Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
Udumalai Road, Pollachi, Coimbatore District - 642003
Established in 1998 ♦ Approved by AICTE ♦ Affiliated to Anna University
(A DIVISION OF NIA EDUCATIONAL INSTITUTIONS)
NAAC A++ GRADE
Cycle 3 (2023-2030)
The Highest Grade

Curriculum and Syllabi

B.Tech. Artificial Intelligence and Data Science

Semesters I to VIII

Regulations 2023

Dr. Mahalingam College of Engineering and Technology, Pollachi 642003.

(An autonomous institution approved by AICTE and affiliated to Anna University)

Department of Artificial Intelligence and Data Science

Vision

To build quality engineers with diversified knowledge to compete globally with innovations in the domain of Artificial Intelligence and Data Science

Mission

- To impart technical content in latest technologies through industry collaborative curriculum
- To produce young engineers with expert knowledge to hoist industry's growth
- To foster ethical engineers for resolving community issues through automation solutions
- To motivate engineers to employ ethical conduct of research for societal benefits

Programme: B.Tech. Artificial Intelligence and Data Science

Programme Educational Objectives (PEOs) - Regulations 2023

B.Tech. Artificial Intelligence and Data Science graduates will:

PEO1. Domain Knowledge: Possess diversified knowledge and expertise in the domain of Artificial Intelligence and Data Science

PEO2. Problem solving skills and Ethics: Apply computing skills to identify the challenges and to develop creative ethical solutions

PEO3. Lifelong Learning and development: Involve in lifelong learning, research and development to fulfill social needs using latest technology

Programme Outcomes (POs) - Regulations 2023

On successful completion of B.Tech. Artificial Intelligence and Data Science, graduating students/graduates will be able to:

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

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

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

PO4. Complex problem Investigation: Investigate complex problems by employing skills pertaining to knowledge acquisition, knowledge representation and knowledge engineering to arrive at valid conclusions

PO5. Modern Tool Usage: Evaluate and use Data analysis tools and AI based techniques for effective decision making in business and engineering domains

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 and present the actionable insights of data using reports through various modes for all professional activities

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

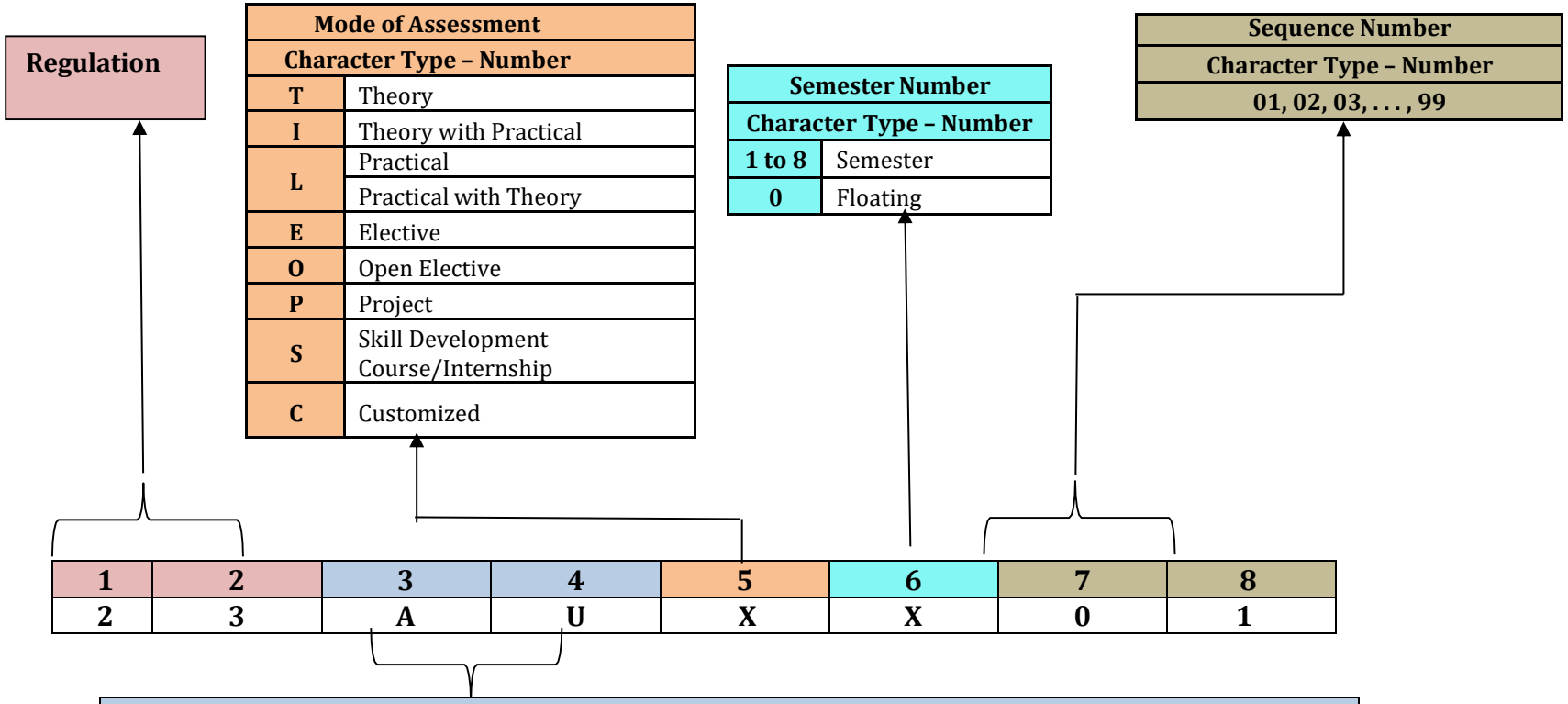
PO12. Life-long Learning: Engage in independent life-long learning and skill development for professional and social well being

Programme Specific Outcomes (PSOs) - Regulations 2023

PSO1. Software Automation: Develop customized automation solutions for Engineering and business problems using intelligent techniques.

PSO2. Data Engineering: Predict significant information and visualize large scale data using latest technologies.

Dr. Mahalingam College of Engineering and Technology, Pollachi
2023 Regulations - Course Code Generation Procedure for UG Courses



AD	Artificial Intelligence & Data Science	**ME**	Mechanical
AM	CSE (Artificial Intelligence & Machine Learning)	**SC**	CSE (Cyber Security)
AU	Automobile	**PH**	Physics
CE	Civil	**CH**	Chemistry
CS	Computer Science	**EN**	English
EA	Advanced Communication Technology	**MA**	Mathematics
EC	Electronics and Communication	**ES**	Employability Skills
EE	Electrical and Electronics	**VA**	Value Added Course
EV	VLSI Design & Technology	**SA**	Studio Activities
IT	Information Technology		

Programme: B.Tech. Artificial Intelligence and Data Science
2023 Regulations (For 2023 Batch Only)
Curriculum for Semester I & II

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

Semester I

Type of Course	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
Minor	23PHT001	Physics for Information Sciences	3	0	0	3	100	AD, AM, CS, IT, SC
Major	23CST101	Problem Solving using C	3	0	0	3	100	AD, AM, CS, IT, SC
Multidisciplinary	23EEI101	Basics of Electrical and Electronics Engineering	3	0	2	4	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	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	தமிழர் மரபு /Heritage of Tamils	1	0	0	1	100	All
AEC	23SAL101	Studio Activities	0	0	2	-	-	All
		Total	**15**	**0**	**16**	**22**	**900**	

Semester II

Type of Course	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	3	0	0			
Minor	23MAI203	Calculus and Transforms	3	0	2	4	100	AD, AM, CS, IT, SC
Major	23ITT201	Data Structures	3	0	0	3	100	AD, AM, CS, IT, SC
Multidisciplinary	23EEI201	Digital System Design	2	0	2	3	100	AD, AM, CS, IT, SC
Multidisciplinary	23MEL001	Engineering Drawing	1	0	3	2.5	100	AD, AM, CS, EA, EC, EE, EV, 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	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	1	0	0	1	100	All
Multidisciplinary	23CHT202	Environmental Sciences	1	0	0	-	100	All
AEC	23SAL201	Studio Activities	0	0	2	-	-	All
		Total	**13**	**0**	**20**	**21**	**1000**	

Programme: B.Tech. Artificial Intelligence and Data Science
2023 Regulations (From 2024 Batch Onwards)
Curriculum for Semester I to VIII

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

Semester I

Type of Course	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
Minor	23PHT001	Physics for Information Sciences	3	0	0	3	100	AD, AM, CS, IT, SC
Major	23CST101	Problem Solving using C	3	0	0	3	100	AD, AM, CS, IT, SC
Multidisciplinary	23EEI102	Introduction to Electrical and Electronics Engineering	3	0	2	4	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	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	தமிழர் மரபு /Heritage of Tamils	1	0	0	1	100	All
AEC	23SAL101	Studio Activities	0	0	2	-	-	All
		Total	**15**	**0**	**16**	**22**	**900**	

Semester II

Type of Course	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	3	0	0			
Minor	23MAI203	Calculus and Transforms	3	0	2	4	100	AD, AM, CS, IT, SC
Major	23ITT201	Data Structures	3	0	0	3	100	AD, AM, CS, IT, SC
Multidisciplinary	23EEI201	Digital System Design	2	0	2	3	100	AD, AM, CS, IT, SC
Multidisciplinary	23MEL001	Engineering Drawing	1	0	3	2.5	100	AD, AM, CS, EA, EC, EE, EV, 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	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	1	0	0	1	100	All
Multidisciplinary	23CHT202	Environmental Sciences	1	0	0	-	100	All
AEC	23SAL201	Studio Activities	0	0	2	-	-	All
Total			**13**	**0**	**20**	**21**	**1000**	

Semester III

Type of Course	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Minor	23MAT306	Probability and Statistics for Data Science	3	1	0	4	100	-
Major	23CST301	Design and Analysis of Algorithms	3	1	0	4	100	AD & CS
Minor	23CST302	Computer Architecture	3	0	0	3	100	AD & CS
Major	23CSI301	Database Systems	3	0	2	4	100	AD & CS
Major	23ADL301	Internet Programming Tools Laboratory	1	0	3	2.5	100	-
Major	23ADL302	Problem Solving using Java Programming Laboratory	1	0	3	2.5	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	**16**	**3**	**12**	**24**	**800**	

Semester IV

Type of Course	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Minor	23MAT403	Discrete Mathematics for Artificial Intelligence	3	1	0	4	100	-
Major	23ADT401	Artificial Intelligence – I	3	0	0	3	100	-
Major	23ADT402	Foundations of Data Science	3	0	0	3	100	-
Major	23ADT403	Operating System Principles	3	0	0	3	100	-
Major	23ADI401	Data Communication and Networks	3	0	2	4	100	-
Major	23ADL401	Intelligent systems - I Laboratory	0	0	3	1.5	100	-
Major	23ADL402	Problem Solving using Python 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**	**12**	**22**	**800**	

Type of Course	Course Code	Course Title	Duration	Credits	Marks
SEC	23XXXXXX	Internship – 1 / Community Internship / Skill Development Program	2 Weeks	1	100

Semester V

Type of Course	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23ADT501	Artificial Intelligence – II	3	0	0	3	100	-
Major	23ADI501	Exploratory Data Analysis	3	0	2	4	100	-
Major	23ADT502	Cyber Security Essentials	3	0	0	3	100	-
Major	23XXXXX	Professional Elective – I	3	0	0	3	100	-
Major	23XXXXX	Professional Elective – II	2	0	2	3	100	-
Major	23ADL501	Intelligent systems – II Laboratory	0	0	4	2	100	-
SEC	23ESL501	Professional Skills 4: Communication Skills and Interview Essentials	0	0	2	1	100	ALL
Project	23ADP501	Reverse Engineering Project	0	0	6	3	100	-
AEC	23SAL501	Studio Activities	0	0	2	-	-	ALL
		Total	**14**	**0**	**18**	**22**	**800**	

Semester VI

Type of Course	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23ADT601	Foundations of Big Data Analytics	3	0	0	3	100	-
Major	23ADI601	Deep Learning Techniques	3	0	2	4	100	-
Major	23XXXXX	Professional Elective – III	3	0	0	3	100	-
Major	23XXXXX	Professional Elective – IV	2	0	2	3	100	-
Minor	23XXXXX	Open Elective – I	3	0	0	3	100	-
Major	23ADL601	Cloud Technologies Laboratory	1	0	4	3	100	-
SEC	23ESL601	Professional Skills 5: Ace and Elevate: Aptitude and Soft Skills	0	0	2	1	100	ALL
AEC	23SAL601	Studio Activities	0	0	2	-	-	ALL
		Total	**15**	**0**	**12**	**20**	**700**	

Type of Course	Course Code	Course Title	Duration	Credits	Marks
SEC	23XXXXXX	Internship – 2 / Research Internship / Skill Development Program	2 / 4 Weeks	1	100

Semester VII

Type of Course	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23ADT701	Generative AI and Its Techniques	3	0	0	3	100	-
Major	23ADI701	Data Security	3	0	2	4	100	-
Major	23XXXXX	Professional Elective – V	3	0	0	3	100	-
Major	23XXXXX	Professional Elective – VI	2	0	2	3	100	-
Minor	23XXXXX	Open Elective – II	3	0	0	3	100	-
Major	23ADL701	Business Intelligence and Analytics Laboratory	0	0	4	2	100	-
Project	23ADP701	Project Phase – I	0	0	8	4	100	-
		Total	**14**	**0**	**16**	**22**	**700**	

Semester VIII

Type of Course	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Project	23ADP801	Project Phase – II	0	0	12	6	200	-
SEC	23XXXXX	Internship – 3 / Skill Development Program	8 / 16 Weeks			4	100	-
		Total	**0**	**0**	**12**	**10**	**300**	

Total Credits: 165

Vertical wise Electives

Vertical I Security Essentials Electives								
Type of Course	**Course Code**	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
			L	**T**	**P**			
Major	23ADE001	Ethics in Artificial Intelligence	3	0	0	3	100	-
Major	23ADE002	Blockchain and Its Applications	3	0	0	3	100	-
Major	23ADE003	Advanced Web Application Security	3	0	0	3	100	-
Major	23ADE004	Fundamentals of Computation	3	0	0	3	100	-
Major	23ADE005	Cryptographic Techniques in Network Security	2	0	2	3	100	-
Major	23ADE006	Foundations of Ethical Hacking	2	0	2	3	100	-
Major	23ADE007	Network and Web Security	2	0	2	3	100	-
Major	23ADE008	Digital Forensics	2	0	2	3	100	-

Vertical II Full Stack Development Electives								
Type of Course	**Course Code**	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
			L	**T**	**P**			
Major	23ADE009	User Interface Design Principles	3	0	0	3	100	-
Major	23ADE010	Graphics and Object Modeling	3	0	0	3	100	-
Major	23ADE011	Computational Vision	3	0	0	3	100	-
Major	23ADE012	Cloud Services Management	3	0	0	3	100	-
Major	23ADE013	Full Stack Programming	2	0	2	3	100	-
Major	23ADE014	Game Designing Techniques	2	0	2	3	100	-
Major	23ADE015	AR/VR for AI	2	0	2	3	100	-
Major	23ADE016	Security and Privacy in Cloud Technologies	2	0	2	3	100	-

Vertical III Software Project Management Electives								
Type of Course	**Course Code**	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
			L	**T**	**P**			
Major	23ADE017	Object Oriented Software Development	3	0	0	3	100	-
Major	23ADE018	Advanced Software Project Management	3	0	0	3	100	-
Major	23ADE019	Software Quality Management	3	0	0	3	100	-
Major	23ADE020	Reliability Engineering and System Safety	3	0	0	3	100	-
Major	23ADE021	Agile Technologies	2	0	2	3	100	-
Major	23ADE022	Basic Skills in Integrated Product Development	2	0	2	3	100	-
Major	23ADE023	UI Design Patterns	2	0	2	3	100	-
Major	23ADE024	Marketing Analytics	2	0	2	3	100	-

Vertical IV Data Analytics Electives								
Type of Course	**Course Code**	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
			L	**T**	**P**			
Major	23ADE025	Data Analytics for Engineers	3	0	0	3	100	-
Major	23ADE026	Business Analytics Management	3	0	0	3	100	-
Major	23ADE027	Data Analytics in Health Care	3	0	0	3	100	-
Major	23ADE028	Graph Analytics and Algorithm	3	0	0	3	100	-
Major	23ADE029	Social Network Analysis	2	0	2	3	100	-
Major	23ADE030	Recommendation Systems	2	0	2	3	100	-
Major	23ADE031	Text and Speech Techniques	2	0	2	3	100	-
Major	23ADE032	Image and Video Analytics	2	0	2	3	100	-

Vertical V Emerging Technologies Electives								
Type of Course	**Course Code**	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
			L	**T**	**P**			
Major	23ADE033	Fuzzy Logic and Neural Computing	3	0	0	3	100	-
Major	23ADE034	Optimization Techniques in AI	3	0	0	3	100	-
Major	23ADE035	Information Retrieval Methods	3	0	0	3	100	-
Major	23ADE036	Reinforcement Learning in AI	3	0	0	3	100	-
Major	23ADE037	Fundamentals of Virtualization	2	0	2	3	100	-
Major	23ADE038	Natural Language Processing Systems	2	0	2	3	100	-
Major	23ADE039	Web Services and DevOps	2	0	2	3	100	-
Major	23ADE040	Edge Analytics	2	0	2	3	100	-

Vertical VI Applied Robotics Electives								
Type of Course	**Course Code**	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
			L	**T**	**P**			
Major	23ADE041	Drone Technologies	3	0	0	3	100	-
Major	23ADE042	Robotic Automation technology	3	0	0	3	100	-
Major	23ADE043	Robot Operating Systems	3	0	0	3	100	-
Major	23ADE044	Collaborative Robotics	3	0	0	3	100	-
Major	23ADE045	Sensors and Instrumentation	2	0	2	3	100	-
Major	23ADE046	Embedded Computing Systems	2	0	2	3	100	-
Major	23ADE047	Mobile Robotics	2	0	2	3	100	-
Major	23ADE048	Agricultural Robotics	2	0	2	3	100	-

Diversified Electives

Type of Course	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23MEE008	PLM for Engineers	2	0	2	3	100	-
Major	23ITE043	Integrated Big Data Solutions	3	0	0	3	100	-
Major	23AUE050	Entrepreneurship Development	3	0	0	3	100	-
Major	23AUE051	Design Thinking and Innovation	3	0	0	3	100	-
Major	23ITE047	Intellectual Property Rights	3	0	0	3	100	-

Open Electives (Offered to other Programmes)

Type of Course	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Minor	23ADO001	Data Mining and Warehousing	3	0	0	3	100	-
Minor	23ADO002	Data Science using Python	3	0	0	3	100	-
Minor	23ADO003	Foundations of Business Analytics	3	0	0	3	100	-
Minor	23ADO004	Cognitive Science	3	0	0	3	100	-
Minor	23ADO005	Total Quality Management Principles	3	0	0	3	100	-
Minor	23ADO006	Professional Ethics	3	0	0	3	100	-
Minor	23ADO007	Ethical Hacking Essentials	3	0	0	3	100	-
Minor	23ADO008	Data Visual Exploration	3	0	0	3	100	-
Minor	23ADO009	Foundations of Marketing Analytics	3	0	0	3	100	-
Minor	23ADO010	Information Extraction and Text Mining	3	0	0	3	100	-
Minor	23ADO011	Drone Technology	3	0	0	3	100	-
Minor	23ADO012	Agri-Robotics	3	0	0	3	100	-

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

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. Familiarization of Department / Branch: HoD's & Senior Interaction - Department Association
4. Universal Human Value Modules: Aspirations and concerns, Self-Management, Relations 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	-	-	-	-

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, 2004.

R2. Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar, “Value Education and Harmonious Life (Manavalakalai Yoga)”, Vethathri Publications, 2010.

R3. Dr.R.Nagarathna, Dr.H.R. Nagendra, “Integrated Approach Of Yoga Therapy For Positive Swami Vivekananada Yoga Prakashana”, 2008.

Web References:

1. https://youtube.com/playlist?list=PLYwzG2fd7hzc4HerTNkc3pS_IvcCfKznV
2. https://www.youtube.com/watch?v=P4vjfEVk&list=PLWDeKF97v9SO0frdgmpaghDMjkom1
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	**CognitiveLevel**
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

Textbook(s):

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

T2. Jack C. Richards, Jonathan Hull, and Susan Proctor, “Interchange - Student’s Book1”, 5th Edition, 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 (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 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 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: 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 (Co2) 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 analyzing 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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., 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, 5th Edition, 2012.

R3. A. Marikani, “Engineering Physics”, PHI Learning, 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: 23CST101		Course Title: Problem Solving using C (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 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) (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 - 3Phase 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:	
CO1: 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	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	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, 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, 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: Analyze the diodes, transistors, opto-electronic devices and transducers	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: 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 arevery essential for an engineering student.

