	3	100	-
23MEE008	PLM for Engineers	2	0	2	3	100	-

Open Electives							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
23CSO001	Management Information System	3	0	0	3	100	-
23CSO002	Relational Database Management System	3	0	0	3	100	-
23CSO003	Basics of Graphical User Interface	3	0	0	3	100	-
23CSO004	Green Computing	3	0	0	3	100	-
23CSO005	Bio Informatics	3	0	0	3	100	-
23CSO006	Programming in C++	3	0	0	3	100	-

SEMESTER I

Course Code:23VAL101		Course Title: Induction Program (Common to all B.E/B.Tech Programmes)
Course Category: VAC		Course Level: Introductory
Duration: 3 weeks	Mandatory Non-Credit Course	Max Marks:100

Pre–requisites

- NIL

Course Objectives

The course is intended to:

1. Explain various sources available to meet the needs of self, such as personal items and learning resources
2. Explain various career opportunities, opportunity for growth of self and avenues available in the campus
3. Explain the opportunity available for professional development
4. Build universal human values and bonding amongst all the inmates of the campus and the society.

List of Activities:

1. History of Institution and Management: Overview on NIA Educational Institutions – Growth of MCET – Examination Process –OBE Practices –Code of Conduct – Centre of Excellence.
2. Lectures, interaction sessions and Motivational Talks by Eminent people, Alumni, Employer and Industry Experts
3. Familiarisation of Department / Branch:HoD‟s & Senior Interaction- Department Association
4. Universal Human Value Modules : Aspirations and concerns, Self Management, Relationships Social and Natural Environment.
5. Orientation on Professional Skills Courses
6. Proficiency Modules : Mathematics, English, Physics and Chemistry
7. Introduction to various Chapters, Cells, Clubs and its events
8. Creative Arts : Painting, Music and Dance
9. Physical Activity :Games, Sports and Yoga
10. Group Visits: Visit to local area and Campus Tour

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1 : Explain various sources available to meet the needs of self, such as personal items and learning resources through visit to local areas and campus	Understand
CO2: Explain various career opportunities and avenues available in the campus through orientation sessions	Understand
CO3: Explain the opportunity available for professional development through professional skills, curricular, co-curricular and extracurricular activities	Understand
CO4: Build universal human values and bonding amongst all the inmates of the campus and society for having a better life	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO2	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO3	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO4	2	-	-	-	-	-	-	2	1	2	-	-	-	-
CO5	1	-	-	-	-	-	-	2	1	2	-	-	-	-

High : 3, Medium :2, Low: 1

Text Book(s):

T1. Reading material, Workbook prepared by PS team of the college

Reference Book(s):

R1. Sean Covey, “Seven habits of highly effective teenagers”, Simon & Schuster Uk, 2004.

R2. Vethathiri Maharishi Institute For Spiritual and Intuitional Education, aliyar, “value education for harmonious life (Manavalakalai Yoga)”, Vethathri Publications, Erode, 2010.

R3. Dr.R.Nagarathna, Dr.H.R. Nagendra, “ Integrated approach of yoga therapy for positive ealth”, Swami Vivekananada Yoga Prakashana Bangalore,2008 Ed.

Web References:

1. https://youtube.com/playlist?list=PLYwzG2fd7hzc4HerTNkc3pS_IvcCfKznV
2. https://www.youtube.com/watch?v=P4vjfEVk&list=PLWDeKF97v9SO0frdgmpaghDMjkom1eudx
3. https://fdp-si.aicte-india.org/download/AboutSIP/About%20SIP.pdf

Course Code: 23ENI101	Course Title: Communication Skills I (Common to all B.E/B.Tech Programmes)		
Course Category: AEC		Course Level: Introductory	
L:T:P(Hours/Week) 2:0:2	Credits: 3	Total Contact Hours:60	Max Marks:100

Course Objectives:

The course is intended to impart formal and informal language effectively and accurately in various real-life contexts on par with B1 level of CEFR Scale.

Module I **20 Hours**

Grammar: Synonyms & Antonyms -Tense forms - Modals - Passives – Reported Speech – Comparatives and Descriptive adjectives.

Listening: Listening for gist and specific information - Listening to past events, experiences and job preferences - Listening to descriptions of monuments - Listening for excuses - Listening to description: transportation systems and public places.

Speaking: Introducing oneself - Exchanging personal information – Effective Conversations: Role Play Situations (Describing personality traits - Describing landmarks, monuments and festivals - Making polite requests and excuses - Discussing facts - Asking for and giving information – Expressing wishes - Talking about lifestyle changes - Talking about transportation and its problems - Describing positive and negative features of things and places - Making comparisons)

Reading: Skimming and Scanning - Reading Comprehension - Reading and comprehending online posts and emails – Case Studies

Writing: Letter writing (Permission letters - Online cover letter for job applications) - Instructions - Recommendations - Write a blog (General) - Report Writing (Industrial Visit Report and Event Reports) - formal and informal emails.

Module II **20 Hours**

Grammar: Sequence adverbs - Phrasal verbs - Relative clauses – Imperatives - Infinitives - Conditionals.

Listening: Listening to review of food items - Listening to results of surveys- Listening to motivational talks & podcasts

Speaking: Expressing likes and dislikes - Describing a favourite snack - Giving advices and **suggestions - Speculating about past and future Events – Group Discussion**

Reading: Reading different expository texts - Reading to factual texts - Print and online media- Reading Comprehension

Writing: Process Descriptions – Email Writing (Requesting for information) - Reviewing Movie – Social media feeds/posts (Any Social Media)

List of Experiments: **20 Hours**

1. Mini Presentation and Picture Prompt Discussion
2. Debate Tournament
3. Listening, Mind Mapping & Summarization
4. Listening to Stories and Providing the Innovative Climax
5. Reading Comprehension
6. Writing - Interpretation of Visuals

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Utilize the basic English grammar and vocabulary to acquire professional communication skills.	Apply
CO2: Develop listening and speaking skills through classroom activities based on listening comprehension, recapitulation, interpretation and debate on the same	Apply
CO3: Read and write social media posts and comments	Apply
CO4: Perform as a member of a team and engage in individual presentation	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	-

High-3; Medium-2;Low-1

Textbooks:

T1. Jack C. Richards, Jonathan Hull, and Susan Proctor, “Interchange - Student‟s book 2”, 5thEdition, Cambridge University Press, South Asia Edition, 2022.

T2. Jack C. Richards, Jonathan Hull, and Susan Proctor, “Interchange - Student‟s Book 1”, 5thEdition, Cambridge University Press, South Asia Edition, 2022.

Reference Book(s):

R1. David Bohlke, Jack C. Richards, “Four Corners”, 2nd Edition, Cambridge University Press,2018.

R2. Adrian Doff, Craig Thaine, Herbert Puchta, Jeff Stranks, Peter Lewis-Jones, Graham Burton,Empower B1 – Student‟s Book, Cambridge University Press, 2020.

R3. Raymond Murphy, "Intermediate English Grammar" 30th Edition, Cambridge University Press,2022.

Web References:

1. https://speakandimprove.com/
2. https://writeandimprove.com/
3. https://www.cambridgeenglish.org/exams-and-tests/linguaskill/

Course Code: 23MAI103		Course Title: Linear Algebra and Infinite Series	
Course Category: Minor		Course Level: Introductory	
L:T:P(Hours/Week) 3:0:2	Credits: 4	Total Contact Hours: 75	Max Marks: 100

Course Objectives:

The course is intended to impart knowledge on Linear Algebra, vector spaces, sequences and series in mathematics to have a strong foundation in science and engineering.

Module I **23 Hours**

Solutions to System of Linear Algebraic Equations: Matrices- Rank of a matrix - Consistency of a system of linear equations- Row echelon form-Row reduced echelon form-Gauss elimination method- Crout‟s method.

Basis and Dimension of Vector Spaces: Vector spaces -Linear Independent and dependent of vectors-Basis, dimension, row space, column space, null space, rank nullity theorem.

Orthogonality and Inner Product Space: Inner product of vectors-Inner product spaces-length of a vector, distance between two vectors, orthogonality of vectors-orthogonal projection of a vector-Gram-Schmidt process- orthonormal basis.

Module II **22 Hours**

Eigen Values and Eigen Vectors: Eigen values and vectors-symmetric, skew symmetric and orthogonal matrices- Diagonalization of matrix through orthogonal transformation- Reduction of quadratic forms to canonical form-rank ,index, signature and nature of quadratic forms-Singular Value decomposition.

Sequences and Series: Sequences-definitions and examples- Series-Tests for convergence-comparison test, integral test, Cauchy‟s root test, Alembert‟s ratio test- Alternating series – Leibnitz‟s test.

List of Experiments: **30 Hours**

1. Introduction to MATLAB
2. Row Echelon form and Row reduced Echelon form of a matrix.

3. Rank of a matrix and solution of a system of linear algebraic equations.
4. Dimension of row space, column space and null space.
5. Gram-Schmidt Orthogonalization.
6. Eigenvalues and Eigenvectors of matrices.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply matrix techniques for solving system of linear equations and Apply the process of orthogonalization to find orthogonal vectors.	Apply
CO2: Determine the canonical form of a quadratic form using orthogonal transformation in Science and Engineering problem solving.	Apply
CO3: Apply different tests to find convergence and divergence of series in the problem solving.	Apply
CO4: Demonstrate the understanding of linear algebra concepts through modern tool.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	-	-	-	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th edition, John Wiley & sons, 2010.

T2. David C Lay, Linear Algebra and its Applications, 3rd edition, Pearson India, 2011.

T3. Howard Anton, Chris Rorres, Elementary Linear Algebra Applications version,11th Edition, Wiley India edition, 2013.

Reference Book(s):

R1. T. Veerarajan, Engineering Mathematics for first year, 3rd edition, Tata McGraw-Hill, 2019.

R2. V. Krsihnamurthy, V. P. Mainra and J. L. Arora, An introduction to Linear Algebra, Affiliated East-West press, Reprint 2005.

R3. P. Sivaramakrishna Das , C. Vijayakumari , Engineering Mathematics, Pearson India, 2017.

Web References:

1. https://nptel.ac.in/courses/111106051
2. https://www.classcentral.com/course/matrix-algebra-engineers-11986

Course Code: 23CST101		Course Title: Problem Solving using C	
Course Category: Major		Course Level: Introductory	
L:T:P(Hours/Week)	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives: The course is intended to impart knowledge on basic concepts of C.

Module I **23 Hours**

C Programming Basics: General Problem solving strategy – Program development cycle - Problem Solving Techniques : Algorithm, Pseudocode and Flow Chart - Overview of C – Structure of C program – C Character set – keywords - Identifiers – Variables and Constants – Data types – typedef- Type conversion – Operators and Expressions – Managing formatted and unformatted Input & Output operation.

Control Structures: Storage classes - Statements: Selection statements - Jump statements - Iteration statements.

Arrays: Characteristics of Array – Single-dimensional array – Two-dimensional array – Array Operations – Applications: Linear search, Selection sort, Matrix Operations.

Functions: Declaration & Definition – Return statement – Classification of functions – Parameter passing methods: call by value – call by reference – Passing Array to a Function– Returning Array from a function – Recursion.

Module II **22 Hours**

Strings: Declaration and Initialization of string – Display of strings with different formats – String library Functions – String conversion functions.

Pointers: Features - Types of Pointers: Null and Void pointer – Operations on pointers – Pointers to an Array.

Structures: Declaration & Initialization of Structures – Structure within Structure – Array of Structures – Pointer to Structures.

Union: Declaration & Initialization of Union – Enumerations.

Files: Introduction to Files – Streams and File Types – File operations (Open, close, read, write) – Command line arguments.

Preprocessor Directives: Macro Expansion, File Inclusion, Conditional Compilation.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Understand the fundamental concepts of programming, such as variables, data types, control structures, and functions.	Understand
CO2: Design and develop C programs for real-world applications	Apply
CO3: Apply problem solving skills and knowledge of C programming constructs to solve a given problem.	Apply
CO4: Analyze and debug C programs to identify and fix errors.	Analyze
CO5: Apply modular programming techniques to break down complex programs into smaller, manageable modules.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	2	-	-	-	-	-	-	-	-	2	-

High-3; Medium-2;Low-1

Text Book(s):

T1. Yashavant P.Kanetkar, “Let Us C”, 19th Edition, BPB Publications, 2022.
T2. Ashok N.Kamthane, Amit.N.Kamthane, “Programming in C”, 3rd Edition, Pearson Education, 2015.

Reference Book(s):

R1. Ajay Mittal, “Programming in C - A Practical Approach”, 3rd Edition, Pearson Education, 2010.
R2. Brian W.Kernighan and Dennis M.Ritchie,”The C Programming Language” 2nd Edition, Pearson Education, 2015.
R3. Venit S, and Drake E, “Prelude to Programming Concepts and Design”,6th Edition, Pearson Education, 2014
R4.Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, 2nd Edition, Oxford University Press, 2013.

Web References:

1. http://www.cprogramming.com/
2. http://www.c4learn.com/

Course Code: 23EEI101	Course Title: Basics of Electrical and Electronics Engineering (Common to AD,AM,CS,IT and SC) (For 2023 Batch Only)		
Course Category: Multidisciplinary		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on engineering fundamentals of DC&AC circuits, Electrical machines, Electron devices, Carpentry and plumbing.

Module I **22 Hours**

Fundamentals of DC Circuits: Definition, symbol and unit of quantities – Active and Passive elements – Ohm‟s Law: statement, – Kirchhoff‟s Laws: statement and illustration – Resistance in series and voltage division rule – Resistance in parallel and current division rule – Star to Delta and Delta to Star transformation- circuit simplification.

AC Fundamentals: Magnetic Circuits: Definition of magnetic quantities – Law of electromagnetic induction – Generation of single phase alternating EMF – Terminology – 3 **Phase System**: 3-Wire and 4 Wire system – Root Mean Square (RMS) – Average value of AC- DC Machines: DC Generator and DC Motor: Construction, Working Principle.

Module II **23 Hours**

AC Machines: Single phase transformer: Construction, working principle - Single phase induction motor: Capacitor start and run -Three phase induction motor: An introduction.

Semiconductor Devices: Theory of Semiconductor: PN junction diode, Forward Bias Conduction, Reverse Bias Conduction, V-I Characteristics – Bipolar Junction Transistor: Operation of NPN and PNP Transistor, Common Emitter Configuration – MOSFET: construction and working principle.

Opto-Electronic Devices and Transducers: Opto-Electronic Devices: Working principle of Photoconductive Cell, Photovoltaic Cell-solar cell Transducers: Capacitive and Inductive Transducer, Thermistors, Piezoelectric and Photoelectric Transducer.

List of Experiments **30 Hours**

Electrical & Electronics:

1) Identification of resistor and capacitor values
2) Soldering practice of simple circuit and checking the continuity
3) Fluorescent tube, staircase and house wiring
4) Characteristics of PN Diode

Civil & Mechanical:

1) Make a wooden Tee joint to the required dimension
2) Make a tray in sheet metal to the required dimension
3) Assemble the pipeline connections with different joining components for the given layout

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1: Apply the basic laws and simplification techniques of electrical Engineering in DC and AC Circuits.	Apply
CO2: Summarize the construction and working of Motors, Generator and transformer.	Understand
CO3: Analyze the characteristics of diodes and transistors based on its construction and working principle.	Analyze
CO4: Summarize the working of opto-electronic devices and transducers	Understand
CO5: Examine and report the analysis of different resistors, capacitors, house wiring concepts, wooden joints and pipeline connection.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	1	1	-	-

High-3; Medium-2;Low-1

Textbooks:

T1.R.Muthusubramanian and S.Salivahanan, “Basic Electrical and Electronics Engineering”, McGraw Hill India Limited, New Delhi, 2014.

T2. S. K. Sadhev, “Basic Electrical Engineering and Electronics”, Tata Mcgraw Hill, 2017.

Reference Book(s):

R1. B.L Theraja, “Fundamental of Electrical Engineering and Electronics”, S.Chand Limited, 2022.

R2. J.B.Gupta, “Basic Electrical and Electronics Engineering”, S.K.Kataria & Sons, 2013.

R3. Smarajit Ghosh, “Fundamental of Electrical and Electronics Engineering”, 2nd Edition, PHI Learning Private Limited New Delhi, 2010.

Web References:

1. https://www.nptel.ac.in/courses/108108076
2. https://archive.nptel.ac.in/courses/108/105/108105112
3. https://archive.nptel.ac.in/courses/108/101/108101091

Course Code: 23EEI102		Course Title: Introduction to Electrical and Electronics Engineering (Common to AD,AM,CS,IT & SC) (From 2024 Batch Onwards)	
Course Category: Multidisciplinary		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on engineering fundamentals of electric circuits, Electrical machines, and Electron devices.

Module I **23 Hours**

Fundamentals of DC Circuits: Definition, symbol and unit of quantities – Active and Passive elements - Ohm‟s Law: statement, - Kirchhoff‟s Laws: statement and illustration - Resistance in series and voltage division rule – Resistance in parallel and current division rule -circuit simplification.

AC Fundamentals: AC Terminologies - Law of electromagnetic induction - Generation of single phase alternating EMF - Root Mean Square (RMS) - Average value of AC

Electrical Machines: Construction and Working Principle of DC shunt Motor, Stepper Motor and single phase transformer

Module II **22 Hours**

Semiconductor Devices: PN junction diode, Forward Bias Conduction, Reverse Bias Conduction, V-I Characteristics – Half wave and Full wave rectifier using diodes – SMPS – UPS - Bipolar Junction Transistor: Operation of NPN and PNP Transistor, Common Emitter Configuration

Opto-Electronic Devices and Transducers: Opto-Electronic Devices: Working principle of Photoconductive Cell, Photovoltaic Cell – LED&LCD display - Thermistors, Thermocouple, and Piezoelectric Transducers.

Fuses - Circuit breaker: MCB, MCCB - Energy efficiency star rating.

List of Experiments **30 Hours**

1. Identification of resistor and capacitor values.
2. Soldering practice of simple circuit and checking the continuity.
3. Staircase and house wiring.
4. Characteristics of PN Diode.
5. Half wave and full wave rectifier using diodes.
6. Characteristics of CE configuration transistor.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the basic laws and simplification techniques in electrical engineering using electric circuits.	Apply
CO2: Make use of the basic laws and principles of electric circuits in analysis of the electrical machines viz.,Motors & transformers, UPS and SMPS	Analyze
CO3: Analyse the Diodes, Transistors, Opto-Electronic Devices and Transducers based on its construction and working principle.	Analyze
CO4: Investigate and report the analysis of different resistors, capacitors, house wiring concepts.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	3	-	-	-	-	1	1	-	-	-	-

High-3; Medium-2;Low-1

Textbook(s):

T1. R.Muthusubramanian and S.Salivahanan, “Basic Electrical and Electronics Engineering”, McGraw Hill India Limited, New Delhi, 2014.

T2. S. K. Sadhev, “Basic Electrical Engineering and Electronics”, Tata Mcgraw Hill, 2017.

Reference Book(s):

R1. B.L Theraja, “Fundamental of Electrical Engineering and Electronics”, S.Chand Limited, 2006.

R2. J.B.Gupta, “Basic Electrical and Electronics Engineering”, S.K.Kataria & Sons, 2009.

R3. Smarajit Ghosh, “Fundamental of Electrical and Electronics Engineering”, 2nd Edition, PHI Learning Private Limited New Delhi, 2010.

Web References:

1. https://www.nptel.ac.in/courses/108108076
2. https://archive.nptel.ac.in/courses/108/105/108105112
3. https://archive.nptel.ac.in/courses/108/101/108101091

Course Code: 23MEL001		Course Title: Engineering Drawing (Common to AD,AM,AU,CS,EA ,EC,EE,EV,IT,ME, SC)	
Course Category: Multi-Disciplinary		Course Level: Introductory	
L:T:P(Hours/Week)1: 0: 3	Credits:2.5	Total Contact Hours: 60	Max Marks:100

Course Objectives:

The course is intended to

- To impart knowledge on basic dimensioning. 2D and 3 D drawings such as points, lines, planes and solids on first quadrant.

Module I **8 Hours**

Basics of Engineering Drawing: Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Basic Geometrical constructions –Orthographic projection- Free hand Sketching.

Projection of Points, Lines: 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 and traces by rotating object method.

Projection of Solids: Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination).

Module II **7 Hours**

Sectioned Solids: Sectioning of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by cutting planes inclined to one reference plane and perpendicular to the other – Orthographic views of sections of simple solids.

Development of Surfaces: Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders using straight line and radial line method.

Isometric Projection: Principles of isometric projection – Isometric scale –Isometric projections of simple solids and truncated solids. Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination).

List of Experiments **45 Hours**

1. Lettering & Dimensioning
2. Projection of Points & Lines
3. Orthographic projections
4. Projection of Simple Solids
5. Projection of Section of Simple Solids
6. Development of Surfaces
7. Isometric Projections

Course Outcomes	**Cognitve Level**
At the end of this course, students will be able to:	
CO 1: Apply the concepts related to free hand sketching, orthographic and Isometric projection in first quadrant.	Understand
CO2: Apply the concepts and draw projections of points in four different quadrants and lines located first quadrant.	Apply
CO3: Apply the concepts and draw projections and sections of simple solids using rotatingobject method.	Apply
CO4: Apply the concepts and draw lateral surface of simple solids using straight line andradial line development methods.	Apply
CO5: Apply the concepts and draw isometric view of simple solids and truncated solids using principles of isometric projection.	Apply
CO6: Conduct experiments to demonstrate concepts, implement and analyze the drawing concepts using engineering tool: Using AutoCAD.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	3	-	-	3	-	-	-	1	1	-	1	-	-

High-3; Medium-2; Low-1

Textbook:

T1. Cencil Jensen, Jay D.Helsel and Dennis R. Short, " Engineering Drawing and Design", TataMcGraw Hill India, New Delhi, 3rd edition, 2019.

Reference Book(s):

R1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill India,NewDelhi, 2nd edition, 2014.

R2. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD" TataMcGraw India, New Delhi, 3rd edition, 2010.

R3. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House,Gujarat, 54th edition, 2023.

Publications Of Bureau Of Indian Standards

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation - Lettering.
2. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
3. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods. The mode ofdelivery is like practical.

Web References:

1. http://nptel.ac.in/courses/112103019/
2. https://www.coursera.org/specializations/autodesk-cad-cam-cae-mechanical-engineering

Course Code: 23CSL101		Course Title: Problem Solving using C Laboratory	
Course Category: SEC		Course Level: Introductory	
L:T:P(Hours/Week) 0:0:3	Credits: 1.5	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to enable the students for writing simple programs in C.

List of Experiments:

1. Develop Algorithm, Flowchart and Pseudo code for given problem.
2. Develop C programs using data types, I/O statements, Operators and Expressions.
3. Develop C programs using Decision-making constructs.
4. Implement C programs using looping statements.
5. Design C programs to implement the concept of arrays.
6. Design C programs to implement the concept of strings
7. Develop C programs using functions.
8. Develop C programs using pointers.
9. Implement the concept of structures using C.
10. Implement C programs to perform file operations.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Demonstrate proficiency in using development environments, compilers, and debugging tools for C programming	Apply
CO2: Apply C programming concepts to practical programming tasks	Apply
CO3: Demonstrate an understanding of the importance of code efficiency and optimization in C programming	Analyze
CO4: Work as a team in a laboratory environment to develop and demonstrate projects with an oral presentation	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	3	-	3	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	2	-			-	-	-	-
CO4	-	-	-	-	-	-	-	-	3	1	1	-	3	-

High-3; Medium-2;Low-1

Reference Book(s):

R1. Ashok N.Kamthane, Amit.N.Kamthane, “Programming in C”, 3rd Edition, Pearson Education, 2015.

R2. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Pearson Education, 2013.

R3. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.

R4. ReemaThareja, “Programming in C”, Oxford University Press, 2nd, 2016.

Web References:

1. https://electronicsforu.com/resources/15-free-c-programming-ebooks
2. https://www.fromdev.com/2013/10/c-programming-tutorials.html
3. https://books.goalkicker.com/CBook/

Course Code: 23VAL102		Course Title: Wellness for Students (Common to all B.E/B.Tech Programmes)	
Course Category: VAC		Course Level: Introductory	
L:T:P(Hours/Week) 0: 0 :2	Credits:1	Total Contact Hours:30	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on setting SMART goals for academic, career and life, applying time management techniques, articulating the importance of wellness for success in life and understanding the dimensions of wellbeing and relevant practices.

Module I **15 Hours**

GOAL SETTING: Understanding Vision and mission statements - Writing personal mission statements – „Focus" as a way of life of most successful people. Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, What you see depends on the role you assume. Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment.

TIME MANAGEMENT - TOOLS AND TECHNIQUES Importance of planning and working to time. Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying „NO" – Managing procrastination.

CONCEPT OF WELLNESS – impact of absence of wellness - Wellness as important component to achieve success. Wellbeing as per WHO - Dimensions of Wellbeing: Physical, Mental, Social, Spiritual – indicators and assessment methods

Module II **15 Hours**

Simplified Physical Exercises. Fitness as a subset of Wellness – health related physical fitness - skill related physical fitness. Joint movements, Warm up exercises, simple asanas, WCSC simplified exercises.

PRACTICES FOR MENTAL WELLNESS

Meditation: Mind and its functions - mind wave frequency – Simple basic meditation – WCSC Meditation and introspection tables. Greatness of friendship and social welfare – individual, family and world peace – blessings and benefits.

Food & sleep for wellness: balanced diet - good food habits for better health (anatomic therapy) – hazards of junk food - food and the gunas.

PUTTING INTO PRACTICE

Practicals: Using the weekly journal – Executing and achieving short term goals – Periodic reviews.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Set well-articulated goals for academics, career, and personal aspirations	Apply
CO2: Apply time management techniques to complete planned tasks on time	Apply
CO3: Explain the concept of wellness and its importance to be successful in career and life	Apply
CO4: Explain the dimensions of wellness and practices that can promote wellness	Apply
CO5: Demonstrate the practices that can promote wellness	Valuing

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	1	-	1
CO2	-	-	-	-	-	-	-	-	1	-	1	1
CO3	-	-	-	-	-	-	-	-	1	-	-	1
CO4	-	-	-	-	-	-	-	-	1	-	-	1
CO5	-	-	-	-	-	1	1	-	1	-	-	1

High-3; Medium-2;Low-1

Text Book:

T1. Reading material, workbook and journal prepared by PS team of the college.

Reference Book(s):

R1. Stephen R Covey, “First things first”, Simon & Schuster UK, Aug 1997.

R2. Sean Covey, “Seven habits of highly effective teenagers”, Simon & Schuster UK, 2004.

R3. Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar, “Value education for harmonious life (Manavalakalai Yoga)”, Vethathiri Publications, Erode, Ed. (2010).

R4. Dr. R. Nagarathna, Dr. H.R. Nagendra, “Integrated approach of yoga therapy for positive health”, Swami Vivekananda Yoga Prakashana, Bangalore, 2008 Ed.

R5. Tony Buzan, Harper Collins, “The Power of Physical Intelligence English”

Course Code: 23VAT101	Course Title: HERITAGE OF TAMILS (Common to all B.E/B.Tech Programmes)		
Course Category: VAC		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:100

Pre–requisites

- NIL

Course Objectives

மாணவர்கள் இப்பாடத்தை கற்றலின் மூலம்

CO.1 மொழி மற்றும் இலக்கியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை , நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் , திணைக் கோட்பாடுகள் மூலம் தமிழர் மரபை அறிந்து கொள்ள இயலும்.

CO.2இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பை அறிந்து கொள்ள இயலும்.

தமிழர் மரபு

அலகு 1 – மொழி மற்றும் இலக்கியம் 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு 2 – மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு 3 – நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு 4 – தமிழர்களின் திணைக் கோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக் கோட்பாடு – சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறைமுகங்களும் – சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு 5 – இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறபகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுய மரியாதை இயக்கம் – இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப் படிகள்– தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

Course Outcomes	**Cognitive Level**
மாணவர்கள் இப்பாடத்தை கற்றபின்	
CO.1 மொழி மற்றும் இலக்கியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை , நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் , திணைக் கோட்பாடுகள் மூலம் தமிழர் மரபை அறிந்து கொள்வார்கள்.	அறிதல் (Understand)
CO.2 இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பை அறிந்து கொள்வார்கள்.	அறிதல் (Understand)

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)

3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by:
Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code: 23VAT101	Course Title: HERITAGE OF TAMILS (Common to all B.E/B.Tech Programmes)		
Course Category: VAC		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:100

Pre–requisites

- NIL

Course Objectives

The course is intended to:

1. Understand the Heritage of Tamils in terms of Language and Literature, Rock Art Paintings to Modern Art – Sculpture, Folk and Martial Arts, Thinai Concept.
2. Understand the Contribution of Tamils to Indian National Movement and Indian Culture.

HERITAGE OF TAMILS

UNIT I LANGUAGE AND LITERATURE 3

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

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

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS **3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, 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	**Cognitive Level**
At the end of this course, students will be able to:	
CO.1 Understand the Heritage of Tamils in terms of Language and Literature, Rock Art Paintings to Modern Art – Sculpture, Folk and Martial Arts, Thinai Concept.	Understand
CO.2 Understand the Contribution of Tamils to Indian National Movement and Indian Culture.	Understand

Course Articulation Matrix

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)

3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies)

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by:
Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

SEMESTER II

Course Code: 23ENI201	Course Title: Communication Skills II (Common to all B.E/ B.Tech Programmes)		
Category: AEC		Course Level: Introductory	
L:T:P(Hours/Week) 2:0:2	Credits: 3	Total ContactHours:60	Max Marks:100

Course Objectives:

The course is intended to impart effective and accurate language in business correspondence on par with B2 level of CEFR Scale.

Module I **20 Hours**

Grammar: Linking Words - Collocations –Sentence Completion - Articles –Adverbs – Indefinite Pronoun

Listening: Listening to short conversations - Listening for gist and summarizing - Listening for detail - Responding to straightforward questions.

Speaking: Making statements of facts - Agreeing and disagreeing to opinions - Respond to queries - Group Discussion.

Reading: Read and select (phrasal verbs & relative clause)- Cloze Test - Gapped sentences - Multiple- choice gap-fill

Writing: Paragraph Writing: Descriptive, narrative, persuasive and argumentative - Emails: Giving information - Making enquiries - Responding to enquiries - Power Point Presentation

Module II **20 Hours**

Grammar: Expressions of cause and result – Concord - Error Spotting (Parts of Speech & Indian English) - Prepositions

Listening: Listening for identifying main points - Responding to a range of questions about different topics - Listening to identify relevant information

Speaking: Empathetic Enunciation – Situation handling – Visual Interpretation - - Short presentations

Reading: Intensive Reading: Comprehending business articles, reports and proposals and company websites-- Open gap-fill - Extended reading

Writing: – Report Writing - Memo – Complaint letter - Business Letters (Seeking permission & Providing Information)

List of Experiments: **20 Hours**

1. Listening to Monologue and Extended Listening Activity I
2. Listening to Monologue and Extended Listening Activity II
3. Expressing Opinions and Situational based speaking
4. Mini Presentation and Visual Interpretation
5. Reading Comprehension
6. Writing letter, email and report

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Identify the common errors in written and spoken correspondence	Apply
CO2: Develop listening, reading and speaking skills through task based activities in listening, reading comprehension, recapitulation, interpretation and discussion.	Apply
CO3 : Read business correspondences like memo, Email, letter, proposals and write reports and website entries and product launches	Apply
CO4: Perform as an individual and member of a team and engage effectively in group discussion and individual presentation.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	-

High-3; Medium-2; Low-1

Textbooks:

T1. Guy Brook- Hart, “Business Benchmark Upper Intermediate”, 2nd Edition, South Asian, Cambridge University Press, 2020.

T2. Norman Whitby, “Business Benchmark pre-intermediate to Intermediate”, 2nd Edition, South Asian, Cambridge University Press, 2014.

Reference Book(s):

R1. Hewings Martin - Advanced Grammar in use Upper-intermediate Proficiency, CUP,3rd Edition,2013.

R2. Clark David – Essential BULATS (Business Language Testing Service), CUP, 2006.

R3. Adrian Doff, Craig Thaine, Herbert Puchta, Jeff Stranks, Peter Lewis-Jones, Rachel Godfrey,Gareth Davies, Empower B1+ – Student's Book, Cambridge University Press,2015.

Web References:

1. https://speakandimprove.com/
2. https://writeandimprove.com/
3. https://www.cambridgeenglish.org/exams-and-tests/linguaski

Course Code:23FLT201	Course Title: Foreign Language - Japanese (Common to all B.E/B.Tech Programmes)		
Course Category: AES		Course Level: Introductory	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives:

The course objectives intended to:

1. Express a basic exposure on Japanese language and culture
2. Express thoughts and communicate in the beginner level of Japanese with native Japanese speaker
3. Identify the kanji etymology as well as use it in basic vocabulary required for the JLPT/NAT 5 examination level
4. Read and write 100 kanji of the official JLPT N5
5. Choose the appropriate verb forms for learning and practicing the Japanese language

UNIT I Introduction to Japan and greetings 9 Hours

Japan : Land and culture - Introduction to Japanese language – Greetings – Seasons - Days of the week - Months of the year – Dates of the month - Self introduction – Numbers (Upto 99,999) – Expressing time – Conversation audio and video.

Listening: Listening to Greetings - Listening for Specific Information: Numbers, Time.

Speaking: Self-Introduction

UNIT II Building vocabulary 9 Hours

Family relationships - Colours - Parts of body - Profession - Directions - Time expressions (today, tomorrow, yesterday, day before, day after) - Japanese housing and living style - Food and transport (vocabulary) - Stationery, fruits and vegetables

Listening: Listening for Specific Information: Directions, Family Members, Parts of body

Speaking: Introducing one's family.

UNIT III Writing systems 9 Hours

Hiragana Chart 1 - vowels and consonants and related vocabulary – Hiragana Charts 2&3, double consonants, vowel elongation and related vocabulary – Introduction to Kanji – Basic Vocabulary – Basic Conversational Phrases.

Listening: Listening to Japanese Alphabet Pronunciation, Simple Conversation.

Speaking: Pair Activity (Day to day situational conversation)

UNIT IV Kanji and preposition 9 Hours

Katakana script and related vocabulary – Basic kanjis: naka, ue, shita, kawa , yama , numbers (1- 10, 100, 1000, 10,000 and yen) , person, man, woman, child, tree , book , hidari, migi, kuchi , 4 directions - Usage of particles wa, no, mo and ka and exercises - Usage of kore, sore, are, kono, sono, ano, arimasu and imasu - Particles – ni (location) and ga , donata and dare - Particles ni (time), kara, made , ne , koko, soko, asoko and doko - Directions : kochira, sochira, achira and dochira , associated vocabulary (mae, ushiro, ue, shita, tonari, soba, etc.)

Listening: Listening to conversation with related particles

UNIT V Verb forms 9 Hours

Introduction to Verbs - Verbs -Past tense, negative - i-ending and na-ending adjectives introduction - ~masen ka, mashou - Usage of particles de, e , o, to, ga(but) and exercises - Adjectives (present/past – affirmative and negative) – Counters - ~te form

Listening: Listening to different counters, simple conversations with verbs and adjectives. Speaking: Pair Activity (Explaining one's daily routine by using appropriate particles and verbs)

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Recognize and write Japanese alphabet	Understand
CO2: Comprehend the conversation and give correct meaning	Understand
CO3: Apply appropriate vocabulary needed for simple conversation in Japanese language	Apply
CO4: Apply appropriate grammar to write and speak in Japanese language	Apply
CO5: Speak using words of the Japanese language	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	1	--	-

High-3; Medium-2;Low-1

Text Book(s):

T1. Genki 1 Textbook: An Integrated Course in Elementary Japanese by Eri Banno, Yoko Ikeda, Yutaka Ohno, Yoko Sakane, Chikako Shinagawa, Kyoko Tokashiki published by The Japan Times

T2. Genki 1 Workbook: An Integrated Course in Elementary Japanese by Eri Banno published by The Japan Times

Reference(s):

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007
2. Japanese for Everyone: Elementary Main Textbook1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007
3. www.japaneselifestyle.com
4. www.learn-japanese.info/
5. www.learn.hiragana-katakana.com/typing-hiragana-characters/
6. www.kanjisite.com/

Course Code:23FLT202	Course Title: Foreign Language - German (Common to all B.E/B.Tech Programmes)		
Course Category: AEC		Course Level: Introductory	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives:

The course is intended to:

1. Listen and understand numbers, names and dialogues of a native speaker on par with A1 level.
2. Speak and introduce self in simple sentences to convey their opinion and ideas on par with A1 level.
3. Read simple passages and given text on par with A1 level.
4. Write letter and simple sentences on par with A1 level.