List of Experiments: **45 Hours**

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 Spectral 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	CognitiveLevel
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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. Dr. R. Jayaraman, V. Umadevi, S. Maruthamuthu, B. Saravanakumar “Engineering Physics Laboratory Manual”, Pearson India Education Services Pvt. Ltd, 2022.

R3. C.L. Arora , "Practical Physics”, 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: 23CSL101		Course Title: Problem Solving using C 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 course is intended to enable the students for writing simple programs in C.

List of Experiments: **45 Hours**

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 Edition, 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. Pare to 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:	
CO 1: 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	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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(s):

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, 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, 2010.

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

R5. Tony Buzan, Harper Collins, “The Power of Physical Intelligence English”, HarperCollins Publishers, 2008.

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.

Course Code: 23ENI201		Course Title: Communication Skills II (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 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

Textbook(s):

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/linguaskill/

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, The Japan Times, 2012.

T2. Genki 1 Workbook: An Integrated Course in Elementary Japanese by Eri Banno, The Japan Times, 2011.

Reference Book(s):

R1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

R2. Japanese for Everyone: Elementary Main Textbook1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Web References:

1. www.japaneselifestyle.com
2. www.learn-japanese.info/
3. www.learn.hiragana-katakana.com/typing-hiragana-characters/
4. 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.	Understand
CO2: Comprehend the conversation and give correct meaning	Understand
CO3: Apply appropriate grammar and vocabulary to write and speak.	Apply
CO4: Apply appropriate cases and texts to listen, write and speak.	Apply
CO5: 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. Stefanie Dengler, Paul Rusch, Helen Schmitz, Netzwerk, “Deutsch als Fremdsprache”, Goyal Publishers & Distributors Pvt Ltd.

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

Reference Book(s)

R1. Hueber, “Fit for Goethe- Zertifikat A1 (Start Deutsch 1)”, 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 RangeSine 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 suitable software): **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: 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 endedQueue- Applications of Queue

Trees: Implementation of Trees - Tree Traversals - Binary Trees: Implementation - ExpressionTrees - 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	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-			-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	2	-	-	-	-	-	-	-	-	-
CO6	-	-	3	2	-	-	-	2	2	2	2	2	-	-

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, 2015.

Reference Book(s):

R1. Sahni Horowitz , “Fundamentals of Data Structures in C”, 2nd Edition Tata McGraw-Hill, 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 Edition, 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 implementations 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 insimplification 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, 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: 23MEL001		Course Title: Engineering Drawing (Common to AD, AM, CS, EA, EC, EE, EV, IT & SC)	
Course Category: Multidisciplinary		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 impart knowledge on basic dimensioning. 2D and 3D 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 At the end of this course, students will be able to:	**Cognitive Level**
CO 1: Apply the concepts related to free hand sketching, orthographic and isometricprojection 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 rotating object method	Apply
CO4: Apply the concepts and draw lateral surface of simple solids using straight line and radial 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”, Tata McGraw Hill India, 3rd Edition, 2019.

Reference Book(s):

R1. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill India, 2nd Edition, 2014.

R2. Dhananjay A. Jolhe, “Engineering Drawing with an introduction to AutoCAD”, Tata McGraw India, 3rd Edition, 2010.

R3. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 54th Edition, 2023.

Publications of Bureau of Indian Standards

1. IS 10711 - 2001: Technical products Documentation - Size and lay out of drawing sheets.IS9609 (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: 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 students' 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 **45 Hours**

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	CognitiveLevel
At the end of this course, students will be able to:	
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	-	-	-	-	-	-	-	-	-
CO2	-	2	-	3	3	-	-	-	-	-	-	-	-	1
CO3	-	-	2	3	3	-	-	-	-	-	-	-	-	2

High-3; Medium-2; Low-1

Reference Book(s):

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

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

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: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 for ensuring efficient user experiences	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, 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 Hours**

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 Hours**

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

Text Book(s):

T1. Dr. R. S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Sultan Chand & Sons Pvt. Ltd, 2018.

T2. Dr. R. S. Aggarwal, "A Modern Approach to Logical Reasoning", Sultan Chand & Sons Pvt. Ltd, 2018.

Reference Book(s):

R1. R. V. Praveen, “Quantitative Aptitude and Reasoning”, 2nd 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	**Cognitive Level**
மாணவர்கள் இப்பாடத்தை கற்றபின்	
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.

Course Code: 23CHT202		Course Title: Environmental Sciences (Common to all B.E/B.Tech Programmes)	
Course Category: Multidisciplinary		Course Level: Introductory	
L:T:P(Hours/Week) 1: 0: 0	Mandatory Non-Credit Course	Total Contact Hours: 15	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on sustainable utilization of natural resources, prevention of pollution, disaster management and environmental issues & public awareness on ecosystem.

Module I **8 Hours**

Natural Resources

Role of Individual in Conservation of Natural Resources; Equitable Use of Resources for Sustainable Lifestyles.

Environmental Pollution and Disaster Management

Role of an Individual in Prevention of Pollution; Disaster Management: Floods, Earthquake, Cyclone and Landslides.

Environmental Ethics and Legislations

Environmental Ethics: Environment Protection Act; Air Act; Water Act; Wildlife Protection Act; Forest Conservation Act; Issues Involved in Enforcement of Environmental Legislation.

Module II **7 Hours**

Environmental Issues and Public Awareness

Public Awareness - Environment and Human Health.

Environmental Activities

(a) Awareness Activities:

i. Small Group Meetings About Water Management, Promotion of Recycle Use, Generation of Less Waste, Avoiding Electricity Waste.
ii. Slogan Making Event.
iii. Poster Making Event.

(b) Actual Activities:

i. Plantation.
ii. Cleanliness Drive.
iii. Drive for Segregation of Waste.
iv. To know about the Different Varieties of Plants.
v. Shutting Down the Fans and ACs of the Campus for an Hour or so.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the use of natural resources for a sustainable life as an individual in prevention of pollution	Understand
CO2: Apply the environmental ethics and legislations for various environmental issues	Apply
CO3: Create the public awareness on environment and human health as an individual or team through various activity-based learning	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Benny Joseph, “Environmental Studies", Tata McGraw Hill, 2006.

T2. Mackenzie Davis and Susan Masten, “Principles of environmental engineering andscience”, Mc-Graw Hill, 3rd Edition, 2014.

Reference Book(s):

R1. Trivedi R.K., “Handbook of Environmental Laws, Rules, Guidelines, Compliancesand Standards", Vol.I and II, Enviro Media.

R2. Cunningham, W.P.Cooper, T.H. Gorhani, “Environmental Encyclopedia", Jaico Publishing House, 2001.

Web References:

1. https://onlinecourses.nptel.ac.in/noc23_hs155/preview.
2. https://en.wikipedia.org/wiki/Environmental_science.

Course Code: 23MAT306		Course Title: Probability and Statistics for Data Science	
Course Category: Minor		Course Level : Introductory	
L : T : P (Hours/ Week) 3: 1: 0	Credits: 4	Total Contact Hours: 60	Max Marks:100

Course Objectives:

The aim of this course is to provide the student with an understanding of probability distributions and random variables. they gain knowledge regarding statistical quality control and hypothesis testing for data science.

Module I **22+8 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 - Binomial - Poisson - Properties, Moment Generating Function - 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.

Test of Hypotheses - Large Sample Test

Sampling Distributions, Estimation of Parameters, Statistical hypothesis, Large Sample Test Based on Normal Distribution for Single Mean and Difference of Means, Variance and Proportion.

Module II **23+7 Hours**

Test of Hypotheses – Small Sample Test

Tests based on T, Chi-square and F Distributions, Contingency Table (Test for Independence), Goodness of Fit.

Design of Experiments

Analysis of Variance (ANOVA) - One-way and Two-way Classification - Completely Randomized Design(CRD) - Randomized Block Design (RBD) - Latin Square Design(LSD).

Statistical Quality Control

Control Charts for Measurements ($\bar{X}$ and R Charts) - Control Charts for Attributes (p, c and np charts - Tolerance Limits - Acceptance Sampling.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply standard distributions and the concepts of random variables, to solve real- world problems	Apply
CO2: Apply suitable test of significance for making decisions in hypothesis testing	Apply
CO3: Demonstrate, design, use measures to interpret control charts for attributes and variables	Apply
CO4: Outline the basic knowledge of probability and random variables, hypothesis testing, and control charts	Understand

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	2	-	-	-	-	-	-	-	-	1	-	-	-	1

High-3; Medium-2; Low-1

Text Book(s):

T1 . Veerajan T, “Probability, Statistics and Random process”, 3rd Edition, Tata McGraw-Hill, 2017.

T2 .Dr.J.Ravichandran, “Probability and Statistics for Engineers”, 1st Edition, 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 Engineers and Scientists”, 9th Edition Pearson Education, 2013.

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

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

Web References:

1. https://archive.nptel.ac.in/courses/111/105/111105090/

2.https://archive.nptel.ac.in/courses/111/105/111105041/

Course Code:23CST301		Course Title: Design and Analysis of Algorithms (Common to CS & AD)	
Course Category: Major		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 impart knowledge on fundamental strategies of algorithm design and how to analyze the efficiency of the algorithm.

Module I Algorithm Analysis and Simple Design Techniques 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 Advanced Algorithm Design Techniques 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	-	-	-	-	-	-	-	-	2	1	-	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 CS & AD)	
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 Processor Architecture **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 Cache Design and Pipelining **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:	
CO1: Compare different instruction set architectures and identify their implications on system performance	Evaluate
CO2: Analyze various design elements to determine suitable memory organization for optimized performance	Analyze
CO3: Apply principles of pipelining and instruction - level parallelism to enhance processor performance	Apply
CO4: 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	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-		-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-	2	1	-	1	1	-	-	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, Morgan Kauffman / 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”, Morgan Kauffman / Elsevier, 5th Edition, 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 CS & AD)	
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 in database fundamentals, develop skills in designing databases and apply SQL for database manipulation.

Module I Database applications and Data Manipulation **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 Storage, Processing and Advanced Database 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	-	-	3	3	-	-	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: https://www.w3resource.com/sql-exercises/

Course Code: 23ADL301		Course Title: Internet Programming Tools Laboratory	
Course Category: Major		Course Level: Intermediate	
L:T:P (Hours/Week) 1: 0: 3	Credits:2.5	Total Contact Hours:60	Max Marks:100

Course Objectives:

The Objective of the course is to impart knowledge in common tools and techniques for developing web-based applications, both client-side and server-side.

Module I HTML5 and CSS3 7 Hours

HTML5: HTML Tags, Structure, HTML Coding Conventions - Lists- Tables - Form Input Types - Lists - Header and Footer Elements.

CSS3: CSS Overview - CSS Rules, CSS Syntax and Style - Class Selectors-ID Selectors-Span and div Elements - Cascading, style Attribute, style Container, External CSS Files - CSS Properties.

Module II JavaScript and PHP 8 Hours

JavaScript: Control Statements - Selection Statements - Repetition Statements - Functions - Events - Arrays - Objects - XML - Schema - DTD - XSLT.

PHP: Basics, String Processing and Regular Expressions, Form Processing and Business Logic - Using Cookies, Dynamic Content, PHP Files - PHP Database Connection.

List of Exercises 45 Hours

1. Create a Webpage using HTML5 Elements
2. Create a Webpage to Embed a Map in Web Page
3. Create a Webpage using CSS3
4. Create a Webpage to Fix Hot Spots in Image Using HTML5 and CSS3
5. Develop a Webpage using the Features of JavaScript
6. Develop a Web Form Application using JavaScript and Validate it
7. Validate the Registration, User Login, User Profile and Payment by Credit Card Pages using JavaScript
8. Convert a XML page into HTML page using XSLT
9. Create a Web Application by using PHP
10. Develop a PHP Application that allows users to Insert and Update Records into a MYSQl Database using Webform

Suggested Areas for Web Application:

1)Passport Automation System
2)Book Bank
3)Exam Registration
4)Stock Maintenance System
5)Online Course Reservation System
6)E– ticketing
7)E– book Management System
8)Recruitment System
9)Library Management System
10)Student Information System
11)Credit Card Processing

Course Articulation Matrix

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

High– 3; Medium– 2; Low– 1

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Build a static web page using client side scripting languages	Apply
CO2: Develop a real time webpage using server side scripting languages	Create

Text Book():

T1**.** Harvey Deitel, Paul Deitel, Abbey Deitel, "Internet and World Wide Web How to Program", 5th Edition, Pearson Education Asia, 2020.

T2. Uttam K.Roy, “Web Technologies”, Oxford University Press, 1st Edition, 2012.

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

R3. Robin Nixon, "Learning PHP, MySQL & JavaScript with jQuery, CSS & HTML5", 5th Edition, O'Reilly, 2018.

Web References:

1. NPTEL Resources:https://onlinecourses.swayam2.ac.in/aic20_sp11/preview.
2. Coursera Resources:https://www.coursera.org/learn/introduction-to-web-development-with-html-css-javacript.
3. Udemy Courses: - https://www.udemy.com/course/html-css-certification-course-for-beginners-e/?couponCode=IND21PM.

Course Code: 23ADL302	Course Title: Problem Solving using Java Programming Laboratory		
Course Category: Major		Course Level: Intermediate	
L: T: P(Hours/Week) 1: 0: 3	Credits:2.5	Total Contact Hours:60	Max. Marks:100

Course Objectives:

The objective of the course is to impart knowledge of object oriented programming concepts interrelated with java programming.

Module 1 Java with OOP Concepts **8 Hours**

OOP Concepts: Object Oriented Programming Concepts in Java.

Java Essentials: Data Types - Variables - Constants - Operators - Java Virtual Machine, Garbage Collection.

Java Classes and Methods: Classes & Methods - Constructors - Constructors overloading, Method Overloading - Static Members, Arrays - String Class.

Inheritance: Class Inheritance: Types - Method Overriding - Super Keyword - Final Variables and Methods - Final Classes - Abstract Classes and Methods.

Interfaces and Packages: Interfaces - Packages - Create & Importing Packages.

Module 2 Java Exceptions, Threads, Collections and Built in Classes **7 Hours**

Exception: Types - Try - Catch - Multiple Catch - Nested Try - Throw - Throws - Finally.
Built in Exceptions - User Defined Exceptions.

Thread: Extending the Thread Class - Thread Life Cycle - Multithreading.

Utility Classes: Java Strings, String Buffer - String Tokenizer - Math.

Collection Interfaces: Set, List, Queue.

Collections Classes: ArrayList, LinkedList, HashSet - Accessing a Collection via an Iterator - Map Interfaces.

List of Exercises **45 Hours**

1. Implement Java Programs using User Inputs and Control Structures
2. Implement Java programs using Arrays and Iterators
3. Implement Java Programs using Classes, Objects with Suitable Modifiers
4. Implement Java programs using Constructors and Static Members
5. Implement Java programs using Inheritance, and Method Overriding
6. Implement Java programs using Interfaces and Packages
7. Implement Java programs for different String Operations
8. Implement Java programs using Abstract Class and Interfaces
9. Implement Java programs using Exception Handling and Thread
10. Implement Java programs using Different Java Collection Framework Structures

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Develop the logical building programs using java for solving real time problems	Apply
CO2: Analyze the principles of java OOP concepts and packages for achieving the code reusability	Analyze
CO3: Apply to solve the business problems with the knowledge of error handling techniques and multi parallel tasking concepts	Apply
CO4: Develop the various data manipulation operations using different java frameworks for efficient programming	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	-	-	1	-
CO3	-	-	3	2	-	-	-	-	1	1	-	-	-	1
CO4	-	-	-	3	2	-	1	-	1	1	-	2	1	1

High-3; Medium-2; Low-1

Text Book(s):

T1. Schildt. Herbert. “Java - The complete Reference”, 11th Edition, McGraw Hill Education, 2019.

Reference Book(s):

R1. Deitel and Deitel, “Java How to Program”, Prentice Hall, 11th Edition, 2017.

R2. Allen B. Downey, Chris Mayfield, “Think Java: How to Think Like a Computer Scientist”, O'Reilly, 2016.

Web References:

1. Programming In Java: “ https://onlinecourses.nptel.ac.in/noc19_cs84/preview”
2. Java Tutorial: “https://www.w3schools.com/java/”

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 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, Menstruation - 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 their 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

Textbook(s):

T1. Dr. R. S. Aggarwal, "Quantitative Aptitude for Competitive Examinations" Sultan Chand & Sons Pvt. Ltd, 2018.

T2. Dr. R. S. Aggarwal, "A Modern Approach to Logical Reasoning", Sultan Chand & Sons Pvt. Ltd, 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: 23VAT301		Course Title: Universal Human Values 2: Understanding Harmony (Common to all B.E / B.Tech Programmes)	
Course Category: VAC		Course Level: Intermediate	
L:T:P (Hours/Week) 2: 1: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Pre-requisites:

- Induction Program (UHV 1)

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 behavior 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, 2010.

Reference Book(s):

R1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
R2. A.N. Tripathi, “Human Values” , New Age Intl. Publishers, 2004.
R3. Annie Leonard, “The story of stuff”, Free Press, 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/

Course Code: 23MAT403		Course Title: Discrete Mathematics for Artificial Intelligence	
Course Category: Minor		Course Level: Introductory	
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 aimed 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 **22+8 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 - Pigeonhole Principle - Permutations with and Without Repetition - Circular Permutation - Combinations.

Module II **23+7 Hours**

Recurrence relations: Recurrence Relations - Solution of Linear Recurrence Relations.

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.

Graph Theory:

Graphs and Graph Models - Graph Terminology and Special Types of Graphs - Matrix Representation of Graphs and Graph Isomorphism - Connectivity - Euler and Hamilton Paths - Spanning Tree Algorithms - Prim's Algorithm - Dijkstra's Algorithm.

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 and implementing the concepts of sets, relations and functions in discrete structures	Apply
CO2: Solve problems using combinatorial techniques, such as counting principles, permutations and combinations in the context of algorithm design and analysis	Apply
CO3: Apply the concepts of groups and its properties to algebraic structures and apply the concepts of graph theory in solving computing problems	Apply
CO4: Demonstrate a deepened understanding of fundamental concepts such as sets, relations, functions and combinatorics covered in lectures through guided practice and in tutorial exercises	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. J.P.Trembly, R. Manohar, “Discrete Mathematical Structures with applications to Computer Science”, 1st Edition, TMH International Edition, 2017.

T2. T.Veerarajan, “Discrete Mathematical Structures with Graph Theory and Combinatorics”,1st Edition, Tata McGraw-Hill Education Private Limited, 2017.

Reference Book(s):

R1. Kennth H. Rosen, “Discrete Mathematics and Its Applications”, 7th Edition, Tata McGraw-Hill Pub. Co. Ltd., 2017.

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

Web References:

1. http://nptel.ac.in/courses/106106094
2. https://nptel.ac.in/courses/111/104/111104026

Course Code: 23ADT401		Course Title: Artificial Intelligence – I	
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 intended to solve the real world problems involving statistical and computational principles.

Module I **22 Hours**

Introduction to Artificial Intelligence: Introduction: Definitions - Foundations - History - State of Art - Intelligent Agents: Agents and Environments - The concept of Rationality - Nature of Environments - Structure of Agents - Problem Solving Agents-Example Problems.

Solving Problems by Searching: Searching for Solutions – Uninformed Search Strategies: Breadth First, Uniform Cost, Depth First, Depth Limited & Iterative Deepening, Bidirectional Search - Comparison of Uninformed Search Strategies - Informed Search strategies: Greedy BFS, A* search - Search contour - Memory Bounded Search - Heuristic Functions.

Search in Complex Environments: Local Search Algorithms and Optimization Problems - Local Search in Continuous Spaces - Search with Nondeterministic Actions - Online Search Agents and Unknown Environments.

Module II **23 Hours**

Adversarial search and Gaming: Game Theory - Optimal Decision in Games - Alpha - Beta Pruning- Monte Carlo Tree Search - Constraint Satisfaction Problem: Define CSP - Inference in CSPs - Backtracking Search for CSP.

Knowledge and Reasoning: Logical Agents - Knowledge Based Agents –Logic: Propositional Logic - Theorem Proving - First Order Logic (FOL): Syntax and Semantics of FOL - Using FOL - Knowledge Engineering in FOL - Inference in FOL - Unification - Forward and Backward Chaining - Resolution.

Automated Planning: Definition for Classical Planning - Algorithm for Classical Planning - Heuristics for Planning - Planning and Acting in Non-Deterministic Domains - Hierarchical Planning - Time, Schedule and Resources - Analysis of Planning Approaches.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Identify the types and behavior of problem solving agents	Apply
CO2: Make use of the efficiency of various searching techniques in solving a problem	Apply
CO3: Apply real time searching technique to solve the given problem	Apply
CO4: Analyze the inference rules to the given knowledge base for theorem proving	Analyze
CO5: Choose the appropriate planning technique to solve the given problem	Evaluate

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	-	-	-	2	-	-	-	-	-	-	-	2	3	-
CO4	-	2	-	-	-	2	-	-	-	-	-	-	-	-
CO5	3	-	2	3	-	-	1	-	-	-	-	3	3	-

High-3; Medium-2;Low-1

Text Book(s):

T1. Stuart J. Russell, Peter Norvig, “Artificial Intelligence – A modern Approach”, 4th Edition, Pearson Education Inc., 2022.

Reference Book(s):

R1. Saroj Kaushik, “Artificial Intelligence”, Cengage Learning, 2019.

R2. Lavika Goel, “Artificial Intelligence – Concepts and Applications”, Wiley, 2021.

Web References:

1.Tool**:**SWI-Prolog

https://www.swi-prolog.org/download

https://www.swi-prolog.org/pldoc/man?section=quickstart

2.AIMA(Artificial Intelligence: A Modern Approach)

https://aima.cs.berkeley.edu/3rd-ed/ -Textbook followed

https://aima.cs.berkeley.edu/code.html-online code repository C++,Java, Python, LISP

3.Learn and Explore the concepts in AI-AI space tool developed at Laboratory of Computational Intelligence at University of British Columbia
https://aispace.org/index.shtml

Course Code: 23ADT402		Course Title: Foundations of Data Science	
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 basics of data science and data mining.

Module I Data Mining and Warehousing Techniques 22 Hours

Data Mining: Introduction to Data Mining: Kinds of Data - Kinds of Patterns - Technologies - Basic Statistical Descriptions of Data - Data Preprocessing: Data Quality - Major Tasks in Data Preprocessing.

Data Warehousing: Data Warehouse Basic Concepts - Data Warehouse Modeling - Data Cube and OLAP - Data Warehouse Implementation.

Association: Basic Concepts and Methods: Frequent Item Set Mining Methods - Apriori Algorithm.

Classification: Basic Concepts - Decision Tree Induction - Bayes Classification Methods - Rule Based Classification - K-Nearest - Neighbor Classifier.

Clustering: Cluster Analysis - Partitioning Methods - Hierarchical Methods - Density - Based Methods - Grid-Based Methods.

Module II Data Science and Predictive Analytics 23 Hours

Data Science: Benefits and Uses - Facets of Data-Retrieving Data - Data Preparation - Exploratory Data Analysis.

Descriptive Analytics: Frequency Distributions - Outliers - IQR - Normal Distributions - Correlation - Regression.

Data Wrangling: Basics of Numpy Arrays - Aggregations - Data Manipulation with Pandas - Pivot Tables.

Predictive Analytics: Linear Least Squares - Implementation - Goodness of Fit -Testing a Linear Model - Multiple Regression - Logistic Regression.

Data visualization: Importing Matplotlib - Line plots - Scatter plots - Histograms.

Course Outcomes	Cognitive level
At the end of this course, students will be able to:	
CO1: Distinguish the types of data and applications of data warehousing	Apply
CO2: Categorize the kinds of patterns that are discovered by association rule mining	Analyze
CO3: Classify the dataset items using algorithms and clustering based on models	Apply
CO4: Utilize the tools and techniques to identify the trends and patterns in data	Apply
CO5: Examine data visualization and wrangling the data to forecast future outcomes using predictive analytics	Analyze

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Jiawei Han, Micheline Kamber, Jian Pei, “Data Mining: Concepts and Techniques”, 3rd Edition, Elsevier, 2012.

T2. David Clenlen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publicationa, 2016

T3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016

T4. Robert S. Witte and John S. Witte, “Statistics”,11th Edition, Wiley Publictions, 2017

Reference Book(s):

R1. Jure Leskovec, Anand Rajaraman, Jeffery David Ullman, “Mining of Massive Datasets”, 2nd Edition, Cambridge University Press, 2014

R2. Ian H.Witten, Eibe Frank, Mark A.Hall, “Data Mining: Practical Machine Learning Tools and Techniques”, 3rd Edition, Elsevier, 2011

R3. EMC Education Services, “Data Science and Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data”, Wiley, 2015

Web References:

Data Mining:

1. https://www.geeksforgeeks.org/data-mining
2. https://onlinecourses.nptel.ac.in/noc21_cs06/preview

Data Science:

1. https://www.simplilearn.com/tutorials/data-science-tutorial/

Numpy and Data visualization:

1. https://onlinecourses.nptel.ac.in/noc22_cs32/preview

Course Code: 23ADT403		Course Title: Operating System Principles	
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 components of operating systems and its services using scheduling algorithms for process and memory management and techniques used for free space management in various administrative tasks of Linux environment for managing memory in cloud and also used for aerospace and defense systems.

Module I Introduction to Process and Memory Management 22 Hours

Operating System Concepts: Computer System Organization Operating System Operations Kernel Data Structures - Operating Systems Structures: System Components, Operating System Services, System Calls - System Programs Process Concepts: Process Scheduling, Operation on Process, Co-Operating Process, Inter Process Communication.

Process Management: CPU scheduling: Scheduling Algorithms 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 from Deadlock.

Memory Management: 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.

Module II File Systems and Linux Programming 23 Hours

File Systems: Mass Storage System: Disk Structure, Disk Attachment, Disk Scheduling File System Interface: File Concepts, Access methods, Directory Structure, File Protection File System Implementation: File System Structure and Operations, Directory Implementation, Allocation methods, Free Space Management.

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: Solve process scheduling and synchronization problems using algorithms	Apply
CO2: Compare different memory management techniques using allocation schemes	Apply
CO3: Develop solutions for free space management using file systems and disk scheduling concepts	Apply
CO4: Make use of various administrative tasks in linux environment using its components and services	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Abraham Silberschatz, Galvin.P.B.and Gagne, “Operating System Concepts”,10th Edition, John Wiley & Sons, 2018.

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: 23ADI401		Course Title: Data Communication and Networks	
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 focuses on fundamentals of networking concepts, aims to equip participants with the necessary skills and knowledge to analyze the working functionalities of different layers in TCP/IP.

Module I **22 Hours**

Computer Network Introduction: Data Communications - Networks - Network Types - Standards and Administration - The OSI Model - TCP/IP Protocol Suite - Transmission media: Guided Media - Unguided Media.

Link Layer: ARP - RARP - Block Coding - Hamming Distance - Cyclic Redundancy Check - Checksum - DLC Services - Stop and Wait Protocol - Go Back N ARQ - Selective Repeat ARQ.

Network Layer I: Network Layer Services - Packet Switching - Network Layer Performance.

Module II **23 Hours**

Network Layer II: IPv4: Classful and Classless Addressing - IPv4 Datagram - Options - ICMPv4 - Mobile IP - IPv6 Addressing - IPv6 Protocol - Routing Information Protocol - Open Shortest Path First Algorithm.

Transport Layer: Transport Layer Services - UDP - TCP Segment - TCP Connection Establishment and Termination - TCP Congestion Control.

Application Layer: HTTP - FTP - Electronic Mail - TELNET - SSH - Domain Name Space.

List of Experiments **30 Hours**

(Exercises are to be carried out using Java / Python / Wireshark / Command Line Utility / GNS3)

1. Network trouble shooting and performance monitoring using ipconfig, ping, netstat and tracert commands
2. Interpret the working principles of address resolution protocol
3. Examine IP traffic and its routing options
4. Analyze the TCP connection establishment and termination
5. Configure LAN for generation of data traffic
6. Implementation of client server communication using socket programming

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Analyze the working principles of TCP/IP model and addressing to effectively manage data communication in networking	Analyze
CO2: Examine the protocol functionalities of the network, transport and application layer in TCP/IP model	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	-	1	-	2

High-3; Medium-2; Low-1

Text Book(s):

T1. Behrouz A. Forouzan, “Data communication and Networking”, 6th Edition, Tata McGraw-Hill Publishing Co. Pvt., Ltd., 2022.

Reference Book(s):

R1. Larry L. Peterson and Bruce S. Davie, “Computer Networks — A Systems Approach”, 6th Edition, Morgan Kaufmann Publishers, 2019.

R2. William Stallings, “Data and Computer Communication”, 10th Edition, Pearson Education, 2013.

Web References:

1. Networking Practice exercises: http://highered.mheducation.com/sites/0073376221/student_view0/index.html
2. NPTEL lecture videos and notes on: https://nptel.ac.in/courses/106105080
3. Text book handouts: https://csc-knu.github.io/sys-prog/books/Andrew%20S.%20Tanenbaum%20-%20Computer%20Networks.pdf

Course Code: 23ADL401		Course Title: Intelligent systems - I 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 Objectives:

This course introduces students to the practical knowledge of programming using advanced python programming language related with emerging artificial intelligence as an implementation tool.

List of Experiments: **45 Hours**

1. Identification of characteristics of data and perform data-preprocessing techniques for any given dataset
2. Perform data classification using decision tree on the given dataset
3. Identification of frequent item set and generation of association rules using apriori algorithm
4. Cluster the given data set using k-means clustering algorithm
5. Visualize and analyze the results for the given dataset using different types of charts
6. Implementation of breadth first and depth first searching techniques
7. Implementing state space search algorithms
    - Hill Climbing Algorithm
    - A* Algorithm
8. Demonstrate the min-max algorithm
9. Knowledge representation and inference using first order logic
10. Develop simple AI applications

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Identify the types of data to be pre-processed for the given dataset	Apply
CO2: Build association rules and cluster the data for the given dataset	Apply
CO3: Apply the suitable type of search technique over the given scenario	Apply
CO4: Develop AI application to interact with environment	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Reference Book(s):

R1. Stuart J. Russell, Peter Norvig, “Artificial Intelligence – A modern Approach”, 3rd Edition, Pearson Education Inc., 2021.

R2. Jiawei Han, Micheline Kamber, Jian Pei, “Data Mining: Concepts and Techniques”, 3rd Edition, Elsevier, 2014.

Web References:

1. Dataset resources: https://www.kaggle.com/datasets?fileType=csv
2. Programming Online Platform: https://colab.research.google.com/
3. Program code resources: https://github.com/topics/python-online
4. AI with python tutorial: https://www.geeksforgeeks.org/python-ai/

Course Code: 23ADL402		Course Title: Problem Solving using Python Laboratory	
Course Category: Major		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 enable the students to develop programs in python.

Module I **8 Hours**

Computational Thinking and Problem Solving: Identification of Computational Problems - Algorithms, Building Blocks of Algorithms - Notation - Algorithmic Problem Solving, Simple Strategies for Developing Algorithms.

Data Types, Expressions, Statements: Python Interpreter and Interactive Mode - Debugging - Values and Types - Variables - Expressions - Statements - Tuple Assignment - Precedence of Operators - Comments.

Module II **7 Hours**

Control Flow, Functions, Strings: Conditionals - Iteration - Functions - Strings.

Lists, Tuples, Dictionaries: List - Operations, Slices, Methods, Loop, Mutability, Aliasing, Cloning, List Parameters - Tuples - Assignment - Return Value - Dictionaries - Operations and Methods - Advanced List Processing - List Comprehension.

Files, Modules, Packages: Files and Exceptions - Text Files, Reading and Writing Files, Format Operator - Command Line Arguments, Errors and Exceptions, Handling Exceptions, Modules, Packages and Pickle.

List of Experiments: **45 Hours**

1. Develop a python program using simple statements and expressions
2. Implement scientific problems using conditionals and iterative loops
3. Implement real-time/technical applications using lists, tuples
4. Implement real-time/technical applications using sets, dictionaries
5. Implement python programs using functions
6. Implement python programs using strings
7. Implement python programs using written modules and python standard libraries
8. Implement real-time/technical applications using file handling
9. Implement real-time/technical applications using exception handling
10. Develop a game activity using python

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop algorithmic solutions to solve computational problems and execute simple python programs	Apply
CO2: Build programs using conditionals and loops for solving problems	Apply
CO3: Utilize python data structures to deal with complex data	Apply
CO4: Develop interactive application using python	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.

T2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1st Edition, BCS Learning & Development Limited, 2017.

Reference Book(s):

R1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.

Web References:

1.Python Basics: https://www.python.org/

2.Python tutorial: https://www.geeksforgeeks.org/python-programming-language/

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 Objectives:

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

Textbook(s):

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

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

Course Code: 23ADT501		Course Title: Artificial Intelligence – II	
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 both theoretical knowledge and practical skills related to the design, development and application of AI systems.

Module I Handling Uncertainty 22 Hours

Probabilistic Reasoning I: Acting under Uncertainty - Bayesian Inference - Naïve Bayes Models - Probabilistic Reasoning - Bayesian Networks - Exact Inference In Bayesian Network - Approximate Inference in Bayesian Network - Causal Networks.

Probabilistic Reasoning II: Probabilistic Reasoning Over Time - Time and Uncertainty - Inference in Temporal Models - Hidden Markov Models - Kalman Filters - Dynamic Bayesian Networks, Probabilistic Programming.

Simple & Complex Decision: Basis of Utility Theory -Utility Functions - Multiattribute Utility Functions - Decision Networks - Value of Information - Unknown Preferences - Sequential Decision Problems - MDPS - Multi Agent Environments - Non-Cooperative Game Theory - Cooperative Game Theory - Making Collective Decisions.

Module II Learning and Modelling 23 Hours

Learning: Forms of Learning - Supervised Learning - Learning Decision Trees - Evaluating and choosing the Best Hypothesis - The Theory of Learning - Regression and Classification with Linear Models - Artificial Neural Networks - Nonparametric Models - Support Vector Machines - Ensemble Learning - Practical Machine Learning.

Learning Probabilistic Models: Statistical Learning - Learning with Complete Data: Maximum Likelihood Parameter Learning with Discrete, Continuous, Bayesian, Naive Bayes Models - Learning with Hidden Variables - Learning The EM Algorithm.

Reinforcement Learning and Robotics: Learning from Rewards - Passive Reinforcement Learning - Active Reinforcement Learning - Generalization in Reinforcement Learning - Inverse Reinforcement Learning - Applications - Robots - Robotic Perception - Planning Movements - Reinforcement Learning in Robotics - Robotic Frameworks.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply bayesian inference and the naïve bayes model to solve real-world problems involving uncertainty	Apply
CO2: Inspect the ability to analyze decision networks, determining the value of information in decision-making scenarios	Analyze
CO3: Examine the philosophical and ethical dimensions of AI, including safety and the societal implications of AI technologies	Analyze
CO4: Evaluate reinforcement learning techniques and probabilistic programming tools in robotic and uncertain environments	Evaluate

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Pearson Education, 2021.

Reference Book(s):

R1. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013.

R2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008.

R3. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007.

R4. Patrick H. Winston, "Artificial Intelligence", 3rd Edition, Pearson Edition, 2006.

Web References:

1. A beginner's Guide to Artificial Intelligence and Machine Learning: https://developer.ibm.com/articles/cc-beginner-guide-machine-learning-ai-cognitive/
2. NPTEL Course Content on Applied Accelerated Artificial Intelligence: https://onlinecourses.nptel.ac.in/noc22_cs83

Course Code: 23ADI501		Course Title: Exploratory Data Analysis	
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 outline the fundamentals of exploratory data analysis and to identify the appropriate method for data visualization for multivariate and time series data.

Module I Exploratory Data Analysis and Visualization 22 Hours

Exploratory Data Analysis: EDA Fundamentals - Visual Aids for EDA - Data Transformation Techniques - Merging Database - Reshaping and Pivoting - Transformation Techniques - Grouping Datasets - Data Aggregation - Pivot Tables and Cross-Tabulations.

Visualizing using Matplotlib: Importing Matplotlib - Histograms - Legends - Colors - Subplots - Text and Annotation Customization - Three Dimensional Plotting - Geographic Data with Basemap - Visualization with Seaborn.

Univariate Analysis I: Introduction to Single Variable - Distributions - Variables - Numerical Summaries of Level.

Module II Advanced Data Analysis Techniques 23 Hours

Univariate Analysis II: Numerical Summaries of Spread - Twyman's Law - Scaling and Standardizing - Inequality - Smoothing Time Series.

Bivariate Analysis: Relationships between Two Variables - Contingency Tables - Percentage Tables - Analyzing Contingency Tables - Handling Several Batches - Box plots - The T Test - Scatterplots and Resistant Lines - Transformations.

Multivariate and Time Series Analysis: Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tablesand Beyond - Longitudinal Data - Fundamentals of TSA - Characteristics of Time series data - Time Based Indexing - Visualizing - Grouping and Resampling. Principle - Dependency Inversion Principle, Interface Segregation Principle

List of Experiments: 30 Hours

1. EDA on E-mail Dataset.
2. Working with NumPy Arrays, Pandas Data Frames, and Basic Plots using Matplotlib
3. R for Data Cleaning
4. Time Series Data Analysis
5. Data Analysis and Representation on a Map
6. Cartographic Visualization for Multiple Datasets

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Outline the fundamentals of exploratory data analysis using various data transformation techniques	Apply
CO2: Analyze data manipulation techniques for performing exploratory data analysis using python libraries	Analyze
CO3: Evaluate the appropriate method for data and information visualization using matplotlib	Evaluate
CO4: Create univariate data to analyze time series dataset	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, 2020. (Module I)

T2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools forWorking with Data", Oreilly, 1st Edition, 2016. (Module I)

T3. Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysisfor Social Scientists”, Wiley Publications, 2nd Edition, 2008. (Module II)

Reference Book(s):

R1. Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training Service, 2017.

R2. Claus O. Wilke, “Fundamentals of Data Visualization”, O’reilly publications, 2019.

R3. Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.

Web References:

1. Coursera content on Exploratory Data : https://www.coursera.org/learn/exploratory-data-analysis

2. NPTEL course content: https://nptel.ac.in/courses/110106064

3. Online courses for EDA: https://analyticsindiamag.com/8-online-courses-for- exploratory-data-analysis/

Course Code: 23ADT502		Course Title: Cyber Security Essentials	
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 the essentials of cyber law, techniques used for malicious attack, ethical dimension of cybercrimes and digital forensics to prevent threats in digital environment.

Module I Cybercrime and Digital Forensics 22 Hours

Cybercrime and IT Act: Cybercrime and Information Security - Classifications of Cybercrimes, Cybercrime: Perspectives, the Indian ITA 2000 - Cyber Offences: Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Attack Vectors.

Tools and Methods used in Cybercrime: Proxy Servers and Anonymizers - Phishing - Password Cracking - Key Loggers - Spywares - Virus and Worms - Trojan Horses and Backdoors - Steganalysis - Attacks: DoS and DDoS, Wireless Network - SQL Injection - Buffer Overflow

Computer Forensics: Historical background - Cyber forensics and Digital Evidence - Steganography - Network Forensics

Module II Advanced Cybercrime and Forensics 23 Hours

Digital Forensics: Life Cycle, Analysis of E-Mail, Social Networking Sites, Auditing, Challenges - Anti Forensics.

Cybercrime and Cyberterrorism: Intellectual Property in the Cyberspace - Ethical Dimension of Cybercrimes - Cybercriminals: Psychology, Mindset and Skills of Hackers, Sociology - Information Warfare - Cost of Cybercrimes and IPR Issues - Web Threats: organizations, Cloud Computing, Social Media Marketing.

Cybercrime Case Study: Indian Case: Online Gambling, Intellectual Property Crime - Case of Counterfeit Computer Hardware - Internet used for Murdering - Financial Frauds in Cyber domain - Digital Signature Related Crime Scenarios.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Examine the it act and cause of a malware attack used in cybercrime	Analyze
CO2: Employ digital forensics to collect and preserve digital evidence in workstation	Apply
CO3: Inspect the information and pattern of real - life case studies in cybercrime	Analyze
CO4: Evaluate advanced cybercrime issues, anti-forensic techniques and psychological profiles of hackers	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	3	-	-	-	-	2	2	2	-	-	-	2
CO4	-	-	-	3	-	2	-	-	-	2	2	2	**1**	2

High-3; Medium-2; Low-1

Text Book(s):

T1. Nina Godbole, Sunit Belapure, “Cyber security: Understanding Cybercrime, Computer Forensics and Legal perspectives”, Wiley India Pvt.Ltd, 2019.

Reference Book(s):

R1. Aparna Viswanatha, “Cyber Law- Indian and International Perspectives on Key Topics Including Data Security, E-Commerce, Cloud Computing and Cyber Crimes”, LexisNexis Publishers, 2012.

R2. Rodney D. Ryder, " Guide to Cyber Laws", Second Edition, Wadhwa and Company, 2007.

Web References:

1. http://www.cyberlawsindia.net/internet-crime.html
2. http://www.computerforensicsworld.com

Course Code: 23ADL501		Course Title: Intelligent Systems - II Laboratory	
Course Category: Major		Course Level: Higher	
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 hands-on experience in building and experimenting with advanced intelligent systems and applications in ai and related technologies.