UNIT I BASIC INTRODUCTION TO GERMAN SCRIPTS 9 Hours

Theme and Text (Introduction to German - German script, Deutsche Namen, Daily Greetings and Expressions) – Grammar („wh" questions, das Alphabet)- Speak Action (Buchstabieren, sich und andere vorstellen nach Namen und Herkunft fragen, internationale Wörter auf Deutsch verstehen, jemanden begrüßen)- pronunciation (Buchstabieren J,V,W,Y, - Long vowels A,E,I,O,U - Pronunciation of Ä,Ü,Ö) – To learn (internationale Wörter in Texten finden, Wörter sortieren)

Theme and Text (Gespräche im caf"e, Getränkekarte, Telefon-buch, Namen, Rechnungen) – Grammar (Frägesatze mit wie, woher, wo, was Verben in präsens Singular und Plural, das Verb Sein, Personalpronomen und Verben)- Speak Action (eine Gespräch beginnen sich und andere vorstellen zählen, etwas bestellen und bezhalen Telefonnummern und verstehen)- pronunciation (Wortakzent in Verben und in Zahlen) – To learn (Grammatiktabelle ergänzen, mit einem Redemittelkasten arbeiten)

UNIT II NUMBERS AND NOMINATIVE CASE 9 Hours

Theme and Text (Numbers – 1 to 12 (Eins bis Zwolf) – 20, 30, 40, 90 (zwanzig-Neunzig) – All Numbers (1-10000) – German Currency (Euro) – Basic Mathematics (plus, Minus, Malen, Geteilt durch)) - Grammar (Introduction of verbs -Have Verb - To Come, To Speak, To Read, To Drive, To Fly, To write, To Eat, To sleep, To take etc.,)

Theme and Text (Communication in course) – Grammar (Singular and Plural, Artikel: der,das,die/ ein,eine, verneinung: kein, keine, Komposita: das Kursbuch) – Speak Action (Gegenständen fragen/ Gegenstände benennen im kurs:) – pronunciation (word accent Marking, Umlaute ö ä ü hören und sprechen) – To learn (Lernkarten schreiben, Memotipps, eine Regel selbst finden)

Theme and Text (City, Town, Language: Nachbar, Sprachen, Sehenswürdigkeiten in Europa) – Grammar (Past tense for Sein, W-Frage, Aussagesatz und Satzfrage) – Speak Action (about city and siteseeing) – pronunciation (Satzakzent in Frage- und Aussagesätzen) – To learn (eine Regel ergänzen, eine Grammatiktabelle erarbeiten, Notizen machen)

UNIT III AKKUSATIVE CASE AND PREPOSITIONS 9 Hours

Theme and Text (Menschen und Hauser, Furniture catalogue, E-Mail, House information) – Grammar (possesivartikel im Nominativ, Artikel im Akkusativ, Adjektive im satz, Graduierung mit zu)– Speak Action (Whonung bescreiben about perons and things)– pronunciation (consonant - ch) – To learn (wortschatz systematisch)

Theme and Text (Termine - Appointment and punctuality in Germany) – Grammar (questions with wann?, Preposition (am, um, von... bis), verneinung mit nicht, trennbare verben, präteritum von haben) – Speak Action (Daily plan making, time commitment, excuse for late coming) – pronunciation (consonants- p,b,t,d / k,g) – To learn (Rollenkarten arbeiten)

Theme and Text (orientation in working area, go for work, floor plan city plan, office and computer) – Grammar (preposition: in,neben, unter, auf, vor, hinter, an, zwischen, bei und mit + Datic)– Speak Action (work place, work, giving appointments)– pronunciation (consonants: f,w und v) – To learn (Making notice in calender)

UNIT IV DATIV CASE AND PREPOSITIONS 9 Hours

Theme and Text (Holiday and Party, holiday plan, party plan in Germany) – Grammar (regular and iregular verbs) – Speak Action (holiday speak, accident, Ich-Text schreiben) – pronunciation (lange und kurze vokale markieren) – To learn (Text Order)

Theme and Text (organising an Excursion to Berlin through city orientation, Bus plan, City plan, post card, Excursion programme) – Grammar (preposition: in, durch, über + Akkusativ: zu, an... vorbei + Dativ, Modalverb wollen) – Speak Action (Tourism, culture, postcard preparation, travel description) – pronunciation (r and l)–

To learn (plaket making)Theme and Text (Beruf und all Tag, Visiten karten, wörterbuch) – Grammar – Speak Action (profession, statistic speaking) – pronunciation (n,ng and nk)– To learn (wörterbuch , text information in tabel)

UNIT V ADJECTIVES AND PRONUNCIATION 9 Hours

Theme and Text (Haushaltstipp, kochrezept, maße und gewichte, Mahlzeiten und Gerichte) – Grammar (jeden Tag, manchmal, nie, Question - welche, Comparison – viel, gut, gern) – Speak Action (about eat, drink question and answers) – pronunciation (e,en,el,er) – To learn (Text auswerten und zusammenfassen)

Theme and Text (Clothing , colour, weather) – Grammar (Adjecktive im Akkusativ, unbestimmer Artikel) – Speak Action (weather, dress and colour understanding) – pronunciation (e-o- ö and ie-u- ü) – To learn (wetter and Farben interkulturelle)

Theme and Text (in super market,purchase, House Maintainence, Emotion, Sports, Body parts) – Grammar (Modal Verb) – Speak Action (Body parts) – To learn (Rollenkarten arbeiten)

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Recognize and write German alphabet, numbers. Recognize and write German alphabet, numbers.	Understand
C02: Comprehend the conversation and give correct meaning. Comprehend the conversation and give correct meaning	Understand
CO3: Apply appropriate grammar and vocabulary to write and speak. Apply appropriate grammar and vocabulary to write and speak.	Apply
CO4: Apply appropriate cases and texts to listen, write and speak Apply appropriate cases and texts to listen, write and speak.	Apply
CO5: Speak and read using words of the German language Speak and read using words of the German language	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	1	--	-

High-3; Medium-2;Low-1

Text book(s):

T1. Netzwerk, “Deutsch als Fremdsprache” by Stefanie Dengler, Paul Rusch, Helen Schmitz published by Goyal Publishers & Distributors Pvt Ltd;

T2. Funk, Kuhn, Demme, “Studio D A1 Deutsch als Fremdsprache” published by Goyal Publishers & Distributors Pvt Ltd;

Reference:

R1. Hueber, “Fit for Goethe- Zertifikat A1 (Start Deutsch 1)” by Goyal Publishers And Distributors; 2016

Course Code: 23MAI203		Course Title: Calculus and Transforms (Common to AD, AM, CS, IT & SC)	
Course Category: Minor		Course Level: Introductory	
L:T:P(Hours/Week) : 3 0 2	Credits: 4	Total Contact Hours: 75	Max Marks: 100

Course Objectives:

The course is intended to impart knowledge on differential calculus, vector calculus, ordinary differential equations, Fourier Series and Z transform to devise engineering solutions to solve real world problems.

Module I **23 Hours**

Differential Calculus: Curvature-Cartesian and Polar coordinates- radius of curvature-center of curvature- circle of curvature- Evolutes and Involutes.

Multivariable Calculus: Partial derivatives-total derivatives-Jacobian- maxima and minima and saddle points- Constrained maxima and minima: Method of Lagrange multipliers--Gradient- directional derivative- curl and divergence.

Ordinary Differential Equations of Second and Higher Orders: Second and higher order linear differential equations with constant coefficients – Second order linear differential equations with variable coefficients (Cauchy - Euler equation, Legendre's equation) – Method of variation of parameters – Solution of first order simultaneous linear ordinary differential equations.

Module II **22 Hours**

Fourier Series: Dirichlet's condition -Fourier series – Even and odd functions- Half range sine and cosine series - Parseval's identity -Harmonic Analysis.

Z Transforms: Z transform- region of convergence- properties of z transforms- inverse transform-Solution to homogeneous linear constant difference equations

List of Experiments(Using Python): **30 Hours**

1. Find the radius of curvature of a given curve.
2. Find the extremum value of a given function.
3. Compute second order ordinary differential equation.
4. Find the Fourier series of a periodic function.
5. Compute solution of difference equation using z transform.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply differential calculus to find curvature of a curve, Jacobian, extremum of functions of several variables and vector quantities to solve problems in Science and Engineering.	Apply
CO2: Solve the second and higher order ordinary differential equations using various techniques.	Apply
CO3: Determine the Fourier series of periodic functions and solve finite difference equations using Z-transforms.	Apply
CO4: Develop programs using calculus and transforms concepts through modern tool.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	-	-	-	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & sons, 2010.

T2. B.S.Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers, 2015.

Reference Book(s):

R1. Veerarajan T., Engineering Mathematics for first year, 3rd edition, Tata McGraw-Hill, New Delhi, 2019.

R2. Srimanta Pal & Subodh C. Bhunia. “Engineering Mathematics”, 1st Edition, Oxford University Press, 2015.

R3. P. Sivaramakrishna Das , C. Vijayakumari , Engineering Mathematics, Pearson India, 2017.

Web References:

1. https://nptel.ac.in/courses/111104092
2. https://www.classcentral.com/course/differential-equations-engineers-13258

Course Code: 23PHT001		Course Title: Physics for Information Sciences (Common to AD, AM, CS, IT & SC)	
Course Category: Minor		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives:

The course is intended to impart the knowledge on working mechanism of laser, fiber optics, display devices and introduce the concepts of integrated circuits, nanotechnology and quantum computing

Module I **22 Hours**

Laser: Characteristics of laser light- Einstein's theory of matter and radiation – A & B Coefficients- Stimulated and spontaneous emission of radiation - Population inversion and pumping methods – Types of laser: Nd: YAG laser and Carbon di oxide (CO_2) molecular gas laser - Semiconductor laser (Homo junction and hetero junction) – Applications: Hologram and Holographic data storage (record/read).

Fiber Optics: Optical fibers – Principle of light propagation through optical fibers - Expressions for numerical aperture and acceptance angle - Types of optical fibers based on material, refractive index, and mode of propagation- Fabrication of optical fiber: Double crucible method- Dispersion and attenuation in optical fiber - Photo detectors: PN, PIN & Avalanche photo diodes- Fiber optic communication system and its advantages.

Nano Technology: Introduction – Importance of Nanotechnology – Nanomaterials – Nanoparticles – Synthesis of Nanoparticles: High-energy ball milling (top-down approach) – Sol-gel process (bottom-up approach) – Application of Nanomaterials.

Module II **23 Hours**

Quantum Computing: Introduction to Quantum Computing - Uses and Benefits of Quantum Computing - Features of Quantum Computing : Superposition, Entanglement, Decoherence - Limitations of Quantum Computing – Comparison of Quantum Computer with Classical Computer - Quantum Computers In Development : Google, IBM, Microsoft and others.

Integrated Circuits: Introduction to semiconductors: Intrinsic and extrinsic semiconductors- Advantages of Integrated circuits (ICs) over discrete components- IC classification- Construction of bipolar transistor: Silicon Wafer Preparation - Epitaxial growth - Oxidation- Photolithography- Isolation diffusion - Base diffusion - Emitter diffusion - Contact mask- Aluminium metallization – Passivation- Structures of integrated PNP transistor.

Display Devices: Human vision - Red, Blue, and Green (RGB) color scheme – Primary and secondary colors- Color addition and subtraction-Optical Emissions: Luminescence, photoluminescence, cathodoluminescence- electroluminescence -Injection electro Luminescence- Displays (Working principles): Plasma display, LED display, Liquid crystal display (LCD) and Numeric display.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply the basic concepts of laser, fiber optics and nanotechnology to solve different optical parameters.	Apply
CO2: Perform as a member of team in analysing the concepts of laser, fiber optics and nanotechnology involved in engineering applications related to science and technology and make a presentation.	Apply
CO3: Interpret the concepts of nanomaterials, IC fabrication techniques and display devices and apply it for different real-life applications.	Apply
CO4: Perform as a member of team in articulating the modern technologies behind nanotechnology, integrated circuits and display devices.	Apply

Course Articulation Matrix

CO Vs PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	-		-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	1	3	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	1	3	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. M. N. Avadhanulu and P. G. Kshirsagar, “Text Book of Engineering Physics”, S. Chand & Company Ltd., New Delhi, 2018.

T2. David Armitage, “Introduction to Micro displays”, John Wiley & Ltd, 2006.

T3. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd, 3rd Edition, 2010

Reference Book(s):

R1. D. Halliday., R. Resnick and J. Walker, “Fundamentals of Physics”, Wiley Publications, 10th Edition, 2014.

R2. Ajoy Ghatak, “Optics”, Tata McGraw-Hill Education, New Delhi, 5th Edition, 2012.

R3. A. Marikani, “Engineering Physics”, PHI Learning, New Delhi, 2nd Edition, 2014.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_ph32/preview
2. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
3. https://www.investopedia.com/terms/q/quantum-computing.asp

Course Code: 23ITT201		Course Title: Data Structures (Common to AD,AM CS,IT &SC)	
Course Category: Major		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objectives:

The objective of the course is to impart knowledge of fundamental data structures and how they are implemented. Additionally, learn how to apply the right data structures for solving problems.

Module I **22 Hours**

Linked List: Introduction- Types of Data Structures- Abstract Data type

List ADT: Array Implementation of list - Linked List Implementation list – Doubly Linked List – Circularly Linked List-Applications: Radix sort.
Stack ADT: Stack Model – Array and Linked List Implementation of Stack - Applications: Balancing Symbols - Postfix Expressions- Infix to Postfix Conversion
Queue ADT: Queue Model – Array and Linked List Implementation of Queue-Double ended Queue- Applications of Queue
Trees: Implementation of Trees - Tree Traversals -Binary Trees: Implementation – Expression Trees – Binary Search Tree: Implementation

Module II **23 Hours**

AVL Trees: Implementation -Single Rotation – Double Rotation.

Binary Heap: Min Heap-Max Heap

Graphs: Definitions – Representation of Graphs – Graph Traversals: Breadth First Search – Depth First Search -Topological Sort
Shortest Path Algorithms: Unweighted Shortest Paths -Dijkstra's Algorithm – Critical Path

All Pairs Shortest Path: Floyds Algorithm

Minimum Spanning Tree: Prim's Algorithm – Krushkal's Algorithm.
Internal Sorting:-Insertion Short-Shell Sort-Merge Sort-Quick sort
External sorting: Simple Algorithm-Multiway Merge
Hashing: Hash Functions-Separate Chaining-Open Addressing-Rehashing-Extendible hashing

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Implement principles of Data Structures that efficiently manage dynamic collections of data in real-world applications.	Apply
CO2: Categorize the linear data structures list, stack and queue to various applications	Analyze
CO3: Relate the nonlinear data structures trees and graph concepts to various applications	Analyze
CO4: Interpret various internal and external sorting techniques to solve real world problems across different domain	Apply
CO5 : Analyze different hash function properties for efficient data storage and retrieval systems	Analyze
CO6: Develop solutions with ethical standards as a team to the practical problems using Data Structures Concepts	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-			-	-	-	-		-	-	-	-
CO5	-	-	-	-	2	-	-	-	-	-	-	-	-	-
CO6	-	-	3	2	-	-	-	-	-		3	3	3	3

High-3; Medium-2;Low-1

Text Book(s):

T1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson Education Asia, New Delhi, 2015.

Reference Book(s):

R1. Sahni Horowitz , “Fundamentals of Data Structures in C”, 2nd Edition Tata McGraw-Hill, New Delhi, 2008.

R2. Seymour “Lipschutz, Data Structures with C”, McGraw Hill, 2014.

R3. Thomas H Cormen, Charles E Leiserson, Ronald L Revest, Clifford Stein, “Introduction to Algorithms” 3rd ed., The MIT Press Cambridge, 2014

Web References:

1. https://www.coursera.org/specializations/data-structures-algorithms
2. https://archive.nptel.ac.in/courses/106/106/106106127/
3. http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithms

Course Code: 23EEI201		Course Title: Digital System Design (common to AD,AM,CS,IT and SC)	
Course Category: Multidisciplinary		Course Level: Introductory	
L:T:P(Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on basics of logic gates, number system and different types of implementation of digital circuits with its simplification methods. Also course describes the analysis of synchronous and asynchronous sequential circuit. At the end of the course the basics in design of computer system is discussed.

Module I **15 Hours**

Number System Representation and Conversion - Logic Gates, Universal Gates - Boolean Algebra and Simplification Techniques: SOP – POS and Karnaugh Map Methods for Boolean Expression Simplification. Implementation of Combinational Logic - Arithmetic Circuits: Full Adder – Full Subtraction - Magnitude Comparator – Multiplexer – De-Multiplexer – Encoder and Decoder.

Module II **15 Hours**

Flip-Flop: RS - JK – T and D – Types of Triggering. Analysis of synchronous sequential circuit - Shift Register. Analysis of asynchronous sequential circuit – Hazards – Static, Dynamic and Essential Hazards

Computer System – Computer Memory - Random Access Memory - Read Only Memory - Expanding Memory Capacity –Secondary Storage -Input / Output Devices.

List of Experiments **30 Hours**

1. Verification of Boolean theorems using digital logic gates
2. Implementation of combinational circuits using basic gates
3. Logic verification of half adder and full adder
4. Logic verification of Multiplexer / De-Multiplexer
5. Logic verification of 4 bit shift register
6. Logic verification of 3 bit binary counter

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Understand the numbers system representation, operation of logic gates and design of computer system	Understand
CO2: Apply the fundamental concepts of Boolean algebra in simplification of digital circuits	Apply
CO3: Design and implement the arithmetic circuits using combinational logic circuits.	Create
CO4: Analyze the sequential logic circuit and infer the results.	Analyze
CO5: Analyze and interpret the digital circuits by performing hardware implementations and report the inference as a team or individual.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	3	-	-	-	-	1	1	-	-	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. M. Morris Mano, "Digital Logic and Computer Design", 1st Edition, Pearson Publication, New Delhi, 2016.

T2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", 6th Edition, McGraw-Hill, 2011.

Reference Book(s):

R1. Anil K. Maini, "Digital Electronics Principles, Devices and Applications", John Wiley & Sons,1st Edition, 2007.

R2. Charles H.Roth, Jr. "Fundamentals of Logic Design", 7th Edition, Jaico publishing House, New Delhi, 2014.

R3. S.Salivahanan and S. Arivazhagan, Digital Circuits and Design, Oxford University Press, 5th Edition, 2018.

R4. Leach P Donald, Albert Paul Malvino and Goutam Saha, "Digital Principles and Applications", 7th Edition, Mcgraw Hill, 2010.

Web References:

1. http://www.nptel.ac.in/courses/ 108105132
2. https://de-iitr.vlabs.ac.in
3. https://nptel.ac.in/courses/117105080

Course Code: 23PHL001		Course Title: Physics for Information Sciences Laboratory (Common to AD, AM, CS, IT & SC)	
Course Category: Minor		Course Level: Introductory	
L:T:P (Hours/Week) 0:0:3	Credits: 1.5	Total Contact Hours: 45	Max Marks: 100

Course Objectives:

The course is intended to expose the students to various experimental skills which are very essential for an Engineering student.

List of Experiments (Any ten):

1. Determination of wavelength of the Laser using plane transmission grating.
2. Estimation of particle size of fine lycopodium powder using laser.
3. Measurement of acceptance angle and numerical aperture of an optical fiber – Laser diffraction method.
4. Determination of band gap of semiconducting materials – Thermistor (Germanium).
5. Light Illumination characteristics of Light dependent resistor (LDR).
6. Measurement of thickness of thin material – Air wedge method.
7. Determination of wavelength of the spect ral lines of mercury spectrum using grating.
8. I-V characteristics of solar cell.
9. I-V characteristics of photo diode.
10. Verification of truth tables of logic gates.
11. Design of logic gates using discrete components.
12. I-V characteristics of LED.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Elucidate the basic principles involved in the given experiments	Understand
CO2: Conduct, analyze and interpret the data and results from physics experiment	Evaluate

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	3	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Reference Book(s):

R1. Physics Laboratory Manual Prepared by Faculty of Physics, Dr. Mahalingam College of Engineering and Technology.

R2. Engineering Physics Laboratory Manual, Dr. R. Jayaraman, V. Umadevi, S. Maruthamuthu, B. Saravanakumar, Pearson India Education Services Pvt. Ltd, 2022.

R3. B.Sc., Practical Physics, C.L. Arora, S. Chand and Co, 2012.

Web References:

1. https://bop-iitk.vlabs.ac.in/List%20of%20experiments.html
2. https://vlab.amrita.edu/index.php?sub=1&brch=281
3. https://vlab.amrita.edu/index.php?sub=1&brch=189

Course Code: 23ITL201	Course Title: Data Structures Laboratory (Common to AD,AM,CS,IT & SC)		
Course Category: SEC		Course Level: Introductory	
L:T:P(Hours/Week) 0:0:3	Credits:1.5	Total Contact Hours:45	Max Marks:100

Course Objectives:

The objective of the course is to improve student's abilities to create and analyze basic linear and nonlinear data structures. It improves students' capacity to pick and use the ideal data

List of Experiments:

1. Array based implementation of List ADT
2. Array based implementation of Stack ADT and Queue ADT
3. Linked list implementation of List ADT
4. Linked list implementation of Stack ADT and Queue ADT
5. Implementation of Binary Tree traversals
6. Implementation of Binary Search Tree
7. Implementation of Graph traversals
8. Implementation of Floyds Algorithms
9. Implementation of insertion sort
10. Implementation of Quick sort

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO1: Implement linear data structure operations using C programs	Apply
CO2: Predict the solution using non-linear data structure data structures using C programs	Evaluate
CO3 : Evaluate the efficiency of sorting algorithms using relevant data structures	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	2	-	-	-	-	-	-	-	3	-
CO2	-	2	-	3	3	-	-	-	-	-	-	-	-	2
CO3	-	-	2	3	3	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	2	-	-	-	-	-	-	-	3	-

High-3; Medium-2; Low-1

Reference Book(s):

R1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson Education Asia, New Delhi, 2015.

R2. Sahni Horowitz , “Fundamentals of Data Structures in C”, 2nd Edition Tata McGraw-Hill, New Delhi, 2008.

Web References:

1. https://www.coursera.org/specializations/data-structures-algorithms
2. https://archive.nptel.ac.in/courses/106/106/106106127/

Course Code:23CSL201		Course Title: IT Practices Laboratory (common to AD,AM,CS,IT&SC)	
Course Category: SEC		Course Level: Introductory	
L:T:P (Hours/Week) 0:0:4	Credits: 2	Total Contact Hours: 60	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on developing web and mobile applications.

List of Experiments: **60 Hours**

1. Study of Peripheral Devices and PC Hardware.
2. Study of different communication protocols
   - USB
   - HDMI
   - WIFI
   - Bluetooth
3. Develop a web page with image, text, links, tables, Menus, Navigations bars, containers and Media.
4. Construct a web page to display resume.
5. Construct a web page to display the products of a company.
6. Create an application using GUI widgets, Layouts, Media and Event handlers.
7. Develop a calculator application to perform all arithmetic operations.
8. Construct an application to calculate BMI.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Identify the components of PC hardware.	Understand
CO2: Design and develop websites, mobile applications for the given scenario using open source tools.	Apply
CO3: Optimize web application performance by considering factors such as page load times, resource usage, and caching mechanisms.	Apply
CO4: Demonstrate the developed web and mobile applications with an oral presentation.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	3	-	-	-	-	-	-	-	3	-
CO3	-	1	-	-	-	-	2	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	3	3	1	1	-	-

High-3; Medium-2; Low-1

Reference(s):
R1. Peter Abel, Niyaz Nizamuddin, “IBM PC Assembly Language and Programming”, Pearson Education, 2007.
R2. Harvey M. Deitel, Paul J. Deitel,“Internet and World Wide Web – How to Program”, 4th Edition ,Pearson Education Asia, 2009.
R3. David Wolber, Hal Abelson, Ellen Spertus, Liz Looney, “App Inventor 2: Create Your Own Android Apps”, 2nd Edition, O'Reilly Media, 2014.

Web References:

1. Open Element Tool: https://www.openelement.uk/index.htm
2. MIT App Inventor Tutorials: https://appinventor.mit.edu/explore/ai2/tutorials

Course Code: 23ESL201		Course Title: Professional Skills 1:Problem solving skills & Logical Thinking 1 (Common to all B.E/B.Tech Programmes)	
Course Category: SEC		Course Level: Introductory	
L:T:P(Hours/Week) 0: 0: 2	Credits: 1	Total Contact Hours:30	Max Marks:100

Course Objectives:

To enhance the students' numerical, analytical and logical reasoning ability.

To make them prepare for various public and private sector exams and placement drives.

Module I Quantitative Ability 20

Number System and LCM & HCF- Percentage- Ratio and Proportion - Average- Progressions- Ages-Partnership- Mixture & Allegation - Profit and loss- Interest calculation- Data interpretation.

Module II Reasoning Ability 10

Seating Arrangement- Linear, circular and Complex – Direction Problems- Blood Relation- Puzzles- Crypt arithmetic- Venn diagrams- Statement and conclusion- Statement and argument- Causes and effects- Self-Learning.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Build the competence in numerical, analytical and logical reasoning ability	**Apply**

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-

High-3; Medium-2; Low-1

Textbook(s):

T1: Dr. R. S. Aggarwal. “Quantitative Aptitude for Competitive Examinations” Sultan Chand & Sons Pvt. Ltd, New Delhi, 2018.

T2: Dr. R. S. Aggarwal. “A Modern Approach to Logical Reasoning”, Sultan Chand & Sons Pvt. Ltd, New Delhi, 2018.

Reference Book(s):

R1: R. V. Praveen. “Quantitative Aptitude and Reasoning” 2nd Revised Edition, Prentice-Hall of India Pvt.Ltd, 2013.

R2: Arun Sharma. “Quantitative Aptitude for Common Aptitude Test”, McGraw Hill Publications, 5th Edition, 2020.

R3: Arun Sharma. “Logical Reasoning for Common Aptitude Test”, McGraw Hill Publications, 6th Edition, 2021.

Web References:

1. https://www.indiabix.com/aptitude/questions-and-answers/
2. https://www.geeksforgeeks.org/aptitude-questions-and-answers/

Course Code: 23VAT201	Course Title: TAMILS AND TECHNOLOGY (Common to all B.E/B.Tech Programmes)		
Course Category: VAC		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:100

Pre–requisites

- NIL

Course Objectives

The course is intended to:

1. Understand Weaving and Ceramic Technology, Design and Construction Technology, Manufacturing Technology, Agriculture and Irrigation Technology.
2. Understand the Scientific Tamil & Tamil Computing.

TAMILS AND TECHNOLOGY

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

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

UNIT III MANUFACTURING TECHNOLOGY 3

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

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL : 15 PERIODS

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO.1 Understand Weaving and Ceramic Technology, Design and Construction Technology, Manufacturing Technology, Agriculture and Irrigation Technology.	Understand
CO.2 Understand the Scientific Tamil & Tamil Computing.	Understand

Course Articulation Matrix

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)

3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code: 23VAT201	Course Title: TAMILS AND TECHNOLOGY (Common to all B.E/B.Tech Programmes)		
Course Category: VAC		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:100

Pre–requisites

- NIL

Course Objectives

மாணவர்கள் இப்பாடத்தை கற்றலின் மூலம்

CO.1 நெசவு மற்றும் பானைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம், உற்பத்தித் தொழில்நுட்பம், வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் ஆகியன குறித்து அறிந்து கொள்ள இயலும்.

CO.2 அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் குறித்து அறிந்து கொள்ள இயலும்.

தமிழரும் தொழில்நுட்பமும்

அலகு 1 – நெசவு மற்றும் பானைத் தொழில்நுட்பம் 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்

அலகு 2 – வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

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

அலகு 3 – உற்பத்தித் தொழில்நுட்பம் 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத் துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு 4 வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன் வளம் – முத்து மற்றும் முத்துக் குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு 5 – அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் 3

அறிவியல் தமிழின் வளர்ச்சி – கணினித் தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின் பதிப்பு செய்தல் – தமிழ் மென் பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக் கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

Course Outcomes மாணவர்கள் இப்பாடத்தை கற்றபின்	**Cognitive Level**
CO.1 நெசவு மற்றும் பானைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம், உற்பத்தித் தொழில்நுட்பம், வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் ஆகியன குறித்து அறிந்து கொள்வார்கள்.	அறிதல் (Understand)
CO.2 அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் குறித்து அறிந்து கொள்வார்கள்.	அறிதல் (Understand)

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)

3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

SEMESTER III

Course Code: 23MAT305		Course Title: Discrete Mathematics (Common to AM,CS,IT&SC)	
Course Category: Minor		Course Level: Intermediate	
L:T:P(Hours/Week) : 3 1 0	Credits: 4	Total Contact Hours: 60	Max Marks: 100

Course Objectives:

The objective of the course is to equip engineering students with the mathematical tools and reasoning skills needed for effective problem-solving and analytical thinking in their respective fields.

Module I **27 + 9 Hours**

Logic: Propositions- Logical operators – Logical equivalences and implications - Normal forms – Rules of inference - Consistency and inconsistency - Theory of Inference – Proofs – Predicates – Quantifiers - Universe of discourse – Validity of arguments.

Relations and Functions: Relations – Types of relations – Properties of relations - Equivalence relations – Relational matrix - Graph of relations – Partial ordering relation - Poset – Hasse Diagram. Functions - Type of functions: Injective, surjective and bijective functions – Composition of functions – Inverse functions.

Combinatorics: Mathematical induction - Basics of counting – Pigeon hole principle – Permutations with and without repetition – Circular permutation – Combinations - Recurrence relations - Solution of linear recurrence relations.

Module II **18 + 6 Hours**

Algebraic Structures: Algebraic Systems – properties – Semi groups and monoids – Groups - Sub groups- Homomorphism – Abelian group – Cyclic group – Normal subgroup and Cosets – Lagrange‟s theorem – Codes and Group codes.

Divisibility and Congruence: Division Algorithm – Prime and Composite Numbers – Fundamental theorem of Arithmetic - Euclidean algorithm - GCD and LCM – Congruence – Linear congruence – Chinese Remainder Theorem.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply propositional and predicate logic to solve engineering problems, demonstrating logical reasoning skills.	Apply
CO2: Apply the concepts of sets, relations and functions in discrete structures.	Apply
CO3: Solve problems using combinatorial techniques, such as counting principles, permutations, and combinations, in the context of algorithm design and analysis.	Apply
CO4: Apply the concepts of groups and its properties to algebraic structures. Also compute GCD using Euclidean algorithm and solve system of linear congruence equations using Chinese Remainder Theorem.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. J.P.Tremblay, R. Manohar, "Discrete Mathematical Structures with applications to Computer Science", TMH International Edition, July 2017.

T2. T.Veerarajan, "Discrete Mathematical Structures with Graph Theory and Combinatorics", Tata McGraw-Hill Education Private Limited, New Delhi, July 2017.

Reference Book(s):

R1. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", 7th Edition, Tata McGraw-Hill Pub. Co. Ltd., New Delhi, July 2017.

R2. Ralph P Grimaldi, Ramana. B. V, "Discrete and Combinatorial Mathematics", 5th Edition, Pearson Education India, 2011.

Web References:

1. NPTEL Course on Discrete Mathematical Structures: http://nptel.ac.in/courses/106106094
2. NPTEL Course on Discrete Mathematics: https://nptel.ac.in/courses/111/104/111104026/

Course Code:23CST301		Course Title: Design and Analysis of Algorithms (Common to AD & CS)	
Course Category: Major		Course Level: Intermediate	
L: T: P(Hours/Week) 3: 1: 0	Credits: 4	Total Contact Hours: 60	Max Marks: 100

Course Objective:

The objective of the course is to impart knowledge on fundamental strategies of algorithm design and how to analyze the efficiency of the algorithm.

Module I **23 + 7 Hours**

Analysis of Algorithm Efficiency: Algorithm – Fundamentals of Algorithmic Problem Solving – Problem types - Algorithm Analysis Framework - Asymptotic Notations - Basic efficiency classes – Mathematical Analysis of non-recursive algorithms - Mathematical Analysis of recursive algorithms - Empirical Analysis of algorithms.

Brute force Technique: Exhaustive Search - String matching: naïve approach – Searching: Linear Search algorithm – Sorting: Bubble sort algorithm - Matrix multiplication - Closest pair problem.

Divide and Conquer Technique: String matching: KMP approach - Searching: Binary Search – Sorting: Quick sort algorithm – Strassens Matrix multiplication – Closest pair problem.

Module II **22 + 8 Hours**

Limitations of Algorithm Power: P, NP and NP Complete problems.

Greedy Technique: Container Loading - Knapsack Problem - Job Sequencing with Deadlines - Huffman Tree.

Dynamic Programming Technique: Binomial Coefficient - Warshall‟s algorithm - Multistage Graph – String Edit Distance.

Backtracking Technique: n-Queens problem - Hamiltonian Circuit - Subset-sum problem - Graph colouring.

Branch and Bound Technique: Assignment problem - Knapsack problem - Travelling salesman problem.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Solve real world problems by using various algorithmic design techniques to find optimal solution	Apply
CO2: Estimate the complexity of algorithms using algorithmic analysis	Analyze
CO3: Compare and contrast the working of various design techniques and choose the suitable technique for problem solving	Evaluate
CO4: Involve in independent learning for finding solutions to real world applications by working individually or as a team.	Apply

Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	1	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	2	-	-	2	1	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Anany Levitin, "Introduction to the Design & Analysis of Algorithms", 3rd Edition, Pearson Education, 2017.

T2. Sartaj Sahni, "Data Structures, Algorithms, And Applications in Java", 2nd Edition, Universities Press (India) Pvt. Limited, 2005.

Reference Book(s):

R1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 4th Edition, MIT Press, 2022.

R2. S.Sridhar, "Design and Analysis of Algorithms", 2nd Edition, Oxford University Press, 2023.

Web References:

1. NPTEL course on Design and analysis of algorithms - https://archive.nptel.ac.in/courses/106/106/106106131/
2. Coursera course on Analysis of Algorithms - https://www.coursera.org/learn/analysis-of-algorithms?action=enroll
3. Udemy course on Introduction to Algorithmic Design and Analysis - Learn The Art of Computer Programming - https://www.udemy.com/course/introduction-to-algorithmic-design-and-analysis/

Course Code: 23CST302		Course Title: Computer Architecture (Common to AD & CS)	
Course Category: Minor		Course Level: Intermediate	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives:

The course is intended to impart knowledge on memory organization, addressing modes of a processor, the organization of cache memory and pipelining techniques for the design of high speed processor.

Module I **22 Hours**

Basic Structure of Computers: Evolution of Microprocessor - Basic Processor Architecture - Operational concepts -Performance.

Instruction Set Architecture: Memory location - Memory Operations – Instructions and sequencing - Addressing modes - CISC Vs RISC.

Basic Input/Output, Processing Unit : Accessing I/O devices - Interrupts -Buses - Instruction Execution-DMA-Hardware Components – Instruction Fetch and Execution Steps – Control Signals-Hardwired Control - CISC Style Processors: Interconnect using Buses, Micro programmed Control.