List of Experiments:

Below listed experiments can be implemented by Spyder

1. Implement Bayesian belief networks
2. Implement hidden markov models
3. Implement EM algorithm for HMM
4. Implement decision problems for various real-world applications
5. Design a Naïve Bayes classifier to classify the given dataset
6. Implement SVM on a Dataset (e.g., Iris dataset) and visualize the decision boundaries
7. Implement gaussian mixture models
8. Implement the reinforcement learning for various reward based applications
9. Implement the value iteration of MDP using the grid world application
10. Mini project

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply probabilistic models such as bayesian networks and hidden markov models to solve uncertainty-based AI problems	Apply
CO2: Analyze the effectiveness of machine learning algorithms like Naïve Bayes, SVM, and GMM on real-world datasets	Analyze
CO3: Evaluate decision-making strategies and reinforcement learning techniques in dynamic environments	Evaluate
CO4: Design an AI-based mini projects using advanced algorithms and tools to address real-time applications	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Reference Book(s):

R1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Pearson Education, 2021.

Web References:

1.NPTEL Course Content: http://nptel.ac.in/courses/106106091/

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 - Proof Reading - 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

Effective Communication

Communication in Diverse Contexts - Presentations - Individual and Group Presentations - Public Speaking - Visual Aids and Presentation Tools

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, Wadsworth Publishing Co Inc., 2017.

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

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

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

Course Code: 23ADP501		Course Title: Reverse Engineering Project	
Course Category: Project		Course Level: Advanced	
L:T:P(Hours/Week) 0: 0: 6	Credits:3	Total Contact Hours:90	Max Marks: 100

Course Objectives

The course is intended to identify and analyze complex engineering problems, apply appropriate tools and techniques to interpret results, and effectively communicate and defend their solutions by explaining the problem, approach, outcomes, and impact.

The objective of the project is to enable students to undertake an investigative study in the broad domain of Artificial Intelligence and Data Science**.** The project may be theoretical, practical, or a combination of both, depending on the nature of the assigned topic. Projects are to be carried out individually or in teams of two to three students, under the guidance of a faculty supervisor appointed by the department.

This initiative aims to serve as a foundation for research and development (R&D)**,** encouraging students to apply their knowledge, explore emerging technologies, and develop innovative solutions to complex problems in AI and Data Science. Through this project, students will gain valuable experience in problem identification, research methodology, system design, and result analysis, thereby strengthening their readiness for advanced academic or professional pursuits.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Evaluate various strategies and methodologies to determine the most effective approach for addressing the defined problem	Evaluate
CO2: Develop innovative solutions by integrating theoretical and practical knowledge with appropriate tools and technologies	Create
CO3: Create new models or frameworks to generate and interpret results using statistical, computational, or visualization techniques	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Course Code: 23ADT601		Course Title: Foundations of Big Data Analytics	
Course Category: Major		Course Level: Advanced	
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 overview of Big Data Architecture and its storage, retrieval and the processing of data. It also focuses on the tools, techniques and algorithms available for storing and processing of Big Data.

Module I Statistics and Big Data Analytics 22 Hours

Introduction to Statistics and Big Data Analytics: Introduction: Nature and Scope of Statistics, Limitations of Statistics - Types of Data: Concept of Population and Sample, Primary and Secondary Data, Quantitative and Qualitative Data, Discrete and Continuous Data, Cross - Sectional and Time Series Data. Scales of Measurement: Nominal, Ordinal, Ratio and Interval Introduction - Classification of Analytics - Greatest Challenges that Prevent Businesses from Capitalizing on Big Data - Top Challenges Facing Big Data - Importance of Big Data Analytics - Data Science - Terminologies Used in Big Data Environment - Other Analytics Tools.

Module II Mongodb, Hive and Pig 23 Hours

Introduction to Mongodb, Hive and Pig: Introduction - Features of MongoDB - Terms used in RDBMS and MongoDB - Data Types in MongoDB - CRUD (Create, Read, Update and Delete). Features of Hive - Integration and Work Flow - Architecture - Data Types - File Format - Hive Query Language - RCFILE Implementation - SERDE - UDF. Pig on Hadoop - Pig Latin Overview - Data Types in Pig - Running Pig - Execution Modes of Pig - HDFS Commands - Relational Operators - Eval Function - Complex Data Type - WordCount Example - Pig versus Hive.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the complex big data problems using advanced statistical techniques	Analyze
CO2: Evaluate the effectiveness of different big data tools and techniques for data processing	Evaluate
CO3: Design scalable and reliable distributed systems for big data analytics	Create
CO4: Innovate new solutions to big data challenges using advanced analytics	Create

Course Articulation Matrix

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

High–3; Medium–2; Low–1

Text Book(s):

T1. S.P.Gupta, “Statistical Methods”, Sultan Chand and sons, 2019.

T2. Seema Acharya, Subhashini Chellappan, “Big Data and Analytics”, 1st Edition, Wiley India, 2015.

Reference Book(s):

R1. EMC Education Services, “Data Science and Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data”, Wiley, 2015.

R2. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and Its Applications", Wiley Publishers, 2015.

R3. DT Editorial Services, “Big Data, Black Book: Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization”, Dreamtech Press, 2016.

R4. Jure Leskovec, Anand Rajaraman, Jeffery David Ullman, “Mining of Massive Datasets”, 2nd Edition, Cambridge University Press, 2014.

Web References:

1.https://bigdatauniversity.com/

2.https://www–01.ibm.com/software/data/infosphere/hadoop/what–is–big–data–analytics.html

3.https://www.tutorialspoint.com/big_data_tutorials.html

Course Code: 23ADI601		Course Title: Deep Learning Techniques	
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 knowledge on the foundational principles and advanced methodologies of deep learning.

Module I Deep Learning and Optimization 22 Hours

Deep Networks: Neural Networks - Training Neural Networks - Activation Functions - Loss Functions - Hyper parameters - Deep Networks - Architectural Principles of Deep Networks - Building Blocks of Deep Networks.

Regularization for Deep Learning: Parameter Norm Penalties - Norm Penalties as Constrained Optimization - Regularization and Under - Constrained Problems - Dataset Augmentation - Noise Robustness - Semi supervisedLearning - Multitask Learning - Early Stopping - Bagging.

Module II Advanced Architectures and Applications 23 Hours

Convolutional Neural Networks: The Convolution Operation - Motivation - Pooling - Variants of Basic Convolution Function - Structured Outputs - Convolution Algorithms - Unsupervised Features.

Sequence Modeling: Recurrent Neural Networks - Bidirectional RNNs - Encoder - Decoder Sequence to Sequence Architectures - Deep Recurrent Networks - Recursive Neural Networks - The Long Short Term Memory - Explicit Memory.

Applications: Performance Metrics - Large Scale Deep Learning - Computer Vision - Speech Recognition - Natural Language Processing.

List of Experiments 30 Hours

1. Implement a feed-forward network
2. Implement an image classifier using CNN
3. Implement a simple LSTM
4. Implement an opinion mining in recurrent neural network
5. Implement an autoencoder
6. Implement an object detection using CNN

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop feed forward and deep networks for solving simple problems	Apply
CO2: Apply various regularization techniques to improve the performance and generalization of deep neural networks	Apply
CO3: Examine Convolutional Neural Network for solving real time problems	Analyze
CO4: Utilize deep learning concepts to design and implement solutions tailored to specific target applications	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.

Reference Book(s):

R1. Josh Patterson, “Deep Learning: A Practitioner's Approach”, O'Reilly Media, 2017.

R2. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems”, O'Reilly Media, 2017.

R3. Antonio Gulli, Sujit Pal , “Deep Learning with Keras: Implement Neural Networks with Keras on Theano and TensorFlow”, Packt Publishing, 2017.

Web References:

1. Practical Deep Learning: https://course.fast.ai/
2. Introduction: https://www.geeksforgeeks.org/introduction-deep-learning/
3. Deep Learning Algorithms: https://www.simplilearn.com/tutorials/deep-learning-tutorial/deep-learning-algorithm

Course Code: 23ADL601		Course Title: Cloud Technologies Laboratory	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 1:0 :4	Credits:3	Total Contact Hours: 75	Max Marks: 100

Course Objectives:

The course intends to impart knowledge on cloud computing and virtualization basics. It focuses on deploying applications using AWS and Google App Engine and introduces containerization, server less computing, and cloud security.

Module I: Fundamentals of Cloud Computing **7 Hours**

Cloud Computing: Definition and Characteristics - Cloud Computing Reference Model - Benefits of Cloud Computing.

Service Models: IaaS, PaaS, SaaS.

Virtualization: Concepts of Virtualization.

Types of Virtualizations: Full Virtualization, Para-Virtualization.

Cloud Architecture: Basic Architecture and Deployment Models - Public, Private, Hybrid, and Community Clouds - Security in Cloud Computing.

Module II: Basics of Cloud Technologies and Applications **8 Hours**

Amazon Web Services (AWS): Overview of AWS - EC2 Instances and S3 Buckets - Application Migration and Deployment on AWS.

Google Cloud Platform (GCP): Google App Engine Overview - Web Services and Google Big Query.

Azure Cloud Services: Overview of Microsoft Azure - Cloud Services offered by Azure.

Emerging Trends: Multi-cloud and Hybrid Cloud Strategies - Containerization and Microservices - Docker - Serverless Computing and Cloud - native Development.

List of Experiments **60 Hours**

1. Configure a network adapter in oracle virtualbox
2. Deploy a java web application using amazon EC2
3. Host a static website using amazon S3
4. Perform application migration using AWS
5. Implement database migration in google app engine
6. Store and query massive datasets using google cloud big query
7. Create a web application using Microsoft azure
8. Implement a serverless application using AWS lambda
9. Deploy a containerized application using Docker
10. Conduct a Security Audit of a Cloud-Based Application

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Implement core cloud computing concepts and virtualization techniques	Apply
CO2: Analyze applications on cloud platforms like AWS and Google App Engine	Apply
CO3: Implement containerization, server less computing solutions, and cloud security best practices	Analyze
CO4: Evaluate emerging cloud technologies and trends such as multi-cloud strategies, containerization, micro services, and server less computing for modern cloud-native development	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Reference Book(s):

R1. Matthew Portnoy, “Virtualization Essentials", Sybex (an imprint of Wiley), 2nd Edition, 2021.

R2. Robert P. H. Lee, "Understanding Virtualization: The Definitive Guide", 2020.

R3. Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture", 2nd Edition, 2016.

R4. Arshdeep Bahga and Vijay Madisett, “Cloud Computing Solutions Architect: A Hands-On Approach”, Vikas Publishing Trust, 2024.

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**

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:

Professional Grooming - Group Discussion - Impromptu - Interview.

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 allegation, 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:	
CO1: 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. Meenakshi Raman, Sangeeta Sharma, “3E: Principles and Practice”, Technical Communication, 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, 2024.

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

Reference Book(s):

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

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

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

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/

Course Code: 23ADT701		Course Title: Generative AI and its Techniques	
Course Category: Major		Course Level: Advanced	
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 deployment of generative AI models and maximizing its performance using effective prompts.

Module I Generative Deep Learning 22 Hours

Generative Modeling: Introduction - Generative Versus Discriminative Modeling - Probabilistic Generative Models - Challenges of Generative Modeling

Variational Autoencoders: Autoencoders - Building a Variational Autoencoder - Autoencoders Vs VAE - VAEs to Generate Faces

Generative Adversarial Networks: Discriminator - Generator - Training the GAN - GAN Challenges - Wasserstein GAN - Gradient Penalty Loss

Module II LLM and Prompt Engineering 23 Hours

Large Language Models: Text Generation Models - GPT 4 - Gemini - Meta's Llama and Open Source - Image Generation Models - DALL E - Stable Diffusion - Model Comparison - Standard Practices of Text and Image Generation Models

Prompt Engineering: LLM Prompts - Prompts: Types, Components and Working - Defining Personality in Prompts - Mix and Match Strategic Combination - Challenges and Limitations of Using Prompts - Agency in AI - Components of Agentic AI - Agentic AI Vs other models - Applications

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the principles and challenges of probabilistic generative models including VAEs and GANs	Analyze
CO2: Evaluate the performance of modern generative architectures in real-world applications	Evaluate
CO3: Design prompt strategies to optimize output quality in large language and image generation models	Apply
CO4: Innovate Agentic AI solutions by integrating prompt engineering and model capabilities	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. David Foster, “Generative Deep Learning Teaching Machines to Paint, Write, Compose, and Play” 2nd Edition, O'Reilly Media, 2023.

T2. James Phoenix, Mike Taylor, "Prompt Engineering for Generative Al"", 1st Edition, O'Reilly Media, 2024.

Reference Book(s):

R1. Sinan Ozdemir, “Quick Start Guide to Large Language Models: Strategies and Best Practices for Using ChatGPT and Other LLMs”, 1st Edition, Addison-Wesley Professional, 2023.

R2. Thimira Amaratunga, “Understanding Large Language Models: Learning their Underlying Concepts and Technologies”, 1st Edition, Apress, 2023.

Web References:

1. Coursera lecture videos and notes on: https://www.coursera.org/learn/intro-gen-ai
2. NPTEL lecture videos and notes on: https://onlinecourses.swayam2.ac.in/nou25_ma05/
3. Course Handouts: https://books.google.co.in/books/about/Agentic_AI.html?id=bMg7EQAAQBAJ&redir_esc=y

Course Code: 23ADI701		Course Title: Data Security	
Course Category: Major		Course Level: Advanced	
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 data security principles, skills in identifying data security risks and efficiency in applying data security in real world scenarios.

Module I Foundations and Techniques of Cryptographic Systems 22 Hours

Cryptosystems: Security Problems in Computing - Security Goals - Threats and Attacks - Services and Mechanisms - Symmetric Key Cryptography - Substitution Cipher - Transposition Cipher - Stream Ciphers and Block Ciphers - Beaufort and DES Family - Product Ciphers - Lucifer and DES.

Asymmetric Key Cryptographic Systems: Advanced Encryption Standard (AES) - Cryptanalysis of Symmetric Key Cryptosystems - Public Key Cryptography - RSA cryptosystem - Attacks on RSA - Hellman and EIGamal Elliptical Curve Cryptography.

Hash Functions and Digital Signature: Cryptographics Hash Functions: Message Authentication - Secure Hash Algorithm (SHA512), Message Authentication Codes: Authentication Requirements - HMAC - CMAC - Digital Signatures - Elgamal Digital Signature Scheme - Digital Signature Standard - Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption - Kerberos - X.509 Authentication Service.

Module II Transport and Network Security 23 Hours

Transport Level Security: Web Security Considerations: Web Security Threats - Web Traffic Security Approaches - Transport Layer Security (TLS) Architecture - TLS Record Protocol - Change Cipher Spec Protocol - Alert Protocol - Handshake Protocol - Cryptographic Computations - SSL/TLS Attacks - HTTPS: Connection Initiation - Connection Closure - Secure Shell (SSH) - Transport Layer Protocol - User Authentication Protocol - Connection Protocol.

IP Security and Network Endpoint Security: IP Security: Overview - IP Security Policy - Encapsulating Security Payload - Combining Security Associations - Internet Key Exchange - Network Endpoint Security: Firewalls - Intrusion Detection Systems - Malicious Software - Distributed Denial of Service Attacks.

List of Experiments **30 Hours**

1. Perform Encryption, Decryption Using the Following Substitution Technique:

a) Caesar Cipher b) Play Fair Cipher c) Hill Cipher d) Vigenere Cipher

2. Apply DES Algorithm for Practical Applications
3. Apply AES Algorithm for Practical Applications
4. Implement RSA Algorithm using HTML & Javascript
5. Implement s Secure HTTPS Server using TLS
6. Defeating Malware-Building Trojans and Rootkit Hunter

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply various classical encryption techniques for analyzing the real world security breaches	Apply
CO2: Analyze Cryptographic hash functions and digital signature techniques to ensure message integrity and authentication	Analyze
CO3: Apply TLS/SSL protocols to secure web traffic and evaluate the effectiveness of secure communication mechanisms	Apply
CO4: Create IPsec and endpoint security tools such as firewalls and IDS to secure computer network against various threats and attacks	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Stallings Williams, “Cryptography and Network Security: Principles and Practice”, 8th Edition, Pearson Education, 2020.

Reference Book(s):

R1. Harold F. Tipton, Micki Krause Nozaki, “Information Security Management Handbook”, 6th Edition, 2016.

R2. Christopher Diaz, “Database Security: Master the Art of Protecting Your Data with Cutting-Edge Techniques”, 1st Edition, Mercury Learning and Information, 2024.

R3. Stuart McClure, Joel Scrambray, George Kurtz, “Hacking Exposed", McGraw-Hill, 7th Edition, 2012.

Web References:

1. NIST develops cybersecurity standards, guidelines, best practices, and other resources: https://www.nist.gov/topics/cybersecurity.
2. NPTEL course:https://nptel.ac.in/courses/106106129
3. Tools link
   i) Snort – https://www.snort.org/downloads
   ii) N-Stalker - https:www.nstalker.com/products/editions/free/download/

Course Code: 23ADL701	Course Title: Business Intelligence and Analytics Laboratory		
Course Category: Major		Course Level: Advanced	
L:T:P(Hours/Week) 0: 0: 4	Credits:2	Total Contact Hours:60	Max. Marks:100

Course Objectives

The course is intended to analyze data for strategic insights and enable informed decision-making. It also focuses on understanding and interpreting customer sentiment for better engagement.

List of Exercises: (Exercises are to be carried out using Python)

1. **Customer Segmentation Analysis:** Identify distinct customer segments based on purchasing behavior, demographics, or other relevant factors. Experiment: Use clustering algorithms (e.g., k-means) to group customers and analyze the characteristics of each segment
2. **Churn Prediction:** Build a predictive model using machine learning algorithms to forecast customer churn and assess the impact of different variables
3. **Sales Forecasting:** Utilize time series analysis and forecasting methods (e.g., ARIMA, Exponential Smoothing) to predict future sales trends
4. **Sentiment Analysis on Social Media Data:** Use natural language processing (NLP) techniques to perform sentiment analysis on social media data related to your business
5. **Fraud Detection:** Implement anomaly detection algorithms to flag unusual patterns or transactions that may indicate fraudulent behavior
6. **A/B Testing for Website Optimization:** Conduct A/B tests by randomly assigning users to different website versions and analyse user engagement metrics
7. **Employee Performance Analysis:** Analyze employee data to identify correlations between performance metrics and various factors such as training, workload, or job satisfaction
8. **Supply Chain Optimization:** Use data analytics to identify bottlenecks, optimize inventory levels, and enhance overall supply chain performance
9. **Customer Lifetime Value Prediction:** Build a predictive model to estimate the future value of customers based on historical data
10. **Market Basket Analysis:** Apply association rule mining algorithms (e.g., Apriori) to analyse transaction data and discover patterns in customer buying habits

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze complex datasets and extract insights using statistical and machine learning techniques	Analyze
CO2: Evaluate the effectiveness of different big data tools and techniques for solving business problems	Evaluate
CO3: Design scalable data systems for real-time processing using big data technologies	Create
CO4: Innovate new analytical models and techniques for advanced big data applications	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Reference Book(s):

R1. Ramesh Sharda, Dursun Delen, Efraim, “Business Intelligence, Analytics and Data Science: a Managerial Perspective”, 4th Edition , Global Edition, 2018.

R2. Pradip Kumar Das, Hrudaya Kumar Tripathy, Shafiz Affendi Mohd yusuf, “Privacy and Security Issues in Big Data, An Analytical View on Business Intelligence”, Springer, 2021.

Web References:

1. Business-Intelligence: https://learn.g2.com/business-intelligence 2. R programming: https://www.geeksforgeeks.org/r-tutorial/
2. Tutorial Business Intelligence and Analytics : https://www.academia.edu/40285447/Business_Intelligence_and_Analytics
3. BI intro video by LearnItFirst: https://www.youtube.com/watch?v=LhZX0MAYKp8
4. Data Analytics for Beginners Video Tutorial: https://www.youtube.com/watch?v=mm2A5tKVIpg

Course Code: 23ADP701	Course Title: Project Phase - I		
Course Category: Project		Course Level: Advanced	
L: T: P (Hours/Week) 0: 0: 8	Credits: 4	Total Contact Hours: 120	Max Marks: 100

Course Objectives

The course aims to equip students with the ability to identify and solve complex engineering problems by applying knowledge of science, engineering principles, and appropriate engineering tools relevant to their discipline.

The task will normally include:

1. Survey and study of published literature on the assigned topic
2. Working out a preliminary Approach to the Problem relating to the assigned topic
3. Conducting Analysis, Design, Implementation/Modelling /Simulation
4. Preparing a Written Report of the Study/Work
5. Final Presentation before a departmental committee

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design Engineering solutions to complex problems by systematically applying scientific knowledge, appropriate tools, and critical analysis techniques through continuous learning	Create
CO2: Collaborate effectively in diverse roles within teams to achieve project goals ethically, while communicating processes, methodologies, and outcomes clearly through reports, presentations, and relevant media	Create
CO3: Evaluate various generative modeling approaches and prompt engineering strategies to select the best fit for the project objectives	Evaluate

Course Articulation Matrix

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

High- 3; Medium- 2; Low- 1

Course Code: 23ADP801		Course Title: Project Phase - II	
Course Category: Project		Course Level: Advanced	
L:T:P(Hours/Week) 0: 0: 12	Credits:6	Total Contact Hours:180	Max Marks: 200

Course Objectives

The course is intended to impart knowledge on enhancing problem-solving skills by engaging in practical, hands-on engineering projects that require systematic analysis and solution formulation.