Module II **23 Hours**

The Memory System: Characteristics of Memory Systems - Cache Memory Principles - Elements of Cache Design - Mapping Function - Example of Mapping Techniques - Replacement Algorithms - Performance Consideration.

Pipelining : Basic concept - Pipeline Organization and issues - Data Dependencies – Memory Delays – Branch Delays – Resource Limitations - Performance Evaluation - Superscalar operation -Pipelining in CISC Processors - Instruction Level Parallelism – Parallel Processing Challenges – Flynn"s Classification – Hardware multithreading – Multicore Processors: GPU, Multiprocessor Network Topologies.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Compare different instruction set architectures and identify their implications on system performance.	Apply
CO 2: Analyze various design elements to determine suitable memory organization for optimized performance.	Analyze
CO 3: Apply principles of pipelining and instruction-level parallelism to enhance processor performance.	Apply
CO 4: Engage in independent learning to deliver an oral presentation on emerging computer architectures and their applications.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-		-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-			-	2	2	-	2	2	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Carl Hamacher, Zvonok Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", 6th Edition, McGraw Hill, 2012.

T2. David A. Patterson and John L. Hennessey, "Computer Organization and Design: The Hardware/Software Interface", 5th Edition, Elsevier, 2014.

Reference Book(s):

R1. William Stallings, "Computer Organization and Architecture: Designing for Performance", 10th Edition, Pearson Education, 2016.

R2. John L. Hennessey and David A. Patterson, "Computer Architecture: A Quantitative Approach", 5th Edition, Elsevier, 2012.

Web References:

1. Computer Architecture –Coursera: https://www.coursera.org/lecture/comparch/course-introduction-Ouq7L
2. Computer System Architecture-MIT Open Courseware Notes: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-823-computer-system-architecture-fall-2005/index.html
3. Computer Architecture: NPTEL Course : http://www.nptel.ac.in/courses/106102062/

Course Code: 23CSI301		Course Title: Database Systems (Common to AD & CS)	
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week) 3:0:2	Credits:4	Total Contact Hours: 75	Max Marks: 100

Course Objective:

The course is intended to impart knowledge on database fundamentals, develop skills in designing databases and apply SQL for database manipulation.

Module I **22 Hours**

Foundations of DBMS: File System versus Database approach - Database applications - View of Data - Database Languages (DDL, DCL, DML, TCL) - Database Design - Data storage and querying - Architecture -Database Users and Administrators.

Relational Model: Terminology – Structure of Relational Database – Keys – Integrity Constraints - Schema Diagrams - Relational operations.**ER Modeling:** Design Process - Entity Types – Relationship Types – Attributes – Structural Constraints – Reduction to Relational Schemas - Design Issues.

SQL Data Manipulation: Overview of Query Language - Data Types - Data Definition - SQL Queries – Aggregate functions – Nested Queries – Joins – Views – Integrity Constraints - Authorization.

Advanced SQL: SQL Programming Language - Functions and procedures - Cursors - Triggers - Accessing SQL from a Programming Language - SQL vs NoSQL.

Module II **23 Hours**

Normalization: Purpose - Data Redundancy and Update Anomalies - Functional Dependencies - Normalization Process - 1NF, 2NF, 3NF, BCNF.

Data Storage: Storage Media - RAID - Database Buffer - Indexing and Hashing.

Query Processing: Query Decomposition - Cost Estimation - Query Optimization.

Transaction and Concurrency Control: Transaction properties - Locking methods - Deadlock - Timestamp Methods - Validation Protocols - Consistency - Granularity.

Recovery System: Failure Classification - Recovery facilities - Recovery Techniques.

Introduction to Advanced Database concepts: Document database - Graph QL - Database Optimization.

List of Experiments: **30 Hours**

1. Design databases using ER modeling.
2. Create and modify database tables using DDL commands and manipulate table data using DML commands.
3. Implement Joins and nesting concept for complex queries.
4. Implement Functions and procedures using advanced SQL.
5. Create Cursors and Triggers using SQL programming.
6. Access database through JDBC connectivity

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Design ER models using various constructs to simulate the real world databases.	Apply
CO2: Formulate structured and optimized queries to manipulate databases.	Apply
CO3: Investigate the dependencies in a database and normalize to appropriate level.	Analyze
CO4: Compare and contrast the various locking facilities to perform concurrent transactions on databases.	Evaluate
CO5: Analyze the various database functionalities as an individual or team for real world applications.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	2	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	3	1	-	-	2	2	-	-	3	-

High-3; Medium-2; Low-1

Text Book(s):

T1. A Silberschatz, H Korth, S Sudarshan, “Database System Concepts”, 7th Edition, McGraw- Hill, 2019.

T2. Thomas Connolly, Carolyn Begg, “Database Systems: A Practical Approach to Design, Implementation and Management”, 6th Edition, Pearson Education, 2015.

Reference Book(s):

R1. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, 7th Edition, Pearson Education, 2017.

R2. C.J. Date, A. Kannan and S. Swamynathan, “An Introduction to “Database Systems”, 8th Edition, Pearson Education, 2006.

Web References:

1. Introduction to Database Systems:
   http://www.inf.unibz.it/~nutt/IDBs1011/idbs-slides.html
2. NPTEL lecture videos and notes:
   https://onlinecourses.nptel.ac.in/noc23_cs79/
3. SQL practice exercises with solutions:

Course Code: 23CST303		Course Title: Java Programming	
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week) 3:0:0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives:

The course is intended to impart knowledge on the principles of Object Oriented Programming using Java. The course intends to provide in-depth knowledge on various concepts of Java programming to develop stand-alone applications.

Module I **23 Hours**

Principles of Object Oriented Programming and Java – Data types – Operators – Control flow.

Classes and Objects – Constructors – Access Specifiers – Static members – Inheritance and types – Method overloading and overriding – Nested and Inner class – Abstract classes and Abstract Methods – Final keyword.

Packages – Interfaces – Exception fundamentals and types – User defined Exceptions – Thread – Creating threads – Synchronization – Inter-thread communication.

Module II **22 Hours**

String Handling – String and String Buffer class and functions – String Tokenizer – Math and Clone functions.

Collections – Collection Interfaces: Set, Queue and List – Collection classes: LinkedList, ArrayList, HashSet and TreeSet – Java I/O classes and interfaces – Streams: DataInput/ OutputStream and Reader/ Writer – File concepts – Reading and Writing Files.

Java Swing – Layout Managers – Event Handling – Swing Components: JLabel, JButton, JTextField, JRadioButton and JTextArea.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply object oriented principles in programming to solve real world problems.	Apply
CO2: Develop lifelong learning ability to provide software solutions for societal issues.	Apply
CO3: Analyze the performance of Java programs and provide optimized solutions using advanced concepts.	Analyze
CO4: Apply appropriate user interface components for an application.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	1	-	-	-	-	-	2	1	-
CO3	-	3	-	-	-	-	1	-	-	-	-	-	1	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-	2	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Herbert Schildt, "Java the Complete Reference", 12th Edition, McGraw-Hill Education, December 2022.

Reference Book(s):

R1. Cay. S. Horstmann, "Core Java – Volume 1: Fundamentals", 12th Edition, Oracle, 2021.

R2. Ken Arnold, James Gosling, David Holmes, Prakash Goteti, "The Java Programming Language", 3rd Edition, Pearson Education, 2000.

Web References:

1. Oracle, Java tutorials, URL: https://www.oracle.com/java/technologies/
2. NPTEL, Course on Programming in Java, URL: https://archive.nptel.ac.in/courses/106/105/106105191/
3. Core Java Tutorial, URL: https://javabeginnerstutorial.com/core-java-tutorial/

Course Code: 23CSL301		Course Title: Java Programming Laboratory	
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week) 0:0:3	Credits: 1.5	Total Contact Hours:45	Max Marks: 100

Course Objective:

The course is intended to impart knowledge on object oriented programming and solving real world problems.

List of Experiments:

1. Develop java programs using operators and control flow statements.
2. Develop java programs to implement Classes, objects and Inheritance.
3. Develop java programs to implement Abstraction and Polymorphism.
4. Develop java programs to implement Packages.
5. Develop java programs to handle Pre-defined and User-defined exceptions.
6. Implement thread synchronization and inter-thread communication.
7. Implement String handling and manipulation functions use Java.
8. Develop java program to solve real world problems using java collection framework.
9. Implement File operations using Java I/O classes and interfaces.
10. Create GUI for the given application using Java Swing components.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop object oriented solutions for solving real world problems	Apply
CO2: Create real-time applications through teamwork and demonstrate with oral presentation.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	1	-	-	1	1	1	-	2	-

High-3; Medium-2; Low-1

Reference Book(s):

R1. Herbert Schildt, “Java the Complete Reference”, 12th Edition, McGraw-Hill Education, December 2022

R2. Kathy Sierra, “Head First Java: A Brain-Friendly Guide”, 3rd Edition, O‟ Reilly Media, June 2022.

R3. Paul J. Deitel, Harvey M. Deitel, “Java How To Program, Late Objects”, 11th Edition, Pearson, 2017.

Web References:

1. Oracle, Java tutorials, URL: https://www.oracle.com/java/technologies/
2. NPTEL, Course on Programming in Java, URL: https://onlinecourses.nptel.ac.in/noc20_cs08/preview
3. Java Online Practice: w3resource, URL: https://www.w3resource.com/java-exercises/

Course Code: 23ESL301		Course Title: Professional Skills 2: Problem solving skills & Logical Thinking 2 (Common to all B.E / B.Tech Programmes)	
Course Category: SEC		Course Level: Introductory	
L:T:P(Hours/Week) 0: 0: 2	Credits: 1	Total Contact Hours:30	Max Marks:100

Course Objectives:

The course is intended to enhance the students‟ numerical, analytical and logical reasoning ability. Also course focus is to make learners prepare for various public and private sector exams and placement drives.

Module I **20 Hours**

Quantitative Ability: Time and work –Pipes and cisterns - Time Speed Distance- Problems on Trains - Boats and Streams - Permutation and Combination - Probability, Mensuration - Heights and distance – Logarithms - Clocks and Calendars – Data Sufficiency

Module II **10 Hours**

Reasoning Ability: Number & Alpha series - Odd man out-Coding and Decoding- Syllogisms - Problems on Cubes and Dices - Logical Venn diagram -Visual Reasoning- Element & logical series -Analogies

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Enhance problem solving skills & Logical thinking Skills	**Apply**

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1: Dr. R. S. Aggarwal. “Quantitative Aptitude for Competitive Examinations” Sultan Chand & Sons Pvt. Ltd, New Delhi, 2018.

T2: Dr. R. S. Aggarwal. “A Modern Approach to Logical Reasoning”, Sultan Chand & Sons Pvt. Ltd, New Delhi, 2018.

Reference Book(s):

R1: R. V. Praveen. “Quantitative Aptitude and Reasoning”, 2nd Revised Edition, Prentice-Hall of India Pvt.Ltd, 2013

R2: Arun Sharma. “Quantitative Aptitude for Common Aptitude Test”, 5th Edition, McGraw Hill Publications, 2020

R3: Arun Sharma. “Logical Reasoning for Common Aptitude Test”, 6th Edition, McGraw Hill Publications, 2021.

Web References:

1. https://www.indiabix.com/aptitude/questions-and-answers/
2. https://www.geeksforgeeks.org/aptitude-questions-and-answers/

Course Code: 23VAT301		Course Title: Universal Human Values 2: Understanding Harmony	
Course Category: VAC		Course Level: Practice	
L:T:P (Hours/Week) 2:1: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objectives

The course is intended to:

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

Unit I Introduction to Value Education 9 Hours

Need for the Value Education; Self -exploration as the process for value education; Continuous Happiness and Prosperity: A look at basic Human Aspirations; Right understanding: Relationship and Physical Facilities; Happiness and Prosperity: current scenario; Method to fulfill the Basic human aspirations

Unit II Harmony in Human Being 9 Hours

Human being as a co-existence of self („I") and the material „Body"; needs of Self ('I') and 'Body'; The Body as an instrument of „I"; Harmony in the self („I"); Harmony of the self („I") with body; Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

Unit III Harmony in the Family and Society 9 Hours

Harmony in the Family the basic unit of human interaction; Values in human to human relationship; Trust as the foundational values of relationship; Respect as the right evaluation ;Understanding harmony in the society (society being an extension of family); Vision for the universal human order.

Unit IV Harmony in the Nature 9 Hours

Understanding the harmony in the Nature Interconnectedness, self-regulation and mutual fulfillment among the four orders of nature; Existence as Co-existence at all levels; Holistic perception of harmony in existence.

Unit V Harmony on Professional Ethics 9 Hours

Natural acceptance of human values; Definitiveness of Ethical Human Conduct; Basic for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics; Case study: holistic technologies, management models and production systems; Strategy for transition towards value-based life and profession.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Reflect on values, aspiration, relationships and hence identify strengths and weaknesses.	Responding
CO2: Appraise physical, mental and social wellbeing of self and practice techniques to promote wellbeing.	Responding
CO3: Value human relationships in family and society and maintain harmonious relationships.	Valuing
CO4: Respect nature and its existence for survival and sustainable of all life forms and hence practice conservation of nature	Valuing
CO5: Appreciate ethical behaviour as a result of value system in personal and professional situations	Receiving

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	1	2	2	-	-	2	-	-
CO2	-	-	-	-	-	1	2	2	2	1	-	2	-	-
CO3	-	-	-	-	-	2	2	2	2	1	-	2	-	-
CO4	-	-	-	-	-	2	2	2	2	-	-	2	-	-
CO5	-	-	-	-	-	1	2	2	2	-	-	2	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. R R Gaur, R Sangal, G P Bagaria, “Human Values and Professional Ethics”, Excel Books, New Delhi, 2010.

Reference Book(s):

R1. Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, “Jeevan Vidya”, Amarkantak, 1999.

R2. A.N. Tripathi, “Human Values”, New Age Intl. Publishers, New Delhi, 2004.

R3. Annie Leonard, “The story of stuff”, Free Press, New York 2010.

Web References:

1. https://aktu.ac.in/hvpe/ResourceVideo.aspx
2. http://hvpenotes.blogspot.com/
3. https://nptel.ac.in/courses/109/104/109104068/

SEMESTER IV

Course Code: 23MAT401		Course Title: Probability and Statistics (Common to AM,AU,CS,EC,EE,IT,ME&SC)	
Course Category: Minor		Course Level: Intermediate	
L:T:P(Hours/Week) 3:1:0	Credits: 4	Total Contact Hours:60	Max Marks:100

Course Objective:

This course aims at helping the students to gain knowledge on random variables, probability distributions and hypothesis testing for data.

Module I **27 + 9 Hours**

Probability and Random Variables :Axioms of Probability- Conditional Probability- Total Probability -Baye‟s Theorem- Random Variables- Probability Mass Function- Probability Density Functions- Properties - Moments- Moment generating functions and their properties.

Standard Distributions: Discrete Distributions - Binomial- Poisson- Properties, Moment generating functions.

Continuous Distributions - Uniform –Exponential- Normal Distributions and their properties.

Two Dimensional Random Variables: Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression using least square method – Transformation of random variables.

Module II **18 + 6 Hours**

Test of Hypotheses: Sampling distributions, Estimation of parameters, Statistical hypothesis, Large sample test based on Normal distribution for single mean and difference of means, Tests based on t, Chi-square and F distributions for mean, variance and proportion, Contingency table (test for independent), Goodness of fit.

Design of Experiments: Analysis of Variance (ANOVA) - One way Classification – Completely Randomized Design (CRD) – Two way Classification – Randomized Block Design (RBD) – Latin square.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Calculate the expected values and variances of random variables.	Apply
CO2: Use the concept of probability distributions to solve real life problems.	Apply
CO3: Compute correlation coefficient and discusses the relationship between two variables.	Apply
CO4: Apply Testing of hypothesis based on samples sizes.	Apply
CO5: Apply the principles of design of experiments and perform analysis of variance.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. Veerarajan T, "Probability, Statistics and Random process", 3rd Edition, Tata McGraw-Hill,New Delhi, 2017.

T2. Dr.J.Ravichandran, "Probability and Statistics for Engineers", Wiley India Pvt. Ltd., 2010.

Reference Book(s):

R1. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineersand Scientists", 9th Edition, Pearson Education, Asia, 2013.

R2. M.R. Spiegel, J. Schiller and R.A. Srinivasan, "Schaum's Outlines Probability and Statistics", 4th Edition, Tata McGraw Hill edition, 2012.

R3. Morris DeGroot, Mark Schervish, "Probability and Statistics", 4th Edition, Pearson Educational Ltd, 2014 India.

Web References:

1. NPTEL Course on Probability and Statistics
   https://archive.nptel.ac.in/courses/111/105/111105090/
2. NPTEL Course on Probability and Statistics

Course Code: 23CSI401		Course Title: Computer Network Technology	
Course Category: Major		Course Level: Intermediate	
L:T:P (Hours/Week) 3:0:2	Credits: 4	Total Contact Hours: 75	Max Marks: 100

Course Objectives:

The course is intended to impart knowledge on network fundamentals and communication protocols. The course also intends to provide exposure on Network layer design issues, routing algorithms, congestion control techniques and application layer protocols with security essentials.

Module I **22 Hours**

Introduction: Data Communications – Topologies – Network Architecture – Socket Implementation.

Link Layer: Encoding: NRZ, NRZ-I, Manchester - Framing: PPP, HDLC - Flow control - Error Control and Error Detection: Internet Checksum and CRC - Multi Access Networks: Ethernet, Wireless LAN, Wi-Fi, Bluetooth.

Network Layer: Internet Protocol – IPV4 – IP Addressing – Subnetting – IPV6 – ICMP – DHCP - Routing Protocols: RIP, OSPF and BGP.

Module II **23 Hours**

Transport Layer: UDP and TCP – TCP Connection Management – Sliding Window Protocol – Congestion Control – Congestion Avoidance Mechanisms: DECbit, RED – Quality of Services.

Application Layer: FTP - Email Protocols - DNS - SNMP - Web Services.

Security Essentials: Fundamentals of Cryptography – HTTPS – Firewalls – Network Security Standards.

List of Experiments **30 Hours**

1. Implementation of TCP/UDP Socket Programming.
2. Implementation of Error Detection Techniques.
3. Simulation of IEEE LAN Topologies.
4. Simulation of Wide area networks with Routing Protocols and Router configuration.
5. Implementation of TCP Congestion Control Algorithms.
6. Implementation of DNS using UDP sockets and SNMP.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the requirements of a given organizational structure and identify appropriate network topologies and protocols.	Analyze
CO2: Deploy network based applications for real time scenarios using socket programming.	Apply
CO3: Design wired and wireless network with suitable IP addressing and routing protocols using Cisco packet tracer simulation tool.	Create
CO4: Implement reliable application layer protocols and security aspects for real time applications through individual/Team work	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	2	-	2	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	2	2	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. James F Kurose, Keith W Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", 8th Edition, Pearson Education, 2022.

T2. Behrouz A Forouzan, "Data Communications and networking with TCP/IP Protocol Suite", 6th Edition, Tata McGraw-Hill Publications, 2022.

Reference Book(s):

R1. Andrew S Tanenbaum, Nick Feamster, David J Wetherall, "Computer Networks", 6th Edition, Pearson Education, 2022

R2. Larry L Peterson and Bruce S Davie, "Computer Networks – A Systems Approach", 6th Edition, Morgan Kaufmann Publications, 2021.

R3. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, 2017.

Web References:

1. NPTEL – Computer Networks and Internet Protocol: http://nptel.ac.in/courses/106105183/
2. NPTEL – Introduction on Computer Networks: http://nptel.ac.in/courses/106106091/
3. NPTEL – Computer Networks: http://nptel.ac.in/courses/106105081/

Course Code: 23CST401		Course Title: Operating Systems	
Course Category: Major		Course Level: Intermediate	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

The course is intended to describe the components of operating systems, solve various process related problems, and find solutions for free space management.

Module I **23 Hours**

Introduction: Computer System Organization – Operating System Operations – Operating Systems Structures: Operating System Services, User and Operating System Interface, System calls.

Processes: Process Concepts: Process Scheduling, Operation on Process, Inter Process Communication.

CPU scheduling: First-Come, First-Served Scheduling, Shortest-Job-First Scheduling, Round-Robin Scheduling, and Priority Scheduling

Process Synchronization: The Critical Section Problem, Peterson‟s Solution, Hardware Support for Synchronization,

Mutex Locks, Semaphores, Monitors – Classical problems of Synchronization.

Deadlock: Deadlock Characterization – Methods for handling Deadlocks: Deadlock Prevention, Avoidance, Detection and Recovery.

Module II **22 Hours**

Main Memory: Contiguous Memory Allocation, Paging, Structure of Page Table, Swapping

Virtual Memory: Demand paging, Copy-on-write, Page Replacement Algorithms, Allocation of Frames, Thrashing.

Mass Storage System: Overview, Disk Scheduling: FCFS, SCAN, C-SCAN scheduling

File System Interface: File Concepts, Access methods, Directory Structure, Protection

File System Implementation: File System Structure and Operations, Directory Implementation, Allocation methods, Free Space Management.

Case Study – Linux: Design Principles – Kernel Modules – Process Management – Scheduling – Memory Management – File Systems – Input and Output – Inter-process Communication – Network Structure – Security

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the different concepts and functionalities of Operating System	Apply
CO2: Analyze various Operating system process strategies and techniques	Analyze
CO3: Implement memory management schemes for a system reflecting various approaches.	Apply
CO4: Demonstrate the various operating systems functionalities in Linux Environment with an oral presentation.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	2	-
CO4	2	-	-	-	-	-	-	-	2	2	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne “Operating System Concepts”, 10th Edition, John Wiley and Sons Inc., 2021.

Reference Book(s):

R1. Andrew S. Tanenbaum, “Modern Operating Systems”, 4th Edition, Pearson Education, 2015.

R2. William Stallings, “Operating Systems Internals and Design Principles”, 9th Edition, Pearson Education, 2018.

Web References:

1. MIT open course on Operating System Engineering: http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-828-operating-system-engineering-fall-2012/
2. Bell‟s Course Notes on Operating Systems Processes: https://www2.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/3_Processes.html
3. NPTEL course on Operating System Fundamentals: https://nptel.ac.in/courses/106/105/106105214/

Course Code: 23EEI401		Course Title: Microcontrollers and IoT	
Course Category: Minor		Course Level: Intermediate	
L:T:P (Hours/Week) 3:0:2	Credits:4	Total Contact Hours: 75	Max Marks: 100

Course Objectives:

The course aims to teach programming the microcontroller‟s boards using Embedded C and connecting peripherals and sensors, building basic IoT applications across a various domains, and implementing IoT LoRaWAN protocols and architecture for IoT communication.

Module I **22 Hours**

Introduction to Microcontroller: Introduction to Microcontroller – Von Neumann and Harvard architecture -RISC vs CISC - PIC18FX Pin connection – File register – I/O ports- Serial port- Analog to digital converter- I/O programming: Data type and Time delay, Logical operations

Interfacing: Arduino Board- pin details, specification - LED and Switch interfacing- LCD interfacing – Keyboard interfacing – Relay and Opto-isolator – Sensor interfacing: Temperature sensor-LM35, DHT11- IR sensor- Ultrasonic Sensor

Module II **23 Hours**

Introduction to IoT : IoT Architecture – Application layer protocol - MQTT, HTTP - Major Components - FOG and Cloud computing

LoRaWAN: IoT wireless protocols - LoRaWAN protocol: Structure of a LoRaWAN network, LoRaWAN end device classes, Activation of LoRaWAN end devices:ABP and OTAA, Pros and cons of ABP and OTAA - LoRaWAN networks and LoRaWAN servers: types of networks, LoRaWAN network configuration - LoRa / LoRaWAN frame: LoRaWAN protocol layers, gateways and network server communication - Exporting data from LoRaWAN server: services provided by the IoT platform, exporting data with the HTTP GET protoco

List of Exercises **30 Hours**

1. Control the LED using switch
2. Control the Lamp using Relay interfacing
3. Interface ultrasonic sensor and display the distance in LCD
4. Interfacing temperature sensor with Edge node
5. Edge node connection to the LoRa Gateway using LoRa network
6. Send the data from the LoRa Gateway network server to web server.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Utilize Embedded C programming skills to implement input/output interfaces on microcontrollers.	Apply
CO2: Analyze the performance and efficiency of microcontroller-based I/O programs through testing and debugging processes.	Analyze
CO3: Analyze the functionalities and communication processes between gateway and network server of LoRaWAN protocol	Analyze
CO4: Estimate different methods of interfacing the temperature sensor with the edge node, considering factors such as sensor accuracy, communication protocols, and power consumption.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	-	-	1	-
CO2	-	3	-	-	3	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	3	3	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Muhammad Ali Mazidi, RolinD.Mckinlay, Danny Causery,"PIC Microcontroller and Embedded systems using assembly and C PIC18", 2nd Edition, Micro Digital Ed, 2016

T2. Charalampos Doukas , "Building Internet of Things with the Arduino", volume1,Create space publishers , April 2012.

Reference Book(s):

R1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.

R2. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.

R3. Pedro Larrañaga, David Atienza, Javier Diaz-Rozo, Alberto Ogbechie, Carlos Esteban Puerto-Santana, Concha Bielza"Industrial Applications of Machine Learning", CRC Press, 2018.

R4.Ravindra Kumar Sharma, LoRA and IoT Networks for Applications in Industry 4.0, Nova Science Publishers Inc,2020

Web References:

1. Introduction to IoT NPTEL Videohttps://www.youtube.com/watch?v=WUYAjxnwjU4
2. https://www.univ-smb.fr/lorawan/wp-content/uploads/2022/01/Book-LoRa-LoRaWAN-and-Internet-of-Things.pdf
3. Connectivity Technologies NPTEL Video: https://www.youtube.com/watch?v=GHUR_GfQQsQ&list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE&index=9

Course Code: 23CST402		Course Title: Data Warehousing and Mining	
Course Category: Major		Course Level: Intermediate	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objectives

The course is intended to describe about various preprocessing techniques, data warehousing and online analytical processing, mining frequent patterns, classification and clustering.

Module I **23 Hours**

Hours

Data Preprocessing: KDD Process – Kinds of knowledge – Applications – Data mining and society – Data types – Date Preprocessing: Cleaning – Integration – Reduction – Transformation and Discretization.

Data Warehousing and Online Analytical Processing:

Data warehouse – Data warehouse modeling: schema and measures – OLAP operations – Data cube computation – Data cube computation methods

Module II **22 Hours**

Pattern Mining: Basic concept – Frequent Itemset Mining Methods: Apriori Algorithm – FP Growth Algorithm – Vertical Data Format – Pattern Mining in Multilevel, Multi-Dimensional Space – Constraint-based Frequent Pattern Mining.

Classification: General Approach to classification – Decision Tree Induction – Bayes Classification – Lazy learners – Linear classifiers – Model Evaluation and Selection – Techniques to improve classification accuracy

Clustering: Cluster Analysis – Partitioning methods – Hierarchical methods – Types of Outliers – Outlier Detection Methods

Course Outcomes	Cognitive Level
At the end of this course – students will be able to:	
CO1: Perform data preprocessing using various techniques for any given dataset.	Apply
CO2: Demonstrate the designed data warehouse model using schemas and operations for any given multidimensional data through oral presentation.	Apply
CO3: Analyze patterns using different types of mining methods for obtaining Interesting relations.	Analyze
CO4: Evaluate the performance of classifier using various classifier evaluation metrics.	Evaluate
CO5: Analyze real-world datasets to generate cluster and detect outliers using various techniques.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	-	-	2	-	-	-	-	-	2	2	-	-	2	-
CO3	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	2	-	-	-	-	-	-	-	-	-	2
CO5	-	2	-	-	-	-	-	-	-	-	-	-	-	2

High-3; Medium-2; Low-1

Text Book(s):

T1.Jiawei Han, Jian Pei, Hanghang Tong, "Data Mining Concepts and Techniques", 4th Edition, Morgan Kaufman, 2022

Reference Book(s):

R1. Alex Berson and Stephen J. Smith "Data Warehousing – Data Mining & OLAP", Tata McGraw-Hill Edition, 13th Reprint 2008

R2. K.P. Soman, ShyamDiwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.

R3.Parteek Bhatia, "Data Mining and Data Warehousing: Principles and Practical Techniques", Cambridge University Press, 2019

Web References:

1. Data Warehouse Concepts: https://www.udemy.com/course/master-datawarehouse-concepts-step-by-step-from-scratch/
2. Data Mining: https://onlinecourses.swayam2.ac.in/cec24_cs12/preview

Course Code: 23CSL401		Course Title: Python Programming Laboratory	
Course Category: SEC		Course Level: Intermediate	
L:T:P(Hours/Week) 1: 0:3	Credits: 2.5	Total Contact Hours: 60	Max Marks: 100

Course Objective:

The course is intended to impart knowledge on python programming constructs, files, libraries, database and GUI programming for developing real time applications.

Module I **8 Hours**

Data Types – Operators - Control statements – List - Tuples- Sets –Dictionary – Strings – Classes and Objects - Inheritance - Polymorphism - Functions - Exception Handling - File Handling

Module II **7 Hours**

Pickled objects - Shelve files - SQL Database interfaces - GUI basics - Working with pandas - numpy – matplotlib - Tkinter

List of Experiments: **45 Hours**

1. Implement data types, operators and expressions.
2. Implementation of branching statements and looping constructs.
3. Implementation of list, set, tuple, dictionary and strings.
4. Implementation of object orientation concepts using functions
5. Implementation of exception handling.
6. Implementation of file handling techniques, pickle and shelve objects.
7. Implement Database Connectivity with SQL Server.
8. Implement programs using Python Standard Libraries (pandas, numpy).
9. Implement programs using Matplotlib.
10. Develop an application using Tkinter.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply programming constructs to provide solutions for real world problems.	Apply
CO2: Analyze any given dataset using python libraries, files and exceptions.	Analyze
CO3: Develop a GUI application using python with ethical standard and Tkinter through teamwork with oral presentation.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	2	-	-	-	-	-	-	-	-
CO2	-	2	-	2	3	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	3	-	-	2	2	2	2	-	3	1

High-3; Medium-2; Low

Reference Book(s):

R1. Peter Wentworth, Jeffrey Elkner, Allen B. Downey, and Chris Meyers, "How to Think Like a Computer Scientist: Learning with Python", 3rd Edition, O"Reilly, 2020.

R2. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 2021.

R3. Guttag, John, "Introduction to Computation and Programming Using Python", MIT Press, 2016.

R4. Mark Lutz, "Learning Python, Powerful OOPs", 5th Edition, O"Reilly, 2013.

R5. Reema Thareja, "Python Programming", Pearson, 2017.

Web References:

1. Official documentation of python 3.10: https://docs.python.org/3/tutorial/
2. Beginner to Advanced Python developer guide: https://www.learnpython.org/
3. Python quick reference guide: https://www.pyschools.com/

Course Code: 23ESL401		Course Title: Professional Skills 3: Professional Development and Etiquette (Common to all B.E/ B.Tech Programmes)	
Course Category: SEC		Course Level: Introductory	
L:T:P(Hours/Week) 0: 0: 2	Credits: 1	Total Contact Hours:30	Max Marks:100

Course Objective:

The course is intended to cultivate students‟ appropriate etiquette across various personal and professional contexts, fostering professionalism and effective communication.

Module I **15 Hours**

Emotional Intelligence: Intrapersonal Skill: Goal Setting- Self-management-Emotional Intelligence: Understanding & Developing EI for Effective Communication and Relationships – Enhancing Social Skills

Professional Development: Introduction to Professional Development - Career State Assessment - Set Career Goals- Stay on Industry Trends - Self & Lifelong learning – Creativity - Problem Solving Skills - Strong Fundamentals – Using/ Creating Opportunities – Work & Life Balancing - Revisiting Goals

Teamness and Interpersonal skills : Paraphrasing: Techniques for Active Listening - Paraphrasing as a Tool for Effective Understanding and Communication – Collaboration and Team Building: Building Trust and Rapport - Self-paced learning.

Module II **15 Hours**

Effective Communication: Effective Verbal Communication - Assertive Communication - Elements of Effective Communication - Barriers to Effective Communication - Persuasion Skills - Effective Presentation: Oral and visual presentation – Drafting formal reports.

Professional Etiquette: Introduction - Types of professional Etiquette- Personal Grooming: Importance of Personal Grooming in Professional Settings- Dress Codes and Professional Appearance Guidelines- Body language - Social – Email – Telephonic – Dining – Classroom - Business.

Activities:

- Emotional Intelligence: Scenario based role play, Debate
- Paraphrasing: Listening, Reading
- Effective Presentation:
    - Oral Presentation: Self-Introduction, JAM , Extempore speech
    - Visual presentation: Email Writing, Power Point Presentation, Vlog
- Professional Etiquette: Demonstrate required Professional Etiquette in all the above activities.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Communicate effectively and exhibit Professional etiquettes in various social forums.	**Apply**

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	2	3	-	1	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Sabina Pillai, Agna Fernandez, “Soft Skills & Employability Skills”, Cambridge University Press, 2018.

T2. Peggy Post &Peter Post, “The Etiquette Advantage in Business: Personal Skills for Professional Success”, 2nd Edition, William Morrow, 2005.

Reference Book(s):

R1. Ashraf Rizvi, "Effective Technical Communication" 2nd Edition, McGraw-Hill India, 2018.

R2. Maithry Shinde, Jyotsna Sreenath, “Life Skills & Personality Development”, Cambridge University Press 2022.

Web References:

1. https://www.indeed.com/career-advice/career-development/etiquette-at-work
2. https://www.skillsyouneed.com/interpersonal-skills.html

SEMESTER V

Course Code: 23CST501		Course Title: Formal Languages and Automata Theory	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3: 1: 0	Credits: 4	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The objective of the Course is to provide a solid understanding of Formal languages, Automata theory and focusses on the design of Finite automata, Pushdown Automata and Turing machines.

Module I **22 + 7 Hours**

Finite Automata: Automata **-** Computability – Complexity – Chomsky Hierarchy of Languages – Finite Automata – Finite Automata for Vending Machine – Non–determinism – Finite Automata with Epsilon Transitions – Equivalence of NFA and DFA – Minimization of DFA**.**

Regular Languages: Regular Grammars – Regular Languages and Operations – Regular Expressions – Equivalence of Finite Automata and Regular Expressions: Thompson Construction – State Elimination Method – Closure Properties of Regular Languages – Pumping lemma for Regular Languages.

Module II **23 + 8 Hours**

Context Free Grammars: Derivations, Parse Tree and Ambiguity – Simplification of Grammars – Normal Forms – CNF – GNF

Pushdown Automata: Language Acceptance of PDA – Applications of PDA – Equivalence of Pushdown Automata and CFG – Closure Properties of Context Free Languages.

Turing Machine: Turing Machine – Language Acceptance – Techniques for Turing Machine Construction – Storage in Finite Control – Subroutine – Checking off Symbols – Multiple Tracks – Variants of Turing Machines – Universal Turing Machine.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply Finite automata model to solve real-time problems.	Apply
CO2: Construct context-free grammars and regular expressions for a variety of languages, demonstrating the ability to identify the appropriate formalism for a given language.	Apply
CO3: Design PDA to recognize the structure of context-free languages for language processing.	Apply
CO4: Analyze various techniques for constructing Turing Machines for performing computational tasks.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	1	-	-	-	-	-	-	2	-
CO2	-	-	3	-	-	-	-	1	-	-	-	-	2	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	1	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	-

High-3; Medium-2; Low-1

Text Book(s):

T1. John E.Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, “Introduction to Automata Theory, Languages and Computation”, 3rd Edition, Pearson Education Publishers, 2015.

T2. Michael Sipser, “Introduction to the Theory of Computation”, 3rd Edition, Cengage Learning, 2020.

Reference Book(s):

R1. Kamala Krithivasan, R. Rama, “Introduction to Formal Languages, Automata Theory and Computation”, Pearson Education, 2016.

R2. K. L. P. Mishra, N. Chandrasekaran, “Theory of Computer Science: Automata,Languages and Computation”, 3rd Edition, PHI, 2023.

Web References:

1. http://www.ics.uci.edu/~goodrich/ teach/cs162/notes/
2. http://nptel.ac.in/courses/106106049/
3. www.jflap.org/

Course Code: 23CSI501		Course Title: Object Oriented Software Engineering	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3: 0: 2	Credits: 4	Total Contact Hours: 75	Max Marks: 100

Course Objectives

The course is intended to impart the knowledge on various object oriented software life cycle models to design and develop functional object oriented software.

Module 1 **22 Hours**

Software Process: Software Process Structure – Software Development Process Models – Agile Development – Understanding Requirements.

Requirements Modeling: Unified Modeling Language – Architecture – Unified Process – Requirements Workflow – Defining Requirements – Use Case Modeling – Actor and Use Case Generalization – Use Case Relationships.

Analysis Modeling: Analysis Workflow – Classes and Objects – Finding Analysis Classes – Relationships Inheritance and Polymorphism

Module 2 **23 Hours**

Analysis Packages – Use Case Realization - Sequence and Collaboration diagrams – Activity Diagrams.

Design Modeling: Design Workflow – Design Classes – Refining Analysis Relationships – Interface and Subsystems – Design Realization – Basic and Advanced State Charts.

Implementation, Testing&Deployment: Implementation Workflow – Components – Software Testing Strategies – Testing Conventional Applications – Testing Object – Oriented Applications – Deployment.

List of Experiments **30 Hours**

1. Develop requirement specification using object-oriented concepts and validate it.
2. Apply Usecase modeling for the given requirement specification.
3. Identify the conceptual classes with its relationships and develop a domain model with UML class diagram.
4. Using the identified scenarios, draw relevant interaction diagram (Activity, Sequence, Collaboration).
5. Using the identified scenarios, draw relevant state diagram.
6. Deploy a fully functional software with data base connectivity.

Suggested case study scenario:

1. Library Management System

2.Ticket Reservation System

3.Online Food Ordering System

4.Payroll Management System

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply a suitable object-oriented software lifecycle model to develop Software.	Apply
CO2: Develop a well-defined software specification and system design by applying the requirement engineering techniques and UML modeling.	Apply
CO3: Develop functional object-oriented software and test it with necessary deployment techniques	Apply

Course Articulation Matrix

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	-	3	-	2	2	-	-	-	1	2	1	-	-	-
CO3	-	-	2	-	2	-	-	1	2	-	-	1	2	-

High-3; Medium-2; Low-1

Text book(s):

T1. Roger. S. Pressman and Bruce R. Maxim, “Software Engineering – A Practitioner’s Approach”, 9th Edition, McGraw Hill, 2020.

T2. Jim Arlow, IIa Neustadt, “UML2 and The Unified Process: Practical Object Oriented Analysis and Design”, Pearson Education, 2016.

Reference Book(s):

R1. Craig Larman, “Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development”, 3rd Edition, Addison Wesley Professional, 2015.

R2. Ian Sommerville, “Software Engineering”, Pearson Education Asia, 9th edition, 2023.

Web References:

1. http://www.mhhe.com/engcs/compsci /pressman/

2. http:/nptel.ac.in/courses/106105153/

Course Code: 23CST502		Course Title: Cyber and Digital Forensics	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on cyber security principles and techniques used to protect digital assets and infrastructures. The course will also cover essential computer forensics methods and practices required to conduct comprehensive cyber investigations

Module I **23 Hours**

Introduction to Cyber Security: Basics of Cyber Security Concepts, Layers of Security, Vulnerability, Threat, Harmful acts, Internet Governance – Challenges and constraints, Computer criminals, CIA Triad, Motive of attackers, active attacks, passive attacks, software attacks, hardware attacks. Cyber Security Issues: Cyber Governance Issues- Cyber User Issues- Cyber Conflict Issues

Cyber Hacking: Nature and Character of Hackers-Types of Hacking, Cracking-Phreaking and Hacking-International Initiatives to Prevent and Control Cyber Hacking- **Cyber Crime:** Cyber Bullying - Cyber Grooming - Online Gaming- Email Fraud - Online Transaction Fraud – Safeguards for Social Networking Profiles- **Cyber Fraud:** Definition-Different Modes of Cyber Fraud-Cyber Fraud in India - Cyber Terrorism: Cyber Terrorism-Pornography-Child Pornography-Web Jacking

Module II **22 Hours**

Scope of Computer Forensics: Forensics Evidence, Investigator Skills - Online Investigations - Photograph Forensics - Network forensics: Advanced Persistent Threats

Incident Response: Process and Framework, Playbook - Digital Forensic: Legal aspects, Digital forensic process - Network Evidence Collection- Network Evidence Analysis - Forensic Reporting

Threat Intelligence: Types, methodology, Direction, Process, Proactive and Reactive threat Intelligence,- **Malware Analysis:** Overview, Static Analysis, Dynamic Analysis- **Integrating Digital forensics:** Incident management and response, Electronic Discovery and Litigation Support Enhancing- **Digital Forensic Capabilities:** Controlling mobile devices, Cloud Computing enablement, Combatting Antiforensics

Case studies: Online gambling, intellectual property crime, financial frauds in cyber domain

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Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Infer fundamental principles of cyber security by identifying and analyzing various types of cyber security threats and risks.	Apply
CO2: Use comprehensive knowledge of cyber fraud and terrorism to analyze and evaluate various forms of cybercrimes.	Analyze
CO3: Apply knowledge to real-world case studies and practical scenarios to developing the skills necessary to handle complex digital forensic investigations effectively.	Apply
CO4: Apply integrated digital forensic methodologies to real-world scenarios, ensuring comprehensive evidence analysis across various digital platforms and systems.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	2	2	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-	-	-	1
CO4	-	-	-	-	3	-	-	-	2	1	-	-	-	2

High-3; Medium-2; Low-1

Text Book(s):

T1. "National Cyber Defence Reference Handbook", Govt. of India, Published by the Additional Director, General Publication Division National Cyber Safety and Security Standards,2018.

T2. "National Cyber Crime Reference Handbook" Govt. of India, Published by the Additional Director, General Publication Division National Cyber Safety and Security Standards, 2019.

T3. Jennifer L. Bayuk, J. Healey, P. Rohmeyer, Marcus Sachs , Jeffrey Schmidt, Joseph Weiss, "Cyber Security Policy Guidebook", John Wiley & Sons, 2017.

Reference Book(s):

R1**.** Nina Godbole & Sunit Belapure, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspective", Wiley publication, 1st edition, 2011.

R2. Gerard Johansen, "Digital Forensics and Incident Response" Packt Publishing Ltd, 2017.

R2. Ministry of Home Affairs, Govt. of India, "A Handbook for Adolescents/Students on Cyber Safety", 2018.

R4. Jason Sachowski "Digital Forensics and Investigations People, Processes, and Technologies to Defend the Enterprise", CRC Press, Taylor & Francis Group, 2018.

Web References:

1. https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview

Course Code: 23CSL501		Course Title: Internet Programming Laboratory	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 1: 0: 3	Credits: 2.5	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart the knowledge to build a static and dynamic real time web pages using client-side and server-side scripting languages such as HTML5, CSS3, XML, JavaScript.

Module I **8 Hours**

HTML: Introduction - Editing HTML - HTML Validation Service - Headings – Linking - Images Special Characters and Horizontal Rules - Lists - Tables - Forms - Internal Linking - Meta Elements. CSS: Introduction - Inline Styles - Embedded Style Sheets - Conflicting Styles - Positioning Elements - Backgrounds - Element Dimensions - Box Model and Text Flow - Media Types - Building a CSS Drop-Down Menu - User Style Sheets

Module II **7 Hours**

Java Script: Introduction - Control Statements - Functions - Arrays - Objects - Events. XML: Namespaces - DTD - Schema - XML Vocabularies - XSLT.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design and develop static web pages using client-side scripting Languages for given application	Apply
CO2: Develop optimized webpages using Java Script and XML for the real time applications	Apply
CO3: Demonstrate the developed web applications with an oral presentation.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	3	-	3	-	-	-	-	-	-	-	3	-
CO2	-	2	-	-	3	-	1	-	-	-	-	-	-	-
CO3	-	-	-	1	-	-	-	-	3	3	1	1	-	-

High-3; Medium-2; Low-1

Reference Book(s):

R1. Harvey Deitel, Paul Deitel, Abbey Deitel “Internet and World Wide Web How To Program”, 5th Edition, Pearson Education Asia, 2019.

R2. Robin Nixon, “Learning PHP, MySQL & JavaScript: A Step-by-Step Guide to Creating Dynamic Websites”, 6th Edition, O'Reilly, 2021.

R3. DT Editorial Services, “HTML 5 Black Book, Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery”, 2nd Edition, Wiley, 2018.

Web References:

1. https://developer.mozilla.org/en-US/docs/Web
2. https://www.geeksforgeeks.org/web-technology/

Course Code: 23CSP501		Course Title: Reverse Engineering Project	
Course Category: EEC		Course Level: Higher	
L:T:P(Hours/Week) 0: 0: 6	Credits: 3	Total Contact Hours: 90	Max Marks: 100

Course Objectives

The course is intended to enable students to systematically Analyze and reverse engineer software and hardware systems by applying engineering principles, solving complex technical problems, adhering to ethical and legal standards, and effectively communicating their findings through detailed reports and presentations.

The assignments in reverse engineering project involves

1. Detailed document summarizing the reverse engineering process, findings, and conclusions.
2. Presentation of the project's findings and results.
3. Practical demonstration of the reverse engineering results.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to	
CO1: Demonstrate the fundamental engineering principles to effectively study and reverse engineer software and hardware systems with an oral presentation.	Apply
CO2: Analyze complex problems related to reverse engineering, including Discovering vulnerabilities and improving legacy systems by following ethical practices and legal guidelines.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	3	3	-	-	3	-
CO2	-	3	-	2	-	-	-	3	-	-	-	1	-	-

High-3; Medium-2; Low-1

Course Code: 23ESL501		**Course Title: Professional Skills 4: Communication Skills and Interview Essentials (Common to all B.E/B.Tech Programmes)**	
Course Category: SEC		**Course Level: Introductory**	
L:T:P(Hours/Week) 0: 0: 2	**Credits: 1**	**Total Contact Hours:30**	**Max Marks:100**

Course Objectives:

The course is intended to equip students with the necessary skills to effectively communicate in various professional settings and excel in the interview process

Module I **15 Hours**

Resume Building & Portfolio Management

Importance of a Strong Resume - Resume Content Development & Core Components – Formatting and Design - Tailoring and Customization – Proofreading - Portfolio Content, design and Structure: Components & Efficient portfolios – Preparing and Maintaining documents for interview – maintaining repositories - Enhancing Personal Brand - Digital Tools and Platforms

Interview - Dress code, Body Language and Grooming

Dress Code Essentials - Body Language – Facial expression, eye contact, gesture, posture, touch behavior & space- Personal Grooming

Module II **15 Hours**

Group Discussion

Introduction & types of Group Discussion – Prerequisites of GD – Techniques and tips of GD - Role of GDs in various professional contexts – GD Etiquettes – Strategies to enhance GD – Mock GD.

Interview Skills

Purpose of an interview - Types of Interviews –Interview Techniques – Interview Etiquette - Planning and Preparation - Mock Interviews with Feedback - Post-Interview Etiquette and Follow-Up

Activities:

Building Portfolio: Resume Building, Updating LinkedIn, Maintaining Repositories.
Effective Presentation:
Oral Presentation: Impromptu speech, Mini Presentation, Picture Perception (Both Speaking and Writing)
Visual presentation: Power Point Presentation, Vlog
Group Discussion: General, Technical
Mock Interview: General, Technical

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Communicate effectively and exhibit required competency in various professional environments and demonstrate proficiency in interview process.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	1	3	3	-	1	-	-

High-3; Medium-2; Low-1

Textbook(s):

T1. Ashraf Rizvi, "Effective Technical Communication" 2nd Edition, McGraw-Hill India, 2018

T2. Pease, Allan, and Barbara Pease. "The Definitive Book of Body Language." Bantam, 2006.

Reference Book(s):

R1. Cheryl Hamilton, “Communicating for Results: A Guide for Business and the Professions”, 11th Edition (1 January 2017), Wadsworth Publishing Co Inc.

R2. Whitcomb, Susan Britton. Resume Magic: Trade Secrets of a Professional Resume Writer. JIST Works, 2010.

R3. Carnegie, D. (2009). The Quick and Easy Way to Effective Speaking. Pocket Books.

Web References:

1 https://www.linkedin.com/pulse/interview-etiquette-dos-donts-interviews-brian-vander-waal-fmy8e/

2 https://www.simplilearn.com/group-discussion-tips-article

SEMESTER VI

Course Code: 23CSI601		Course Title: Compiler Design	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3: 0: 2	Credits: 4	Total Contact Hours: 75	Max Marks: 100

Course Objectives

The objective of the course is to impart knowledge on functionality of language processors and fundamental concepts of lexical analysis, syntax analysis, intermediate code generation, code generation and optimization.

Module I **23 Hours**

System Software: Overview of Language Processors - Elements of Assembly Language Programming - Program Relocation – Linking – Loaders

Compilers: Phases of a compiler – Analysis of the Source Program – Grouping of Phases – Compiler construction tools.

Lexical Analysis: Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens

Syntax Analysis: The Role of a Parser – Context Free Grammar – Top Down Parsing – Predictive Parser – Bottom up Parsing – LR Parsers – Construction of SLR, CLR and LALR Parsing Table – YACC

Module II **22 Hours**

Intermediate languages: Declarations – Assignment Statements – Boolean Expressions – Case Statements – Back Patching – Procedure Calls.

Code Generation: Issues in the Design of Code Generator – Target Machine – Runtime Storage Management – Basic Blocks and Flow Graphs – DAG Representation of Basic Blocks – Generating Code from DAGs – A Simple Code Generator.

Code Optimization: Principal Sources of Optimization – Optimization of Basic Blocks – Peephole Optimization – Loops in Flow Graphs.

List of Experiments **30 hours**

1. Design and implement a lexical analyser using LEX.
2. Implement Predictive Parsing algorithm.
3. Construct a parser for context-free grammars using YACC.
4. Translate high-level language constructs into intermediate code.
5. Generate target machine code for the given intermediate code.
6. Implement simple code optimization techniques.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Construct Lexical Analyzer for the given code using finite automata and LEX Tool.	Apply
CO2: Design and implement different types of parsers for performing syntax analysis using YACC.	Apply
CO3: Demonstrate code generation by employing various techniques and addressing the design challenges with an oral presentation.	Apply
CO4: Optimize the given code by applying various optimization techniques for improving code efficiency.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	1	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	1	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	2	1	-	-	2	-
CO4	-	-	2	-	-	-	1	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D. Ullman, “Compilers Principles,Techniques, and Tools”, 2nd Edition, Pearson Education, 2023.

Reference Book(s):

R1. Dhamdhere D.M., “Systems Programming”, Tata McGraw Hill Education Pvt. Ltd., 2011.

R2. Keith D. Cooper and Linda Torczon, “Engineering a Compiler”, Morgan Kaufmann Publishers, 2022.

R3. Des Watson, “A Practical Approach to Compiler Construction”, Springer International Publishing AG, 2017.

Web References:

1. http://nptel.ac.in/courses/106108052/17
2. http://nptel.ac.in/courses/106108052/31
3. https://www.cs.cmu.edu/~fp/courses/15411– f08/

Course Code: 23CST601		Course Title: Artificial Intelligence	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to describe the agent behaviour, its various searching, reasoning and planning techniques for efficient construction of AI models.

Module I **22 Hours**

Problem Solving Agents: Foundation and History of artificial intelligence-Agents and Environments– Nature of Environments – The Structure of Agents – Problem Solving agents-Measuring problem solving performance- Uninformed Search strategies.

Problem And Searching: Informed search strategies: Greedy BFS- A* Search – Local search algorithms-Online search agent-Adversarial search-Optimal decision in games-Constraint Satisfaction Problem-Inference in CSP-Backtracking search for CSP.

Module II **23 Hours**

Knowledge and Reasoning: Logical agents-Propositional logic-First order logic- Syntax and Semantics of First Order logic, Using First Order logic

Knowledge engineering in FOL-Inference in FOL – Unification and Lifting- Forward Chaining, Backward Chaining, Resolution.

AI Planning: Classical planning-Planning as State space search-Planning Graphs-Hierarchical planning -Planning and acting in nondeterministic domains -Multiagent planning- Introduction to Machine Learning Methods - Introduction to Deep Learning Methods

Applications: Natural Language Processing-Language model-Text classification-Information retrieval -Information extraction-Speech recognition

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply knowledge of agent architecture, searching and reasoning techniques for different applications.	Apply
CO2: Compare the efficiency of various searching techniques in solving a problem.	Analyze
CO3: Choose the appropriate planning technique to solve a given problem.	Apply
CO4: Demonstrate the working of AI applications using oral presentation.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	1	-	-	-	-	-	-	-	-	-	-
CO3	-	-	1	-	-	-	-	-	-	-	-	-	-	1
CO4	-	-	-	-	1	-	-	-	-	2	-	-	-	1

High-3; Medium-2; Low-1

Text Book(s):

T1. Stuart J. Russell, Peter Norvig, “Artificial Intelligence - A Modern Approach”, 3rd, Pearson Publishers, 2022.

T2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, “Artificial Intelligence”, 3rd, Tata McGraw-Hill Education, 2024.

Reference Book(s):

R1. Dheepak Khemani, “A first course in Artificial Intelligence”, McGraw Hill Education Pvt Ltd., NewDelhi, 2017

R2. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, O’Reilly, 2009

Web References:

1. http://nptel.ac.in/courses/106105079/2.
2. https://in.udacity.com/course/intro-toartificial-intelligence--cs271

Course Code: 23CSL601		Course Title: Artificial Intelligence Laboratory	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 0: 0: 3	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to demonstrate the artificial intelligence techniques in real-time scenarios.

List of Experiments **45 hours**

1. Choose the suitable searching techniques for the given problem (Find the shortest route from source to destination,8 puzzle problems, Vacuum cleaner agent problem, wolf-goat-cabbage problem)
2. Demonstrate Min-Max algorithm.
3. Implement Simulated Annealing Algorithm.
4. Study and implementation of prolog syntax.
5. Create a knowledge base using prepositional logic and show that the given query entails the knowledge base or not.
6. Create a knowledge base using prepositional logic and prove the given query using resolution.
7. Implement unification in first order logic.
8. Construct knowledge base consisting of first order logic statements and prove the given query using forward reasoning.
9. Demonstrate backtracking for the given problem (N Queens, Subset sum, Graph coloring).
10. Develop simple AI applications (Build a chatbot, spam filtering in email, speech recognition and question answering system).

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply searching, reasoning techniques and inference rules to the given knowledge base to solve real world problems.	Apply
CO2: Develop an AI model using artificial intelligence techniques in real-time scenarios.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	-	-	3	-	-	-	-	-	3	1	-	-	2	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Stuart J. Russell, Peter Norvig, “Artificial Intelligence - A Modern Approach”, 3rd Edition, Pearson Publishers, 2022.

T2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, “Artificial Intelligence”, 3rd Edition, Tata McGraw-Hill Education, 2024.

Reference Book(s):

R1. Dheepak Khemani, “A first course in Artificial Intelligence”, McGraw Hill Education Pvt Ltd., NewDelhi, 2017

R2. Dipanjan Sarkar, “Text Analytics with Python: A Practitioner's Guide to Natural Language Processing”, Apress, 2019.

Web References:

1. http://nptel.ac.in/courses/106105079/2
2. https://in.udacity.com/course/intro-toartificial- intelligence--cs271

Course Code:23ESL601		Course Title: Professional Skills 5: Ace and Elevate : Aptitude and Soft Skills (Common to all B.E/B.Tech Programmes)	
Course Category: SEC		Course Level:Higher	
L:T:P (Hours/Week) 0: 0: 2	Credits: 1	Total Contact Hours: 30	Max Marks: 100

Course Objectives:

To enhance students' problem-solving skills in the aptitude segment while also equipping them with effective communication skills for professional settings and success in the interview process.

Module I Verbal Ability & Effective Communication **15 Hours**

Verbal Ability

Parts of Speech – Tenses – Subject Verb Agreement – Synonyms – Antonyms – Idioms and Phrases - One Word Substitution – Reading Comprehension – Cloze test – Error Spotting.

Verbal Enhancement

Self-Introduction – Just A Minute- Picture Perception - Writing Skills: Sentence Types (Simple, Compound, Complex), Email drafting.

Campus to Corporate

Module II Quantitative & Reasoning Ability **15 Hours**

Quantitative Ability

Simplification & Approximation, Number System, Percentage, Averages, Ratios and Proportion, Ages, Profit & Loss, Interest Calculation, Time and work, Time, speed and distance, Clocks and Calendar, Mixtures and alligation, Permutations and Combinations, Probability, Mensuration, Data Interpretation, Data Sufficiency

Reasoning Ability

Seating Arrangement, Blood relations, Directions Problems, Syllogisms, Number & Alpha Series, Coding and Decoding, Non Verbal Reasoning, Analogies, Cubes and Dices.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Exhibit strong problem-solving skills in the aptitude segment while enhancing their communication abilities for professional settings, enabling them to excel in interviews and placement processes.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	2	3	3	-	1	-	-

High-3; Medium-2; Low-1

Textbook(s):

T1: Technical Communication, 3E: Principles and Practice book. Authors. Meenakshi Raman, Sangeeta Sharma, 2006

T2: Pease, Allan, and Barbara Pease. "The Definitive Book of Body Language." Bantam, 2006.

T3: Dr. R. S. Aggarwal. “Quantitative Aptitude for Competitive Examinations” Sultan Chand & Sons Pvt. Ltd, New Delhi, 2024

T4: Dr. R. S. Aggarwal. “A Modern Approach to Verbal and Non-Verbal”, Sultan Chand & Sons Pvt. Ltd, New Delhi, 2024

Reference Book(s):

R1: Cheryl Hamilton, “Communicating for Results: A Guide for Business and the Professions”, 11th edition (1 January 2017), Wadsworth Publishing Co Inc.

R2: Whitcomb, Susan Britton. Resume Magic: Trade Secrets of a Professional Resume Writer. JIST Works, 2010.

R3: Carnegie, D. (2009). The Quick and Easy Way to Effective Speaking. Pocket Books.

R4: Arun Sharma. “Quantitative Aptitude for Common Aptitude Test”, McGraw Hill Publications, 5th Edition, 2020

R5: Arun Sharma. “Logical Reasoning for Common Aptitude Test”, McGraw Hill Publications, 6th Edition, 2021.

Web References:

1. https://www.linkedin.com/pulse/interview-etiquette-dos-donts-interviews-brian-vander-waal-fmy8e/
2. https://www.simplilearn.com/group-discussion-tips-article
3. https://talentbattle.in
4. https://www.geeksforgeeks.org/aptitude-questions-and-answers/

SEMESTER VII

Course Code: 23CSI701		Course Title: Cloud Technology	
Course Category: Professional Core		Course Level: Mastery	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The objective of this course is to Gain foundational knowledge and skills in cloud computing, including its core concepts and services and Build proficiency in cloud networking, security, and global infrastructure essentials.

Module I **15 Hours**

Fundamentals of Cloud Computing: Introduction to Cloud Computing, History and Characteristics of Cloud Computing; Cloud computing Technologies: Virtualization, Types of Virtualizations, Service Oriented Architecture, Cloud Computing Infrastructure; Cloud Deployment Models: Public, Private, Hybrid, Community.

Cloud Service Models: Infrastructure-as-a-Service, Platform-as-a-Service, Software-as–a-Service, Identity as a Service, Network as a Service; Challenges.

Networking and Cloud Security: Virtual Private Cloud - Subnets, Routing tables, NAT gateways - VPC Security: Security Groups, Network Access Control Lists (NACLs).

Module II **15 Hours**

Compute Services: EC2: Instances, EC2 Network Performance, AMIs, EC2 Pricing, Spot fleet, EC2 fleet, EC2 instance Storage Options, Reversed Instances, EC2 Auto Recovery, Cloud Watch, Auto Scaling: - Elastic Load Balancing.

Cloud Storage: EBS Block Storage, EBS Snapshots, S3 Storage, Management, S3 Bucket Security, S3 Glacier Archive Storage, Shared File System, Elastic File System, Relational Database Service, App Engine: App Engine Overview- Web services- Big Query

List of Experiments: **30 Hours**

1.Configure the network adapter settings in Oracle Virtual Box to enable proper communication between the host machine and the virtual machine.

2. Deploy a single-node or multi-node OpenStack cloud environment using DevStack.

3. Configure an Amazon EC2 instance, install the necessary Java runtime and web server, and deploy a Java-based web application.

4. Create an Amazon S3 bucket, upload the static website files (HTML, CSS, JS), Configure the bucket for static website hosting, and set appropriate permissions to make the website publicly accessible.

5. Migrate an existing application to AWS using AWS Application Migration Service. Test and verify the application's functionality in the AWS cloud environment.

6. Stream large datasets into Google Cloud BigQuery, then write and execute SQL-like queries to perform data analysis and generate insights from the massive volume of data.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply cloud computing concepts to configure and manage cloud deployment models.	Apply
CO2: Demonstrate the concept of Virtualization Techniques using Virtualization Software.	Apply
CO3: Analyze Cloud services like EC2, IAM, and S3 for efficient cloud management.	Analyze
CO4: Analyze Cloud storage and database services to optimize data management and performance.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2							1						
CO2			2		3					2				
CO3				2								2	3	
CO4		2										2	3	

High-3; Medium-2; Low-1

Text Book(s):

T1. Rittinghouse, John W, and James F. Ransome, — Cloud Computing: Implementation, Management and Security‖, CRC Press, 2017.

T2. Mike Rossie, “AWS 2024: From Beginner to Advanced AWS The Complete Guide”, Kindle Edition, 2024.

T3. Mark Wilkins, “Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud”, 2019.

Reference Book(s):

R1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, —Distributed and Cloud Computing, From Parallel Processing to the Internet of Things‖, Morgan Kaufmann Publishers, 2012.

R2. David E.Y. Sarna, —Implementing and Developing Cloud Application‖, CRC press 2011.

R3. Lee Badger, Tim Grance, Robert Patt-Corner, Jeff Voas, NIST, —Draft cloud computing synopsis and recommendation‖, May 2011.

Web References:

1. https://www.geeksforgeeks.org/cloud-computing/
2. https://www.geeksforgeeks.org/aws-tutorial/?ref=lbp
3. https://docs.aws.amazon.com/whitepapers/latest/aws-vpc-connectivity-options/introduction.html
4. https://www.geeksforgeeks.org/aws-tutorial/?ref=lbp
5. https://docs.aws.amazon.com/whitepapers/latest/applying-security-practices-to-network-workload-for-csps/identity-and-access-management-iam.html

Course Code: 23CST702		Course Title: Agile Methodologies	
Course Category: Professional Core		Course Level: Mastery	
L:T:P (Hours/Week) 3:0:0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on various activities involved in the agile software development process. The course also intends to provide exposure on the various agile frameworks such as scrum, Kanban, and design principles to achieve

Module I **23 Hours**

Agile Software Development: Agile Overview – Agile vs. Waterfall Method – Agile Manifesto – Agile Principles – Business Practices: Planning, Small Releases, Acceptance Tests, Whole Team – Team Practices: Metaphor, Sustainable Pace, Collective Ownership, Continuous Integration – Technical Practices: Test Driven Development, Refactoring, Simple Design, Pair Programming

Agile Frameworks

Scrum: Scrum Team: Product Owner, Scrum Master, Development Team – User Story – Scrum Events: Sprint, Planning, Daily Scrum, Sprint Review, Retrospectives – Scrum Artifacts: Product Backlog – Sprint Backlog.

Other Frameworks: Kanban, Scaled Agile Framework (SAFe), Scrumban, Extreme Programming (XP), Crystal – Principles and Practices.

Module II **22 Hours**

Agile Testing: Principles for Agile Testing – Roles of Testers – Test Planning – Agile Testing Quadrant: Types of Testing – Test Automation: Technical Debt in Testing – Pyramids of Automation – Test Automation Design Patterns.

Agile Design: Design Smells – Agile Design Principles: Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Dependency Inversion Principle, Interface Segregation Principle.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply agile practices in a collaborative project environment to meet industry-standards.	Apply
CO2: Analyze the effectiveness of various Agile frameworks in addressing software development challenges	Analyze
CO3: Apply Agile testing practices in real-world projects to enhance software quality.	Apply
CO4: Apply Agile design principles to improve software systems in project-based environments to enhance code quality	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	-	2	-	-	-	-	-	-	-	-	-	1	-	-
CO3	3	-	-	-	1	1	-	-	-	-	-	1	-	-
CO4	-	-	2	-	-	-	-	-	1	1	-	-	2	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Peter Wlodarczak,"Agile Software Development", CRC Press, 2023

T2. Robert C. Martin, “Clean Agile: Back to Basics”, Pearson Education, Inc, 2020.

Reference Book(s):

R1. Christian Mastnak, Helmut Pichler, Manfred Baumgartner, Martin Klonk, Richard Seidl, Siegfried Tanczos, "Agile Testing:The Agile Way to Quality", Springer, 2021

R2. Janet Gregory and Lisa Crispin, “More Agile Testing: Learning Journeys for the Whole Team”, Addison-Wesley Professional, 2014.

R3. Robert C. Martin, “Functional Design: Principles, Patterns, and Practices”, Addison-Wesley Professional, 2023.

R4. Richard Knaster, Dean Leffingwell,"Safe 5.0 Distilled: Achieving Business Agility With the Scaled Agile Framework",Addison-Wesley,2020

R5. Andrew Stellman,"What Is Scrumban?",O'Reilly Media, Inc.,2019

R6. Karen Frazier,"Crystals for Beginners: The Guide to Get Started with the Healing Power of Crystals",Althea Press, 2021.

Web References:

1. Agile Methodology: https://agilemodeling.com
2. Scrum: https://scrumguides.org/index.html
3. Agile Software Development: https://www.atlassian.com/agile/project-management
4. https://www.coursera.org/specializations/safe

Course Code: 23CSL701		Course Title: Open Source Software Laboratory	
Course Category: SEC		Course Level: Mastery	
L:T:P(Hours/Week) 0: 0: 4	Credits: 2	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on Open Source Software and encourage students to contribute to open-source projects and develop real-world problem-solving skills.

List of Experiments: **60 hours**

1. Create a database using PostgreSQL and Mongo DB.
2. Implement Django MVT.
3. Implement forms using Django.
4. Perform database connectivity using Django.
5. Develop a web service using Django.
6. Crafting the User Interface for building basic Components with React.
7. Implement Frontend-Backend Communication by Connecting React to the Flask API.
8. Interactive Form Submission Using React with Flask-Based Data Capture.
9. Creating and Using Deployments in Kubernetes using YAML.
10. Automating Deployments with CI/CD Pipelines.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design a database for any application using PostgreSQL and MongoDB.	Apply
CO2: Apply Django framework features to develop dynamic web applications by creating interactive forms, enabling database connectivity, and building web services.	Apply
CO3: Apply front-end development techniques using React to build and integrate with a Flask-based backend to enable interactive data communication and processing.	Apply
CO4: Apply knowledge of YAML syntax to define, configure Kubernetes and implement a functional CI/CD pipeline.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		-		3	-	-	-	-	-	-	-	-	1
CO2		2	-	2	3	1	-	-	-	-	-	-	2	-
CO3		-	2		3	-	-	-	1	-	-	-	-	-
CO4		-			3	-	-	-	1	-	1	1	-	-

High-3; Medium-2; Low-1

Reference Book(s):

R1. Luca Ferrari, Enrico Pirozzi, “Learn PostgreSQL: use,manage and build secure and scalable databases with PostgreSQL 16”, Second Edition, Packt Publishing, 2023.

R2. Shannon Bradshaw, Kristina Chodorow, Eoin Brazil,” MongoDB: The Definitive Guide - Powerful and Scalable Data Storage”, Third Edition, O Reilly Publication, 2020.

R3. Daniel Rubio, “Beginning Django: Web Application Development and Deployment with Python”, Apress, 2017.

R4. Olatunde Adedeji, “Full-Stack Flask and React: Learn, code, and deploy powerful web applications with Flask 2 and React”, First Edition, Packt Publishing, 2023.

R5. Nigel Poulton, “The Kubernetes Book”, Third Edition, Gray Scale India Edition, 2025.

Web References:

1. PostgreSQL : https://www.postgresql.org/docs/current/tutorial.html
2. MongoDS : https://www.mongodb.com/docs/manual/tutorial/
3. Django : https://www.djangoproject.com/start/
4. ReactJS : https://legacy.reactjs.org/community/courses.html
5. Flask : https://flask.palletsprojects.com/en/stable/
6. Kubernetes : https://kubernetes.io/

Course Code: 23CSP701		Course Title: Project Phase I	
Course Category: Project		Course Level: Mastery	
L:T:P(Hours/Week) 0: 0: 8	Credits: 4	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The objective of this course is to provide students with the opportunity to initiate independent Application/ Research by identifying a relevant problem statement, conducting an indepth literature review, and understanding existing methodologies. The course aims to develop analytical, technical, and problem-solving skills through the implementation and evaluation of a base system, thereby preparing students for the subsequent phases of their research project.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Identify a application/ research problem, review relevant literature, and formulate clear research objectives aligned with current trends and technological advancements.	Analyze
CO2: Compare the existing methodologies in the identified domain and communicate the findings through documentation and oral presentations.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2		2				3					
CO2	-			3		2	2	2		3	3	3	3	3

High-3; Medium-2; Low-1

SEMESTER VIII

Course Code: 23CSP801		Course Title: Project Phase II	
Course Category: Project		Course Level: Mastery	
L:T:P(Hours/Week) 0: 0: 12	Credits: 6	Total Contact Hours: 90	Max Marks: 200

Course Objectives

The objective of this course is to enable students to design, develop, and implement innovative solutions to the identified problem, analyze results using appropriate methodologies, and effectively communicate their findings through technical documentation and presentations, demonstrating readiness for professional practice or further research.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the tools, technologies, and methodologies to implement solutions for the defined problem	Create
CO2: Evaluate and validate the obtained results and communicate the findings through report and oral presentations.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	3	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	-	3	3	3	3	3	3	3	3	3

High-3; Medium-2; Low-1

ELECTIVES

VERTICAL I DATA SCIENCE

Course Code: 23CSE001		Course Title: Data Science in Bioinformatics	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Prerequisites: Basic programming (Python/R), statistics, molecular biology concepts.

Course Objectives

The course is designed to impart knowledge on data science in bioinformatics and integrate to solve modern biological problems. The course is also intended to apply biological data, including emerging tools in structural biology and functional genomics.

Module I **22 Hours**

Introduction to Bioinformatics – NCBI Data Model – GENBANK Sequence Database – DNA sequences to the Database – Structure Databases – Genomic maping and mapping Databases – Information retrieval from Biological databases

Module II **23 Hours**

Sequence Alignment – Data searching – creation and analysis of protein multiple sequence alignments – Predictive methods using DNA sequences - Predictive methods using Protein sequences – Expressed sequence Tags – Sequence assembly and finishing methods - Phylogenetic Analysis - Comparative Genome Analysis - Large-Scale Genome Analysis -

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Build sequence alignment, phylogenetic analysis, and gene/protein annotation using established algorithms and tools.	Apply
CO2: Implement statistical and machine learning techniques on biological dataset.	Apply
CO3: Analyze structural bioinformatics problems using open-source tools.	Analyze
CO4: Evaluate complex biological systems in a team and communicate the effectiveness with real world applications.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	2	-	-	2	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	2	-	-	-	-	-	-	-
CO3	-	1	-	-	1	-	-	1	-	-	-	1	-	2
CO4	-	-	-	2	-	-	-	-	2	2	1	-	-	2

High-3; Medium-2; Low-1

Text Book(s):

T1. Vince Buffalo, “Bioinformatics Data Skills”, 1st Edition, O'Reilly, 2015.