The objective of Project is to enable the student to take up investigative study in the broad field of Artificial Intelligence and Data Science, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop the ability to formulate, analyze, and address real-world engineering problems systematically	Create
CO2: Analyze the experimental results, perform error analysis, and iteratively optimize the model or prompts for improved performance	Analyze
CO3: Create project findings effectively through comprehensive reports and presentations, demonstrating the impact and limitations of the developed solution	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Vertical I

Course Code: 23ADE001		Course Title: Ethics in 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:

This course aims to provide knowledge on morality and ethics in AI, including the interpretation of ethical harms and global initiatives. It also focuses on applying ethical principles to AI standards, regulations, and real-world challenges.

Module I Ethics, Morality, and Governance in Artificial Intelligence 22 Hours

Morality ethics and AI: Definition of Morality and Ethics in AI - Impact on Society - Impact on Human Psychology Impact on the Legal System - Impact on the Environment and the Planet - Impact on Trust Emerging Challenges: AI in Climate Change and Surveillance - AI in Misinformation (e.g., Deepfakes, AI-Generated Content)

Ethical Initiatives in AI: International Ethical Initiatives - Ethical Harms and Concerns - Case Study: Healthcare Robots - Autonomous Vehicles and Ethical Decision Making- Warfare and Weaponisation.

AI Standards and Regulation: Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems - Data Privacy Process - Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems

Module II Roboethics and Ethical Landscape of Artificial Intelligence 23 Hours

Roboethics: Robot - Roboethics - Ethics and Morality - Moral Theories - Ethical Frameworks: Utilitarianism, Virtue Ethics, Deontological Ethics - Ethics in Science and Technology - Ethical Issues in an ICT Society - Harmonization of Principles - Ethics and Professional Responsibility - Roboethics Taxonomy.

Challenges and Opportunities: Challenges – Opportunities - Ethical Issues in Artificial Intelligence - Societal Issues Concerning the Application of Artificial Intelligence in Medicine - Decision - Making Role in Industries - National and International Strategies on AI - Ethical Considerations of Generative AI and Large Language Models.

Usage of AI: Ethical Initiatives of AI in Healthcare, Autonomous Vehicle and Defense-Case Study on Ontology**.**

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the multifaceted ethical, societal, and psychological impacts of AI technologies across various domains such as climate change, surveillance and misinformation	Analyze
CO2: Evaluate International Ethical Initiatives, Standards, and Regulations Addressing Ethical Harms, Algorithmic Bias, and Transparency in AI systems	Evaluate
CO3: Apply Ethical Frameworks (e.g., Utilitarianism, Virtue Ethics, Deontological Ethics) and Robo-ethics Principles to Assess AI Applications In Healthcare, Autonomous Vehicles and Defense	Apply
CO4: Create Responsible AI governance models and propose strategies to mitigate ethical challenges in emerging AI technologies, including generative AI and Large Language Models	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitk amp and Alan Winfield," The ethics of artificial intelligence: Issues and initiatives", European Parliamentary Research Service Scientific Foresight Unit, 2020.(MODULE I)

T2. Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press, 2014. (MODULE II)

Reference Book(s):

R1. Paula Boddington, "Towards a Code of Ethics for Artificial Intelligence" (Artificial Intelligence: Foundations,Theory, and Algorithms), 2017.

R2. Mark Coeckelbergh, "AI Ethics", The MIT Press Essential Knowledge series, 2020.

Web References:

1.Artificial Intelligence and Ethics: Sixteen Challenges and Opportunities: https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence- and- ethics- sixteen-challenges- and- opportunities/

2. Ethical issues in artificial intelligence: https://www.weforum.org/agenda/2016/10/top- 10-ethical-issues- in- artificial-intelligence/

Course Code: 23ADE002		Course Title: Blockchain and its Applications	
Course Category: Major		Course Level: Advanced	
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 decentralization, introduce cryptocurrency, develop smart contracts on Ethereum, create distributed ledgers using Hyperledger Fabric, and explore challenges and trends in blockchain projects.

Module I Basics of Blockchain 22 Hours

Blockchain and Decentralization: History of Blockchain - Types of Blockchain - Consensus - Decentralization using Block Chain - Methods of Decentralization- Blockchain and Full Ecosystem Decentralization - Platforms for Decentralization- Decentralized Autonomous organization.

Crypto Currency and Smart Contracts: Private key vs. Public key - Hash function - Secure Hash Algorithms - Bitcoin - Digital Keys and Addresses - Transactions - Mining - Bitcoin Networks and Payments - Wallets - Alternative Coins - Theoretical Limitations - Bitcoin limitations - Smart Contracts - Ricardian Contracts - Legal and Regulatory Challenges Surrounding Cryptocurrencies and Blockchain Systems.

Ethereum: The Ethereum Network - Components of Ethereum Ecosystem - The Ethereum Virtual Machine (EVM).

Module II Ethereum, Web3 & Alternatives 23 Hours

Further Ethereum: Programming Languages - Ethereum Development Tools and Frameworks - Ethereum Development Environment - Solidity Language - Introduction to Zero-Knowledge Proofs.

WEB3 and Hyperledger: Introduction to Web3 - Contract Deployment - POST Requests - Development Frameworks - Hyperledger as a Protocol - The Reference Architecture - Hyperledger Fabric - Distributed Ledger.

Alternative Blockchains and Challenges: Kadena - Ripple - Rootstock - Quorum - Multichain - Scalability - Privacy - Emerging trends - Other challenges - Blockchain Research - Notable Projects - Layer 2 Solutions and Cross-chain Interoperability.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Understand the fundamental concepts and architecture of blockchain technology, including its history, types, consensus mechanisms, and methods of decentralization, as well as explore decentralized platforms and organizations	Apply
CO2: Analyze the workings of cryptocurrencies and smart contracts, focusing on cryptographic principles, Bitcoin and Ethereum ecosystems, mining, wallets, legal/regulatory challenges, and the Ethereum Virtual Machine (EVM)	Analyze
CO3: Gain practical knowledge of Ethereum programming languages, development tools, Solidity smart contracts, and advanced cryptographic concepts such as Zero-Knowledge Proofs to build secure decentralized applications	Apply
CO4: Explore emerging blockchain ecosystems including Web3, Hyperledger frameworks, and alternative blockchains	Evaluate

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Kang Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, 2nd Edition, Packt Publishing, 2018.

T2. Andreas Antonopoulos, Satoshi Nakamoto, “Mastering Bitcoin”, O’Reilly, 2014.

Reference Book(s):

R1. Arshdeep Bahga, Vijay Madisetti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.

R2. Roger Wattenhofer, “The Science of the Blockchain”, Create Space Independent Publishing, 2016.

R3. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.

Web References:

1. Blockchain Architecture Design and Use Cases: https://nptel.ac.in/courses/106105184
2. Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts e-book available in: https://www.google.co.in/books/edition/Mastering_Blockchain/3ZlUDwAAQBAJ?hl=en&gbpv=0

Course Code: 23ADE003		Course Title: Advanced Web Application Security	
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 addressing prevalent vulnerabilities, adopting secure coding techniques, and performing comprehensive security testing.

Module I Web Application Security Principles 22 Hours

Web Application Reconnaissance: The history of Software Security - Introduction to Web Application Reconnaissance - Recognizing Web Application Security Threats - Web Application Security - Web Servers - Secure Socket layer - Transport Layer Security - Session Management - Input Validation.

Authentication: Access Control - Authentication Fundamentals - Two Factor and three Factor Authentication - Web Application Authentication - Authorization: Access Control - Session Management - Securing Web Application Session Management.

Secure Development and Deployment: Web Applications Security - Security Testing - Security Incident Response Planning - Microsoft Security Development Lifecycle (SDL) - OWASP Comprehensive Lightweight Application Security Process (CLASP) - Software Assurance Maturity Model (SAMM).

Module II API Security 23 Hours

Browser Security Principles: Defining the Same Origin Policy - Exceptions - Cross - Site Scripting - Cross - site Request Forgery.

Secure API Development: API Security - Elements of API Security, Security mechanism, Natter API - Overview - Implementation - Securing Natter APIs: Addressing threats with Security Controls - Rate Limiting for Availability - Authentication to prevent spoofing - Encryption - Audit logging - Access Control.

Session cookie Authentication: Authentication in Web browsers - Token Based Authentication - Session Cookies - Preventing Cross - Site Request Forgery attacks.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the efficacy of various web application security measures by examining real-world case studies.	Apply
CO2: Design secure authentication and authorization mechanisms for web applications	Create
CO3 : Examine the ability to synthesize advanced techniques for securing web servers and databases in enterprise environments	Analyze
CO4: Design a secure web application prototype that incorporates best security practices throughout the development life cycle	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Bryan Sullivan, Vincent Liu, “Web Application Security: A Beginners Guide”, The McGraw-Hill Companies, 2012. (Module: I)

T2. Neil Madden, “API Security in Action”, Manning Publications Co., 2020. (Module: II)

Reference Book(s):

R1. Andrew Hoffman, “Web Application Security: Exploitation and Counter measures for Modern Web Applications”, O’Reilly Media, Inc,1st Edition, 2020.

R2. Michael Cross, “Developer’s Guide to Web Application Security”, Syngress Publishing, Inc 2007.

R3. Ravi Das and Greg Johnson, “Testing and Securing Web Applications”, Taylor & Francis Group, LLC, 2021.

Web References:

1. Web Application Security Vulnerabilities: https://relevant.software/blog/web-application-vulnerabilities/

2. Web Security Testing: https://www.blackduck.com/glossary/what-is-web-application-security.html

Course Code: 23ADE004		Course Title: Fundamentals of Computation	
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 the theoretical foundations of computation in solving problems related to finite-state machines and regular languages and design finite automata to model and solve problems.

Module I Formal Languages and Automata Theory 22 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

Context Free Languages: Context Free Grammars - Derivations - Parse Tree and Ambiguity - Simplification of Grammars - Normal Forms - CNF - GNF - Pushdown Automata - Language Acceptance of PDA - Applications of PDA

Module II Turing Machines and Computability Theory 23 Hours

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.

Computability Theory

Decidability: Decidable Languages - Undecidability - Reducibility: Undecidable Problems from Language Theory - Halting Problem - Post Correspondence Problem.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the fundamental concepts of automata theory to design and analyze computational models	Apply
CO2: Analyze regular and context-free languages using grammars, regular expressions, and pushdown automata, and understand their properties, normal forms, and applications in language recognition and parsing	Analyze
CO3: Build the formal definition, construction techniques, and variants of Turing Machines, including their role in language acceptance and the concept of Universal Turing Machines	Apply
CO4: Analyze the fundamental concepts of computability theory, and classic undecidable problems such as the Halting Problem and Post Correspondence Problem	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	-	-	-	-	-	-	-	1	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-	1	-
CO4	-	2	-	-	1	-	-	-	-	-	-	-	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, 2006. (Module I)

T2. Michael Sipser, “Introduction to the Theory of Computation”, 3rd Edition, Cengage Learning, 2013. (Module II)

Reference Book(s):

R1. Kamala Krithivasan, R. Rama, “Introduction to Formal Languages, Automata Theory and Computation”, Pearson Education, 2009.

R2. K. L. P. Mishra, N. Chandrasekaran, “Theory of Computer Science: Automata, Languages and Computation”, 3rd Edition, PHI, 2006.

Web References:

1. NPTEL Course Grammars and Natural Language Processing URL: http://nptel.ac.in/courses/106106049/

2. JFLAP tool - Home URL: www.jflap.org/

Course Code: 23ADE005		Course Title: Cryptographic Techniques in Network Security	
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 encryption techniques and to make students to learn different encryption techniques along with hash functions, MAC, digital signatures and their use in various protocols for network security and system security.

Module I Classical Encryption and Ciphers **15 Hours**

Basic Concepts - Security Attacks - Services and Mechanisms - Characteristics of Good Ciphers - Security Standards - Classical Encryption Techniques: Symmetric Cipher - Substitution Techniques and Transposition Techniques. 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 - Fermat's and Euler's Theorem - RSA Algorithm - Diffie-Hellman Key Exchange

Module II Hash Function and Network Security **15 Hours**

Hash function: Applications - Requirements - Secure Hash Algorithm (SHA) - Message Authentication Codes: Requirements - Functions - Hash Based Message Authentication Codes (HMAC) - Digital Signature: Properties - ElGamal Digital Signature Scheme - Schnorr Digital Signature Scheme - Digital Signature Standard (DSS). Key Management and Authentication-Key Management and Distribution - X.509 Certificate - Public Key Infrastructure - Kerberos Protocol. Network Security: Threats in Networks - Network Security Controls - Intruders - Intrusion Detection - Password Management - Malicious Software - Firewalls: Characteristics - Types - Firewall Basing - Firewall Location and Configurations

List of Experiments: **30 Hours**

(Exercises are to be carried out using OS with Java SE support, JDK 1.8 or higher, Eclipse, IntelliJ IDEA, or NetBeans)

1. Implement various traditional Substitution and Transposition techniques (without using built-in package).
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 (without using built-in package).
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 the fundamental concepts of cryptography including security attacks, cipher characteristics, classical encryption techniques, and block cipher design principles	Apply
CO2: Analyze number theory principles essential for cryptography, and apply them to modern cryptographic algorithms including RSA, Diffie-Hellman key exchange, and stream ciphers like RC4.	Analyze
CO3: Analyze the principles and applications of cryptographic hash functions, message authentication codes, and digital signature schemes, and analyze their role in ensuring data integrity and authentication.	Analyze
CO4: Evaluate key management techniques and network security controls, including certificates, public key infrastructure, Kerberos, intrusion detection systems, and firewalls to secure communication networks.	Evaluate

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
CO3	-	3	-	-	2	-	-	-	-	-	-	-	-	2
CO4	-	-	-	3	-	-	-	-	-	-	-	-	1	-

High-3; Medium-2;Low-1

Text Book(s):

T1. William Stallings, “Cryptography and Network Security - Principles and Practices”, 7th Edition, Pearson Education, 2017.

Reference Book(s):

R1. Behrouz A Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata McGraw Hill Ltd. 2017.

R2. Douglas R Stinson, “Cryptography - Theory and Practice”, Chapman and Hall / CRC Press, 2013.

R3. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, “Handbook of Applied Cryptography”, CRC Press, 2010.

Web References:

1.NPTEL Course Cryptography and Network Security URL:
https://nptel.ac.in/courses/106/105/106105162/

2.Tutorials point Course Content on cryptography URL :
https://www.tutorialspoint.com/cryptography/index.htm

3.Khan Academy Course Content on cryptography URL :
https://www.khanacademy.org/computing/computer-science/cryptography

Course Code: 23ADE006		Course Title: Foundations of Ethical Hacking	
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 security, foot printing and scanning network, vulnerability analysis and security testing in network protection systems.

Module I Ethical Hacking and Network Penetration Testing 15 Hours

Ethical Hacking Introduction: Overview of TCP/IP and OSI Layers - Attacks: Network and Computer, Intruder and Malware, Physical and Malware Security

Foot Printing and Scanning Networks: Concepts - Foot printing through Search Engines and Social Engineering - Competitive Intelligence - Port - Foot printing and Scanning Techniques - Scanning Beyond IDS and Firewall

Enumeration: NetBIOS - SNMP, LDAP, NTP, SMTP and DNS

Module II Ethical Hacking: Vulnerability Assessment & Network Defense **15 Hours**

Vulnerability Analysis: Concepts - Desktop and Server OS - Windows OS - Linux OS - Embedded OS

System Hacking: Web Servers - Web Application Components - Vulnerabilities - Wireless Networks - Components of a Wireless Network - War Driving - Wireless Hacking - Tools for Web Attackers, Security Testers and Trade.

Network Protection Systems: Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Network - Based and Host-Based IDSs and IPSs - Web Filtering - Honeypots - AI Based Firewall - AI Based Intrusion Detection and Prevention Systems.

List of Experiments 30 Hours

(Exercises are to be carried out using Kali or Backtrack Linux / Nessus / Wireshark / Metasploitable / FOCA / Armitage/ Robtex/ Paterva's Maltego)

1. Apply the authorized reconnaissance to gather information about the target.
2. Perform extraction on metadata and expand the target list.
3. Aggregate information from public databases.
4. Identify the target and perform different types of scanning.
5. Examine Network traffic among the targets.
6. Perform Automate dig for vulnerabilities and match exploits.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the fundamental concepts of computer networks and security threats by analyzing the TCP/IP and OSI models, and identify different types of attacks	Apply
CO2: Apply ethical hacking techniques to assess vulnerabilities in computer networks	Apply
CO3: Analyze vulnerabilities across different operating systems to identify security weaknesses and exploit paths.	Analyze
CO4: Implement network protection mechanisms to defend against cyber threats.	Create

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
CO3	-	3	-	-	1	-	-	-	-	-	-	-	-	2
CO4	-	-	-	3	-	1	-	-	-	-	-	-	3	-

High-3; Medium-2;Low-1

Text Book(s):

T1. Michael T. Simpson, Kent Backman, and James E. Corley, “Hands-On Ethical Hacking and Network Defense, Course Technology”, Delmar Cengage Learning, 2022 (MODULE I)

T2. Kris Hermans, “Mastering Hacking with AI: A Comprehensive Guide to Hack with Artificial Intelligence”, 2023 (MODULE II)

Reference Book(s):

R1. Justin Seitz “Black Hat Python: Python Programming for Hackers and Pentesters”, 2014

R2. Dafydd Stuttard and Marcus Pinto “The Web Application Hacker’s Handbook: Finding and Exploiting Security Flaws”, 2nd Edition, Wiley Publication, 2011.

Web References:

1. NPTEL Courses on Ethical Hacking: https://onlinecourses.nptel.ac.in/noc22_cs13/preview
2. COURSERA Courses on Ethical Hacking Essentials: https://www.coursera.org/learn/ethical-hacking-essentials-ehe

Course Code: 23ADE007		Course Title: Network and Web Security	
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 intrusion detection techniques and firewalls to identify suitable e-mail security protocols and to utilize wireless security protocols and security services in cloud environment.

Module I Network Security and Email security 15 Hours

Network Security and Email security: Threats in Networks - Network Security Controls - Intruders - Intrusion Detection - Password Management - Malicious Software - Firewalls: Characteristics - Types - Firewall Basing - Firewall Location and Configurations. Store and Forward - Security Services - Source Authentication - Message Integrity - Non- Repudiation - Proof of Submission and Delivery - Pretty Good Privacy (PGP) - Secure/Multipurpose Internet Mail Extension (S/MIME). IP and Web Security: IP security: IP Security Policy - Encapsulating Security Payload - Web security: Secure Socket Layer - Transport Layer Security - HTTPS - Secure Shell (SSH).

Module II Wireless Network Security and Security In Cloud Computing 15 Hours

Wireless Network Security and Security in Cloud Computing: IEEE 802.11 wireless LAN overview - IEEE 802.11i wireless LAN security - Wireless Application Protocol - Wireless Transport Layer Security - WAP end-to-end security. Cloud Information Security Objectives - Cloud Security Services - Cloud Security Design Principles - Penetration Testing Tools and Techniques - Cloud Computing Risk Issues: CIA Triad - Privacy and Compliance Risks - Threats to Infrastructure - Data and Access Control - Cloud Service Provider Risks.

List of Experiments: 30 Hours

1. Demonstrate Intrusion Detection System using any simulation tool (Example: Snort).
2. Setup a honey pot and monitor it on the available network (Example: KF Sensor).
3. Implement packet filtering firewall. (Example: Using jpcap package)
4. Perform wireless audit on an access point or a router and decrypt WEP and WPA. (Example: Net Stumbler)
5. Implement the encryption and decryption process used in PGP protocol.
6. Study and analyze the various security protocols used to secure the transport layer for a gmail account.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze various network security threats and controls to identify vulnerabilities in network environments	Analyze
CO2: Evaluate email security protocols such as PGP and S/MIME, and assess IP and web security measures for secure communication	Evaluate
CO3: Analyze wireless network security standards and protocols to determine their effectiveness in protecting wireless communications	Analyze
CO4: Design comprehensive cloud security strategies that address risks related to confidentiality, integrity, availability, compliance, and access control in cloud environments	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. William Stallings, “Cryptography and Network Security - Principles and Practice”, 7th Edition, Pearson Education, 2017.

T2. Ronald L Krutz and Russell Dean Vines, “Cloud Security- A Comprehensive Guide to Secure Cloud Computing”, Wiley, 2016.

Reference Book(s):

R1. Bernard Menezes, “Network Security and Cryptography”, Cengage Learning, 2014.

R2. Behrouz A Forouzan and Debdeep Mukhopadhyay, “Cryptography and Network Security”, 3rd Edition, Tata McGraw Hill, 2016.

R3. Bruce Schneier, “Applied Cryptography: Protocols, Algorithms and Source Code in C”, John Wiley and Sons, 2013.