T2. Andreas D. Baxevanis, B. F. Francis Ouellette, “BIOINFORMATICS - A Practical Guide to the Analysis of Genes and Proteins”, 4th Edition, Wiley - Interscience, 2014.

Reference Book(s):

R1. Peter Bruce, Andrew Bruce, Peter Gedeck, “Practical Statistics for Data Scientists”, 2nd Edition, O'Reilly, 2020.

R2. Phillip Compeau & Pavel Pevzner, “Bioinformatics Algorithms: An Active Learning Approach”, 3rd Edition, Active Learning Publishers, 2018.

Web References:

1. NPTEL course on BioInformatics: Algorithms and Applications: https://onlinecourses.nptel.ac.in/noc21_bt06/preview
2. Coursera course on Bioinformatics Specialization: https://www.coursera.org/specializations/bioinformatics
3. NCBI tutorials: https://www.ncbi.nlm.nih.gov/home/tutorials/
4. Ensembl: https://www.ebi.ac.uk/training/online/courses/ensembl-browsing-genomes/ and https://www.embl.org/training/self-paced-learning/
5. UCSC Genome Browser: https://genome.ucsc.edu/

Course Code: 23CSE002		Course Title: Social Network Analytics	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to impart skills to model, analyse and extract insights from real-world social network platforms and design recommendation systems by understanding the user behaviour and community structures.

Module I **22 Hours**

Graph Basics: Social Media Mining – Challenges – Graph Essentials – Representations – Types of Graphs – Connectivity – Special Graphs – Graph Algorithms.

Measures & Models: Network Measures – Centrality – Transitivity and Reciprocity – Similarity. Network Models – Properties of Real-World Networks – Random Graphs – Small-World Model – Preferential Attachment Model.

Mining Twitter: Analyzing tweets and identifying trends using the data mining process: Data quality – Preprocessing – Supervised Learning – Algorithms and Evaluation – Unsupervised Learning – Clustering algorithms – Evaluation.

Module II **23 Hours**

Communities and Interactions: Community Analysis – Community Detection – Evolution – Evaluation – Information Diffusion in Social Media – Herd Behavior – Information Cascades – Diffusion of Innovations.

Applications: Influence and Homophily – Recommendation in Social Media – Classical Recommendation Algorithms – Recommendation Using Social Context – Evaluating Recommendations.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply graph concepts in analyzing social media structures to extract structural insights.	Apply
CO2: Analyze patterns and trends in real world network data by applying appropriate learning algorithm.	Analyze
CO3: Analyze community behavior in social media networks to track evolution and model information diffusion effectively.	Analyze
CO4: Develop context-aware recommendation strategies by analyzing user behavior in dynamic social network to enhance personalization.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	2	-	1	-	-	-	-	-	-	-	1
CO3	-	3	-	-	1	-	-	-	-	-	-	-	-	1
CO4	-	-	3	-	-	1	-	-	-	-	1	1	-	1

High-3; Medium-2; Low-1

Text Book(s):

T1. Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, “Social Media Mining: An Introduction”, Cambridge University Press, 2022.

T2. Matthew A. Russell, “Mining the Social Web”, O’Reilly Media Inc., 3rd Edition, 2019.

Reference Book(s):

R1. Nilanjan Dey, Samarjeet Borah, Rosalina Babo, Amira Ashour, “Social Network Analytics – Computational Research Methods and Techniques”, Academic Press Inc, 2018.

R2. David Knoke, Song Yang, “Social Network Analysis”, SAGE publications, 5th Edition, 2021.

Web References:

1. NPTEL – Social Network Analysis: https://onlinecourses.nptel.ac.in/noc22_cs117/preview

2. MIT Open Courseware. URL: https://ocw.mit.edu/search/?d=Engineering%20Systems%20Division&q=social%20network%20analytics

3. Visible Network Labs: https://visiblenetworklabs.com/guides/social-network-analysis-101/

Course Code: 23CSE003	Course Title: Information Retrieval Techniques		
Course Category: Major		Course Level: Higher	
L:T:P (Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks:100

Course Objectives

The course is intended to impart effective text retrieval systems and query refinement techniques to enhance the information retrieval.

Module I **15 Hours**

Text Retrieval Systems: Boolean retrieval – The term vocabulary and postings lists: Document delineation – Determining the vocabulary of terms – Faster postings list intersection via skip pointers – Dictionaries and tolerant retrieval.

Index construction and Compression: Hardware basics – Blocked sort-based indexing – Single pass in-memory indexing – Distributed indexing – Dynamic indexing – Dictionary compression – Postings file compression – Term frequency and weighting.

Module II **15 Hours**

Vector Space Models and Evaluation: Vector Space Model – TF–IDF functions – Scoring & Ranking – Evaluation in information retrieval: Information retrieval system evaluation – Standard test collections – Evaluation of unranked retrieval sets – Evaluation of ranked retrieval results – Assessing relevance.

Query Expansion: Relevance feedback – Pseudo relevance feedback – Query Reformulation – Review of basic probability theory – Probability ranking principle – Binary independence model – Language models for information retrieval.

List of Exercises **30 Hours**

1. Develop an algorithm to retrieve relevant documents using the Boolean retrieval model
2. Implement Blocked sort-based indexing algorithm
3. Implement an algorithm to retrieve relevant documents using the Vector Space Model
4. Implement query reformulation techniques for improving search accuracy and relevance of retrieved documents
5. Design a Question/Answering System using information retrieval techniques
6. Implement information retrieval techniques to extract relevant information from blog content

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply indexing and compression techniques to construct efficient text retrieval systems	Apply
CO2: Apply vector space models and evaluation techniques to develop and assess information retrieval systems	Apply
CO3: Analyze and enhance information retrieval systems using advanced query expansion techniques and probabilistic models	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	-	1
CO3	-	2	-	2	-	-	-	-	-	-	-	-	-	1

High– 3; Medium– 2; Low– 1

Text Book:

T1. Christopher D. Manning and Prabhakar Raghavan, “Introduction to Information Retrieval”, Cambridge University Press, 2020.

Reference Book(s):

R1. Bruce Croft, Donald Metzler, Trevor Strohman, “Search Engines: Information Retrieval in Practice”, Pearson Education, 2015.

R2. Ricardo Baeza-Yates, Berthier Ribeiro-Neto, “Modern Information Retrieval”, 2nd Edition, Pearson Education, 2023.

Web Reference(s):

1. https://www.coursera.org/learn/text-retrieval?
2. https://ciir.cs.umass.edu/irbook/
3. http://nlp.stanford.edu/IR-book /html / htmledition/ irbook.html
4. http://www.mir2ed.org/

Course Code: 23CSE004		Course Title: Big Data Analytics	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to describe the concepts of Big data, its storage and various big data tools for performing data analytics.

Module I **15 Hours**

Fundamentals of Big Data: Database Evolution – Big data characteristics – Big data use cases – Characteristics of big data Applications

Big Data Storage & Tools: High Performance Architecture – HDFS – Map reduce: Data flow, MapReduce API – YARN: Architecture, Running an application – Hive: Architecture, Data types, CRUD Operations, Partitioning, functions – Hbase: Data model, CRUD Operations

Module II **15 Hours**

NOSQL Data Management & Tools: Introduction to NoSQL – Schema less Models – Key Value Stores – Document Stores – Tabular Stores – Object Data Stores – Graph Databases – Sharding – MongoDB: CRUD operations, Export and Import data – Apache spark:RDD, In-built functions

List of Experiments **30 hours**

1. Perform various basic HDFS commands
2. Develop a map reduce programming model
3. Perform analysis operations using HiveQL
4. Perform crud operations on Hbase
5. Perform crud operations on MongoDB
6. Perform data processing and analytic using Apache Spark integrating with MongoDB

The experiments from 3 till 6 can be completed for a common application.

Suggested Case Studies:

Passport Automation System, Book Bank, Exam Registration, Stock Maintenance System, Online Course Reservation System, E– ticketing, Credit Card Processing, E– book Management System, Recruitment System, Library Management System, Student Information System, etc.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the fundamental characteristics of big data to implement effective data management and processing solutions.	Apply
CO2: Design high-performance big data architectures using big data tools.	Apply
CO3: Compare different NoSQL data models to determine their suitability For specific use cases.	Analyze
CO4: Demonstrate the process of integrating Apache Spark with NoSQL Databases.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	3	-	-	-	-	-	-	-	2	-
CO3	-	2	-	1	3	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	3	-	-	-	2	2	-	-	-	3

High-3; Medium-2; Low-1

Text Book(s):

T1. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.Learning Series, 3rd Edition, MIT Press, 2014.

Reference Book(s):

R1. EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley Publishers, 2015.

R2. Seema Acharya, Subha shini Chellappan,”Big Data and Analytics”, Wiley Publication,2015.

Web References:

1. https://onlinecourses.nptel.ac.in/noc20_cs92/preview
2. https://www.mongodb.com/resources/basics/databases/nosql-explained
3. https://spark.apache.org/docs/latest/quick-start.html

Course Code: 23CSE005		Course Title: Data Visualization	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart the knowledge and skills required to effectively manipulate, analyze and visualize data using various techniques. Students will learn to create static and interactive visualizations, design dynamic dashboards, and develop comprehensive data visualization projects that communicate insights clearly and effectively.

Module I **15 Hours**

Data types-Basic Array Function : Universal function, Aggregations, Comparisons, Masks, and Boolean Logic -Data Manipulation - Data transformation techniques -Data preprocessing- Grouping datasets - Data aggregation –Pivot tables and cross-tabulations.- Basic Plotting: bar charts and scatter plots- Data Handling and Visualization: histograms and box plots-Customizing Visualizations-Visual Variables.

Module II **15 Hours**

Creating Subplots: Statistical Visualizations-pair plots, heatmaps, and violin plots-Interactive Plots:3D scatter plots and interactive line charts-Text and Document Visualization - Characterizing time oriented data -Visualizing Time-Series Data-Geographical Data Visualization: choropleth maps and scatter maps- Dashboards: Connecting to a database, Building a data model- Reports - custom Visualizations.

List of Experiments **30 hours**

1. Demonstrate basic visualizations using plotting techniques by applying visual variables
2. Develop statistical visualizations by creating and arranging multiple subplots to compare and analyze different data distributions
3. Apply visualization techniques to analyze and interpret trends and patterns in time-oriented data
4. Create interactive visualizations that enable users to explore and interact with the data dynamically
5. Create map-based visualizations to show data distribution across different geographic areas
6. Create a dashboard that enables user interaction with various visualizations

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply data transformation techniques to preprocess datasets for analysis real-world datasets.	Apply
CO2: Apply plotting techniques to effectively visualize real-world datasets.	Apply
CO3: Analyze complex data to produce interactive visualizations using advanced visualization techniques.	Analyze
CO4 : Develop a dashboard for real time data visualization systems	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-		-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	2	-	-	-	-	-	-	-	-	3
CO3	-	2	-	-	2	-	-	-	-	-	-	-	-	3
CO4	-	-	3	-	2	-	-	-	-	-	-	-	3	3

High-3; Medium-2; Low-1

Text Book(s):

T1. Scott Murray, "Interactive Data Visualization for the Web: An Introduction to Designing with D3," 2nd Edition, O'Reilly, 2017.

T2. Alberto Ferrari and Marco Russo ,“Introducing Microsoft Power BI.” Microsoft Press 2016.

T3. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Oreilly, 2016.

Reference Book(s):

R1. Claus O. Wilke, “Fundamentals of Data Visualization”, O’Reilly publications, 2019.

R2. Kristen Sosulski, “Data Visualization Made Simple: Insights into Becoming Visual”, Routledge, 2018

Web References:

1. https://pll.harvard.edu/course/data-science-visualization

2. https://www.kaggle.com/learn/data-visualization

3. https://www.mygreatlearning.com/academy/learn-for-free/courses/data-visualization-with-power-bi

Course Code: 23CSE006		Course Title : Data Analytics	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0:2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course aims to provide students with a comprehensive understanding of data analytics, covering key concepts, methodologies, and tools essential for data analysis, interpretation, and decision-making. Students will learn to collect, preprocess, and analyze data from various source using statistical techniques and applying data science methods to real-world problems.

Module I **15 Hours**

Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues. Data Collection and API, Web Scraping– Extracting Data from Websites- Accessing Different Sources of Data - Data Integration and Transformation – Data Reduction – Data Discretization.

Module II **15 Hours**

Single variable: Distributions and Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality - Smoothing Time Series. Relationships between Two Variables - Percentage Tables - Analyzing Contingency Tables.

List of Experiments **30 Hours**

1. Perform web-Scrapping by creating data frame for any given data set
2. Collaborate with multiple datasets in diverse formats (CSV, JSON, and SQL databases) and combine, join, and transform the data to create a data set that is both clean and usable.
3. Reduce the dimensionality of given dataset and visualize the results using Principal Component Analysis (PCA).
4. Create histogram and box plot to visualize the distribution and identify the outliers for any given dataset.
5. Implement min-max scaling and z-score standardization on a dataset and compare the effects on the distribution of the data.
6. Compute percentage by creating contingency table for a categorical dataset. Also discuss about the significant relationships.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply foundational concepts to practical applications and contribute effectively to data-driven decision-making processes across various fields.	Apply
CO2: Analyze contingency tables to evaluate associations between categorical variables and derive insights that inform decision-making.	Analyze
CO3: Design the data science model to analyze and visualize data for real-world applications.	Apply
CO4: Evaluate analytical skills in data analysis and visualization for data-driven decision-making processes in real-world applications.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	-	2	-	-	2	-	-	-	-	-	-	-	-	3
CO3	-	-	3		2	-	-	-	-	-	-	-	-	3
CO4	-	-	-	2	2	-	-	-	-	-	-	-	-	3

High 3; Medium-2; Low-1

Text Book(s):

T1. Avrim blum, John Hop croft and Ravindran kannan, “Foundations of Data Science”, Springer-2018

T2. Jake vander Plas, “Python Data Science Handbook-Essential Tools for Working with Data”,Packt Publishing.2020.

Reference Book(s):

R1. Jojo Moolayil, “Smarter Decisions: The Intersection of IoT and Data Science”, PACKT, 2016.

R2. Amit kumar Tyagi, “Data Science and data Analytics Opportunities and challenge”, 2021

R3. Data Science Concepts and Practice 2nd Edition Vijay Kotu Bala Deshpande

Web References:

1. https://pll.harvard.edu/course/data-science-visualization
2. https://www.kaggle.com/learn/data-visualization
3. https://epjdatascience.springeropen.com/

Course Code: 23CSE007		Course Title: Text and Web Mining	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to develop the ability to extract, process, and analyze unstructured data through text mining and web mining techniques. It aims to provide learners with the knowledge and practical skills needed to build intelligent systems for information retrieval, classification, link analysis, and pattern discovery from online sources.

Module I **15 Hours**

Text Mining Tasks – Converting Text to Numerical Vectors: Document standardization – Tokenization –Lemmatization – Vector Generation – POS Tagging – Word Sense Disambiguation – Phrase and named entity recognition – Parsing – Feature generation- Using Text for Prediction - Information Retrieval and Text Mining -Measuring Similarity- Clustering Documents by Similarity- Hierarchical Clustering

Module II **15 Hours**

Web Page Pre-Processing – Inverted Index and compression -Web Search-Web Spamming-Social Network Analysis-Co-Citation and Bibliographic Coupling-Page Rank-HITS-Community Discovery- Web Crawling- Basic Crawler Algorithm-Implementation Issues-Universal Crawlers-Focused Crawlers-Topical Crawlers- Crawler Ethics and Conflicts

List of Experiments: **30 Hours**

1. Apply feature extraction techniques to prepare data for classification.
2. Implement an algorithm that retrieves relevant documents based on Boolean retrieval model.
3. Apply hierarchical clustering on textual data to uncover document groupings based on content similarity.
4. Extract and clean data from online sources using real-time web scraping and preprocessing techniques.
5. Analyze link structures by implementing the PageRank algorithm on a set of web pages or a social graph.
6. Identify communities or influential users in a Twitter/Facebook-like dataset using web mining algorithms.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply text mining techniques to preprocess the documents for building an information retrieval model.	Apply
CO2: Analyze the similarity of textual documents using appropriate clustering techniques to identify document groupings	Analyze
CO3: Apply web mining principles to develop solutions for real-time information extraction in online environments	Apply
CO4: Analyze the effectiveness of web link mining techniques in identifying relationships and patterns within social media networks.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	-	2	-	-	1	-	-	-	-	-	-	-	-	3
CO3	-	-	3	-	-	1	-	-	-	-	-	-	3	3
CO4	-	-	-	2	-	-	-	-	-	-	1	-	-	3

High-3; Medium-2; Low-1

Text Book(s):

T1. Sholom M. Weiss, Nitin Indurkhya, Tong Zhang, “Fundamentals of Predictive Text Mining”, 2nd Edition, Springer-Verlag London Limited, 2024.

T2. Bing Liu, “Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data”, 2nd Edition, Springer, 2023.

Reference Book(s):

R1. Charu C. Aggarwal, “Machine Learning for Text”, 2nd Edition, Springer, 2019.

R2. Dipanjan Sarkar, “Text Analytics with Python: A Practitioner's Guide to Natural Language Processing”, 2nd Edition, Apress, 2019.

Web References:

1. Text Mining with R: A Tidy Approach, URL: https://www.tidytextmining.com/

2. Coursera, Text Mining and Analytics, URL : https://www.coursera.org/learn/text-mining

Course Code: 23CSE008		Course Title: Healthcare Analytics	
Course Category: Professional Elective		Course Level: Practice	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course aims to equip students with the knowledge and skills to analyse diverse healthcare data using advanced analytics techniques. This course also aims to explore visual analytics for clinical decision support.

Module I **15 Hours**

Healthcare Data Sources and Analytics: Electronic Health Records – Components – Coding Systems.

Biomedical Image Analysis: Biomedical Imaging Modalities - Object Detection - Image Segmentation (Thresholding, Watershed transform, Region Growing, Clustering) - Image Registration - Feature Extraction.

Mining of Sensor Data in Healthcare: Mining Sensor Data in Medical Informatics – Challenges - Sensor Data Mining Applications - Nonclinical Healthcare Applications.

Module II **15 Hours**

Clinical Prediction Models: Statistical Prediction Models: Linear Regression – Logistic Regression – Bayesian Models – Advanced Prediction Models: Decision Trees – Artificial Neural Networks – Reinforcement Learning: Survival Models – Nonparametric Survival Analysis – Cox Proportional Hazards Model – Survival Trees – Evaluation and Validation

Visual Analytics for Healthcare: Visual Analytics and Medical Data Visualization – Analytics for Public Health and Population Research - Analytics for Clinical Workflow - Analytics for Clinicians - Analytics for Patients - Ethical and Legal Aspects of Healthcare Analytics – Legal compliance – Auditing and compliance in healthcare AI systems.

List of Experiments: **30 hours**

Suggested Tools: Python/R libraries (scikit-learn, lifelines, matplotlib, Plotly, TensorFlow) and platforms (MIMIC-III, PhysioNet).

1. Perform basic data analytics using the given Electronic Health Record dataset.
2. Perform semantic segmentation on biomedical images.
3. Analyze physiological sensor data such as heart rate and temperature.
4. Develop logistic regression model for disease classification.
5. Develop decision tree model for risk classification.
6. Create an interactive visual dashboard to support clinical decision-making.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply analytical techniques to develop predictive models for clinical decision-making	Apply
CO2: Analyze biomedical images and sensor data to derive meaningful insights in healthcare contexts	Analyze
CO3: Analyze machine learning models and visual analytics in healthcare environments	Analyze
CO4: Develop predictive models and interactive dashboards using healthcare datasets to support health care data analysis	Create
CO5: Demonstrate awareness of ethical, legal, and societal implications of healthcare data analytics and communicate findings effectively through visual reports as individual and team work	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	2	-	-	-	-	-	-	-	-	-	3
CO4	-	-	2	-	2	-	-	-	-	-	-	-	3	3
CO5	-	-	-	-	-	1	-	1	2	1	-	-	-	-

High-3; Medium-2; Low-1

Text Book:

T1. Chandan K. Reddy, Charu C. Aggarwal, “Healthcare Data Analytics”, 2nd Edition, CRC Press, 2023.

Reference Book(s):

R1. A. Jaya, Dhiya Al-Jumeily, Dinesh Goyal, K. Kalaiselvi, “Handbook on Intelligent Healthcare Analytics Knowledge Engineering with Big Data”, Wiley, 2022.

R2. Kolluri Venkateswaranaidu, “Artificial Intelligence in Healthcare: The Impact of Digital Transformation and Big Data Analytics in Healthcare System”, Notion Press, 2025.

Web References:

1. NPTEL - Exploring Survey Data on Health Care: https://onlinecourses.nptel.ac.in/noc22_hs40/preview
2. Coursera - AI in Healthcare Specialization: https://www.coursera.org/specializations/ai-healthcare
3. Coursera - Healthcare Analytics Essentials: https://www.coursera.org/learn/healthcare-analytics-essentials

ELECTIVES

VERTICAL II ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Code: 23CSE009		Course Title: Explainable AI	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The objective of this course is to introduce foundational knowledge of interpretable models, model-agnostic explanation methods, and practical tools for building explainable systems. This course also aims to explore real-world applications and understand the ethical and societal implications of deploying Explainable AI.

Module I **22 Hours**

Foundations of Explainable AI (XAI): Machine Learning and XAI – Need for XAI – Explainability and Interpretability – Needs, Opportunities and Challenges

Intrinsic Explainable Models: Loss Function – Linear Regression – Logistic Regression – Decision Trees – K-Nearest Neighbors

Model-Agnostic & Deep Learning Models for XAI: Global Explanations – Local Explanations – KernalSHAP – Agnostic Approach – Neural Networks – Deep Networks – Unsupervised Methods

Module II **23 Hours**

Interpretable Models & Tools: XAI Tools and Libraries – Interpretable Machine Learning with Python – Transparent Model Design Strategies – Sparse Models and Feature Selection – Visualization Tools for Model Interpretation – Frameworks for building XAI Models.

Applications: Healthcare and Medical diagnostics – Financial and Banking sectors – Autonomous Systems and Robotics – Retail and Customer Analytics

Challenges: Limitations – Computation Cost and Resource Constraints – Ethical and Social Implications of XAI

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply concepts of explainability and interpretability to analyze the transparency of various machine learning models.	Apply
CO2: Apply intrinsic and model-agnostic explainability techniques to classical and deep learning models for both global and local explanations.	Apply
CO3: Analyze the effectiveness of different XAI tools, frameworks, and visualization techniques in interpreting complex machine learning models across various domains.	Analyze
CO4: Evaluate the limitations, ethical implications, and resource constraints associated with deploying explainable AI systems in real world applications.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	3	-	2	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	1	-	-	2	-
CO4	-	-	-	2	-	2	2	2	-	-	-	-	-	3

High-3; Medium-2; Low-1

Text Book(s):

T1. Leonida Gianfagna, Antonio Di Cecco, “Explainable AI with Python”, Springer, 2021

T2. Robert Johnson, “Introduction to Explainable AI (XAI): Making AI Understandable”, HiTex Press, 2024

Reference Book(s):

R1. Pradeepta Mishra, “Practical Explainable AI Using Python”, APress, 2021

R2. Indranath Chatterjee, Mayuri Mehta, Vasile Palade, “Explainable AI: Foundations, Methodologies and Applications”, Springer, 2022

Web References:

1.Coursera, Explainable AI (XAI) Specialization, https://www.coursera.org/specializations/explainable-artificial-intelligence-xai

2.Udemy, XAI: Explainable AI, https://www.udemy.com/course/xai-explain-ml-models/

Course Code: 23CSE010		Course Title: Bio Inspired Computing	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on the fundamental principles, design, and application of computational techniques inspired by biological systems.

Module I **22 Hours**

Optimization:

Optimization Algorithms in Machine Learning and AI: Gradient-Based Algorithm – Newton's Method – Hill Climbing – Simulated Annealing – Evolutionary Optimization: Genetic Algorithm – Differential Evolution

Optimization Techniques: Convex Optimization – Equality constrained optimization – Stochastic and Robust Optimization – Sequential Quadratic Programming

Hyperparameter Optimization Techniques: Parameter Tuning – Hyperoptimization – Multi-objective Optimization – Parameter Control

Module II **23 Hours**

Analysis of Optimization Algorithms: Algorithm as Iterative Process – No free Lunch Theorem – Ideal Algorithm – Self- Organization System – Exploration and Exploitation

Swarm Intelligence Algorithms: Ant Colony Optimization – Artificial Bee Colony Optimization – Particle Swarm Optimization – Cuckoo Search Algorithm – Firefly Algorithm – Bat Algorithm

Applications of Optimization in Machine Learning and AI: White Blood Cell Classification using Bat Algorithm – Artificial Intelligence Methods for Music Generation – Cuckoo Search Based Intelligent Image Segmentation Technique – Machine Learning Model tuning using Hyperparameter Optimization techniques

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply optimization techniques to provide optimal solutions for real world problems.	Apply
CO2: Apply hyperparameter tuning techniques in machine learning and AI applications.	Apply
CO3: Demonstrate Swarm Intelligence algorithms for optimization, design and learning problems.	Apply
CO4: Collaborate effectively in teams to implement Bio inspired algorithms for solving real world problems.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	2	-	2	-	-	-	-	-	-	-	-	-	2
CO4	3	-	3	-	-	-	-	-	2	2	-	-	-	2

High-3; Medium-2; Low-1

Text Book(s):

T1. Xin-She Yang, “Nature-Inspired Optimization Algorithms”, Elsevier Science, 2020.

T2. Xin-She Yang, “Optimization Techniques and Applications with Examples”, Wiley Publications, 2018.

Reference Book(s):

R1. Sukanta Nayak, “Fundamentals of Optimization Techniques with Algorithms”, Elsevier Academic Press, 2020.

R2. Suvrit Sra, Sebastian Nowozin, Stephen J. Wright, “Optimization for Machine Learning”, MIT Press, 2017.

Web References:

1. NPTEL SWAYAM, Evolutionary Computation for Single and Multi-Objective Optimization,
URL: https://onlinecourses.nptel.ac.in/noc21_me43/preview

2. Newfoundland University, Introduction to Nature-Inspired Computing,
URL: https://www.mun.ca/computerscience/undergraduates/courses/comp-3201- introduction-to-nature-inspired-computing/

3. Magdeburg University, Swarm Intelligence,
URL:https://www.is.ovgu.de/Teaching/WS+2020_2021/SwarmIntelligence.html

Course Code: 23CSE011		Course Title: Soft Computing Techniques	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart knowledge and practical expertise in various neural network and computational intelligence techniques.

Module I **15 Hours**

Artificial Neural Network: Introduction – Terminologies - McCulloch-Pitts neuron - Linear Separability - Hebb network

Supervised Learning Network: Perceptron networks - Adaptive Linear Neuron - Multiple Adaptive Linear Neuron – Back Propagation Network - Radial Basis Function Network

Associative Memory network: Auto-associative memory network - Hetero-associative memory network - Bidirectional Associative Memory - Hopfield networks - Iterative Autoassociative memory network

Unsupervised Learning Networks: Kohonen self-Organizing feature maps - Learning Vector Quantization – Counterpropagation networks - Adaptive Resonance Theory Network

Module II **15 Hours**

Introduction to Fuzzy Logic – Classical Sets and Fuzzy Sets - Fuzzy Relations Membership Functions: Features of the Membership Functions – Methods of Membership Value Assignments

Fuzzification – Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy propositions, Aggregation, Decomposition - Fuzzy Reasoning - Fuzzy Inference Systems

Fuzzy Decision Making – Fuzzy Logic Control Systems - Applications of Fuzzy Logic Control System.

List of Experiments **30 hours**

1. Implement back propagation network for XOR function using bipolar inputs and binary targets.
2. Develop a hetero associative memory network using Hebbian learning rule to set the weights. Use appropriate input and corresponding target output patterns.
3. Implement Kohonen self-organizing map for a specific application.
4. Implement various primitive operations of classical sets using fuzzy relations.
5. Develop a fuzzy logic based decision making systems.
6. Design a fuzzy control/ inference system for a real time application.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply suitable learning algorithms and neural network architectures for solving real-time applications effectively.	Apply
CO2: Develop decision making and expert system that provides optimal solutions in dynamic environment	Apply
CO3: Analyze fuzzy logic concepts to evaluate their applicability in decision-making and control applications.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	-	-	3	-	-	-	3	-	-	-	-	-	-	1
CO3	-	-	-	2	1	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book:

T1. S.N. Sivanandam, S.N. Deepa, “Principles of Soft Computing”, 3rd Edition, John Wiley & Sons, New Delhi, 2019

Reference Book(s):

R1. Timothy J.Rose, ”Fuzzy Logic with Engineering Applications”, 7th Edition, John Wiley, 2016

R2. J.S.R Jang, C.T Sun and E. Mizutani, ”Neuro-Fuzzy and Soft Computing”, 2nd, Prentice Hall of India, 2015

Web References:

1. https://onlinecourses.nptel.ac.in/ noc24_cs37/ preview
2. https://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html

Course Code: 23CSE012		Course Title: Deep Learning Methods	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on Deep Learning by equipping students with the ability to implement deep learning models, and apply them to solve complex real-world problems.

Module I **14 Hours**

Introduction: The Neuron – Expressing Linear Perceptrons as Neurons – Feed-Forward Neural Networks – Linear Neurons and their Limitations - **Multilayer Perceptron**s: **I**mplementation, Forward Propagation, Backward Propagation, Computational Graphs, Numerical Stability and Initialization, Generalization in Deep Learning, Dropout.

Optimization Algorithms: Optimization and Deep Learning, Convexity, Gradient Descent, Stochastic Gradient Descent, RMSProp, Adadelta, Adam, Common Image Augmentation Methods.

Convolutional Neural Networks: Convolutions, Padding and Stride, Multiple Input and Multiple Output Channels, Pooling, LeNet

Module II **16 Hours**

Pre-Trained CNN Models: Self-Supervised Pretraining, AlexNet, VGG, NiN, GoogleNet, ResNet, DenseNet, Transfer Learning - **Region-Based CNNs:** R-CNN, Fast R-CNN, Faster R-CNN, Mask RCNN.

Generative Adversarial Networks: Generator, Discriminator, Training, GAN variants.

Recurrent neural network: Working with Sequences, Converting Raw Text into Sequence Data, Language Models, RNN Implementation, LSTM, GRU, Deep RNN, Bidirectional RNN, Encoder−Decoder Architecture.

List of Experiments **30 hours**

1. Build a Deep Feed Forward Network by implementing the Backpropagation algorithm and test the same using appropriate data sets from sklearn.
2. Build a CNN model with 4 layers of convolutions to classify multi-category image datasets.
3. Perform Object Detection using various predefined CNN models such as YOLO, VGG R-CNN etc. with optimization algorithms.

4. Implement Simple/Bidirectional/Deep RNN for sentiment analysis on online shopping customer reviews.
5. Construct a LSTM/GRU Network for opinion mining on movie reviews.
6. Develop an auto encoder to train on the MNIST dataset to reconstruct handwritten digits.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Develop multilayer perceptron networks using forward and backward propagation techniques to provide solutions for real-world problems.	Apply
CO2: Analyse the performance of CNN models, R-CNNs, and GANs using optimization techniques to address real-world challenges.	Analyze
CO3: Analyse the effectiveness of implementing RNNs for text sequences using LSTM and GRU.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	2	-		-	-	-	-	-	-	-	-	-
CO2	-	-	-	2	2	-	-	-	-	-	-	-	-	2
CO3	-	2	-	-	2	-	-	-	-	-	-	-	-	2

High-3; Medium-2; Low-1

Text Book(s):

T1. Aston Zhang, Zachary C. Lipton, Mu Li and Alexander J. Smola, “Dive into Deep Learning”, Cambridge University Press, 2023.

T2. Nikhil Buduma, Nicholas Locascio, “Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms”, O’Reilly Media, 2017.

Reference Book(s)

R1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.

R2. Josh Patterson, “Deep Learning: A Practitioner's Approach”, O'Reilly Media, 2017.

R3. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2017.

R4. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow : Concepts, Tools, and Techniques to Build Intelligent Systems”, O'Reilly Media, 2017

Web References:

1. https://nptel.ac.in/courses/106/106/106106184/
2. https://in.mathworks.com/discovery/deep-learning.html
3. https://www.kaggle.com/code/kanncaa1/deep-learning-tutorial-for-beginners

Course Code: 23CSE013		Course Title : Generative AI	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart the knowledge and skills required to understand and gain practical experience by integrating and fine-tuning Generative AI tools. Students will learn the concepts of AI, Deep learning, Neural Network by exploring various generative AI tools and effectively analyze the advantages and limitations of using various tools.

Module I **15 Hours**

Prompt Engineering Fundamental: Five Principles of Prompting- Elements of a Prompt - Tips for Designing Prompt - Example prompts for various use cases

Large Language Models for Text Generation: Text generation Models - transformer architecture - use cases and various models for natural language processing - Fine-tuning - Standard Practices for Text Generation with ChatGPT - Usecases of ChatGPT, BERT, LLaMA, LaMDA - Advanced Techniques for Text Generation with LangChain

Generative Images: Image Generation - Image Sourcing Vs, Image Generation - Popular AI tools for Image Generation Diffusion Model - DALLE, CLIP - Generative Adversarial Networks (GAN) for image generation

Module II **15 Hours**

OpenAI APIs: understanding OpenAI APIs, OpenAI playground, creating API keys, Authentication, making requests, Building ChatGPT powered applications: build chatbots, integration with OpenAI API keys.

Generative Codes: Role of AI Tools in Programming, Copilot by Github, Working of Copilot, - GitHub Copilot Extension – Conversion of Comments to Code - Auto filling Repetitive Code.

List of Experiments **30 Hours**

1. Develop applications for text generation tasks such as story generation, dialogue generation, or code generation using trained Generative AI models
2. Implement Fine-Tuning a GPT Model for a text generation tasks
3. Train the LSTM model on a dataset of music sequences and generate new musical compositions
4. Implement a Variational Autoencoder (VAE) for image reconstruction
5. Perform artistic style transfer on images and manipulation using RunwayML
6. Generate an automatic code completion based on code comments using GitHub Copilot

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Implement and train various generative models for real world scenarios.	Apply
CO2: Analyze various pre-trained models and fine-tuning techniques to solve specific problems and improve model performance.	Analyze
CO3: Develop projects that leverage generative models for practical applications	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	2	-	-	-	-	-	-	-
CO3	-	-	-	-	3	-	-	-	2	-	2	-	2	-

High-3; Medium-2; Low-1

Text Book(s):

T1. David Foster, “Generative Deep Learning”, 2nd Edition, O'Reilly, 2023

Reference Book(s):

R1. James Phoenix, Mike Taylor, "Prompt Engineering for Generative AI," O'Reilly, 2024.

R2. Stephen Few, "Designing Large Language Model Applications ", O'Reilly, 2024.

R3. Altaf Rehmani, “Generative AI for everyone”, Weekendai, 2024.

Web References:

1. https://pytorch.org/tutorials/beginner/basics/intro.html.

2. https://kailashahirwar.medium.com/a-very-short-introduction-to-diffusion-models a84235e4e9ae

3. https://docs.github.com/en/copilot.

Course Code: 23CSE014		Course Title: Machine Learning	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on classical and foundational concepts, results, methodologies and applications in machine learning and apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Module I **15 Hours**

The Machine Learning Landscape – Classification: MNIST, Performance Measures, Multi class Classification, Multi label and Multi output classification, Error Analysis- Bayesian Learning: Bayes Theorem, Gibbs Algorithm, Naïve Bayes classifier, The EM Algorithm – Training Models: Linear regression, Gradient Descent, Learning Curves, Polynomial Regression, Regularized Linear Models, Logistic regression - Support Vector Machines (SVM): Linear SVM Classification, Non - Linear SVM Classification, SVM Regression – Decision Trees: ID3, C4.5, CART.

Module II **15 Hours**

Ensemble Learning and Random Forests: Voting Classifiers, Bagging and Pasting, Random Forests, Boosting, Stacking –Dimensionality Reduction: The curse of Dimensionality, Main Approaches for Dimensionality Reduction, PCA, Kernel PCA – Unsupervised Learning Techniques: Clustering, Gaussian Mixtures – Back propagation algorithm Resampling: Cross Validation, Bootstrapping – Linear Model Selection: Subset selection, Shrinkage methods, Dimension reduction methods – High Dimensional data.

List of Experiments **30 hours**

1. Develop Linear & Logistic regression model with regression metrics in order to fit data points. Select appropriate data set and generate graphs.
2. Design a Naïve Bayes classifier to classify the given dataset with classification metrics and generate ROC Curve.
3. Construct a Decision Tree classifier based ID3 and CART algorithm for appropriate data set and apply it to classify new sample.
4. Design SVM classifier to classify the dataset with classification metrics. Print both correct and wrong Predictions.

5. Design a k-Nearest Neighbor algorithm to classify the given dataset with classification & Regression metrics and generate ROC Curve.
6. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Utilize regression and classification algorithms for data modeling and prediction.	Apply
CO2: Model data classification using tree based methods and support vector machines for solving multi class problems	Apply
CO3: Design and apply various supervised and unsupervised models to solve real time complex problems.	Apply
CO4: Analyze the performance of machine Learning Models using appropriate metrics with an oral presentation.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	1	-	-	2	-	2	-
CO2	-	2	-	-	-	-	-	-	-	-	-	1	2	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	2
CO4	-	-	-	3	2	-	-	-	3	2	1	-	-	1

High-3; Medium-2; Low-1

Text Book(s):

T1. Aurelien Geron, “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems”, 3rd Edition, O’reilly Publications, 2022.

T2. Tom M. Mitchell, “Machine Learning”, Indian Edition, McGraw Hill Education, 2017.

Reference Book(s):

R1. Sebastian Raschka “Machine Learning with PyTorch and Scikit-Learn”, Packt Publishing, 2022.

R2. Ethem Alpaydin, “Introduction to Machine Learning”, 4th Edition, PHI Learning Private Limited, 2022.

Web References:

1. https://nptel.ac.in/courses/106/106/106106139/
2. https://archive.ics.uci.edu/ml/datasets.php
3. https://www.kaggle.com/

Course Code: 23CSE015		Course Title: Speech Processing	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

This course aims to provide a deep understanding of language modelling, phonetics, speech synthesis (TTS), and automatic speech recognition (ASR). Students will gain hands-on experience in text processing, signal analysis, and speech technology tools for real-world applications.

Module I **15 Hours**

COMMUNICATION AND LANGUAGE: Types of Communication – Human Communication: Verbal communication - Linguistic levels - Affective Prosody - Augmentative Prosody - Communication processes

LANGUAGE MODELLING: Text Normalization - Minimum Edit Distance - N-gram Language Models - N Grams - Evaluating Language Models - Smoothing - Word Classes and Part of Speech Tagging - Named Entities and Named Entity Tagging

Module II **15 Hours**

SPEECH PRONUNCIATION AND SIGNAL PROCESSING: Phonetics – Speech Sounds and Phonetic Transcription – Articulatory Phonetics - Prosody - Acoustic Phonetics and Signals

Text To Speech (TTS) and Automatic Speech Recognition (ASR): Speech Synthesis Systems - Key Problems in TTS – TTS Architectures - Automatic Speech Recognition – Feature Extraction - Architecture – TTS & ASR Evaluation

List of Experiments: **30 hours**

1. Implement text normalization and build an N-gram language model using NLTK and spaCy python packages
2. Implement POS tagging and Named Entity Recognition using NLP libraries.
3. Visualize pitch contours and compare variations in emotional speech vs. neutral speech.
4. Analyze and extract features from a speech signal using Librosa, SciPy and Matplotlib packages.

5. Implement a basic Text-to-Speech (TTS) system using different TTS libraries and evaluate the performance using gTTS, pyttsx3 packages.
6. Implement a model to Convert speech to text and evaluate the performance of the system.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply various Natural Language Processing techniques over text.	Apply
CO2: Analyze the different features of speech signals.	Analyze
CO3: Design TTS and ASR systems by selecting suitable architectures.	Apply
CO4: Evaluate the performance of speech systems using appropriate metrics.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	-	-	-	2	-	-	2	-	-	-	1	-
CO2	2	1	-	-	2	-	-	-	2	-	-	-	2	-
CO3	1	1	2	-	-	2	-	-	2	2	-	-	2	-
CO4	-	1	-	2	-	2	-	2	2	-	-	-	1	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Daniel Jurafsky, James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Pearson education, 2020.

Reference Book(s):

R1. Peter Vary, Rainer Martin, “Digital Speech Transmission and Enhancement”, 2nd Edition, Wiley publishers, 2023.

R2. Israel Cohen, “End-to-End Speech Processing with Deep Learning”, Springer publications, 2022**.**

R3. Thierry Dutoit, “Handbook of Text-to-Speech Synthesis” , Springer publications, 2020.

R4. Paul Taylor, “Text-to-Speech Synthesis”, Cambridge University Press, 2011.

Web References:

1. Speech Processing – URL: https://speech.zone/courses/speech-processing/

Course Code: 23CSE016		Course Title: Prompt Engineering for AI	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is designed to impart knowledge on the architecture and functioning of large language models (LLMs) and how they interpret and generate responses based on prompts.

Module I **15 Hours**

Introduction to Generative AI & Prompt Engineering - Introduction to Large Language Models for Text Generation - Tokenization, Context Windows, Temperature, Top-k, Top-p - Types of Prompts: Zero-shot, Few-shot, Chain-of-Thought - Prompt Grammar, Structure & Formatting - Role Prompting and Instruction-based Prompting - Advanced Prompting Strategies: ReAct, Tree-of-Thought, Self-consistency.

Module II **15 Hours**

Prompt Tuning: Soft Prompts, Prefix-Tuning - Prompt Evaluation and Metrics - Ethics, Safety, Bias & Prompt Injection - Domain-Specific Prompting: Text Generation -Question & Answers- Summarization- Code Generation - Prompting for Vision-Language Models - Multilingual Prompting & Translation - Chatbot and Assistant-Oriented Prompting.

List of Experiments: **30 Hours**

1. Implementation of basic Prompting.
2. Implementation of Chain-of-Thought and Self-Consistency Prompts.
3. Implement Prompting for Text Summarization.
4. Implement Prompting for Text Translation.
5. Implement Code Generation Prompting.
6. Design Role-Based Prompts for Chatbot applications.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design effective prompts using different strategies for Chatbot application.	Apply
CO2: Implement advanced strategies and prompt tuning for improved task performance.	Apply
CO3: Analyze prompt performance using evaluation tools and metrics, and optimize for accuracy, coherence, and safety.	Analyze
CO4: Design project that uses prompt engineering to solve a practical problem, integrating retrieval, chaining, or multi-modal components.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	1	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	1	-	-	-	-	-	-	-	-	-
CO3	-	2	-	3	2	-	2	-	-	-	-	-	1	-
CO4	-	-	1	-	1	1	-	-	1	1	-	1	1	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Nathan Hunter, “The Art of Prompt Engineering with ChatGPT A Hands-on Guide”, 2023.

T2. James Phoenix, Mike Taylor **“**Prompt Engineering for Generative AI”, O'Reilly Media, 2024.

Reference Book(s):

R1. Francois Chollet, “Deep Learning with Python”, 2nd Edition, Manning, 2021.

R2. Lewis Tunstall, Leandro von Werra, Thomas Wolf, “Natural Language Processing with Transformers” , Revised Edition, O'Reilly Media, 2022.

Web References:

1. NPTEL Course on Introduction to Large Language Models (LLMs) https://onlinecourses.nptel.ac.in/noc25_cs45/preview
2. Coursera Course on Prompt Engineering for ChatGPT https://www.coursera.org/learn/prompt-engineering
3. Udemy Course on ChatGPT Prompt Engineering https://www.udemy.com/course/chatgpt-prompt-engineering-free-course/?srsltid=AfmBOoryWQJofmm_fTjwmWbZji8Peuuce3rl9KOc9Wl78uayTgD66niK

ELECTIVES

VERTICAL III NETWORK SECURITY

Course Code: 23CSE017		Course Title: Distributed Systems	
Course Category: Professional Elective		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on basic concepts, design goals, and architectural styles of distributed systems. The course intends to provide the ability to analyse and implement core distributed system functionalities in real world applications.

Module I **22 Hours**

Characterization of Distributed Systems – Middleware and Distributed Systems – Design goals – Types of Distributed Systems.

Architectural styles: Layered architecture, Object based and service oriented architecture, Resource based architecture, Publish-subscribe architecture – Middleware organization – System Architecture – Case Studies: Network File System and the Web File System.

Inter-process Communication: External data representation and marshalling – Multicast communication – Remote Invocation: Remote Procedure Call – Remote Method Invocation.

Module II **23 Hours**

Naming: Names – identifiers-address – Flat Naming – Structured Naming – Attribute based naming – Synchronization: Clock synchronization – Logical clock – Mutual Exclusion – Election Algorithms – The bully algorithm.

Distributed Multimedia Systems: Introduction – Characteristics of Multimedia data – Quality of service management – Resource management – Stream adaptation – Case studies: Tiger, BitTorrent and End System Multicast.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design distributed systems by applying suitable architectural styles to ensure scalability and efficiency.	Apply
CO2: Implement inter-process communication mechanisms using Internet protocols in a distributed environment to enable efficient and reliable data exchange.	Apply
CO3: Implement synchronization techniques in distributed systems to ensure consistent identification and coordination among processes.	Apply
CO4: Design distributed multimedia solutions by managing resources and adapting streams to meet quality of service requirements in real-time environments.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	3	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	-	-	1	-	-	-	-	-	-	-	-	-
CO3	-	3	-	2	-	-	-	-	-	-	-	-	1	-
CO4	-	-	3	-	1	-	-	-	-	-	-	-	1	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Maarten Van Steen, Andrew S. Tanenbaum, “Distributed Systems”, 4th Edition, Pearson Education, 2023.

T2. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, “Distributed Systems: Concepts and Design”, 5th Edition, Pearson Education, 2019.

Reference Book(s):

R1. Unmesh Joshi, “Patterns of Distributed Systems”, 1st Edition, Pearson Education, 2023.

R2. Ian Gorton, “Foundations of Scalable Systems: Designing Distributed Architectures”, O'Reilly, 2022.

Web References:

1. https://www.sciencedirect.com/topics/computer-science/distributed-computing

2. https://onlinecourses.nptel.ac.in/noc21_cs87/preview

3. https://www.confluent.io/learn/distributed-systems/

Course Code: 23CSE018		Course Title: Information Security	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on information and network security principles, technologies, threats, software vulnerabilities, various forms of malware, detection methods.

Module I **22 Hours**

Introduction to Information Security – The Need for Security - Legal, Ethical, and Professional Issues in Information Security – Risk Management: Risk Identification, Risk Assessment and Risk Control - Security Technology: Access Controls, Firewalls, Intrusion Detection and Prevention Systems, Honeypots, Honeynets and Padded Cell Systems, Scanning and Analysis Tools – Authentication Protocols – Kerberos.

Module II **23 Hours**

Advanced Cryptanalysis - Secure Socket Layer - IP Security: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management – Software Flaws – Malware: Brain, Morris Worm, Code Red, SQL Slammer, Malware Detection – Malware Software based attacks – Information Hiding: Steganography – Insecurity in Software.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply risk management techniques to identify, assess and control security threats in an organizational context.	Apply
CO2: Implement security technologies and authentication protocols to protect information systems from unauthorized access and threats.	Apply
CO3: Apply cryptographic and network security techniques, to secure data transmission over networks.	Apply
CO4: Detect and analyze software vulnerabilities and malware threats, and apply appropriate mitigation strategies such as malware detection tools and secure coding practices.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	2		-	1	-	-	1	-	1	2
CO2	1	2	3	-	-	2	-	-	-	-	-	-	3	-
CO3	1	2	-	-	-	-	2	-	-	-	-	3	1	-
CO4	1	2	3	1	-	1	1	-	2	2	-	-	1	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Michael E. Whitman, Herbert J. Mattord, “Principles of Information Security”, 7th Edition, Cengage Learning Publishers, 2021.

T2. Mark Stamp, “Information Security: Principles and Practice” 3rd Edition, Wiley Publication, 2021.

Reference Book(s):

R1. Khumanthem Manglem Singh, “Applied Cryptography: Theory and Practice” , 1st Edition, PHI Publications, 2025.

R2. William Stallings, “Network Security Essentials: Applications and Standards” 6th Edition, Pearson Education Publishers, 2018.

R3. Dhiren R.Patel, “Information Security: Theory and Practice”, 2nd Edition, PHI Publications, 2010.

Web References:

1. NPTEL – Introduction to Information Security http://nptel.ac.in/courses/106106129/

2. NPTEL – Information Security - Secure Systems Engineering http://nptel.ac.in/courses/106106199/

Course Code: 23CSE019		Course Title: Cryptographic Techniques	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The objective of the course is to equip students with a thorough understanding of cryptographic techniques, focusing on encryption algorithms, key management, and secure communication protocols.

Module I **22 Hours**

Classical Encryption: Basic concepts – Security attacks – services and mechanisms – Characteristics of good ciphers – Security Standards.

Classical encryption techniques: Symmetric cipher– Substitution techniques and Transposition techniques – Steganography. Symmetric Ciphers: Block cipher design principles – Data Encryption Standard (DES) – Fields and finite field arithmetic – Advanced Encryption Standard (AES) – Block cipher modes of operation. Principles of random number generation – random number generators – Stream ciphers – RC4. Number theory concepts: Euclidean algorithm – Modular arithmetic – Prime numbers – Fermats and Euler's theorem – Discrete logarithms

Module II **23 Hours**

Hash Function and Digital Signature: Hash function: Applications – Secure Hash Algorithm (SHA) – Hash based Message Authentication Codes (HMAC) - Cipher-based Message Authentication Code (CMAC)

Digital signature: ElGamal digital signature scheme – Schnorr Digital Signature Scheme – Digital Signature Standard (DSS).

E-Mail Security: Pretty Good Privacy, S/MIME

IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, combining security associations.

Web Security: Web Security considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction.

Firewalls: Firewall Design Principles, Trusted Systems, Common Criteria for Information Technology Security Evaluation.

List of Experiments **30 hours**

1. Implement various traditional Substitution and Transposition techniques.
2. Implement DES and AES algorithms using Java built-in packages.
3. Implement RSA algorithm using Java built-in packages.
4. Develop Diffie-Hellman key exchange algorithm.
5. Implementation of Hash Function using Java built-in packages.
6. Implementation of Digital signature using Java built-in packages

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply classical encryption techniques to provide confidentiality services to address real time security challenges.	Apply
CO2: Implement symmetric key algorithms for encrypting text and multimedia data.	Apply
CO3: Design asymmetric key algorithms for confidentiality and use hash functions and digital signatures to secure documents.	Apply
CO4: Analyze key management and authentication protocols to assess their effectiveness.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	2	-	-	1	-	-	-	-	-	-	-	-
CO2	-	-	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	-	1	-	-	-	-	-	-	-	1	-	2	-
CO4	-	2	-	-	-	-	-	-	-	-	-	-	-	1

High-3; Medium-2; Low-1

Text Book(s):

T1. T1. William Stallings, “Cryptography and Network Security - Principles and Practices”, 8th Edition, Pearson Education, 2020.

T2. Behrouz A Forouzan and Debdeep Mukhopadhyay, “Cryptography and Network Security”, 3rd Edition, Tata McGraw Hill, New Delhi, 2016.

Reference Book(s):

R1. Atul Kahate, “Cryptography and Network Security”, 4th Edition, Tata Mcgraw Hill, New Delhi, 2020.

R2. Douglas R Stinson, “Cryptography - Theory and Practice”,4th Edition Chapman and Hall / CRC Press,New York, 2018.

Web References:

1. http://nptel.ac.in/courses/106105162/
2. https://www.tutorialspoint.com/cryptography/index.htm

Course Code: 23CSE020		Course Title: Embedded Systems	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to gain hands-on experience with real-time operating systems, communication protocols, and bus standards to effectively create and optimize embedded solutions for various applications.

Module I **15 Hours**

Introduction to Embedded Computing: Complex systems and microprocessors– Embedded system design process –Design example: Model train controller- Instruction sets preliminaries

ARM Processor Interfacing Techniques: GPIO register map – Pin Connect Block - 8 bit LEDs – 8bit Switches – Buzzer – Relay – Timer/Counter -Vector Interrupt Controller (VIC) – ADC –Temperature sensor interfacing.

Sensor Interfacing with Arduino: Basics of hardware design and functions of basic passive components-sensors and actuators-Arduino code - library file for sensor interfacing-construction of basic applications.

Module II **15 Hours**

Real Time Operating Systems: Tasks and states, scheduling, Inter Process Communication- Semaphore(s), Shared data problem, Priority Inversion Problem and Deadlock Situations, Message Queues, Mailboxes, Pipes - Introduction to µC OS II – Porting of µC OS II– RTOS functions.

Communication Devices and Bus Standards: I/O Devices: Types and Examples of I/O devices, Synchronous, ISO-synchronous and Asynchronous Communications from Serial Devices - Internal Serial-Communication Devices: SPI, UART – Serial Communication using I2C.

List of Experiments **30 hours**

Implement and test - 8 bit LED and switch Interface.

1. Implement and test Buzzer and Relay Interface in window security alarms.
2. Interfacing stepper motor and temperature sensor in Automated Temperature-Controlled Fan System.

3. Implement a program to transmit a message from one microcontroller and display it on another using UART.
4. Implement a timing loop to alternately turn on and off each LED, creating a visual alternating effect.
5. Design a LM35 temperature sensor with an ARM processor, read the temperature data, and plot a temperature vs. time graph using Graphics LCD.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply the concept of embedded system, microcontroller and their interactions in real time scenario.	Apply
CO2: Analyze the hardware design and development tools of ARM microcontroller for practical applications.	Analyze
CO3: Examine the significance of operating systems in embedded system design for Real Time operating Systems	Analyze
CO4: Analyze I/O devices, communication types, and bus Standards to configure and utilize serial communication protocols.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2					-	-	-	-	-	-	-	-	-
CO2		3			2	-	-	-	-	-	-	-	1	-
CO3			2			-	-	-	-	-	-	-	1	-
CO4				3		-	-	-	-	-	-	-	1	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Wayne Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Morgan Kaufman Publishers, 2016.

T2. Rajkamal, “Embedded Systems Architecture, Programming and Design”, 3rd Edition, Tata McGraw-Hill, 2017.

Reference Book(s):

R1. K.V.K.K.Prasad “Embedded /Real-Time Systems: Concepts, Design and Programming”, Dream Tech, Wiley 2019.

R2. Steve Furber, “ARM System – on – chip Architecture”, 2nd Edition, Addision Wesley, 2015.

Web References:

1. https://nptel.ac.in/courses/106/105/106105193/
2. https://www.coursera.org/learn/real-time-embedded-systems-concepts-practices

Course Code: 23CSE021		Course Title: Malware Analysis	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on malware analysis by exploring tools and techniques for detecting, analysing, and mitigating various types of malwares, including self-defence mechanisms.

Module I **15 Hours**

Introduction: Types of Malware - Malware Attack Life Cycle - Combat Teams- Anti-Malware Products - Tools: Hashing, CFF Explorer & PEView, Autoruns, Fakenet, Yara, PEiD, OllyDbg2.0, Cukoo sandbox, IDA Pro etc.

Basic Static Analysis: Antivirus Scanning, Fingerprint for Malware, Finding Strings, Packed and Obfuscated Malware, Portable Executable File Format, Linked Libraries and Functions, Static Analysis in Practice, Static Analysis in Practice, PE File Headers and Sections.

Advanced Static Analysis: IDA Pro Interface, Cross - References, Analysing Functions, Graphing options.

Basic dynamic analysis: Sandboxes, Running Malware, monitoring with Process Monitor, Viewing Processes with Process Explorer, Comparing Registry Snapshots with Regshot, Faking a Network, INetSim, Basic Dynamic Tools in Practice.

Advanced dynamic analysis: OLLYDBG: Loading Malware, Interface, breakpoints, Tracing, exception handling, Patching.

Module II **15 Hours**

Malware analysis in virtual machines: structure of Virtual Machine, Malware Analysis Machine, Risks.

Malware functionality: Downloaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Handles, Mutexes, Privilege Escalation- Covert malware launching: Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection, YARA rule based detection.

Android Malware Analysis: Android architecture, App framework, Static Analysis tools: Androguard, Radare2, Dex2Jar and JD-GUI, APKInspector - Dynamic Analysis Tools: TaintDroid, DroidBox, DECAF.

Anti-Malware analysis: Anti-debugging - Anti-VM - Anti-emulation - Anti-dumping – CFF explorer – Deadlisting - Analysis of HTML scripts - MS Office macro analysis - PDF file analysis – SWFTools – FLASM – Flare.

List of Experiments **30 hours**

1.Examine the Packing and Unpacking of malware using tools OllyDbg and CFF Explorer in a safe and isolated environment.

2.Analyse the structure of sample Portable Executable (PE32) File Format using tools like PEview, CFF explorer etc.

3.Analyse the threat posed by Malicious Microsoft Office and Adobe PDF Documents using tools like OLE Tools, PDF parser etc.

4.Perform Static and Dynamic Malware Analysis for the following.
Sandboxing the malware using SANDBOX tool: Cuckoo (open source)
Sample Malware analysis using Virus Total
Registry analysis using Any run
Malware analysis using hex code

5. Perform Anti Malware analysis using Tools IDA Pro / OllyDBG.

6. Perform static and dynamic analysis of mobile malware.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Construct a secure environment to **examine** malware packing/ unpacking and PE32 files using relevant tools.	Apply
CO2: Analyse both static and dynamic malware behaviour using a range of tools and techniques to solve real world problems	Analyze
CO3: Analyse malware functionality and covert launching techniques using static and dynamic Android malware analysis tools to identify malware patterns in practical scenarios.	Analyze
CO4: Analyse anti-malware techniques using various tools to develop independent problem-solving skills	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			2		2	-	-	-	-	-	-	-	2	-
CO2		2			2	-	-	-	-	-	-	-	-	2
CO3				2		2	-	-	-	-	-	-	-	-
CO4				2	2	-	--	-	-	-	-	-	-	1

High-3; Medium-2; Low-1

Text book(s):

T1. Abhijit Mohanta, Anoop Saldanha, “Malware Analysis and Detection Engineering a Comprehensive Approach to Detect and Analyze Modern Malware”, Apress, 2020.

T2. Michael Sikorski and Andrew Honig, “Practical Malware Analysis”, No Starch Press, 2017.

T3. Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, “Android Malware and Analysis", CRC Press, 2015

T4. Reginald Wong, “Mastering Reverse Engineering”, Packt Publishing Ltd, 2018.

Reference Book(s)

R1. Alex Matrosov, Eugene Radionov, and Sergey Bratus Blunden, “Rootkits and Bootkits: Reversing Modern Malware and Next Generation Threats”, No Starch Press, 2019.

R2. Victor Marak, "Windows Malware Analysis Essentials", Packt Publishing, O’Reilly, 2015.

Web References:

1. https://www.udemy.com/course/expert-malware-analysis-and-reverse-engineering
2. https://www.coursera.org/learn/malware-analysis-and-assembly
3. Medium-https://medium.com/@sakshi.benake/a-step-by-step-journey-into-malware-analysis-4417c7ea070a

Course Code: 23CSE022		Course Title: Blockchain Technology	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on blockchain technologies for various security applications.

Module I **15 Hours**

Blockchain Basics: History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Methods of Decentralization - Blockchain and Full Ecosystem Decentralization – Decentralized Autonomous Organization - Platforms for Decentralization.

Cryptocurrency: digital keys and addresses - transaction: life cycle, data structure, Types, Verification - mining – bitcoin networks – wallets - payments - Alternative coins: Theoretical foundations, Name coin, Zcash.

Module II **15 hours**

Ethereum: Ethereum Network – Components of Ethereum Ecosystem – Ethereum Development tools and frameworks: smart contracts, solidity language.

Web3 and Hyperledger: Introduction to Web3: Contract Deployment, POST Requests, Truffle – Hyperledger as a Protocol – Reference architecture – Hyperledger Fabric.

List of Experiments **30 hours**

1. Construct Merkle Tree for Hash-Based Data Integrity in blockchain Systems.
2. Implement Block Creation for validation mechanisms in Cryptocurrency blockchain.
3. Implement and Simulate ERC-20 Token Transfers for Cryptocurrency Transactions.
4. Perform Merkle Tree Construction and Mining for Transaction Verification.
5. Deploy and Interact with a Smart Contract Using Remix IDE.
6. Develop real time application using blockchain technologies.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Implement cryptographic techniques and blockchain fundamentals for secure block creation and validation.	Apply
CO2: Build blockchain systems for token transfers, block mining, and transaction validation.	Apply
CO3: Develop smart contracts using Solidity and Ethereum tools to interact with ecosystem components.	Apply
CO4: Design real world application using Smart Contracts and Hyperledger technologies adhering ethical standards.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	1	-	-	-	-	-	-	-	1	-
CO2	-	1	-	-	1	-	-	-	-	-	-	-	-	1
CO3	1	-	-	-	2	-	2	-	-	-	-	-	-	-
CO3	-	-	2	-	2	-	-	1	-	2	-	-	2	-

High-3; Medium-2; Low-1

Text book(s):

T1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, 2nd, Packt Publishing, 2018.

Reference Book(s)

R1. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction” Princeton University Press, 2016.

R2. Antonopoulos, “Mastering Bitcoin”, O’Reilly Publishing, 2015.

R3. E. Golden Julie, J. Jesu Vedha Nayahi, and Noor Zaman Jhanjhi ,” Blockchain Technology : Fundamentals, Applications, and Case Studies”, CRC Press, 2021.

R4. Antonopoulos and G. Wood, “Mastering Ethereum: Building Smart Contracts and Dapps”, O’Reilly Publishing, 2018.

Web References:

1. https://archive.nptel.ac.in/courses/106/104/106104220/
2. https://www.udemy.com/course/build-your-blockchain-az/
3. https://www.ibm.com/topics/blockchain

Course Code: 23CSE023		Course Title: Security in Quantum Computing	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to provide a mathematical foundation for Quantum Computing

Module I **15 Hours**

INTRODUCTION: Fundamentals of Linear algebra, Inner Products and Hilbert Spaces, Hermitian and Unitary Matrices, Vectors and Vector Spaces, Quantum computing – Principles, Elements and Properties.

MULTIPLE QUBITS AND ENTANGLEMENT: Multiple Qubits and Entangled States- Phase Kickback- More Circuit Identities- Proving Universality- Classical Computation on a Quantum Computer. Quantum Circuits - Single qubit gates- multiple qubit gates- design of quantum circuits -Quantum Teleportation

Module II **15 Hours**

QUANTUM ALGORITHMS: Quantum Programming - QASM, Q#, Deutsch's Algorithm, Deutsch Jozsa Algorithm, Simon's Periodicity Algorithm, Grover's Search Algorithm, Shor's Factoring Algorithm, Quantum Machine Learning, Quantum Neural Networks.

QUANTUM CRYPTOGRAPHY: Quantum Cryptography and Quantum Information Processing, Quantum Error Correction, Quantum Communication Protocols - Quantum Key Distribution - BB84 Protocol, Teleportation vs. Superdense Coding, Quantum Simulators – IBM Qiskit, Microsoft Quantum Development kit, Google Cirq, Quipper.

List of Experiments: **30 Hours**

1. Implement 16 Qubit random number generator.
2. Implement Quantum Teleportation algorithm.
3. Implement 5 Qubit Quantum Fourier Transform.
4. Design Deutsch Jozsa Algorithm to illustrate the speed of quantum.
5. Develop Shor's algorithm for integer factorization.
6. Implement Grover's Algorithm for pattern matching.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design quantum circuits using Qiskit to solve real world problems.	Apply
CO2: Implement quantum algorithms to provide security to the data.	Apply
CO3: Apply quantum algorithms to solve real world use cases.	Apply
CO4: Analyze various key exchange algorithms for securing the data	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				3	2					-	-	-	1	-
CO2	3									-	-	-	1	-
CO3	3					1				-	-	-	1	-
CO4		2								-	-	-	1	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Thomas G. Wong, "Introduction to Classical and Quantum Computing", Rooted Grove, 2022.

T2. James L. Weaver & Frank J. Harkins, "Qiskit Pocket Guide Quantum Development with Qiskit", O'Reilly, 2021.

Reference Book(s):

R1. Olivier Ezratty, "Understanding Quantum Technologies", Seventh Edition, 2024.

R2. Nielsen M. A., "Quantum Computation and Quantum Information", Cambridge University Press, 2013.

Web References:

1. Qiskit TextBook - https://qiskit.org/textbook/preface.html

2. https://archive.nptel.ac.in/courses/106/106/106106232/

3. https://onlinecourses.nptel.ac.in/noc25_cs31/announcements

Course Code: 23CSE024		Course Title: Edge Computing Practices	
Course Category: Professional Elective		Course Level: Practice	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on Edge computing, focusing on version control, continuous integration, deployment and automation

Module I **15 Hours**

Edge Computing and Its Essentials: Introduction, Edge computing Architecture, IoT devices, Networking architecture and management, interfaces and devices, simulators, research directions- Edge data analytics - Machine learning for edge devices - Edge Data Storage Security - high potential use cases.

Case studies: Pulse Oximeter to Detect Acute Respiratory Distress Syndrome (ARDS) in Edge Server, Blood Pressure to determine Hypotension in Edge Server - Firework: Data Analytics in Hybrid Cloud-Edge Environment

Module II **15 Hours**

Edge IoMT based enabled architecture for smart healthcare system: Applications and Challenges - Case study: diagnosis of diabetes mellitus.

HetNet / M2M/D2D communication in 5G technologies: Heterogenous networks - Device-to-Device communication - Machine-to-Machine communication - Heterogeneity and interoperability - Research issues and challenges

IoT for Smart healthcare: Edge computing infrastructure - Low power hardware architecture for edge computing devices - Edge computing for intelligent healthcare applications

List of Experiments: **30 Hours**

1. Build a simulation to manipulate edge environment components.
2. Perform automated test planning for evaluating resource management parameters.
3. Design a Worst-Fit service migration algorithm for optimal edge server allocation.
4. Develop a First-Fit algorithm to place services on the first edge server with sufficient resources.
5. Analyze custom metric collection and MessagePack-based log data to interpret simulation behavior.
6. Choose appropriate custom mobility and power consumption models and analyze their impact on simulation outcomes.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Construct simulation workflows and test automation to evaluate and improve decision-making strategies in resource constrained environments.	Apply
CO2: Develop simulation models and optimization algorithms using edge computing tools to solve real-world problems.	Apply
CO3: Choose suitable communication models to assess interoperability and challenges in complex networks.	Analyse
CO4: Examine edge computing infrastructure and hardware architecture to assess their effectiveness in smart healthcare IoT applications	Analyse

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	1	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	2	2	-	-	-	-	-	-	-	-
CO3	-	1	3	1	2	2	-	-	-	-	-	-	1	2
CO4	-	1	-	1	2	-	-	-	2	2	2	-	1	2

High-3; Medium-2; Low-1

Text book(s):

T1. Dr. Akash Kumar Bhoi, Victor Hugo Costa de Albuquerque, Samarendra Nath Sur Paolo Barsocchi,"5G IoT and Edge Computing for Smart Healthcare", Academic press, Elsevier, 2022

T2. Jie Cao, Quan Zhang, Weisong Shi, "Edge Computing_ A Primer", Springer International Publishing, 2018.

Reference Book(s)

R1. K. Anitha Kumari, G. Sudha Sadasivam, D. Dharani, M. Niranjanamurthy – "Edge Computing_ Fundamentals, Advances and Applications", CRC Press, 2021

R2. Buyya, Rajkumar Srirama, Satish Narayana - Fog and edge computing principles and paradigms-John Wiley & Sons, 2019

R3. Mohit Kumar - AI-Based Advanced Optimization Techniques for Edge Computing, wiley 2025

Web References:

1. https://www.coursera.org/learn/security-at-the-edge-first-course-1

2. https://onlinecourses.nptel.ac.in/noc24_cs66/preview

3. https://www.udemy.com/course/introduction-to-edge-computing/

ELECTIVES

VERTICAL IV SOFTWARE DEVELOPMENT

Course Code: 23CSE025		Course Title: Reliability Engineering	
Course Category: Professional Elective		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on software reliability engineering concepts, system dependability, failure behavior, and reliability assessment techniques to build a strong foundation in developing reliable software systems.

Module I **23 Hours**

Need for reliable software- reliability engineering concepts-basic definitions- fault prevention, fault removal, fault tolerance, fault/failure forecasting, the software reliability engineering process- software reliability and hardware reliability.

Software Reliability and System Reliability- Dependability - Failure behavior of X-ware System- Failure behavior of X-ware System - Developing Operational Profiles- Technical foundation -development procedure, test selection- best practice of Software Reliability Engineering

Module II **22 Hours**

Measurement based analysis of software reality : frame work - measurement techniques- analysis of software metrics for reliability assessment- static program complexity- dynamic program complexity- software complexity and software quality- software reliability modeling - software testing and reliability - operational profiles- time/structure-based software reliability estimation-software reliability tools: AT&T Software Reliability Engineering Toolkit- Computer Aided Software Reliability Estimation tool

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply software reliability engineering principles to improve the dependability of software systems.	Apply
CO2: Design reliable systems by applying software and system reliability principles.	Apply
CO3: Apply software testing techniques to assess and improve software reliability.	Apply
CO4: Apply reliability metrics and measurement techniques to evaluate software and system performance.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2						-	-	-	-	-	-	2	-
CO2				2			-	-	-	1	-	-	2	-
CO3			2		2		-	-	-	-	-	-	-	2
CO4	2				2		-	-	-	-	1	-	-	2

High-3; Medium-2; Low-1

Text Book(s):

T1. Anu G. Aggarwal, Abhishek Tandon, Hoang Pham," Optimization Models in Software Reliability", Springer Series in Reliability Engineering, 2022.

T2. Mangey Ram, "Recent Advancements in Software Reliability Assurance", CRC Press , 2019.

Reference Book(s):

R1. J.D. Musa, Software Reliability Engineering, McGraw Hill, New York , 2004

R2. Michael R. Lyu" Handbook of Software Reliability Engineering", McGraw-Hill ,1995

Web References:

1. https://www.ibm.com/think/topics/site-reliability-engineering

2. https://www.tpointtech.com/software-engineering-software-reliability

Course Code: 23CSE026		Course Title: Software Quality Assurance and Testing	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to equip students with software quality assurance principles and their integration into the software development lifecycle, focusing on effective testing strategies to ensure software quality

Module I **22 Hours**

Software Quality and Architecture: Need for Software Quality – Software Quality Assurance – Software Quality Factors: McCall's Factor Model – SQA System and Architecture – Pre-Project Components – Software Project Life Cycle Components – Infrastructure Component for error prevention and improvement – Management of SQA components – CASE Tools.

Software Quality Assurance Process: Reviews Objectives – Formal design Review – Peer Review – Expert Opinions – Procedures and work instructions – Templates – Checklists – Corrective and Preventive Actions process – Configuration Management – Documentation Control – SQA Units.