Web References:

1.NPTEL Course contents on Cryptography and Network Security URL:http://nptel.ac.in/courses/106105162/

2. Learn Internet Security at Tutorial point
URL: https://www.tutorialspoint.com/internet_security/index.htm

3. Network Security Tutorial of APNIC.
URL: https://training.apnic.net/wp-content/uploads/sites/2/2016/12/TSEC01.pdf

Course Code: 23ADE008		Course Title: Digital Forensics	
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 digital forensics methodologies, enabling students to effectively analyze and interpret digital evidence in various investigative scenarios.

Module I Legal Frameworks and Evidence Acquisition 15 Hours

Cyber Security: Cyber Security - Cyber Security Policy - Domain of Cyber Security Policy: Laws and Regulations

Scope and Laws of Computer Forensics: Introduction - Types of Evidence - Investigator Skills - Importance - History of Computer Forensics - Law Enforcement Training- Operating Systems and File Systems

Acquiring Evidence and Documentation: Lab Requirements - Private Sector Computer Forensics Laboratories - Computer Forensics Laboratory Requirements - Extracting Evidence from a Device - Documenting The Investigation

Module II Forensics Across Platforms 15 Hours

Network Forensics: Tools - Networking Devices - Network Devices - OSI Model - Advanced Persistent Threats - Investigating a Network Attack.

Mobile Forensics: Cellular Network - Handset Specifications - Mobile Operating Systems - Standard Operating Procedures for Handling Handset Evidence - Handset Forensics - Case Studies.

List of Experiments: 30 Hours

1. Investigate Live Forensics Case using Autopsy
2. Recover Deleted Files using Forensics Tools
3. Find Last Connected USB on your system (USB Forensics)
4. View Last Activity of Your PC
5. Extract Browser Artifacts
6. Study the steps for hiding and extract any text file behind an image file/ Audio file using Command Prompt

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the digital evidence using forensic tools to identify artifacts and reconstruct timelines	Analyze
CO2: Identify the process of acquiring and documenting computer forensic evidence for investigation	Apply
CO3: Select appropriate digital forensics techniques for different scenarios	Apply
CO4: Inspect the importance of continuous learning in the field of digital forensics and identify strategies for staying current with advancements	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	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	1	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-	2	1	-	-	-	-	2	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. Jennifer L. Bayuk, J. Healey, P. Rohmeyer, Marcus Sachs , Jeffrey Schmidt, Joseph Weiss, “Cyber Security Policy Guidebook”, John Wiley & Sons, 2012.

T2. Darren R. Hayes, “A Practical Guide to Computer Forensics investigations”, Pearson, 2014.

Reference Book(s):

R1. Bill Nelson, Amelia Phillips, Christopher Steuart, “Computer Forensics and Investigations”, 6th Edition, Cengage learning, 2018

R2. James Graham, Ryan Olson, Rick Howard, “Cyber Security Essentials”, Auerbach Publications, 2017

Web References:

1.Digital Forensics: https://www.eccouncil.org/cybersecurity-exchange/computer-forensics/what-is-digital-forensics/

2. Steps: https://www.simplilearn.com/what-is-digital-forensics-article

3. incident response: https://www.ibm.com/topics/dfir

Vertical II

Course Code: 23ADE009		Course Title: User Interface Design Principles	
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 teach students to design user interfaces using appropriate windows and menu controls.

Module I User Interface Design and Menus 22 Hours

Principles and Process: Importance of the User Interface - Interaction Styles - Graphical User Interface - Direct Manipulation - Characteristics - Web User Interface - Principles of User Interface Design - User Interface Design Process - Human Characteristics in Design.

Windows and Menus: Windows - Characteristics - Components - Presentation Styles - Types - Organizations - Operations - Web Systems - Device Based Controls - Screen Based Controls - Menus-Structures - Functions - Contents - Formatting - Phrasing - Selecting Menu Choices -Web Site Navigation - Graphical Menus.

User Interface Designing: Emotions and the User Experience - Expressive Interfaces - Frustrating Interfaces - Models of Emotion - Interfaces - Process of Interaction Design.

Module II Application of UI 23 Hours

User Interface Testing: Requirements Gathering - Analysis - Interpretation -The Evaluation Framework - Usability Testing - Prototypes - Kinds of Test. Case Study: Just in mind Prototype.

Mobile HCI: Mobile Ecosystem: Platforms - Application frameworks - Types of Mobile Applications - Mobile Information Architecture - Mobile Design - Elements of Mobile Design - Case study: Mobile 2.0.- In Page Editing.

Web HCI: Drag &Drop-Direct Selection - Contextual Tools-Overlays - Inlays and Virtual Pages - Process Flow - Static Invitations - Dynamic Invitations.

Course Outcomes	CognitiveLevel
At the end of this course, students will be able to:	
CO1: Analyze fundamental principles of user interface design and interaction styles to create effective and user-friendly interfaces across platforms	Analyze
CO2: Develop interaction design, evaluation and testing process to solve real world problems	Apply
CO3: Develop mobile applications by choosing appropriate mobile design elements for a given scenario	Apply
CO4: Develop usability testing and prototyping to assess and improve interface functionality on mobile and web platforms	Evaluate

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Wilbert O.Galitz, “The Essential Guide to User Interface Design”, 3rd Edition, John Wiley &Sons, 2007.

T2. Brian Fling, “Mobile Design and Development”, O’Reilly Media Inc., 2009.

Reference Book(s):

R1.Yvonne Rogers , Helen Sharp, Jenny Preece, “Interaction Design: Beyond Human - Computer Interaction”, 5th Edition, John Wiley & Sons, 2019.

R2. Jenifer Tidwell, “Designing Interfaces”,2nd Edition, O’Reilly Publications, 2011

R3. Marc Silver, “Exploring Interface Design”, Delmar Cengage Learning, 2013

Web References:

1.NPTEL Course: https://onlinecourses.nptel.ac.in/noc21_ar05/preview

2.IBM tutorial: https://www.ibm.com/developerworks/library/wa-interface/

3. UI Design Patterns: https://www.interaction-design.org/ literature/ article/10-great-sites-for-ui-design-patterns

Course Code: 23ADE010		Course Title: Graphics and Object Modeling	
Course Category: Major		Course Level: Advanced	
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 creating interactive computer graphics and to implement 2D and 3D transformation with viewing operations using OpenGL.

Module I: 2D Graphics and its Primitives **23 Hours**

Graphics Software Standards and Primitives: Coordinate Representations - Graphics Functions - Software Standards - Introduction to OpenGL - Coordinate Reference Frame - Specifying 2D using OpenGL - Point Functions - Line Functions - Fill Area Primitives - Polygon Fill Area - Polygon Fill Area Functions.

Output Primitives and Attributes: Line Drawing Algorithms - DDA Line Drawing Algorithm - Bresenhams Line Drawing Algorithm - Circle Drawing Algorithm. Point Attributes - Line Attributes - Fill Area Attributes - Character Attributes - OpenGL Functions.

2D Geometric Transformation and Viewing: Basic 2D Transformations - Matrix Representations - Homogeneous Coordinates - Transformation - Viewing Pipeline - Clipping Window - Window to Viewport Transformation - OpenGL 2D Viewing Functions - Clipping Algorithms: Point, Line, Text, Cohen Sutherland Line Clipping Algorithm.

Module II: 3D Graphics and its Visualization **22 Hours**

3D Geometric Transformation and Viewing: Three Dimensional Translations - Rotation-Scaling - Composite Three Dimensional Transformation - OpenGL Geometric Transformation Functions - 3D Viewing - 3D Viewing Pipeline - Projection Transformations - Orthogonal Projections - Oblique Parallel Projections - Perspective Projections - OpenGL Functions.

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 - Comparison - OpenGL Visibility Detection Functions.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop interactive computer graphics using basic OpenGL functions with 2D geometric transformations using OpenGL functions	Apply
CO2: Implement clipping and viewing techniques for 2D scenes using OpenGL	Apply
CO3: Design 3D models and apply 3D viewing and projection techniques using OpenGL built-in functions	Apply
CO4: Apply surface visibility and detection algorithms for 3D visualization using appropriate OpenGL functions	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Donald D. Hearn, M. Pauline Baker, Warren Carithers, “Computer Graphics with OpenGL”, 4th Edition, 2024.

Reference Book(s):

R1. D.F. Rogers and J. A. Adams, “Mathematical Elements for Computer Graphics”, 2nd Edition, McGraw-Hill International Edition, 2017.

R2. Edward Angel, “Interactive Computer Graphics A Top-Down Approach with OpenGL”, 5th Edition, Addison-Wesley, 2012.

R3. Shalini Govil Pai, “Principals of Computer Graphics Theory and Practice using OpenGL and Maya”, Springer, 2010.

Web References:

1. NPTEL Course User Interface Design: https://nptel.ac.in/noc/courses/

2. The Official Guide to Learning OpenGL: http://www.glprogramming.com/

3. OpenGL Latest :http://nehe.gamedev.net/

Course Code: 23ADE011		Course Title: Computational Vision	
Course Category: Major		Course Level: Advanced	
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 image processing, feature detection, segmentation, motion estimation and 3D reconstruction of images to interpret and analyze visual information.

Module I Computer Vision and Image Processing 22 Hours

Introduction to Image Formation and Processing: Computer Vision - Geometric primitives - Photometric image formation - Sampling - Point operators - Linear and Non-linear filtering - Fourier transforms - Wavelets - Global optimization

Feature Detection, Matching and Segmentation: Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy - based methods - YOLO and SSD model.

Module II Computer Vision and 3D Reconstruction 23 Hours

Feature - Based Alignment: 2D and 3D feature - based alignment - Pose estimation

Motion Estimation: Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Dense motion estimation

Image-Based Rendering and Recognition: View interpolation - Layered depth images - Environment mattes - Video-based rendering - Object detection - Face and Category recognition - Context and scene understanding - Recognition databases and test set

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply fundamental computer vision principles and algorithms for real-world problems in image processing	Apply
CO2: Make use of feature based recognition and motion estimation for identifying the characteristics of an object	Apply
CO3: Analyze the ongoing theoretical advancements and the implications for future applications in computer vision	Analyze
CO4: Develop advanced motion estimation and image-based rendering techniques to enhance object recognition, scene understanding, and video-based applications	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer - Texts in Computer Science, 2nd Edition, 2022.

Reference Book(s):

R1. Richard Hartley and Andrew Zisserman, “Multiple View Geometry in Computer Vision”,Second Edition, Cambridge University Press, 2004.

R2. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

R3. E. R. Davies, “Computer and Machine Vision”, 4th Edition, Academic Press, 2012.

Web References:

1. NPTEL Course computer Vision and image processor https://onlinecourses.nptel.ac.in/noc19_cs58/

Course Code: 23ADE012		Course Title: Cloud Services Management	
Course Category: Major		Course Level: Advanced	
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 how to manage modern cloud services, including architecture, deployment, automation, and security. It covers key trends like containerization, serverless computing, and AI integration.

Module I Cloud Ecosystem, Architectures, and Service Models 22 Hours

Cloud Ecosystem and Service Models: Cloud Ecosystem Overview and Characteristics - Cloud Service Models: IaaS, PaaS, SaaS - Cloud Deployment Models: Public, Private, Hybrid, Multi-cloud - Cloud-Native Design Principles - Edge Computing and Distributed Cloud - Modern Cloud Architectures: Serverless, Containers, Microservices

Cloud Strategy and Management in Modern Architectures: AI and Machine Learning in Cloud Services - Multi-cloud Strategies: Benefits, Challenges, and Use Cases - Cloud Strategy Management Framework - Risk Management and Compliance in Cloud - IT Capacity Planning and Utilization - Sustainability in Cloud Computing - Cloud Migration

Module II Cloud Service Management, Automation, and Governance 23 Hours

Cloud Service Lifecycle and Automation: Cloud Service Lifecycle and Design - Automation in Cloud Management (CI/CD, Infrastructure as Code) - Functions-as-a-Service (FaaS) - Cloud Cost Management - Cloud Cost Benefit Analysis - Cloud Operations and Observability - Disaster Recovery and Business Continuity

Cloud Governance, Security, and Optimization: Cloud Governance Framework and Policy - Security and Privacy in Cloud: Shared Responsibility Model - Zero Trust Security in Cloud - AI-driven Cloud Automation - Compliance Standards and Frameworks - Site Reliability Engineering (SRE) Concepts - Service Mesh Concepts - Optimization

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze cloud ecosystem components, service, and deployment models to design scalable and resilient cloud-native architectures	Analyze
CO2: Evaluate multi-cloud strategies, risk management, and sustainability considerations to formulate effective cloud adoption and migration plans	Evaluate
CO3: Design automated cloud service lifecycles to optimize cloud operations	Create
CO4: Develop cloud governance and security frameworks to ensure compliance, reliability, and operational excellence	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Arshdeep Bahga and Vijay Madisetti, "Cloud Computing: A Hands - On Approach", 2021.

T2. Manoj D. Sharma and Yun He, "Cloud Management and Security: Advances, Methods, and Techniques", 2020.

Reference Book(s):

R1. Abhishek P. Joshi and Harini A. Gupta, "Cloud Governance and Risk Management: An Expert Guide to Effective Strategy, Policies, and Practices", 2022.

R2. Justin Garrison and Kris Nova, "Cloud Native Infrastructure: Patterns for Scalable Infrastructure and Applications in a Dynamic Environment", 2021.

Web References:

1. Amazon Cloud: https://aws.amazon.com/types-of-cloud-computing/
2. Azure E-Resource: https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-are-private-public-hybrid-clouds/

Course Code: 23ADE013		Course Title: Full Stack Programming	
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 the basics of Full Stack, Node JS, React JS, Express and MONGO DB to design an effective web application.

Module I Full Stack Web and Node.js Development 15 Hours

Basics Of Full Stack: Basic Web Development Framework - Browser - Webserver - Backend Services - MVC Architecture - Understanding the Different Stacks -The role of Express - Angular - Node - Mongo DB - React

Node JS: Basics and Installation of Node JS- Working with Node packages - Using Node package manager - Using Events - Listeners -Timers - Callbacks - Handling Data I/O

Module II MERN Stack Development 15 Hours

MONGO DB: NoSQL and MongoDB - Building MongoDB Environment - User accounts - Access control - Administering Databases - Managing Collections

Expressions: Data binding - Built-in directives - Configuring routes - Using Request and Response Objects

React JS: MERN STACK - Basic React applications - React Components - React State - Express REST APIs - Modularization and Webpack - Routing with React Router - Server-side Rendering

List of Experiments 30 Hours

1. Develop a portfolio website for yourself for a potential recruiter
2. Implement HTTP services in Node.js
3. Develop a web page by connecting MongoDB from Node.js
4. Develop a web page using angular components in Node.js
5. Create a web page using expressions in Node.js
6. Create a front-end web page using React JS

The above experiments can be implemented using Visual Studio Code, Angular or Django

Suggested Areas for Web Application

1) Passport Automation System
2) Book Bank
3) Exam Registration
4) Stock Maintenance System
5) Online Course Reservation System
6) E- ticketing
7) E- book Management System
8) Recruitment System
9) Library Management System
10) Student Information System
11) Credit Card Processing

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply the principles of full stack web development and MVC architecture to build basic client-server models	Apply
CO2: Apply Node.js functionalities such as events, timers, and callbacks to build backend services	Apply
CO3: Create optimized MongoDB queries and aggregation pipelines that enhance the performance of web applications	Create
CO4: Build MERN stack applications using React components, routing, and RESTful APIs for dynamic web experiences	Create

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	-
CO4	-	-	2	-	-	-	-	-	3	3	-	-	-	-

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. COURSERA Courses on Frontend Development using React Specialization: https://www.coursera.org/specializations/full-stack-react

Course Code: 23ADE014		Course Title: Game Designing Techniques	
Course Category: Major		Course Level: Advanced	
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 essential skills in video game programming and design, covering 2D and 3D graphics, physics, and AI. Participants will develop interactive games using Pygame, focusing on asset creation, sound integration, and gameplay mechanics.

Module I 3D Graphics 15 Hours

Introduction: Evolution of Video Game Programming - The Game Loop - Time and Games - Game Objects - 2D Rendering Foundations - Sprites - Scrolling -Tile Maps - Vectors - Matrices

3D Graphics for Games: 3D Graphics - Basics - Coordinate - Spaces - Lighting and Shading - Visibility - Input Devices - Event based input system - Mobile Input - Basic sound - 3D sound - Digital Signal Processing - Physics - Planes, Rays, and line segments - Collision Geometry - Collision Detection

Module II Game Design and Development 15 Hours

Game Design and AI: Cameras -Types of cameras - Perspective projection - Camera implementation - Camera support algorithm - Real AI versus Game AI - Pathfinding - State based behaviors - Strategy and planning.

Game Development Using Pygame: Developing 2D and 3D Interactive Games using Pygame - Avatar Creation - 2D and 3D Graphics Programming - Incorporating Music and Sound - Asset Creations - Game Physics Algorithms Development - Device Handling in Pygame.

List of Experiments: 30 Hours

1. Installing and Running Pygame
2. Displaying Text, Image and Rectangle Box using Pygame
3. Develop a code to animate a simple object using Pygame
4. Develop a code to animate an object with sound effects using Pygame
5. Simulate bouncing ball using Pygame
6. Developing a Puzzle game using Pygame

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the fundamental principles of 2D and 3D graphics to create immersive game environments	Analyze
CO2: Evaluate different camera systems and AI techniques to design intelligent and interactive game dynamics	Evaluate
CO3: Design interactive 2D and 3D games for comprehensive gameplay experiences	Create
CO4: Develop advanced game physics algorithms and event-driven input systems to enhance game realism and user engagement	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Sanjay Madhav, “Game Programming Algorithms and Techniques: A platform - Agnostic Approach-Game Design”,1st Edition, Addison-Wesley Professional, 2013.

T2. Harrison Kinsley and Will McGugan, “Beginning Game Development with Pygame”, Apress, 2015.

Reference Book(s):

R1. JouniSmed, HarriHakonen, Algorithms and Networking for Computer Games, 2nd Edition, Wiley Publications, 2017.

R2. Paul Craven, “Python Arcade games”, Apress Publishers, 2016.

Web References:

1 Introduction to Game Design URL: https://www.coursera.org/learn/game-design

2. Introduction to Game Design Theory URL: https://www.udemy.com/course/welcome-to-game-design-introduction-to-game- theory/

3. https://www.pygame.org/.

Course Code: 23ADE015		Course Title: AR/VR for 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 knowledge on exploring XR fundamentals and applications, outline AR architecture for real-time use, develop AR apps using suitable tools, explain AR basics with real examples, and apply design principles for AR in industrial sectors.

Module I Immersive Technology 15 Hours

XR Overview: Introduction - XR Spectrum - Definitions - Augmented Reality - Virtual Reality - Mixed Reality - History – Challenges – XR and Business – Applications: Retail - Training - Education - Healthcare - Entertainment - Sports - Manufacturing - Military.

VR IO, Modelling: VR Definition - Input Devices: Trackers - Navigation and Gesture Interfaces - Output Devices: Graphics - Three Dimensional Sound and Haptic Displays - Computer Architecture for VR - Modelling.

VR Application Development: Enabling VR Environment - Building: Steam VR - Oculus Rift - Windows Gear VR - Oculus Go - Google VR - Setting up VR for Android Devices - 3D Walkthrough - Object Grabbing - Transformation - Hand Avatar manipulation - World Space Menu Creation.

Module II AR Application Development 15 Hours

AR Principles: AR Definition - Displays: Multimodal Displays - Spatial Display Model - Visual Displays – Tracking - Calibration and Registration - Mobile Sensors - Computer Vision for AR-AI in AR: Machine Learning, Object Recognition, Gesture Recognition, and Natural Language Processing in AR Systems.

AR Application Development: Mobile Application for Image Tracking - Image Dataset Generation - Setting up AR Environment - Animation and Transformation (Scale, Move, Rotate, Transform) - Build Generation for IOS and Android. Case Study: Picture Puzzle.

List of Experiments: **30 Hours**

1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender
2. Use the primitive objects and apply various projection types by handling camera. Download asset from asset store and apply various lighting and shading effects
3. Model three dimensional objects using various modelling techniques and apply textures over them
4. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity
5. Add audio and text special effects to the developed application
6. Develop AI-powered AR apps for object recognition or user interaction
7. Integrate AI with AR for real-time object detection and gesture recognition in an AR environment

Software tools to be used:
Unity (latest version) with AR Foundation, Vuforia SDK, and AI libraries (TensorFlow/OpenCV) integration.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Analyze the integration of AI techniques in identifying potential use cases for object recognition, image processing, and user interaction based on the understanding of fundamentals	Analyze
CO2: Design a simple AR prototype using chosen tools that incorporates basic AI features for object recognition or user interaction	Create
CO3: Evaluate the new developments and independently seeking relevant information on AR and AI	Evaluate
CO4: Develop augmented reality applications leveraging computer vision, AI techniques, and mobile AR environments for real-world use cases	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Jesse Glover, Jonathan Linowes, “Complete Virtual Reality and Augmented Reality Development with Unity”, Packt Publishing Ltd, 2019.

T2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles and Practice”, Pearson Education, 2017.

Reference Book(s):

R1. Steve Aukstakalnis, “Practical Augmented Reality: A Guide to the Technology Applications, and Human Factors for AR and VR”, Addison-Wesley, 2016.

R2. Robert Scoble, Shel Israel, “The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything”, Patrick Brewster Press, 2016.

Web References:

1. Build Virtual Worlds URL:https://developers.google.com/vr/

2. Quick Start for unreal URL:https://developers.google.com/ar/develop/unreal/quickstart

3. Unity User Manual URL:https://docs.unity3d.com/Manual/UnityManual.htm

Autodesk Maya (educational license) for 3D modeling and animation.

Blender (latest version) as an alternative 3D modeling tool (open-source and free).

Course Code: 23ADE016		Course Title: Security and Privacy in Cloud Technologies	
Course Category: Major		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 cloud computing concepts, emphasizing security, Privacy, compliance, automation and performance optimization.

Module I Cloud Security and Governance 15 Hours

Fundamentals of Cloud computing: Cloud Computing - SPI Framework for Cloud Computing - Traditional Software Model - Cloud Service Delivery Model - Cloud Services Delivery Model - Cloud Deployment Models - Impact of Cloud Computing on Users - Governance in the Cloud.

Infrastructure and Data Security In Cloud: Infrastructure Security: Network Level - Host Level - Application Level - Data Security and Storage: Aspects of Data Security - Data Security Mitigation - Provider Data and its Security.

Identity and Security Management: Trust Boundaries - Challenges and Definitions- Architecture - IAM Standards and Protocols for Cloud Services- IAM Practices - Cloud Authorization Management. Security Management: Standards- Availability Management - IaaS - PaaS - SaaS- Access Control - Security Vulnerability, Patch and Configuration Management.

Module II Privacy and Compliances in Cloud 15 Hours

Privacy in Cloud: Privacy - Data Life Cycle - Key Privacy Concern in Cloud - Internal Privacy Compliance - Changes to Privacy Risk Management and Compliance in Cloud - Legal and Regulatory Implications.

Audit, Compliance: Internal Policy Compliance - GRC - Control Objectives for Cloud Computing - Incremental CSP - Specific Control Objectives - Control Consideration for CSP Users - Regulatory External Compliance - Cloud Security Alliance - Auditing the Cloud for Compliance.

Cloud Service Providers and Impact of Cloud in Corporate: Examples of Cloud Service Providers: Amazon Web Services - Google - Microsoft Azure Services Platform - Salesforce.com - Sun Open Cloud Platform - Impact of Cloud Computing on the Role of Corporate.

List of Experiments: **30 Hours**

1. Simulate a cloud scenario using CloudSim and run a scheduling algorithm not present in CloudSim.
2. Simulate resource management using CloudSim.
3. Simulate a secure file sharing using CloudSim.
4. Implement data anonymization techniques over the simple dataset (masking, k-anonymization,etc)
5. Implement any encryption algorithm to protect the images
6. Develop a log monitoring system with incident management in the cloud

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply cloud service and deployment models to assess their suitability for different organizational IT needs and governance frameworks	Apply
CO2: Implement infrastructure and data security strategies across network, host, and application levels within a cloud environment	Apply
CO3: Apply identity access management (IAM) protocols and security management practices to enforce secure cloud service operations	Apply
CO4: Apply privacy, audit, and compliance frameworks to evaluate regulatory implications and ensure cloud service provider compliance	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1.Tim Mather, Subra Kumaraswamy, Shahed Latif, “Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance”, O’Relly Media, 2009.

Reference Book(s):

R1. Thomas Erl, Robert Cope, Amin Naserpour, “Cloud Computing Design Patterns”, Pearson Education, 2015.

R2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, “Mastering Cloud Computing Foundations and Applications Programming”, Elsevier, 2013.

R3. Raj Kumar Buyya , James Broberg, and rzejGoscinski, “Cloud Computing”, Wiley, 2013

Web References:

1. https://www.oreilly.com/library/view/cloud-security-a/9780470589878/bi01.html
2. https://aws.amazon.com/free/
3. https://journals.sagepub.com/doi/full/10.1155/2014/190903

Vertical III

Course Code: 23ADE017		**Course Title: Object Oriented Software 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 impart knowledge on software life cycle models for software development process.

Module I Software Engineering Process 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.

Module II Modeling & Deployment 23 Hours

Analysis Modeling: Analysis Workflow - Classes and Objects - Finding Analysis Classes - Relationships - Inheritance and Polymorphism - Analysis Packages - Use Case Realization - 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.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Impart the knowledge on Software Life cycle models for Software development process	Apply
CO2: Develop functional object oriented software with deployment techniques	Apply
CO3: Analyze the design trade-offs and architectural decisions involved in object-oriented software development to ensure the successful delivery of software projects	Analyze
CO4: Develop object-oriented software applications by applying implementation workflows, testing strategies, and deployment techniques	Create

Course Articulation Matrix

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

Text Book(s):

T1. Roger. S. Pressman and Bruce R. Maxim, “Software Engineering - A Practitioner’s Approach”, 9th Edition, McGraw Hill, 2019.

T2. Jim Arlow, Ila Neustadt, “UML2 and The Unified Process: Practical Object Oriented Analysis and Design”, Pearson Education, 2015.

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”, 9th Edition, Pearson Education Asia, 2011

Web References:

1. Geeksforgeeks Tutorial: https://www.geeksforgeeks.org/software-engineering-object-oriented-life-cycle-model/
2. Roger S. Pressman online learning Center
   URL: http://www.mhhe.com/engcs/compsci/pressman/
3. NPTEL Course on Object Oriented Analysis and Design
   URL:http:/nptel.ac.in/courses/106105153/

Course Code: 23ADE018		Course Title: Advanced Software Project Management	
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 the importance of Project Management with its methods and methodologies.

Module I Software Project Management and Methodologies 22 Hours

Project Evaluation and Management: Importance of Software Project Management - Types of Project - Contract and Technical Project Management - Activities - Plans, Methods and Methodologies - Categorizing Software Projects - Stakeholders - Setting Objectives - Project Success and Failure - Management Control - Portfolio Management - Evaluation Techniques - Risk Evaluation - Programme Management.

Project Planning and selection of Approaches: Stepwise Project Planning - Build or Buy-Choosing Methodologies and technologies - Software Process and Models - Prototyping - Categorizing Prototypes - Incremental Delivery - Atern/Dynamic System Development – RAD - Agile Methods -Extreme Programming(XP) - SCRUM - Managing Iterative Process - Selecting Appropriate Process Model.

Module II Software Project Estimation, Planning, and Control 23 Hours

Software Effort Estimation: Estimation - Problems in Estimation - Basis for Estimation - Software Effort Estimation Techniques - Bottom-up Estimating - Top-down Approach and Parametric Models - Expert Judgment - Estimating by Analogy - Albercht Function Point Analysis - Function Points Mark II - COSMIC Full Function Points -Parametric Productivity Model - Capers Jones Estimating Rules of Thumb.

Activity Planning and Risk Management: Objectives of Activity Planning - Project Schedules - Project and Activities - Sequencing and Scheduling Activities - Network Planning Model - Forward Pass - The Backward Pass - Activity Float - Project Duration - Critical Activities - Activity on Arrow Networks - Risk - Categories of Risk - Identification - Assessment - Planning - Management -Evaluating Risk - Applying PERT - Monte Carlo Simulation - Critical Chain Concepts.

Resource Allocation, Monitoring and Control: Identifying Resource Requirements - Scheduling Resources - Creating Critical Paths - Counting the Cost - Publishing Resource Schedule - Cost Schedules - Scheduling Sequence - Creating Framework - Collecting Data - Visualizing Progress - Cost Monitoring - Earned Value Analysis- Managing Contracts- Types of Contract - Stages in Contract Placement - Contract Management - Acceptance.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze various software project management methodologies and process models to determine their suitability for different project types and organizational needs	Analyze
CO2: Evaluate software estimation techniques to assess effort, cost, and productivity for accurate project planning	Evaluate
CO3: Design comprehensive project plans including activity sequencing, resource scheduling, and risk management strategies	Create
CO4: Develop project control mechanisms to monitor progress, manage costs, and ensure project deliverables are met effectively	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Bob Hughes, Mike Cotterell, Rajib Mall, “Software Project Management”, 6th Edition, Tata McGraw Hill Publishers, 2017.

Reference Book(s):

R1. Robert K. Wysocki, “Effective Software Project Management”, Wiley Publication, 2011.

R2. Walker Royce, “Software Project Management”, Addison Wesley, 1998.

R3. Gopalaswamy Ramesh, “Managing Global Software Projects”, McGraw Hill Education, 14th Edition, 2013.

Web References:

1. NPTEL Course: https://onlinecourses.nptel.ac.in/noc24_mg01/preview
2. NPTEL Course: https://nptel.ac.in/courses/110104073

Course Code: 23ADE019		Course Title: Software Quality Management	
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 appropriate software testing strategies for designing effective test cases and how to choose the suitable type of software testing for specific project stages.

Module I Software Quality Architecture and components **22 Hours**

Software Quality Factors and Architecture: Software Quality Challenge - Software Quality Assurance - Software Quality Factors - Components of SQA System: SQA System and Architecture - Pre-Project Components - Development and Quality Plans.

SQA components and Quality devices: Integrating Quality Activities in the Project Life Cycle - Reviews: Objectives - Formal Design Review - Peer Review - Expert Opinions.

Software Testing Strategies and Implementation: Objectives - Strategies - Classifications - White Box Testing - Black Box Testing. Implementation: Testing Process - Test Case Design - Automated Testing - Alpha and Beta Testing - CASE Tools.

Module II SQA Infrastructure and Management Components **23 Hours**

Procedures, work instructions and Supporting Quality Devices: Needs - Manuals - Quality Devices: Templates - Checklists.

Certifications, Corrective and Preventive actions: 3S Development Team - Objectives - Training and Certification Process - Corrective and Preventive Actions - Configuration Management - Documentation Control.

Management Components: Progress Control - Metrics - Costs - Quality Management Standards - Management and its Roles - SQA Unit and other Actors.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the principles and architecture of Software Quality Assurance (SQA) and its role in software development	Apply
CO2: Apply appropriate software testing strategies and techniques for quality assurance	Apply
CO3: Analyze the use of quality infrastructure elements such as templates, checklists, and manuals in real-time projects	Analyze
CO4: Analyze management components including metrics, certification, configuration management, and quality control processes for software quality improvement	Analyze

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Daniel Galin, “Software Quality Assurance - From theory to implementation”, Pearson Education, 2016.

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.

R3. Dorothy Graham, Mark Fewster, “Experiences of Test Automation: Case of studies of Software Test Automation”, Pearson Education, 2012.

Web References:

1.Software Quality Assurance Tutorial: https://reqtest.com/testing-blog/software-qualityassurance/https://reqtest.com/testing-blog/software-quality-assurance/

2.Software Project Management URL: https://www.classle.net/#!/classle/largecontent/software-project-managment-lecture-slides/

3. Software Testing: https://www.toolsqa.com/software-testing/defect-life-cycle

Course Code: 23ADE020		Course Title: Reliability Engineering and System Safety	
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 analyze failure data, design reliable systems, and improve system reliability through various techniques.

Module I Concepts and designs of Reliability 22 Hours

Concepts of Reliability, System and Models: The Study of Reliability and Maintainability - Concepts, Terms and Definitions - Reliability Function - MTTF - Hazard Rate Function - Bathtub Curve - Conditional Reliability - Constant Failure Rate Model - Time Dependent Failure Models.

Reliability: Configurations - State Dependent Systems - Physical Reliability Models.

Module II Reliability, Analysis and Applications 23 Hours

Design for Reliability and Repair Process: Specifications - Measurements - Design Methods - Failure Analysis - Analysis of Downtime - The Repair Time Distribution - Stochastic Point Processes - System Repair Time **-** Reliability Under Preventive Maintenance - State Dependent Systems with Repair - Design for Maintainability - Availability.

Analysis of Failure Data and Reliability Testing: Data Collection and Empirical Methods - Identifying Failure and Repair Distributions - Statistical Tests - Reliability Testing.

Applications - Case Studies: Reliability Estimation and Application - Implementation: Objectives, Functions and Processes - Economics of Reliability and Maintainability - Organizational Considerations - Data Sources and Data Collection Methods - Product Liability, Warranties and Related Matters - Software Reliability - Case Study: Multiply Censored Data - Repairable System Analysis.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze system reliability using models and methods	Analyze
CO2: Design reliability tests and maintenance strategies	Apply
CO3: Evaluate safety regulations and risk management	Evaluate
CO4: Analyze failure data using statistical techniques and reliability testing for real-world decision-making and design improvement	Analyze

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Charles E. Ebling, “An Introduction to Reliability and Maintainability Engineering”, Tata McGraw-Hill, 2017.

Reference Book(s):

R1. David J. Smith, “Reliability, Maintainability and Risk: Practical Methods for Engineers”, Butterworth-Heinemann, Elsevier, 10th Edition, 2021.

R2. R.Subburaj, “Software Reliability Engineering”, McGraw Hill Education, 2015.

R3. P.K.Kapur, H.Pham, A.Gupta,P.C.Jha, “Software Reliability with OR Assessments”, Springer, 2013.

Web References:

1. Reliability Engineering : Definition, Goals,Techniques:

https://limblecmms.com/blog/reliability-engineering

2. Introduction to Reliability Engineering:

https://reliabilityweb.com/articles/entry/introduction_to_reliability_engineering Springer-Verlag London Limited, 2011

Course Code: 23ADE021		Course Title: Agile 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 Implement the various activities involved in the agile software development process and to understand about scrum roles in agile project.

Module I Agile Software Development and Scrum Framework **15 Hours**

Agile Development: Agile Manifesto: Agile Principles - Overview of Extreme Programming: User Stories - Pair Programming - Test Driven Development - Continuous Integration - Simple Design - Refactoring - Metaphor - Agile Process Models - Technology Directions: Test Driven development, Lean Software Development.

Scrum, Sprint and Product Backlog: Introduction to Scrum: Adapting to Scrum - Patterns for adopting Scrum, Product Backlog - Sprints, Planning - Progressively Refine Requirements - Iceberg, Refining User stories.

Scrum Roles: Individual New Roles: Scrum Master - Product Owner: Roles and Responsibilities.

Module II Agile Roles, Testing, and Software Design **15 Hours**

Changed Roles: Analysts: Project Managers, Functional Managers - Programmers, Database Administrators, Testers, User Experience Designers.

Agile Testing: Test-Driven Development (TDD) Cycle - Acceptance tests - Continuous planning - Agile Test Automation: Agile Testing Quadrant - Test Automation Backlog - Pyramid - Unit Test Characteristics -xUnit frameworks - Multidimensional Testing Coverage Matrix.

Agile Software Design and Development: Agile Design: Design Smells - Agile Design Principles: Single Responsibility Principle - Open Closed Principle - Liskov Substitution Principle - Dependency Inversion Principle, Interface Segregation Principle

List of Experiments **30 Hours**

1. Implement agile software development dashboard using Jira
2. Create scrum using Jira software
3. Apply Jira for assigning scrum roles in an organization
4. Write test cases for Test driven Development using Junit
5. Create user stories in scrum using Jira
6. Create sprint in the backlog using Jira

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply the core principles of Agile development and methodologies to determine their impact on software quality and team collaboration	Apply
CO2: Evaluate the roles, responsibilities, and workflows within Scrum to optimize Agile project delivery	Evaluate
CO3: Design Agile testing strategies like Test-Driven Development (TDD) and automated testing frameworks to ensure continuous integration and software reliability	Create
CO4: Apply Agile software design principles and refactoring techniques to improve code maintainability, modularity, and adherence to SOLID design patterns	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Roger S. Pressman and Bruce R Maxim, “Software Engineering - A Practitioner’s approach, 7th Edition, McGraw-Hill Education, 2020.

T2. Mike Cohn, “Succeeding with Agile: Software Development Using Scrum”, Addison-Wesley, 2013.

T3. Robert C. Martin and Micah Martin, “Agile Principles, Patterns and Practices in C#”, Prentice Hall, 2013.

Reference Book(s):

R1. Ken Schwaber, “Agile Project Management with Scrum Microsoft Professional”, Microsoft Press, 2015

R2. Thomas Stober, Uwe Hansmann, “Agile Software Development - Best Practices for large Software Development Projects”, Springer, 2014.

Web References:

1. Agile Methodology Tutorial: https://www.tutorialspoint.com/agile/index.htm
2. Scrum: https://www.scrum.org/

Course Code: 23ADE022		Course Title: Basic 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 knowledge on Perform validation of new product and to Implement sustenance engineering and End of Life support activities.

Module I Product Development & System Design 15 Hours

Fundamentals of Product Development: 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.

Requirements and System Design: 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.

Design and Testing: Conceptualization - Industrial Design and User Interface Design -

Module II Design Challenges & Business Dynamics 15 Hours

Challenges in Design: Challenges: Concept Screening & Evaluation - Detailed Design - Component Design and Verification - Mechanical - Electronics and Software Subsystems -

Sustenance Engineering and End-of-Life (EoL) Support: Product Verification Processes - Stages, Product Validation Processes - Stages: Product Testing Standards and Certification - Product Documentation - Sustenance - Maintenance and Repair - Product EoL: Obsolescence Management, Configuration Management, EoL Disposal.

Business Dynamics - Engineering Services Industry: Industry : Engineering Services Industry - Embedded and Software Systems - Product Development Trade-offs - Intellectual Property Rights and Confidentiality - Security and Configuration Management

List of Experiments: **30 Hours**

1. PESTLE and SWOT 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 design thinking to create innovative product concepts	Apply
CO2: Collaborate in multidisciplinary teams for product development	Analyze
CO3: Evaluate environmental, ethical, and societal impact of products	Evaluate
CO4: Develop product validation, testing, and sustenance strategies, addressing challenges in component verification, maintenance, end-of-life management, and compliance with industry standards	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. "Foundation Skills in Integrated Product Development", NASSCOM student Handbook, McGraw Hill Education, 1st Edition, 2013.

Reference Book(s):

R1. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering Design", 7th Edition, McGraw Hill Education, 2013.

R2. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Concepts", 2nd Edition, Prentice Hall, 2011.

Web References:

1.NPTEL Course Product Design and Development: https://onlinecourses.nptel.ac.in/noc21_me83/preview

2.Scrum: https://www.scrum.org/ MIT Open Courseware Product Design and Development: https://ocw.mit.edu/courses/sloan-school-of-management/15-783j and development-spring-2006/

3.NPTEL Course Introduction to Strategic Management: https://nptel.ac.in/courses/110/108/110108047

Course Code: 23ADE023		Course Title: UI 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:

This course aims to develop students' ability to analyze system requirements and apply design patterns effectively for robust software design. It focuses on practical implementation of architectural and behavioral patterns, including MVC and distributed object designs.

Module I Design Patterns & OOP Basics 15 Hours

Design Pattern Concepts: Design Pattern - Describing Design Patterns - Catalog - Organizing the Catalog - Solve Design Problems with Design Patterns - Selecting Design Pattern - Using Design Pattern - Object - Oriented Development - Key Concepts and Related Concepts - Benefits and Drawbacks - Basics of OOP.

System Analysis, Design and Implementation: Overview of the Analysis Phase - Gathering the Requirements - Functional Requirements Specification - Defining Conceptual Classes - Relationships - Using the Knowledge of the Domain - Design and Implementation: Design - Implementing Design.

Module II Advanced Patterns & Distributed Design 15 Hours

Design Pattern Catalog: Structural Patterns: Motivation - Applicability - Implementation Adapter: Motivation - Applicability - Implementation - Bridge: Motivation - Applicability Implementation - Composite: Motivation - Applicability - Implementation - Decorator- Facade - Flyweight- Proxy.

Interactive Systems and The MVC Architecture: Introduction - Mvc Architectural Pattern - Analyzing A Simple Drawing Program - Designing The System - Designing of the Subsystems - Getting into Implementation - Implementing Undo Operation - Drawing Incomplete Items - Adding A New Feature - Pattern Based Solutions.

Behavioral Patterns & Designing With Distributed Objects: Behavioral Patterns: Chain of Responsibility - Command - Interpreter - Iterator - State- Designing with Distributed Objects: Client Server System - Java Remote Method Invocation- Implementing an Object Oriented System on the Web.