Module II **23 Hours**

Test Case Design: Testing as a Process – Test Case Design Strategies – Black Box Approach: Equivalence Class Partitioning, Boundary Value Analysis, Cause-and-Effect Graphing – State Transition Testing – White Box Approach: Test Adequacy Criteria, Coverage and Control Flow Graphs, Covering Code Logic – Data Flow and White Box Test Design – Loop Testing – Mutation Testing.

Levels of Testing: Need for Levels of Testing – Unit Test: Need, Plan & Design – Integration Test – System Test: Functional Testing – Performance Testing – Stress Testing – Configuration Testing – Security Testing – Recovery Testing – Regression Testing – Alpha, Beta, and Acceptance Tests – Test Planning – Test plan Components – Defect Lifecycle – Fixing / Closing Defects.

Case Study for Test Case Design and Levels of Testing: Online Banking System, E-Commerce Web Application, Online Learning Management System

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply Software Quality Assurance principles to design and implement quality control mechanisms in software projects.	Apply
CO2: Demonstrate on integrating software quality assurance components and process to ensure software quality with an oral presentation	Apply
CO3: Analyze the appropriate software testing strategies for designing test cases for any given problem	Analyze
CO4: Examine various levels of testing to determine their impact on software performance and security.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	2	2	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	2	-
CO4	-		-	3	-	-	-	-	-	-	-	-	2	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Daniel Galin, “Software Quality Assurance - From theory to implementation”, Pearson Education, 2016.

T2. Ilene Burnstein, “Practical Software Testing - A Process Oriented Approach”, Springer, 2010.

Reference Book(s):

R1. Alan Gilles, “Software Quality: Theory and Management”, 3rd Edition, Thomson Computer Press, 2011.

R2. Srinivasan Desikan, Gopalaswamy Ramesh, “Software Testing: Principles and Practice”, Pearson Education, 2008.

Web References:

1. Software Quality Assurance Tutorial: https://reqtest.com/testing-blog/software-quality-assurance/https://reqtest.com/testing-blog/software-quality-assurance/

2. Software Testing - NPTEL Course Content NPTEL Course Content URL: https://nptel.ac.in/courses/106/105/106105150/

3. Software Testing: https://www.toolsqa.com/software-testing/defect-life-cycle

Course Code: 23CSE027		Course Title: Design Patterns	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on developing reusable solutions while development of a software model. This course also helps to model a reliable and efficient design in order to reduce the amount of refactoring while developing a software.

Module I **15 Hours**

Fundamentals of Design Patterns: Design Pattern Configuration – Patterns of Structural Design and Behavioural Design - Design Pattern Classification

Factory Pattern: UML for Factory Method - Patterns for Factory Pattern Design

Observer Pattern: Participants in Design - Solution Based on the Observer Pattern - Class Diagram - Rules of Thumb

Template Method Pattern: Comparison with Factory Method – Implementation of Template pattern method using Python

Module II **15 Hours**

Singleton Pattern: Motivation - Design Pattern of Monostate /Borg Singleton - Early and Lazy Singleton Instantiation Pattern

Strategy Pattern: Fundamentals - UML Diagrams – Class, Object and Interaction diagrams

Other Patterns: Proxy Pattern – Bridge Patterns - Adapter and Façade Patterns

List of Experiments **30 Hours**

Implement the given real time application using the following types of patterns

1. Implementation of Factory Method
2. Implementation of Template Method Design Pattern
3. Implementation of Singleton and Strategy Design Pattern
4. Implementation of Proxy and Bridge Patterns
5. Implementation of Adapter and Façade Patterns
6. Source Code Analysis for Design Patterns using Open Source Tools

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Implement software patterns for the given real time applications.	Apply
CO2: Compare the features of various methods used to develop design patterns for the given application.	Apply
CO3: Apply open source tools to develop reusable and reliable solutions for software development.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	2	-	-	-	-	-	-	-	-	2	-
CO3	-	-	3	-	2	1	-	-	-	-	-	1	2	-

High-3; Medium-2; Low-1

Text book(s):

T1. Sufyan bin Uzayr, “Software Design Patterns: The Ultimate Guide”, CRC Press, 2022

Reference Book(s):

R1. Lalit Mehra, “Software Design Patterns for Java Developers”, BPB Publications, 2021

R2. Olaf Musch, “Design Patterns with Java: An Introduction”, Springer, 2023

R3. Gaurav Aroraa, Jeffrey Chilberto, “Hands-On Design Patterns with C# and .NET Core”, Packt Publishing, 2019

Web References:

1. https://nptel.ac.in/courses/106105224
2. “https://www.coursera.org/learn/design-patterns”

Course Code: 23CSE028		Course Title : Foundation Skills in Integrated Product Development	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart the conceptualization, design and development of a new product. Students will learn to design and validate a new product for various real world problems.

Module I **15 Hours**

Global Trends Analysis and Product decision - Social Trends - Technical Trends - Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

Module II **15 Hours**

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing - System Integration, Testing, Certification and Documentation.

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

List of Experiments **30 Hours**

Design a new products or improve existing ones, ensuring that the product meet customer needs, market demands and business goals like pen, Bottle, clock or any application and perform the test analysis.

1. PESTLE Analysis.
2. Traceability Matrix and Analysis.
3. Concept Screening & Evaluation.
4. Product Testing standards and Certification.
5. Product Documentation.
6. Product EoL.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply the concepts of designing for a new product by considering various global trends.	Apply
CO2: Perform validation of new product based on design specification.	Analyze
CO3: Apply product management plan for a new product based on the type of the new product and development methodology.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2											2	2	-
CO2		2		2									2	-
CO3	2												2	-

High-3; Medium-2; Low-1

Text Book:

T1. NASSCOM student Handbook "Foundation Skills in Integrated Product Development".

Reference Book(s):

R2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", 7th Edition, Tata McGraw Hill, 2020

R3. John W Newstrom and Keith Davis, "Organizational Behavior", 12th Edition, Tata McGraw Hill, 2017.

Web References:

1. https://onlinecourses.nptel.ac.in/noc21_me83/preview

2. https://ocw.mit.edu/courses/sloan-school-of-management/15-783j-product-design-and-development-spring-2006/

3. https://nptel.ac.in/courses/110/108/110108047/

Course Code: 23CSE029		Course Title: Full Stack Development	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

This course is designed to equip students with the knowledge and skills to develop both front-end and back-end components of web applications using modern technologies and frameworks.

Module1 **15 Hours**

Basics of Full Stack: Introduction to Web Development Framework - User - Browser - Webserver - Backend Services - MVC Architecture - Understanding the different stacks - The role of Express - Angular - Node - Mongo DB – React.

MongoDB: Understanding NoSQL and MongoDB - Building MongoDB Environment - User accounts -Access control - Administering databases - Managing collections - Connecting to MongoDB from Node.js.

Module II **15 Hours**

Node JS: Basics of Node JS - Installation - Working with Node packages -Node package manager - Creating a simple Node.js application - Using Events - Listeners -Timers - Callbacks -HTTP services

Express, Angular and React: Implementing Express in Node.js - Configuring routes - Using Request and Response Objects Angular - Typescript - Angular Components - Expressions - Data binding - Built-in directives, MERN stack - React Components.

List of Experiments **30 hours**

1. Build a web application that allows users to discover, play, and share music in real-time.
2. Build a social media platform that allows users to connect globally, share content, and interact with each other in real-time.
3. Develop a web-based CMS for blogging that allows users to create, manage, and share blog content with features for multimedia support and collaboration among authors.
4. Implement a real-time Project Management Dashboard that streamlines project management processes, enhances collaboration, and provides a comprehensive view of project progress.

5. Develop a real-time analytics web application that enables users to analyze, visualize, and gain insights from streaming data.
6. Develop a crowd funding web application that provides a dynamic platform for creators to showcase their projects, attract backers, and manage funding in real-time.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Build dynamically enriched web pages using Node.js, MongoDB for real time applications.	Apply
CO2: Develop ExpressJS applications that defines routes and handle HTTP requests and responses.	Apply
CO3: Use front-end frameworks to develop fully functional front-end Applications.	Apply
CO4: Implement data handling and fetching in React applications.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	3	-	3	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	3	-	-	-	-	-	-	-	2	-
CO3	-	-	3	-	3	-	-	-	-	-	-	-	2	-
CO4	2	-		-	-	-	-	-	-	-	-	-	2	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, 2nd Edition, 2018.

T2. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', 2nd Edition, Apress, 2019.

Reference Book(s):

R1. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018.

R2. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018.

Web References:

1. https://www.tutorialspoint.com/the_full_stack_web_development/index.asp
2. https://www.coursera.org/specializations/full-stack-react
3. https://www.udemy.com/course/the-full-stack-web-development/

Course Code: 23CSE030		Course Title: DevOps Technologies	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on DevOps technologies, focusing on version control, continuous integration, deployment and automation.

Module I **15 Hours**

Introduction: Devops lifecycle, Version control, Continuous Integration, Continuous Deployment

Git and GitHub: Installation and Configuration: Git installation steps, Git Configuration steps, Setting up Github account, Connecting Git to Github - Hosting Project: Create and Cloning repository, Adding files, Commit, Push request – Project version control with Git: Updating Local repository, Branching, Comparing versions, Undoing changes, Tagging versions - Working with branches : Switching, Merging, Resolving conflicts-Collaborating with others on **GitHub:** Social coding, Forking a repository, Making Changes, Opening pull request, Receiving pull request, Fork synchronization - **Ansible:** Introduction, Simple Ansible playbook.

Module II **15 Hours**

CI with Jenkins: Installation steps of Jenkins – Methods to manage plugins - Simple plugins: Git, HTML publisher, SonarScanner, Email- Pipline: -scripted and declarative pipeline, Terms, CI/CD, work flow management, infrastructure management – Master/Slave Architecture- Global tool configuration: JDK, Maven, Ant, Gradle, Docker, Sonarqube - CI Pipeline with Pre-Deployment Steps integration: Artifact Upload to Nexus, Deployment to Dev Environment.

CI/CD with Jenkins and Docker: Container, Container engines, Architecture, Images, dockerfile, registry, CLI, Installation, containerization of application- CI Pipeline with Pre-Deployment Steps integration checks: Docker build, stage views of Code stability, Code quality, Unit testing, Code coverage and Security testing - Continuous deployment: Different kinds of environments, CD Testing elements, Deployment strategies, CD for QA environment.

List of Experiments **30 hours**

1. Demonstrate Source code management on GitHub with using Git.
2. Build a simple application using Gradle/Maven.
3. Create an Ansible playbook for a simple web application infrastructure.
4. Create a Jenkins job which will create a docker container from docker file which can run a java application.
5. Create CI/CD pipeline using Jenkins and docker with integration of SonarQube analysis.
6. Build automated deployment of real time applications.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Perform source code management using Git and GitHub by building repositories, branching, and merging.	Apply
CO2: Build automated deployment processes using Ansible by developing and executing playbooks.	Apply
CO3: Develop automated deployment for real-time applications using various devops tools through team work with oral presentation.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	2	-	-	-	-	-	-	-	2	-
CO2	-	-	3	-	2	-	-	-	-	-	-	-	2	-
CO3	-	-	3	-	2	-	-	-	2	1	-	-	2	-

High-3; Medium-2; Low-1

Text book(s):

T1. Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, 2nd, Kindle Edition, 2016.

T2. Sandeep Rawat, “CI-CD Pipeline with Docker and Jenkins: Learn How to Build and Manage Your CI-CD Pipelines Effectively” BPB publications, 2023.

T3. Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, Lean pub, 2023.

Reference Book(s)

R1: Mariot Tsitoara, “Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer”, Apress, 2020.

R2: Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2016.

R3. Mitesh Soni, “DevOps for Web Development”, Packt Publishing, 2016.

Web References:

1. https://www.jenkins.io/user-handbook.pdf

2. https://maven.apache.org/guides/getting-started/

3. https://www.udemy.com/course/devops-git-github/

Course Code: 23CSE031		Course Title: Advanced Java Programming	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart comprehensive knowledge of enterprise-level Java technologies and frameworks.

Module I **15 Hours**

Servlet API: Servlet API Introduction - Servlet Life Cycle(SLC) - Types of Servlet - Servlet Configuration and Context - Attributes in Servlet - Response and Redirection objects

JSP: JSP Architecture - JSP life cycle - Scripting elements - Implicit objects - Directives - Actions - JSP Error handling

RMI: Introduction – Architecture of RMI – Creating and Executing RMI applications

Module II **15 Hours**

Hibernate: Hibernate and Object Relation Mapping (ORM) - Hibernate Architecture and Configuration - Hibernate Annotation - Hibernate Query Language (HQL)

Spring: Introduction to Spring Framework – Spring Core concepts – Aspect Oriented Programming in Spring (AOP) - Spring Bean lifecycle and Configuration - Spring MVC (Model-View-Controller) architecture – Data Access in Spring – Introduction to Spring Boot

List of Experiments: **30 Hours**

1. Develop web applications using Servlets to manage and respond to the client requests.
2. Develop a real time application using JSP to handle user input and display dynamic content.
3. Build a simple multi-client chat application using RMI callbacks.
4. Use Hibernate Query Language (HQL) to retrieve and manipulate the persistent data.
5. Develop database-driven applications using Hibernate.
6. Implement Spring MVC framework to handle form inputs and display data.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop static web applications that communicate with backend services to create structured and maintainable solutions	Apply
CO2: Build and deploy dynamic web applications independently or collaboratively through effectively teamwork.	Apply
CO3: Apply industry-standard frameworks to promote modularity and scalability in application development.	Apply
CO4: Analyze the performance of web applications by effectively integrating user interface components and frameworks.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3			-	-	-	-	-	-	-	2	-
CO2			3		3	-	-	1	1	1	1	-	2	-
CO3	3				3	2	1	-	-	-	-	2	2	-
CO4		2			3	-	-	-	-	-	-	-	2	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Jim Keogh, “J2EE: The Complete Reference”, McGraw Hill Education,10th edition 2022.

T2. Catalin Tudose, “Java Persistence with Spring Data and Hibernate”, Manning Publications, 2023.

Reference Book(s):

R1. Kathy Sierra, Beta Bates, Trisha Gee, “Head First Java: A Brain-Friendly Guide”, 3rd Edition, O’Reilly, 2022.

R2. Paul Fisher and Brian D. Murphy, “Spring Persistence with Hibernate”, Second edition, Apress, 2016.

Web References:

1. Udemy Course on JSP, Servlet, JSLT + Hibernate: A complete guide: https://www.udemy.com/course/jsp-servlet-free-course/?couponCode =ST13MT80425G3

2. Oracle, Java Tutorials: https://docs.oracle.com/javaee/7/tutorial/index.html

Course Code: 23CSE032		Course Title: Robotic Process Automation Design	
Course Category: Professional Elective		Course Level: Practice	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objective:

The course is intended to impart knowledge on the principles of Robotic Process Automation (RPA) and to equip students with the skills needed to automate repetitive tasks and improve operational efficiency.

Module I **15 hours**

RPA Environment: Components of RPA - RPA Platforms - Types of Robot - RPA Orchestrator - Learning RPA Studio

Programming Workflow: Sequencing the workflow - Various types of loops and decision making Assign activity - Delay activity- Break activity - While activity Do While activity- For Each activity- If activity - Switch activity

Data Manipulation and Controls Variables and scope- Collections - Arguments - Data table usage - Clipboard management - File operations - Mouse and Keyboard Activities - UiExplorer

Module II **15 Hours**

Plugins: Terminal plugin - Java plugin- Citrix automation- Mail plugin - PDF plugin Web integration- Excel and word plugin - Credential management.- System event triggers monitoring - Image and element triggers monitoring.

Exception Handling: Exception handling - Common exceptions- Debugging techniques- Collecting crash dumps- Error reporting- Project organization - Layout for each workflow - Nesting workflows- Reusability of workflows

List of Exercises: **30 Hours**

1. Generate recording of a web-based application and windows-based application using RPA studio.
2. Develop an automation that utilizes both If and Switch activities to handle conditional logic.
3. Build a data table using Data Scraping techniques from a web or application source.
4. Construct a program to read an Excel file and creating a data table by using data from the Excel file.
5. Create automation workflows to interact with virtual environments using image and text-based automation.
6. Create an automation that includes Exception Handling to manage errors during activity execution.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop an RPA environment that effectively supports process automation	Apply
CO2: Develop RPA programs that integrate file operations with simulated mouse and keyboard controls for task automation	Apply
CO3: Perform automation using plugins and extensions through assistant bots and event triggers.	Apply
CO4: Apply exception handling techniques for automation activity to handle real time scenarios.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			2		1	-	-	-	-	-	-	-	1	-
CO2			2		1	-	-	-	-	-	-	-	1	-
CO3	2				1	-	-	-	-	-	-	-	-	2
CO4	2					1	1	-	-	-	-	-	-	2

High-3; Medium-2; Low-1

Text Book(s):

T1. Alok Mani Tripathi **"**Learning Robotic Process Automation", Packt Publishing, 2023

Reference Book(s):

R1. Robotic Process Automation with Automation Anywhere, Packt Publishing Limited, April 2022.

R2. Romil Rawat, Rajesh Kumar Chakrawarti, Sanjaya Kumar Sarangi, Rahul Choudhary, Anand Singh Gadwal, Vivek Bhardwaj "Robotic Process Automation", September 2023, Wiley-Scrivene.

Web References:

1.Robotic Process Automation (RPA) Specialization:
https://www.coursera.org/specializations/roboticprocessautomation

2 Introduction to Robotics: .https://onlinecourses.nptel.ac.in/noc21_me32/preview

3.Robotic Process Automation (RPA): https://www.udemy.com/topic/robotic-process-automation/?srsltid=AfmBOoq1z35EGcZcLggQwSmIwvgjwBBD63OsxleUrmPTzoNY16os1DM

ELECTIVES

VERTICAL V HUMAN COMPUTER INTERACTION

Course Code: 23CSE033		Course Title: 3D User Interface	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is designed to equip learners with the theoretical knowledge and practical skills necessary to design and evaluate 3D User Interfaces (3D UIs), with a strong emphasis on Human-Computer Interaction (HCI) principles and cutting-edge Virtual Reality (VR) technologies.

Module I **22 Hours**

Introduction to 3D User Interfaces - Selection and Manipulation - Manipulation Tasks Input Devices - Interaction Techniques. System Control - Classification - Graphical Menus - Voice, Gestural Commands and Tools - Multimodal System Control - Symbolic Input Tasks and Techniques.

Strategies for Designing and Developing 3D User Interfaces: Designing for Humans- Inventing 3D interface - Evaluation of 3D interface- Purpose and Tools - Evaluation metrics Characteristics of Evaluation and Approaches - Guidelines - 3D User Interfaces.

Module II **23 Hours**

Virtual Reality - Modern VR Experiences – Implications of VR – Visual Perception – Visual Rendering – Motion in real and virtual worlds - Tracking - Interaction – Evaluating VR Systems and Experiences.

Future of 3D User Interfaces - Augmented Reality- AR Interfaces as 3D Data Browsers - 3D Augmented Reality Interfaces - Augmented Surfaces and Tangible Interfaces - Tangible AR Interfaces - Design of Tangible AR - Time-Multiplexed Interaction in Tangible AR - Agents in AR - Transitional AR - VR Interfaces - Case Studies.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop efficient and accessible 3D UIs using universal design standards across multiple platforms.	Apply
CO2: Solve real-world problems by applying principles of 3D user interface design to create interactive systems using multimodal interaction techniques.	Apply
CO3: Design and apply multimodal interaction techniques in immersive 3D user interfaces for VR/AR systems to solve real world problems.	Apply
CO4: Design user-friendly interfaces by developing Augmented Reality (AR) interfaces as 3D data browsers and tangible AR systems.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			2	2	2	-	-	-	-	-	-	-	1	-
CO2	2		2		2	-	-	-	-	1	-	-	1	-
CO3			2		2	-	-	1	-	-	-	-	1	-
CO4	2		2		2	-	1	-	-	-	-	-	2	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Doug Bowman, Ernst Kruijff, Joseph J. LaViola Jr., Ivan Poupyrev, “3D User Interfaces: Theory and Practice”, Addison-Wesley, 2nd Edition, 2017.

T2. Steven M. LaValle, “Virtual Reality”, Cambridge University Press, 2017.

Reference Book(s):

R1. Francisco R. Ortega, Fatemeh Abyarjoo, Armando Barreto, Naphtali Rishe, Malek Adjouadi, “Interaction Design for 3D User Interfaces” CRC Press 2016

R2. Rajeev Tiwari, Neelam Duhan, Mamta Mittal, Abhineet Anand, “Multimedia Computing Systems and Virtual Reality”, CRC Press, 1st Edition, 2024.

Web References:

1. https://onlinecourses.nptel.ac.in/noc21_ar05/preview

2. https://www.coursera.org/learn/3d-interaction-design-virtual-reality

Course Code: 23CSE034		Course Title: Wearable Technology	
Course Category: Professional Elective		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

This course is intended to provide students with the knowledge and skills to apply wearable sensor technologies, wireless communication systems, and health platforms, and to analyze haptic interfaces and body area networks for healthcare and assistive applications.

Module I **22 Hours**

Role of wearable - Attributes of wearable - Meta wearable - Challenges, opportunities and future - Inertia movement sensors - Physiological Sign Sensors: Respiration activity, Galvanic Skin Response, Pulse Oximetry, Thermal Sensors, Gas sensors, Cardiopulmonary Activity Systems- Case study: smart watch for health monitoring

Wireless Communication Standards for Wearable Systems: System Level Considerations, Lower Level Tradeoffs, Applications - Wireless Health Platforms: System architecture requirements and design, MicroLEAP, SmartCane.

Module II **23 Hours**

Wearable haptics: Categories of wearable haptic and tactile display, fingertip manipulation, a wearable sensorimotor enhancer – Wearable bio impedance systems for home care monitoring using BSNs - Detection and characterization of food intake by wearable sensors-Assistive devices for individuals with severe paralysis.

Body area networks: Architecture, Applications, Middleware for a BAN based pervasive health monitoring system - BAN models and requirements -Security in BAN

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply knowledge of sensor integration and signal processing to demonstrate real-time data acquisition and analysis.	Apply
CO2: Utilize System design and wireless communication skills to develop wearable system applications for health monitoring.	Apply
CO3: Analyze wearable haptic and BSN systems to evaluate their effectiveness in real world applications.	Analyse
CO4: Compare body area network architectures and sensor systems for health monitoring and assistive applications.	Analyse

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	2	1	-	-	1	1	-	-	-	-	-	-	-	1
CO3	2	2	1	1	2	2	-	-	-	-	-	-	-	2
CO4	2	2	2	2	2	2	-	-	2	2	-	-	-	2

High-3; Medium-2; Low-1

Text Book(s):

T1. Edward Sazonov and Micheal R Neuman, “Wearable Sensors: Fundamentals, Implementation and Applications”, Academic Press, Elsevier, Second Edition, 2020.

T2. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2014.

T3. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, “Body Area Networks Safety, Security, and Sustainability”, Cambridge University Press, 2014.

Reference Book(s):

R1. Al-Turjman, Fadi, “Internet of Nano-Things and Wireless Body Area Networks (WBAN)” CRC Press, 2019.

R2. Vladan Koncar, “Smart Textiles and their Applications”. Woodhead Publishing, Elsevier, 2016.

R3. Zhang and Yuan-Ting, “Wearable Medical Sensors and Systems”, Springer, 2024.

Web References:

1. https://www.coursera.org/learn/wearable-technologies
2. https://www.futurelearn.com/info/courses/internet-aging/0/steps/298361
3. https://www.classcentral.com/subject/wearables

Course Code: 23CSE035		Course Title: Digital Image Processing Techniques	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is designed to impart knowledge of basic image processing methods, including image enhancement and restoration techniques. It also covers image compression and segmentation algorithms, as well as feature extraction and image pattern classification methods.

Module I **15 Hours**

Image Processing Methods: Steps in Image Processing - Image Sensing and Acquisition – Sampling and Quantization – Relationships between Pixels: Pixel Connectivity, Distance Measures – Color Fundamentals and Models - Image Transforms: DFT, DCT, Hadamard, Haar, Wavelet

Image Enhancement and Restoration: Gray level transformations - Histogram equalization and specifications - Smoothing Spatial filters - Pixel- domain sharpening filters: first and second order derivative - Frequency domain filters: Low-pass and High-pass - Model of Image Degradation/Restoration.

Module II **15 Hours**

Image Compression: Redundancies, Image Compression standards, Lossy and Loss-less predictive coding - **Image Segmentation:** Detection of isolated points, Line, edge detection models - Thresholding: global and adaptive – Region based segmentation.

Feature Extraction and Image Pattern Classification: Boundary feature descriptors - Region feature descriptors - Principal Component as feature descriptors - Whole image features: Harris-Stephens Corner detector - Scale Invariant Feature Transform (SIFT) – Pattern and Pattern classes - Pattern Classification using prototype matching

List of Experiments **30 hours**

1. Display the grayscale and color images before and after performing histogram equalization.
2. Perform Image Enhancement using spatial/ frequency domain filters.
3. Demonstrate the conversion between color space models.
4. Perform compression on an image using lossy and lossless predictive coding.
5. Implement the line and edge detection methods of an image.
6. Demonstrate image segmentation methods.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply image processing methods to enhance and restore digital images, and evaluate their effectiveness in real-world applications.	Apply
CO2: Analyze image compression techniques and segmentation methods, to identify their effectiveness in reducing image size and separating regions of interest.	Analyze
CO3: Apply feature extraction and image pattern classification techniques, to detect and classify patterns in various image datasets.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-		-	-	1	-	-	-	-		2
CO2	-	1	-	3	2	-	-	-	-	-	-	-	-	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	2

High-3; Medium-2; Low-1

Text Book:

T1. R.C. Gonzalez, R.E. Woods, “Digital Image Processing”, 4th Edition, Pearson Education, 2018.

Reference Books:

R1. Anil K Jain, “Fundamentals of Digital Image Processing”, 2nd Edition, Pearson India, 2015.

R2. Rafael Gonzalez, Richard Woods, Stevens Eddins, "Digital Image Processing using MATLAB", 3rd Edition, Gatesmark publishing, 2020.

R3. Sandipan Dey, “Image Processing Masterclass with Python”, BPB Publications, 2021

Web References:

1. https://www.coursera.org/learn/introduction-image-processing
2. https://nptel.ac.in/courses/117105135

Course Code: 23CSE036		Course Title: Graphics and Visualization	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart fundamental knowledge and practical skills in creating and interpreting visual representations of data using computer graphics.

Module I **15 Hours**

Introduction to Graphics – Coordinate Representations – Graphics Functions – Software Standards – Introduction to OpenGL – Coordinate reference frame – Specifying 2D using OpenGL – OpenGL point functions – OpenGL Line functions – Fill area primitives – Polygon Fill area – OpenGL polygon fill area functions.

Algorithms for graphics primitives: Line Drawing Algorithm: DDA, Bresenhams – Circle Drawing Algorithm – Ellipse Drawing Algorithm.

2D transformation: Basic transformations – Composite transformations – Clipping window – window to viewport transformation – Clipping algorithms: Point Clipping – Line Clipping – Cohen Sutherland Line Clipping algorithm – Polygon Clipping

3D transformation: 3D object representation – OpenGL functions – Quadratic and Cubic surfaces – 3D transformation. 3D viewing – Projection transformations – Orthogonal projections..

Module II **15 Hours**

Visualization of 3D objects: Visible surface detection methods – Classification – Back face detection – Depth Buffer method – A Buffer method – Scan Line method – Depth Sorting method – BSP tree method – Octree method.

Illumination and surface rendering: Light sources – Surface Lighting Effects – Surface rendering.

Multimedia System Design: Elements - Multimedia system architecture - Evolving technologies for Multimedia system - Defining objects - Multimedia Data Interface standards - Multimedia databases – Applications.

List of Experiments **30 hours**

1. Implement OpenGL built-in functions
2. Display complex objects using line drawing algorithms
3. Demonstrate the Circle and Ellipse drawing algorithms
4. Perform 2D and 3D transformation
5. Illustrate window to viewport transformation using line clipping algorithms
6. Perform visualization of 3D objects using latest tools

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Develop interactive computer graphics applications using OpenGL.	Apply
CO2: Perform 2D and 3D transformations on real world objects.	Apply
CO3: Analyze the various visualization techniques and identify the appropriate technique to effectively represent real world objects.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	2	-	-	-	-	-	-	1	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-		-
CO3	-	2	-	3	-	-	-	-	1	1	1	-	2	-

High-3; Medium-2; Low-1

Text Book(s):

T1**.** Donald D.Hearn, M.Pauline Baker, Warren Carithers, “Computer Graphics with OpenGL”, Pearson Education, Fourth Edition, 2015.

T2. Prabhat K Andleigh and Kiran Thakrar, "Multimedia Systems and Design", Prentice Hall of India, 2015..

Reference Book(s):

R1. John Vince, Mathematics for Computer Graphics, Springer-Verlag, 5th, 2017.

R2. Sumanta Guha, Computer Graphics through OpenGL: From Theory to Experiments, CRC press, 3rd Edition, 2019.

Web References:

1. https://www.csa.iisc.ac.in/~vijayn/courses/Graphics/index.html

2. https://onlinecourses.nptel.ac.in/noc20_cs90/preview

3. https://www.udemy.com/course/graphic-design-theory-for-beginners-course/

4. https://www.coursera.org/learn/interactive-computer-graphics

Course Code: 23CSE037		Course Title: Game Design And Development	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to enhance the students' creative game designing ability. Also course make the learners to work with unity tool for creating new game environments.

Module I **15 Hours**

Unity: Unity strengths and advantages – Scene view - Game view – Toolbar – Mouse and Keyboard – Hierarchy tabs – Simple program

3D space: 3D coordinate space - Place objects in the scene – The Scenery – Lights and cameras – Player's collider and Viewpoint – Transformations – Mouse Look – First Person Controls

Graphics: Raycasting – Reactive targets – Spawning enemies – Creating projectiles – Whiteboxing – Texture – Custom 3D models – Particle effects

Module II **15 Hours**

2D Game Development: Preparing projects – Displaying images – React to clicks – Game logics – Scoring – Restart option – UI controls

2D GUI in 3D: Setting up the GUI display – Interactivity in UI – Player movements and Animation – Jump action – Speed and Acceleration

Interactive items: Creating doors – Interacting with Objects – Inventory data – Game state – Inventory UI

List of Experiments **30 hours**

1. Create a new 3D project using unity interface and add basic game objects.
2. Create a simple 2D platform for a game with single player.
3. Design interaction between the player and the game world.
4. Design a 3D game environment with obstacles, enemies, and collectibles
5. Design and implement a user interface (UI) for 3D game.
6. Develop a Multiplayer game using unity.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Manipulate 2D and 3D game objects within a game environment	Apply
CO2: Develop a multiplayer game and manage game states effectively, both individually and as part of a team	Apply
CO3: Analyze the architecture and logic behind 2D and 3D game elements, to develop interactive gaming applications.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	3	-	-	-	2	2	-	-	2	-
CO3	-	2	-	2	3	-	-	1	-	-	-	-	2	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Joseph Hocking, “Unity in Action-Multiplatform game development in C#”, Manning Publications Co, 2nd Edition 2018.

T2. Jeremy Gibson Bond, “Introduction to Game Design, Prototyping, and Development: From Concept to Playable Game with Unity and C#”, Addison-Wesley Professional, 3rd Edition, 2022.

T3. Alan Thorn, “Practical Game Development with Unity and Blender”, Cengage Learning, 2016.

Reference Book(s):

R1. Alex Okita. A K Peters, “C# Programming with Unity 3D”, CRC Press, 2015.

R2. Jeff W Murray, “C# Game Programming Cookbook for Unity 3D”, CRC Press, 2nd Edition, 2021.

Web References:

1. https://unity3d.com/learn/tutorials
2. https://www.gamedesigning.org/learn/unity/
3. http://www.unity3dstudent.com/
4. https://www.coursera.org/specializations/game-development

Course Code: 23CSE038		Course Title : UI and UX Design Essentials	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 2: 0:2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart the knowledge on UI & UX tools and skills required to create a wireframe, prototype for real time applications.

Module I **15 Hours**

UI Fundamentals-Menus–Tabs-Bottom- tab -bar -Buttons –Accordion- Carousel Breadcrumbs –Modals- Forms-UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles –Sketching Principles - Sketching Red Routes - Responsive Design

Module II **15 Hours**

Intersection of Design, Technology, & Business-Knowing Your User-User Research Through Interviews-Refining User Research and Creating Personas-Wireframing – Creating-Wireflows - Building a Prototype -Prototyping & User Testing- Building High-Fidelity Mockups - Designing Efficiently with Tools- Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods -Synthesizing Test Findings - Prototype Iteration Branding - Style Guides- Creating Scenarios - Flow Diagrams

List of Experiments **30 Hours**

1. Design a responsive layout for a societal application
2. Construct various UI Interaction Patterns
3. Develop an Interface with Proper UI Style Guides
4. Develop wire flow diagram for application using open-source software
5. Design various open-source collaborative interface Platform
6. Develop a design Thinking Process for a new product

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design responsive and user-centered layouts for user applications utilizing various UI interaction patterns.	Apply
CO2: Apply UX Skills in any product or application development and evaluate UX design.	Apply
CO3: Demonstrate Sketching principles, Wireframe and Prototype for real time applications based on UI principles with an oral presentation.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	3	-	3	-	-	-	-	-	-	-	2	-
CO2	-	-	-	3	3	-	1	-	-	-	-	-	2	-
CO3	-	-	3	-	-	-	-	-	2	2	1	1	2	-

High-3; Medium-2; Low-1

Text Book:

T1. Joel Marsh, “UX for Beginners”, O’Reilly , 2022

Reference Book(s):

R2. Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly, 2021

R3. Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3rd Edition , O’Reilly, 2020

R4. Steve Schoger, Adam Wathan “Refactoring UI”, 2018

Web References:

1. https://www.nngroup.com/articles/
2. https://www.interaction-design.org/literature

Course Code: 23CSE039		Course Title: Multimedia System Techniques	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart knowledge in multimedia system design elements and techniques and further enhance the ability to create and optimize multimedia applications.

Module I **15 Hours**

Introduction to Multimedia: Components – Multimedia Software Tools – Multimedia tasks and presentation – Multimedia Editing and Authoring Tools – Graphics and Image Data Representation – Digital video – Display interfaces – Digitization of sound.

Multimedia Tools: Editing Tools – Painting and Drawing Tools – Image Editing Tools – Audio Editing Tools – Digital Movie Tools – Creating interactive presentations.

Module II **15 Hours**

Multimedia Data Compression: Lossless vs Lossy Compression Techniques – Lossless Compression: Variable Length Coding: Shannon-Fano Algorithm, Huffman Coding – Lossy Compression: Discrete Cosine Transform – Image compression standards.

Multimedia Information Sharing and Retrieval: Social Media Sharing – Cloud Computing for Multimedia services – Content-Based Retrieval in Digital Libraries.

List of Experiments: **30 Hours**

1. Create logos for websites and Edit images.
   Suggested tools: GIMP/ InkScape / Krita / Pencil
2. Perform audio editing, sound mixing and perform special effects like fade-in or fade-out.
Suggested tools: Audacity / Ardour
3. Perform audio compression by choosing a proper codec with audio editing tools.
4. Edit and mix video content, remove noise, create special effects, add captions.
   Suggested tools: OpenShot / Cinelerra / HandBrake

5. Compress and convert video file format to other formats.
6. Perform screen recording/editing and create E-learning module

   Suggested tools: EdApp / Moovly / CourseLab/ IsEazy and CamStudio/Ampache

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply multimedia authoring tools to develop structured multimedia presentations using audio, video and image data.	Apply
CO2: Create and Edit digital media content using multimedia editors and modeling software to meet the user requirements.	Create
CO3: Apply suitable compression techniques to compress multimedia data with minimal data loss.	Apply
CO4: Create simple e-learning modules to develop interactive contents.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3				3	-	-	-	-	-	-	-		2
CO2		2			3	-	-	-	1	-	-	-	2	-
CO3	3				3	-	-	-	-	-	-	-		-
CO4			3			-	-	1	1	1	-	-	2	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia", Third Edition, Springer Texts in Computer Science, 2021.

Reference Book(s):

R1. Rajeev Tiwari, Neelam Duhan, Mamta Mittal, Abhineet Anand, "Multimedia Computing Systems and Virtual Reality", CRC Press, 1st Edition, 2024.

R2. Ranjan Parekh, "Principles of Multimedia", Tata McGraw-Hill Reference: 2nd Edition 2017.

Web References:

1. https://www.sciencedirect.com/topics/engineering/multimedia-systems

2. https://www.vedantu.com/computer-science/multimedia

3. https://city-uk-ett.libguides.com/staff/multimedia/why-multimedia/types

Course Code: 23CSE040		Course Title: Mixed Reality	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on creating 3D objects & MR assets using MR tools. The course aims to enable the learners to develop simple MR applications considering the human and legal factors.

Module I **15 Hours**

Introduction: Fundamentals of AR, VR and MR - XR system - Immersion in XR- MR Devices; Foundation: Session Management – 3D Objects – Textures – Surfaces – Adding Physics – Portal – Adding Objects; AR tools: Geometry – Textures – Lighting – Place Holders – User Interactions - Location Tracking & Beacons; AR assets: Face Tracking Sessions – Face Geometry – Creating Assets – Blend Shapes – Enhancing UX – Vehicle Physics

Module II **15 Hours**

XR Hardware and Software: Hardware XR systems - VR Headsets - AR display devices, glasses - MR Devices - Software and Development Tools - Unity Game Engine; Applications : Gaming and Entertainment – Architecture and Construction – Science and Engineering – Health and Medicine – Education – Information Control and Big Data Visualization – Telerobotics and Telepresence; Human Factors Considerations: Physical Side Effects, Visual Side Effects – Legal Considerations – Moral and Ethical Considerations

List of Experiments: **30 Hours**

The experiments may be conducted using open source and free software tools like Unity (with free Personal license), Blender, Vuforia, 8thWall, and AR.js.

1. Setting up Development Environment by exploring immersion.
2. Working with 3D objects.
3. Implementation of Physics and portals.
4. Implementation of Hand and Eye Tracking.
5. Implementation of Face Tracking and Blend Shapes**.**
6. Implementation of a location-tracking.

Mini Projects on applications for industry use cases like Surgery Simulation & Training in Healthcare, Manufacturing & Engineering, Education & Military Training

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design 3D objects, apply textures and physics, and integrate them into immersive virtual environments.	Apply
CO2: Implement face tracking, face geometry, and blend shapes to create expressive and interactive AR experiences that enhance user engagement.	Apply
CO3: Analyze marker-based and location-based applications using open source tools.	Analyze
CO4: Develop domain-specific applications demonstrating interaction, portal navigation, and data visualization capabilities.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2		3	-	-	-	-	-	-	-	3	-
CO2	3				3	-	-	-	-	-	-	-	3	-
CO3		2		2	3	-	-	-	-	-	-	-		-
CO4			2		3	-	-	-	1	1	-	1	3	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Steve Aukstakalnis, “Practical Augmented Reality A Guide to the Technologies, Applications and Human Factors for AR and VR”, Pearson Education, Inc., 2017.

T2. Ralf Doerner et al., “Virtual and Augmented Reality (VR/AR): Foundations and Methods of Extended Realities (XR)”, Springer, 2022.

Reference Book(s):

R1. Chris Language, NamrataBandekar, Antonio Bello & Tammy Caron , “ARKit by Tutorials Building Augmented Reality Apps in Swift”, Raywenderlich Tutorial Team, Third Edition.

R2. Julie A.Jacko, “The Human Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications”, Third Edition, CRC Press, 2012.

R3. “The Swift Programming Language – Swift 3.0.1”, Apple Inc – Swift Programming series, 2016.

Web References:

1. Udemy course on Mixed Reality Development Fundamentals https://www.udemy.com/course/mixed-reality-development-fundamentals/
2. Courser course on Developing AR/VR/MR/XR Apps with WebXR, Unity & Unreal: https://www.coursera.org/learn/develop-augmented-virtual-mixed-extended-reality-applications-webxr-unity-unreal
3. NPTEL course on Foundation Course on Virtual Reality and Augmented Reality: https://elearn.nptel.ac.in/shop/iit-workshops/completed/foundation-course-on-virtual-reality-and-augmented-reality/?v=c86ee0d9d7ed

Diversified Electives

Course Code: 23ITE043		Course Title: Integrated Big Data Solutions	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objective

This course is intended to impart knowledge on distributed computing, NoSQL databases, and data warehousing for scalable data management, and to explore big data technologies for solving real-world problems.

Module I **22 Hours**

Distributed Computing: Introduction, Message Passing, Shared Memory, Consensus algorithms, Distributed Transactions, Mutual exclusions, dead locks, Local & Global time and state, Distributed file systems.

NoSQL: Introduction to NoSQL Databases, CAP Theorem, Type of NoSQL Databases, Key-Value Stores, Document Stores Column, Family Stores, Graph Databases.

Data Warehouse: Data Warehouse Basics, Data Warehouse Architecture, Modeling Facts, Modeling Dimensions, Schemas, Data Cleaning Techniques, ETL Process.

Module II **23 Hours**

Data Mining: Introduction, Data Mining Functionalities, Data Pre-processing, Data Cleaning, Data Integration and Transformation, Classification of Data Mining Systems.

Introduction to Big Data computing: Defining Big Data, 3 Vs, Challenges and Opportunities, Hadoop, Introduction to Apache Hadoop, Components of the Hadoop Ecosystem, Map Reduce Programming Model, HDFS: Architecture, HDFS Commands, Data Replication and Fault Tolerance.

Big Data Analytics Tools: Apache Spark, Spark's Role in Big Data Analytics, PySpark, Overview of PySpark, Data Processing with PySpark, Data Lakehouse Concepts Performance Considerations.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply distributed computing concepts to design and implement solutions for parallel and scalable systems.	Apply
CO2: Analyze various data storage and retrieval techniques in NoSQL databases to determine their effectiveness in high-performance application scenarios.	Analyze
CO3: Apply data warehousing concepts and data mining techniques to extract insights and inform decision-making in real-world scenarios.	Apply
CO4: Analyze the big data using Map-reduce programming in Both Hadoop and Spark framework.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	-	-	3	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	3	3	-	-	-	-	-	-	-	3	-
CO4	-	-	3		3	-	-	-	3	3	-	-	3	3

High-3; Medium-2; Low-1

Text Book(s):

T1. Andrew S. Tanenbaum, Maarten Van Steen, “Distributed Systems”, 3rd Edition, Pearson Education, 2017. (Unit 1)

T2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013. (Unit 2,3,4,5)

Reference Book(s):

R1. Jiawei Han, Micheline Kamber and Jian Pei, “Data mining concepts and Techniques”,3rd Edition, Elsevier, 2012.

R2. Tom White, “Hadoop: The Definitive Guide”, O"Reilly Publication and Yahoo! Press, 4th Edition, 2015.

R3. George Coulouris, Jean Dollimore, and Tim Kindberg, “Distributed Systems Concepts and Design”, 5th Edition, Pearson Education, 201

R4. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications,1st Edition ,2019.

Web References:

1.https://onlinecourses.nptel.ac.in/noc20_cs92/

2.https://hadoop.apache.org

3. https://www.ibm.com/cloud/learn/nosql-databases

Course Code: 23ITE047		Course Title: Intellectual Property Rights	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to learn the fundamental concepts of Intellectual Property Law, including patent classifications, trademark strategies, and copyright protections.

Module I **22 Hours**

Intellectual Property: An Introduction: Intellectual Property Law: Patent Law-Copyright Law-Trademark Law- Trade secret Law-Right of Publicity-Paralegal tasks in Intellectual Property Law-Ethical obligations of the paralegal in Intellectual Property Law-Trade secrets: Protectible as a trade secret-Maintaining trade secrets-Protecting an Idea.

Patents: Rights and Limitations: Sources of patent law-Subject matter of Patents: Utility Patents-Plant Patents-Design Patents-Design Patents and copyright-Design Patents and trademarks-Computer Software, Business methods and Patent Protection-Rights under Patent Law-Patent Requirements-Limitations on Patent Rights-Patent Ownership.

Module II **23 Hours**

Patents: Research, Applications, Disputes, and International Considerations: Patent Search Process-Patent Application Process-Patent Infringement-Patent Litigation, International Patent laws.

Principles of Trademark: Trademarks and Unfair Competition-Acquiring Trademark Rights-Types of Marks, Strong Marks Versus Weak Marks-Selecting and Evaluating a Trademark-International Trademark Laws.

Principles of Copyrights: Sources of Copyright Law- The Eight Categories of Works of Authorship-Derivative Works and Compilations- Rights and Limitations: Grant of Exclusive Rights–Copyrights Ownership- International Copyright Laws.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the fundamental concepts of Intellectual Property Law to real-world scenarios.	Apply
CO2: Demonstrate an understanding of the Rights and Limitations of various patents through practical examples.	Apply
CO3: Analyze the process of patent searching and application filing to assess its effectiveness in protecting intellectual property.	Analyze
CO4: Examine the principles of trademark and copyright to differentiate their roles and implications in intellectual property law.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	-	-	-	2	-	-	-	-	-	-	-	-	-	2
CO3	-	3	-	-	2	-	-	-	-	2	-	-	-	2
CO4	-	2	-	-	3	-	-	-	2	-	-	-	-	2

High-3; Medium-2; Low-1

Text Book(s):

T1. Richard Stim, “Intellectual Property: Copyrights, Trademark and Patents”, Cengage learning, 2nd edition 2012.

Reference Book(s):

R1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, 3rd Edition, 2013.

R2. Prabuddha Ganguli,”Intellectual Property Rights: Unleashing the Knowledge Economy”, McGraw Hill Education, 2017.

R3. David Llewelyn, Tanya Frances Aplin, “Intellectual Property Patents, Copyrights, Trademarks & Allied Rights”, Sweet & Maxwell, 2023.

R4. William F. Patry ,"Principles of Intellectual Property: Patents, Trademarks, and Copyrights", Wolters Kluwer, 2023.

Web References:

1. https://ipindia.gov.in/writereaddata/Portal/ev/sectionsindex.html

Course Code: 23AUE050		Course Title: Entrepreneurship Development	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives:

The course is intended to develop entrepreneurial mindset and skills by identifying and validating problems through human-centered design, analyzing markets and customers to create value propositions and MVPs, exploring business models with financial and feasibility analysis, and preparing investible pitch decks to attract stakeholders.

Module I **22 Hours**

Entrepreneurial Mindset

Introduction to Entrepreneurship: Definition – Types of Entrepreneurs – Emerging Economics – Developing and Understanding an Entrepreneurial Mindset – Importance of Technology Entrepreneurship – Benefits to the Society.

Opportunities

Problems and Opportunities – Ideas and Opportunities – Identifying problems in society – Creation of opportunities – Exploring Market Types – Estimating the Market Size, - Knowing the Customer and Consumer - Customer Segmentation - Identifying niche markets – Customer discovery and validation; Market research techniques, tools for validation of ideas and opportunities

Activity Session: Identify emerging sectors / potential opportunities in existing markets - Customer Interviews: Conduct preliminary interviews with potential customers for Opportunity Validation - Analyse feedback to refine the opportunity.

Prototyping & Iteration

Prototyping – Importance in entrepreneurial process – Types of Prototypes - Different methods – Tools & Techniques. Hands-on sessions on prototyping tools (3D printing, electronics, software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the prototypes.

Module II **23 Hours**

Business models & pitching

Business Model and Types - Lean Approach - 9 block Lean Canvas Model - Riskiest assumptions to Business Models – Using Business Model Canvas as a Tool – Pitching Techniques: Importance of pitching - Types of pitches - crafting a compelling pitch – pitch presentation skills - using storytelling to gain investor/customer attention.

Activity Session: Develop a business model canvas for the prototype; present and receive feedback from peers and mentors - Prepare and practice pitching the business ideas- Participate in a Pitching Competition and present to a panel of judges - receive & reflect feedback

Entrepreneurial Ecosystem

Understanding the Entrepreneurial Ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors. Financing models – equity, debt, crowdfunding, etc, Support from the government and corporates. Navigating Ecosystem Support: Searching & Identifying the Right Ecosystem Partner – Leveraging the Ecosystem - Building the right stakeholder network

Activity Session: Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers; angels; etc), Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or makerspace or interact with startup founders).

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply entrepreneurial mindset principles to identify societal problems and transform them into viable business opportunities.	Apply
CO2: Develop prototypes using suitable tools and techniques for the validated opportunities through iterative processes.	Apply
CO3: Demonstrate a Business Model Canvas using the Lean approach and pitch the startup idea effectively using storytelling and presentation skills.	Apply
CO4: Analyze customer segments, market size, and niche markets to validate entrepreneurial opportunities through market research and customer interviews.	Analyze
CO5: Evaluate the role and components of the entrepreneurial ecosystem to identify and engage the right ecosystem partners and funding models for	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	1	-	-	-	-	-	-	-	-
CO2	-	-	3	-	1	-	-	-	-	-	-	-	2	-
CO3	-	-	3	-	-	-	-	-	1	1	-	-	2	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	2	-	-	-	-	-	-	1	1	2	-

High-3; Medium-2; Low-1

Reference Book(s):

1.Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha Entrepreneurship, McGrawHill, 11th Edition,2020.

2. Ries, E. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to create Radically Successful Businesses. Crown Business, 2011.

3. Blank, S. G., & Dorf, B. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch.2012.

4. Roy, R. Indian Entrepreneurship: Theory and Practice. New Delhi: Oxford University Press,2017.

5. Osterwalder, A., & Pigneur, Y. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons, 2010.

Course Code:23AUE051	Course Title: Design Thinking and Innovation		
Course Category: Major		Course Level: Practice	
L:T:P: 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

The course is intended to equip learners with practical skills in design thinking, empathy, prototyping, testing, and implementation for user-centered innovation and effective product development.

Module I **17 + 6 Hours**

Introduction- Importance of Design Thinking, Human Centered Design, Six-Step Design Thinking Process-Framework for Innovation-DT-a nonlinear process.

Empathy-importance of empathy in design thinking- empathy vs sympathy- steps of empathize-understanding customer needs-empathy methods and tools-empathy map-5W 1H framework-empathize in UX/UI Design-users Interview

Module II **18 + 4 Hours**

Prototype: Introduction to Proof of concept-MVP-Prototype and its types-prototype methodology- innovation and its types-Tools for prototyping: concept sketching/CAD/3D Printing.

Testing: Importance of testing in product development-design validation-market analysis: TAM-SAM-SOM-EVG.

Implementation - redesign of solution and iterative process.

List of activities

Core Stream

Empathy

1. What challenges does the user face daily commuting to work place?
2. What are the user's biggest frustrations when interacting with vehicle maintenance engineer?
3. Understand the user for building old age home.

Define

1. A construction site supervisor needs better real-time communication tools because delayed updates cause safety risks. (Provide the empathy data)
2. “Drivers get confused by inconsistent road signs,” create: “How might we improve road sign clarity to reduce driver confusion?”
3. A daily commuter needs a safer way to cross busy intersections because current pedestrian signals are confusing and slow. (Provide the empathy data)

Ideate

1. Develop a creativity safer vehicle dashboard design
2. Develop an improved road drainage system
3. Design an innovative solution to reduce urban flooding caused by heavy rains.
4. Design a Hybrid engine designs incorporating solar panels on the car roof.

Prototype

1. Prototype development (both low fidelity and high fidelity) on any real world problem

IT and Circuit Stream:

Activity 1:

Students role-play as designers and users- create an empathy map with 4 quadrants: *Says, Thinks, Does, Feels*

Circuit Stream- Empathy Interview and Persona Creation

Define- development of problem Statement-Elements of a Good Problem Statement-Tools: Point-of-View (POV) Statements-How Might We (HMW) Questions-User Personas.

Ideation in Design Thinking-Importance of Ideation-Metrics of ideation -tools: Brainstorming-Mind Mapping-SWOT.

Activity 2:

IT Stream- SWOT analysis on software project idea.

Circuit Stream -Idea Pitch Canvas using Brainstorming + Mind Mapping

Convert ideas into quick prototypes and validate through early testing.

Activity 3:

IT Stream -Build a simple algorithm to test feasibility- TAM-SAM-SOM market analysis chart

Circuit Stream -MVP Canvas and Concept Sketching

Circuit Stream -Iterative Redesign and Peer Testing Sprint

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply design thinking tools like empathy mapping, problem definition, and ideation to create user-centered innovative solutions.	Apply
CO2: Apply prototyping, innovation, testing, and iterative redesign techniques in product development and market analysis..	Apply
CO3: Apply design thinking to develop, prototype, and validate innovative engineering solutions in capstone projects for real-world applications.	Apply

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	-	-	-	2			2	2	2	2	-	2	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Sabell Osann, Lena Mayer , Inga Wiele ,The Design Thinking Quick Start Guide: A 6-Step Process for Generating and Implementing Creative Solutions, Wiley, 2020.

T2. Christian Müller-Roterberg, Handbook of Design Thinking, Kindle Direct Publishing,2018.

Reference Book(s):

R1. Teun den Dekker, Design Thinking, Taylor & Francis, International edition, 2020.

R2. Kaushik Kumar, Divya Zindani, J.Paulo Davim, Design Thinking to Digital Thinking, Springer, 2019.

R3. S. Balaram, Thinking Design, SAGE Publications, 2011.

Course Code: 23MEE008		Course Title: PLM for Engineers (Common to all Programmes)	
Course Category: Minor		Course Level: Higher	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives:

The course is intended to apply Product Lifecycle Management (PLM) fundamentals and principles to develop strategies, manage product lifecycles, optimize engineering processes, configure Bills of Materials, and leverage digital manufacturing environments for practical applications and customer-centric use cases.

Module I **22 Hours**

Business Strategy in the PLM

Definition, PLM Lifecycle Model, Threads of PLM, Need for PLM, Opportunities and Benefits of PLM, Components and Phases of PLM, PLM feasibility Study, PLM Visioning, Strategy, Impact of strategy, Implementing a PLM strategy, PLM Initiatives to Support Corporate Objectives, Infrastructure Assessment.

Business Processes in the PLM and Product Development Concepts

Characteristics of PLM, Environment Driving PLM, PLM Elements, Drivers of PLM, Conceptualization, Design, Development, Validation, Production, Support of PLM. Engineering Vaulting, Product Reuse, Smart Parts, Engineering Change Management, Workflow Management.

Bill of Materials (E-BOM, M-BOM, S-BOM) and Process Consistency, Product Structure, Configuring BOM

Module II **23 Hours**

Digital Mock Up and Validation

Simulation Process Management, Variant Management, Digital Mock-Up and Prototype Development, Design for Environment, Virtual Testing and Validation, Marketing Collateral

Digital Manufacturing in the PLM

Digital Manufacturing, Benefits of Digital Manufacturing, Manufacturing the First-One, Ramp Up, Virtual Learning Curve, Manufacturing the Rest, Production Planning.

Customer Use Cases of the PLM

Impact and Challenges faced while implementing a successful PLM strategy -Rolls Royce, Nissan Motor, Sunseeker International, Xtrac, kesslers international and monier and weatherford international.

List of Exercises: **15 Hours**

1. Demonstrate the 2-Tier & 4-Tier Architectures and Basic Team center applications like Organization, Project, and Schedule Manager.
2. Create CAD and Non-CAD datasets (MS Office, Notepad, etc.) by using explicit and implicit Check-In and Check-Out to create multiple iterations
3. Create the access control (Read, Write, and Delete) for the given dataset and block the access rights to other group members belongs to the same department. Also Perform the Impact Analysis (Where Used and Where Referenced) of a given dataset which is used in multiple assemblies.
4. Create the Product Structure in Structure Manager with 5 components assembled in first level and 3 components Assembled in second, third and fourth level with the sub-assemblies and export the assembly in local drive. Also, demonstrate the Variant Management.
5. Export the CAD dataset as a JT file and perform the various visualization tasks like Measurements, Sectioning, PMI, and Mark-up using JT2GO application

Text Book(s):

T1. John Stark, “Product Lifecycle Management: Volume 1: 21st Century Paradigm for Product Realisation”, Springer International Publishing Switzerland, 4th Edition, 2020.

T2. Grieves Michael, “Product Lifecycle Management- Driving the Next Generation of Lean Thinking”, McGraw-Hill, 2010.

T3. Wang, Lihui; Nee, Andrew Y.C. (Eds.) Collaborative Design and Planning for Digital Manufacturing, Springer, 2009.

Reference(s):

R1. Elangovan, U., “Product Lifecycle Management (PLM)”. Boca Raton, CRC Press, 2020.

R2. Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006.

R3. Antti Saaksvuori, “ Product Life Cycle Management” - Anselmi Immonen, Springer, 3rd Edition, 2008.

Course Outcomes	Cognitive Level
At the end of the course students will able to	
CO1: Apply the fundamentals of PLM principles to develop a PLM strategy for a system.	Apply
CO2: Apply PLM principles to manage product lifecycles, optimize engineering processes, and configure Bill of Materials with consistent workflows	Apply
CO3: Apply the Digital Manufacturing environment using PLM for use cases.	Apply
CO4: Develop and present a report individually by applying various modules of PLM software for an engineering project.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	-	-	-	-	-	-	-	-	2	-
CO2	3	-	-	-	-	-	-	-	-	-	1	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	-	-	-	-	1	1	-	-	2	-

High-3; Medium-2; Low-1

Open Electives

Course Code: 23CSO001		Course Title: Management Information System	
Course Category: Minor		Course Level: Intermediate	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to impart a comprehensive understanding of the fundamental concepts, components and functions of Management Information Systems (MIS) and acquire skills in designing and developing MIS by creating system requirements, design specifications and implementation plans.

Module I **22 Hours**

Management Information system(MIS) concept – Role of MIS – Impact – MIS and the User – Management as a control system – Effectiveness – Strategic management of Business performance – Creating model of Organization Excellence.

Strategic management of Business – Strategic design – Balance scorecard – Dash board – Information requirement – Information quality in MIS – MIS development process model. Case Study: EFQM model for organization excellence.

Organizational and Information System Structure – Data and Information – Management and Decision Making – Classification of Information Systems – MIS in Organizations – Case Study: Office Automation System.

Module II **23 Hours**

Nature and Characteristics of Organizations – Social Goals – Legal Framework – Professionalism – Organizational Context of Systems Analysis – SDLC – Feasibility Analysis – Computers and Information Systems – Case Study – Basic Library Information System.

Enterprise Management Systems – ERP, SCM, CRM, EMS and MIS – Decision Support System and Knowledge Management – Group DSS – Artificial Intelligence system – Expert system – Benefits of MIS – Business Intelligence for MIS – Case Study – Post ERP implementation benefits.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Choose appropriate MIS Business model for strategic management and process improvement.	Apply
CO2: Develop Decision Making systems using support of Information systems to excel in functional areas of Management.	Apply
CO3: Apply suitable emerging system for improving Business in key performance areas.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	1	1	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Waman S Jawadekar, Sanjiva Shankar Dubey, “Management Information System: Text and Cases”, 6th, Tata McGraw Hill, 2020.

Reference Book(s):

R1. Robert Schultheis and Mary Summer, “Management Information Systems – The Managers View”, Tata McGraw Hill, 2018.

R2. Gordon Davis, “Management Information System: Conceptual Foundations, Structure and Development”, Tata McGraw Hill, 2017.

Web References:

1. https://pdfcoffee.com/management-informationsystems-pdf-free.html
2. https://nptel.ac.in/courses/110/105/110105148/
3. https://www.researchgate.net/publication/256039738_Management_Information_System_ for_Effective_and_Efficient_Decision_Making_A_Case_Study

Course Code: 23CSO002		Course Title : Relational Database Management System	
Course Category: Minor		Course Level: Intermediate	
L:T:P(Hours/Week) 3:0:0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to impart knowledge on database fundamentals, develop skills in designing databases and apply SQL for database manipulation.

Module I **23 Hours**

File System – Database System – File System Vs. DBMS – Roles in DBMS Environment– Data Models and Conceptual Modeling – Functions of DBMS – Components of DBMS – Multi user DBMS Architecture Relational Model: Terminology, Integrity Constraints – Relational Algebra

ER Modeling: Concepts, Relationship Types, Attributes, Structural Constraints – Normalization: Data Redundancy and Update Anomalies, Functional Dependencies,1NF, 2NF, 3NF, BCNF SQL: Overview of Query Language, Data Types, Data Definition, Views, Access Control –Data Manipulation – Joins – Nested Queries

Module II **22 Hours**

Advanced SQL: Functions and procedures, Cursors, Triggers – Accessing SQL from a Programming Language – Query Processing: Decomposition, Heuristical Approach to Query Optimization, Cost Estimation for Relational Algebra Operations

Transaction: Properties – Concurrency Control: Locking methods, Deadlock, Timestamp Ordering, Multi-version Timestamp Ordering, Optimistic Techniques Database Recovery: Transaction and Recovery, Recovery facilities, Recovery Techniques

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design ER models using various constructs to simulate the real world databases.	Apply
CO2: Investigate the dependencies in a database and normalize to appropriate level.	Apply
CO3: Formulate structured and optimized queries to manipulate databases.	Apply
CO4: Implement different locking facilities in database system to enhance the management of concurrent transactions.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	3	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	1	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-

High 3; Medium-2; Low-1

Text Book(s):

T1. Thomas Connolly, Carolyn Begg, “Database Systems: A Practical Approach to Design, Implementation and Management”, 6th Edition, Pearson Education, 2015.

T2. A Silberschatz, H Korth, S Sudarshan, “Database System Concepts”, 7th Edition, McGrawHill, 2019.

Reference Book(s):

R1.RamezElmasri,Shamkant B. Navathe, “Fundamentals of Database Systems”, 7th Edition Pearson Education, 2017.

R2. C.J. Date, A. Kannan and S. Swamynathan– “An Introduction to Database Systems”, 8th Edition, Pearson Education, 2019 .

Web References:

1. http://www.inf.unibz.it/~nutt/IDBs1011/idbs-slides.html
2. https://nptel.ac.in/courses/106106093/
3. https://www.w3resource.com/sql-exercise

Course Code: 23CSO003		Course Title: Basics of Graphical User Interface Design	
Course Category: Minor		Course Level: Intermediate	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to impart a comprehensive understanding of the fundamental Human Computer Interaction concepts, Standards and various modes of user interactions and acquire skills in analyse user interactions, design interactive systems that enhance user experience, and critically assess the impact of technology on users in diverse contexts.

Module I **22 Hours**

Human: Input - Output Channel - Human Memory - Thinking: Reasoning and Problem Solving - Emotion - Psychology - Computer: Text Entry devices-Display Devices-Pointing Devices Memory-Processing and Networks.

Interaction : Modes of Interaction – Frameworks and HCI – Ergonomics – Interaction Styles – Windows Icon Pointer and Menus Interfaces – Interactivity – Context – Paradigms.

Process of Design - User Focus – Scenarios – Navigation Design – Screen design and Layout

Module II **23 Hours**

Prototyping – HCI Software Life Cycle – Usability Engineering – Iterative Design and Prototyping – Design Rationale

Principles – Standards – Guidelines – Golden Rules – Patterns – Implementation elements – Programming – Toolkits – UI Management Systems – Evaluation Techniques

Universal design Principles – Multimodal Interaction – Designing for Diversity – Requirements and approaches for User Support – Help Systems – Designing user Support systems

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply common interaction design patterns to enhance usability and provide consistent user experiences across platforms.	Apply
CO2: Choose appropriate modes of user interactions suitable for the given real time application.	Apply
CO3: Design user interfaces using standards and principles with an oral presentation.	Apply
CO4: Analyze universal design concepts to determine their effectiveness in enhancing user experience across diverse populations and interaction contexts.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-
CO3	2	-	3	-	-	-	-	-	-	2	-	-
CO4	-	2	-	3	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, 3rd Edition, Pearson Education, 2017.

Reference Book(s):

R1. Gerard Jounghyun Kim, “Human Computer Interaction: Fundamentals and Practice”, CRC Press, 2015.

R2. Samit Bhattacharya, “Human Computer Interaction”, McGraw-Hill, 2017.

Web References:

1. http://nptel.ac.in/courses/106103115/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-831-user interface-design-and-implementation-spring-2011/

Course Code: 23CSO004		Course Title: Green Computing	
Course Category: Minor		Course Level: Intermediate	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course is intended to explore the significance of green computing by examining strategies, green assets, business process management, and environmental aspects. It also addresses energy management, recycling methods, and virtualization concepts with relevant evaluation metrics in IT systems.

Module I **22 Hours**

Green IT Fundamentals: Business, IT, and the Environment – Green vision –Green value Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.

Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture – Green Enterprise Transformation Roadmap.

Energy Management: Process Reengineering - Teleworkers and Outsourcing - Paperless Office - Intranets -Electronic Data Interchange.

Module II **23 Hours**

Recycling: Problems - Means of Disposal, Life Cycle, Recycling Companies, Hard Drive Recycling, CDs and DVDs - Hardware Considerations: Energy Star, Servers and Remote Desktop.

Virtualizing IT Systems: Consolidation and Virtualization - Server Virtualization - Storage Virtualization – Client Virtualization - Creating Virtual Servers - Blade Servers and Virtualization - Impacts of Server Virtualization on Data Storage –**Metrics:** SPEC, EPA and LEED Green Building Rating System.

Case Studies: Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies: Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply green computing strategies and policies to develop sustainable engineering solutions by utilizing green assets.	Apply
CO2: Employ virtualization techniques to improve the efficiency and environmental sustainability of IT systems.	Apply
CO3: Apply business strategies with environmental considerations to solve real-world challenges across sectors like healthcare, packaging, and telecommunications.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	1	-	-	-	1	-	-	-	-	-
CO2	-	-	3	2	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	2	-	2	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1.Bhuvan Unhelkar, “Green IT Strategies and Applications-Using Environmental Intelligence”, CRC Press, April 2016.

T2. "Green Information Technology: A Sustainable Approach" by Mohammad Dastbaz, Colin Pattinson, and Babak Akhgar “Morgan Kaufman”, 1st ed. 2015..

Reference Book(s):

R1.Srivastava,Rajshree,Kautish Sandeep and Tiwari, Rajeev” Information and Communication Systems for a Sustainable Future (Green Engineering and Technology) “CRC Press,2020

R2. Wilson Rivera ,”Sustainable Cloud and Energy Services: Principles and Practice “Springer International Publishing AG; 1st edition. 2018

Web References:

1. https://www.techopedia.com/definition/14753/green-computing
2. http://nptel.ac.in/courses/110108056/module5/Lecture28.pdf
3. http://meity.gov.in/content/green-computing

Course Code:23CSO005		Course Title: Bio Informatics	
Course Category: Minor		Course Level: Intermediate	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

To understand and apply DNA sequencing methods, utilize bioinformatics resources and sequence databases. Students can also develop practical applications in bioinformatics research by performing sequence analysis.

Module I **23 Hours**

Introduction to Bioinformatics - Basic biomolecular concepts: Protein and amino acid - DNA & RNA Sequence - structure and function - Forms of biological information - Types of Nucleotide Sequence: Genomic DNA -Complementary DNA (cDNA) - Recombinant DNA (rDNA) - Genomic survey sequences (GSSs). DNA sequencing methods - Gene expression data - Bioinformatics Resources - NCBI,EBI,RCSB

DDBJ : Databases and bioinformatics tools - Organization of databases: data contents - purpose and utility - Open access bibliographic resources and literature databases: PubMed, Public Library of Sciences (PloS), CiteXplore.

Module II **22 Hours**

Sequence databases - Nucleic acid sequence databases - Protein sequence databases - Structure Databases - Sequence file formats - - Protein and nucleic acid properties: Proteomics tools - GCG utilities - Sequence Analysis- Basic concepts of sequence similarity - Scoring matrices: basic concept of a scoring matrix - Matrices for nucleic acid and protein sequences - matrix derivation methods and principles.

Sequence alignment - Measurement of sequence similarity: Similarity and homology- Pairwise sequence alignment: Needleman and Wunsch - Smith and Waterman algorithms for pairwise alignments - gap penalties.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Construct DNA sequences using bioinformatics tools such as NCBI, EBI, and RCSB to derive biological insights.	Apply
CO2: Implement DDBJ databases and PubMed for organizing and accessing bioinformatics literature resources in real-world applications	Apply
CO3: Analyze protein and nucleic acid sequence databases to evaluate sequence similarity using scoring matrices for addressing biological research challenges	Analyze
CO4: Examine sequence alignment techniques to assess similarity using various algorithms for solving real-world problems.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-		-	-	-	-	-	-	-	-	-
CO2	1	-	2	-	-	-	-	-	-	-	-	-
CO3	-	1	-	2	-	-	-	-	-	-	-	-
CO4	1	1	-	1	-	-	-	-	-	-	-	2

High – 3; Medium -2; Low - 1

Text Book(s):

T1. Baxevanis, A.D. and Francis Ouellellette - a Practical Guide to the Analysis of Genes and Proteins, Wiley India Prvate Ltd, 2020**.**

Reference Book(s):

R1. David W. Mount “Biological Sequence Analysis, consider Bioinformatics: Sequence and Genome Analysis”, Pearson Education,2020..

R2**.** Teresa K,Attwood and David J Parry-Smith,”Introduction to bioinformatics” Pearson Education,2015

Web References:

1. https://onlinecourses.swayam2.ac.in/cec21_bt04/preview

2. https://onlinecourses.nptel.ac.in/noc21_bt06/previewew

Course Code: 23CSO006		Course Title: Programming in C++	
Course Category: Minor		Course Level: Intermediate	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Course Objectives

The course aims to impart knowledge of the principles of Object-Oriented Programming (OOP) using C++. It intends to provide in-depth understanding of various OOP concepts to develop stand-alone applications.

Module I **23 Hours**

Introduction: C++ fundamentals: Data types, operators and expressions – Control flow- Elements of Object Oriented Programming- Classes & Objects – Modifiers: Access, Non-Access Modifiers- Constructors & Destructors – Inheritance Types of Inheritance

Module II **22 Hours**

Polymorphism: Method overloading, Method overriding Abstract Class- Virtual function – Virtual Base Class- Encapsulation and Data hiding

Exception handling – try,catch,throw paradigm-exception specification-terminate and unexpected exception-uncaught exception

C++ streams-console streams classes-formatted and unformatted I/O operations – manipulators-file streams-file modes- file operations-file pointers- file I/O

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply problem solving skills and knowledge of C++ programming constructs to solve a given problem.	Apply
CO2: Apply Object Oriented Programming Concepts to provide software Solutions.	Apply
CO3: Apply error-handling strategies to manage runtime errors and enhance the robustness of object-oriented programs.	Apply
CO4: Analyze the performance of C++ programs and use advanced concepts to implement optimized solutions.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	1	2	-	-	-	-	-	-	-	-	-	-
CO3	1	2	-	-	-	-	-	-	-	-	-	-
CO4	1	2	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. E.Balagurusamy, “Object Oriented Programming with C++”, 8th Edition, MC Graw Hill, 2021.

T2. Herbert schildt , “C++: The Complete Reference” , 4th Edition, MC Graw Hill , 2021.

Reference Book(s):

R1. Nicolai M. Josuttis,”C++20 - The Complete Guide”, 2022

R2. Bjarne Stroustrup, “C++ Programming Language”, 4th Edition, Pearson-2022

Web References:

1. https://onlinecourses.nptel.ac.in/noc24_cs125/preview
2. https://www.coursera.org/specializations/object-oriented-programming-s12n
3. https://onlinecourses.swayam2.ac.in/aic20_sp01/preview