List of Experiments **30 Hours**

1. Illustrate Use Case Diagram for a Suitable Scenario.
2. Implement the Adapter Design Pattern for an Appropriate Scenario in Suitable Java Based Application.
3. Implement the MVC Design Pattern for an Appropriate Scenario in Suitable Java Based Application.
4. Implement the Flyweight Design Pattern for an Appropriate Scenario in Suitable Java Based Application.
5. Implement the Decorator Design Pattern for a Suitable Scenario in Text Editor Application.
6. Implement the Iterator Design Pattern for a Suitable Scenario in Text Editor Application.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Develop feed forward and deep networks for solving simple problems	Apply
CO2: Apply various regularization techniques to improve the performance and generalization of deep neural networks	Apply
CO3: Examine convolutional neural network for solving real time problems	Analyze
CO4: Utilize deep learning concepts to design and implement solutions tailored to specific target applications	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.

Reference Book(s):

R1. Josh Patterson, “Deep Learning: A Practitioner's Approach”, O'Reilly Media, 2017.

R2. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems”, O'Reilly Media, 2017.

Web References:

1. Practical Deep Learning: https://course.fast.ai/

2. Introduction: https://www.geeksforgeeks.org/introduction-deep-learning/

3. Deep Learning Algorithms: https://www.simplilearn.com/tutorials/deep-learning-tutorial/deep-learning-algorithm

Course Code: 23ADE024		Course Title: Marketing 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 focuses on the crucial role of marketing analytics in business decisions. It will develop your skills in data analysis using R, introduce you to machine learning for marketing research, and teach you how to analyze social media data using APIs and other tools.

Module I Data-Driven Marketing **15 Hours**

Introduction to Marketing Analytics: Introduction - Marketing Research - Marketing Analytics - Web Analytics - Online and Offline Data - Type of Media - Data Type: Structured - Semi-Structured - Unstructured Data

Descriptive Analysis: Introduction - Key Ideas in the World of R-Taste of R-Summarizing data - Generating an Overall Data Summary - Summarizing Numeric Variables - Summarizing Categorical Variables - Exploring Relationships Between Numeric Variables - Exploring Relationships between Categorical Variables Plotting data.

Module II Data-Driven Advertising **15 Hours**

Advertising Analytics: Introduction - Media Budget Decisions - Advertising Effectiveness - Consumer Perception and Preference - Mapping Consumer Perception and Preference - Factor Analysis - Cluster Analysis - Multi-Dimensional Scaling - Correspondence Analysis - Conjoint Analysis.

Social Media Data: Introduction - Overview of Social Media Platforms - Social Media APIs - Observable aspects of Consumer Behavior on Social Media - Workflow for Social Media Data Collection.

List of Experiments: **30 Hours**

1. Create clutter-free plots that effectively convey insights using facets and advanced plot types in R programming.
2. Analyze a sample web analytics report and identify key insights for improving online marketing strategies.
3. Explore relationships between categorical variables using contingency tables and chi- square tests.
4. Implement a supervised learning algorithm (e.g., linear regression) to predict sales based on marketing expenditures. (ANOVA, ANCOVA, MANOVA, MANCOVA)
5. Implement an unsupervised learning algorithm (e.g., k-means clustering) to segment customers based on their purchasing behavior.
6. Develop visualizations, reports, and actionable strategies (e.g., perceptual maps, segmentation reports).

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Analyze different types of marketing and apply descriptive analytics techniques using R to extract meaningful insights	Analyze
CO2: Evaluate machine learning models such as correlation and regression for their effectiveness in solving marketing research problems	Evaluate
CO3: Design advertising analytics strategies to optimize media budget and measure advertising effectiveness	Create
CO4: Develop workflows for social media data collection and analyze consumer behavior using social media APIs to enhance targeted marketing campaigns	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Moutusy Maity and Pavankumar Gurazada, "Marketing Analytics for Strategic decision Making"", Oxford University press, 1st Edition, 2021.

Reference Book(s):

R1. Chuck hemann and Ken Burbary, “Digital marketing analytics: Making Sense of Consumer Data in a Digital”, QUE Publication, 2nd Edition, 2018.

R2. Wayne L. Winston, “Marketing Analytics: Data-Driven Techniques with Microsoft Excel”, Wiley Publication, 1st Edition, 2014.

Web References:

1. Web analytics: https://www.hotjar.com/web-analytics/
2. R programming: https://www.geeksforgeeks.org/r-tutorial/
3. Advertising analytics: https://www.knorex.com/blog/articles/advertising-analytics

Vertical IV

Course Code: 23ADE025		**Course Title: Data Analytics for Engineers**	
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 provide knowledge on data input and data access using R, represent data through graphical methods, analyze data using concepts of probability and statistics, and draw inferences through correlation and regression analysis.

Module I Foundations Of Statistical Analysis With R 22 Hours

Introduction to R: Introduction R as A Statistical Software and Language - R as a Calculator - R Preliminaries - Methods of Data Input - Data Accessing or Indexing. Some Useful Built-In Functions - Graphics with R-Getting Help, - Saving, Storing and Retrieving Work.

Descriptive Statistics: Introduction - Diagrammatic Representation of Data - Graphical Representation of Data - Measures of Central Tendency - Dispersion - Skewness and Kurtosis - Selection of Representative Samples.

Probability And Probability Distributions: Probability: Definitions and Properties - Probability Distributions - Some Special Discrete Distributions - Continuous Distributions.

Module II Statistical Inference and Regression Analysis 23 Hours

Statistical Inference: Sampling Distribution of Sample Mean - Estimation of Parameters - Plots to Check Normality - Hypothesis Testing - Goodness of Fit Tests.

Correlation and Regression Analysis: Correlation - Inference Procedures for Correlation Coefficient - Linear Regression - Inference Procedure for Simple Linear Model - Validation of Linear Regression Model - Transformation of the Variables - Polynomial Regression Models.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Analyze data using R programming techniques for descriptive statistical analysis	Analyze
CO2: Evaluate different measures of central tendency, dispersion, skewness, and kurtosis to interpret statistical properties of datasets	Evaluate
CO3: Apply probability theory and common probability distributions to model real-world random variables	Apply
CO4: Create regression models using correlation, hypothesis testing, model transformations, and polynomial regressions	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Sudha G. Purohit, Sharad D. Gore and Shailaja R. Deshmukh, “Statistics using R”, Narosa Publications, 2019.

Reference Book(s):

R1. Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014.

R2. Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008.

Web References:

1. NPTEL Course Data Science for Engineers: https://onlinecourses.nptel.ac.in/noc21_cs69/
2. R programming basics: https://www.w3schools.com/R
3. Probability-and-statistics for data science: https://www.coursera.org/learn/machine-learning-probability-and-statistics

Course Code: 23ADE026		Course Title: Business Analytics Management	
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 information technology applications and design a dashboard and scorecard.

Module I Business Intelligence and IT Applications 22 Hours

Introduction: Business View of IT Applications - Key Purpose of using it in Business - Enterprise Applications and Bespoke IT Applications. - Types of Digital Data

OLTP and OLAP: OLTP - OLAP - Different OLAP Architecture - OLTP and OLAP - Data Models for OLTP and OLAP - Role of OLTP Tools in BI Architecture.

BI Concepts: BI - Evolution of BI and Role of DSS, EIS, MIS, and Digital Dashboards - BI Users - BI Component Framework - BI Roles and Responsibilities.

Module II Data Warehousing and Enterprise Reporting 23 Hours

Data Integration: Need for Data Warehouse- Data Mart - ETL - Data Integration Technologies - Data Quality.

Multidimensional Data Modeling: Data Modeling Basics - Types of Data Model - Data Modelling Techniques - Fact Table - Dimensional Table - Typical Dimensional Models - KPI usage in Companies.

Enterprise Reporting: Reporting Perspectives Common to All Levels of Enterprise - Report Standardization and Presentation Practices - Balanced Scorecard- Dashboards - Scrorecards Vs Dashboards.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the role of OLTP and OLAP systems within Business Intelligence architectures to distinguish their impact on data processing and decision-making	Analyze
CO2: Evaluate the effectiveness of various enterprise reporting tools and techniques in delivering actionable business insights	Evaluate
CO3: Design a multidimensional data model using fact and dimension tables to support data warehousing and advanced reporting needs	Create
CO4: Integrate data from multiple sources using ETL processes to build a data warehouse that meets organizational reporting requirements and ensures data quality	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. RN Prasad, Seema Acharya, "Fundamentals of Business Analytics", 2nd Edition, Wiley, 2016.

T2. Ramesh Sharda, Dursun Delen, Efraim Turban, "Business Intelligence and Analytics, Systems for Decision Support", 10th Edition, Pearson Education Inc, 2015.

Reference Book(s):

R1. David Loshin, "Business Intelligence: The Savvy Manager's Guide", 2nd Edition, Morgan Kaufman, 2012.

R2. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley, 2009

Web References:

1. Business Intelligence: https://cloud.google.com/learn/what-is-business-intelligence
2. Data warehousing: https://www.geeksforgeeks.org/data-warehousing/
3. Nptel course in Business Anaytics for Management Decision: https://onlinecourses.nptel.ac.in/noc20_mg11/preview

Course Code: 23ADE027		Course Title: Data Analytics in Health Care	
Course Category: Major		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 design data models for better patient outcomes and trend analysis through integrated, patient-focused analytics.

Module I Healthcare Analytics & ML Foundations 22 Hours

Introduction to Healthcare Data Analytics: Introduction - Need for Healthcare Analytics - Foundations of Healthcare Analytics - Examples of Healthcare Analytics.

Healthcare Foundations: Healthcare Delivery - Healthcare Financing - Healthcare Policy - Handling Patient Data: The Journey from Patient to Computer - Standardized Clinical Codesets - Breaking Down Healthcare Analytics: Population, Medical Task, Data Format, Disease - Ethical Guidelines and Regulatory Acts.

Machine Learning Foundations for Healthcare: Model Frameworks for Medical Decision Making: Tree-Like Reasoning, Probabilistic Reasoning and Bayes Theorem, Criterion Tables and the Weighted Sum Approach, Pattern Association and Neural Networks - Machine Learning Pipeline: Loading the Data, Cleaning and Preprocessing the Data, Exploring and Visualizing the Data, Selecting Features, Training the Model Parameters, Evaluating Model Performance.

Module II Healthcare Quality & Predictive Modeling 23 Hours

Measuring Healthcare Quality: Introduction to Healthcare Measures, Medicare Value-Based Programs: The Hospital Value-Based Purchasing (HVBP) Program, The Hospital Readmission Reduction (HRR) Program, The Hospital-Acquired Conditions (HAC) Program, The End-Stage Renal Disease (ESRD) Quality Incentive Program, The Skilled Nursing Facility Value-Based Program (SNFVBP), The Home Health Value - Based Program (HHVBP), The Merit-Based Incentive Payment System (MIPS).

Making Predictive Models in Healthcare: Introduction to Predictive Analytics - Obtaining and Importing the NHAMCS Dataset - Making the Response Variable - Splitting the Data into Train and Test Sets - Preprocessing the Predictor Variables - Building the Models - Using the Models to Make Predictions - Improving our Models.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the concepts of Healthcare Data Analytics and healthcare foundations	Analyze
CO2: Apply machine learning techniques on healthcare data analytics	Apply
CO3: Analyze the quality of health-care systems	Analyze
CO4: Develop models for effective predictions in healthcare applications	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Kumar, Vikas Vik, “Healthcare Analytics Made Simple: Techniques in healthcare computing using machine learning and Python”, Packt Publishing Ltd, 2018.

T2. El Morr, Christo, and Hossam Ali-Hassan, “Analytics in healthcare: a practical introduction”, Springer, 2019.

Reference Book(s):

R1. Dinov, Ivo D, "Data Science and Predictive Analytics" Springer, Ann Arbor, MI, USA https://doi. org/10 1007 (2018): 978-3.

R2. Yang, Hui and Eva K. Lee, “Healthcare analytics: from data to knowledge to healthcare improvement” John Wiley & Sons, 2016.

Web References:

1. Data Analytics in Healthcare Blog: https://intellipaat.com/blog/data-analytics-in-healthcare

2. Watson for healthcare Data Analytics: https://www.ibm.com/watsonhealth/learn/healthcare-data-analytics

3. Article on data analytics in Health-Care :https://www.comptia.org/content/articles/how-is-data-analytics-used-in-health-care

Course Code: 23ADE028		Course Title: Graph Analytics and Algorithm	
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:

This course aims to equip students with the knowledge and skills to model, analyze, and process complex data using graph-based techniques and algorithms. It emphasizes practical applications of graph analytics in real-world domains and their integration with machine learning.

Module I Graph Analytics **22 Hours**

Introduction to Graphs: Introduction - Graph Analytics and Algorithms - Graph Processing, Databases, Queries, and Algorithms OLTP and OLAP - Graph Analytics Use Cases - Graph Theory & Concepts - Terminology - Graph Types and Structures - Flavors of Graphs - Types of Graph Algorithms.

Graph Platforms and Processing: Graph Platform and Processing Considerations - Representative Platforms - Path Finding and Graph Search Algorithms - Example Data: The Transport Graph - Shortest Path & its Types.

Community Detection Algorithms: Example Graph Data: The Software Dependency Graph - Triangle Count and Clustering Coefficient - Strongly Connected Components - Connected Components - Label Propagation - Louvain Modularity.

Module II Graph Algorithm **23 Hours**

Graph Algorithms in Practice: Analyzing Yelp Data with Neo4j - Overview of the Yelp Data - Analyzing Airline Flight Data with Apache Spark.

Using Graph Algorithms to Enhance Machine Learning: Machine Learning and the Importance of Context - Connected Feature Extraction and Selection - Graphs and Machine Learning in Practice: Link Prediction

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze complex datasets using graph theory concepts to identify relationships, patterns, and structures within real-world networks	Analyze
CO2: Evaluate the suitability of different graph platforms and algorithms for solving specific analytical problems	Evaluate
CO3: Create graph-based models for real-world applications by integrating graph data with machine learning workflows	Create
CO4: Design efficient graph algorithms for community detection, path finding, and component analysis	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Mark Needham, Amy E. Hodler, “Graph Algorithms: Practical Examples in ApacheSpark and Neo4j”, 2019.

Reference Book(s):

R1. R. Ahuja, L. Magnanti, and J. Orlin, “Network Flows: Theory, Algorithms and Applications”, Prentice - Hall, Inc., 1993.

R2. B. Mohar and C. Thomassen, “Graphs on Surfaces”, Johns Hopkins University Press, 2001.

Web References:

1. Graph_Algorithm Tutorial point : https://www.tutorialspoint.com/parallel_algorithm/graph_algorithm.htm
2. Graph-Algorithms real world application: https://www.oracle.com/a/tech/docs/asktom-graph-algorithms.pdf
3. Graph-Analytics Guide: https://www.nvidia.com/en-us/glossary/data-science/graph-analytics

Course Code: 23ADE029		Course Title: Social Network 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 to analyze graph features, apply network models, implement algorithms, and develop social mining applications.

Module I: Fundamentals of Network Modeling and Analysis **15 Hours**

Graph Foundations & Network Analysis

Graph Essentials - Representations - Types of Graphs - Graph Algorithms - Network Measures - Centrality - Transitivity - Reciprocity - Balance and Status - Similarity.

Network Modeling

Network Models - Real-World Network Properties - Random graphs - Small World Model - Preferential Attachment Model.

Module II: Social Network Analysis and Mining **15 Hours**

Mining Social Networks, Community Detection

Data Mining Essentials - Community Analysis: Community Detection, Community Evolution, Community Evaluation.

Information Diffusion in social media

Herd Behavior -Information cascades - Diffusion of Innovations - Epidemics - Influence and Homophily - Recommendation in Social Media - Behavior Analytics.

List of Experiments: **30 Hours**

1. Develop a Program to Identify Degree Centrality and Page Rank for the Given Graph
2. Clustering of Twitter Dataset using K-Means Algorithm
3. Identification of User Community using Brute-Force Clique Technique
4. Analyze and Visualize Patterns of Homophily in a Social Network Dataset using Correlation or Similarity Measures
5. Simulate the Growth of a Scale - Free Network using the Barabasi - Albert Model
6. Analyzing Real-World Social Network Dataset and Visualize the Network Structure

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze various graph representations, types, and network measures such as centrality, transitivity, reciprocity, and similarity to understand network structures	Analyze
CO2: Evaluate the structural characteristics of real-world networks using different network models like random graphs, small-world, and preferential attachment models	Evaluate
CO3: Apply data mining techniques for social network analysis including community detection, evolution, and evaluation	Apply
CO4: Create models to simulate and interpret information diffusion, influence propagation, and recommendation systems in social media environments	Create

Course Articulation Matrix

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

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, 2014.

Reference Book(s):

R1. Maksim Tsvetovat and Alexander Kouznetsov, “Social Network Analysis for Startups”, O’Reilly Media Inc., 2011.

R2. Charu. C.Aggarwal, “Social Network Data Analytics”, Springer, 2011.

R3. Matthew A. Russell, “Mining the Social Web”, 2nd Edition, O’Reilly Media Inc., 2013.

Web References:

1. NPTEL - Social Networks course. URL: http://nptel.ac.in/courses/106106169

2. MIT Open Courseware.URL: https://ocw.mit.edu/courses/media-arts-and-sciences/mas-961-networks-complexity-and-its-applications-spring-2011/index.htm

Course Code: 23ADE030		Course Title: Recommendation 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 impart knowledge on understanding the foundational concepts of recommender systems and the importance of machine learning and data mining algorithms.

Module I Introduction to Recommender Systems 15 Hours

Introduction - Basic Taxonomy of Recommender Systems - Traditional and Non-Personalized Recommender Systems - Overview of Data Mining Methods for Recommender Systems - Similarity Measures - Dimensionality Reduction – Singular Value Decomposition (SVD) - Content-Based Recommendation Systems: High Level Architecture of Content-Based Systems - Item Profiles - Representing Item Profiles - Methods for Learning User Profiles - Similarity - Based Retrieval - Classification Algorithms

Module II Recommender Systems & Evaluation 15 Hours

Systematic Approach - Nearest Neighbor Collaborative Filtering (CF) - User Based and Item-Based CF - Components of Neighborhood Methods: Rating Normalization - Similarity Weight Computation - Neighborhood Selection

Attack-Resistant Recommender Systems: Introduction - Types of Attacks - Detecting Attacks on Recommender Systems - Individual Attack – Group Attack – Strategies for Robust Recommender Design - Robust Recommendation Algorithms - Evaluating Recommender Systems: Evaluating Paradigms - User Studies - Online and Offline Evaluation - Goals of Evaluation Design - Design Issues - Accuracy Metrics - Limitations of Evaluation Measures

List of Experiments: 30 Hours

1. Implement Data Similarity Measures using Python
2. Implement Dimension Reduction Techniques for Recommender Systems
3. Implement User Profile Learning
4. Implement Content-Based Recommendation Systems and Collaborative Filter Techniques
5. Create an Attack for Tampering with Recommender Systems
6. Create an Attack for Tampering with Recommender Systems

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the fundamental concepts of recommender systems and their applications	Analyze
CO2: Analyze different data mining methods used in recommender systems	Analyze
CO3: Implement Collaborative Filtering in carrying out performance evaluation of recommender systems	Apply
CO4: Evaluate the vulnerabilities of recommender systems and propose strategies for robust design	Apply
CO5: Critically assess the effectiveness of recommender systems using different evaluation methods	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Charu C. Aggarwal, “Recommender Systems: The Textbook”, Springer Publication, 2016.

Reference Book(s):

R1. Dietmar Jannach, Markus Zanker, Alexander Felfernig and Gerhard Friedrich, “Recommender Systems: An Introduction”, Cambridge University Press, 1st Edition, 2011.

R2. Francesco Ricci, Lior Rokach, Bracha Shapira, “Recommender Systems Handbook”, 1st Edition, Springer publication, 2011.

Web References:

1. Coursera Recommender-systems course material: https://www.coursera.org/specializations/recommender-systems.

Course Code: 23ADE031		Course Title: Text and Speech 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 on emerging deep learning techniques for text and speech processing.

Module I Natural Language foundations and Text Classification 15 Hours

Natural Language: Foundations - Language Syntax and Structure - Text Preprocessing and Wrangling - Text Tokenization - Stemming - Lemmatization - Removing Stop - Words - Feature Engineering for Text Representation - Bag of Words Model- Bag of N - Grams Model - TF - IDF Model.

Text Classification: Vector Semantics and Embeddings - Word Embeddings - Word2Vec Model - Glove Model - FastText Model - Deep Learning Models - RNN - Transformers.

Question Answering and Dialogue Systems: Information Retrieval - IR-Based Question Answering - Knowledge-Based Question Answering - Language Models for QA - Classic QA Models - Chatbots - Design of Dialogue Systems- Evaluating Dialogue Systems.

Module II Text-To-Speech and Automatic Speech Recognition 15 Hours

Text-To-Speech Synthesis: Overview. - Text Normalization - Letter-to-Sound-Prosody, Evaluation. Signal Processing - Concatenative and Parametric Approaches, Wavenet and Other Deep Learning - Based TTS Systems.

Automatic Speech Recognition : Speech Recognition - Acoustic Modelling - Feature Extraction - HMM, HMM-DNN Systems.

List of Experiments 30 Hours

1. Create Regular Expressions in Python for Detecting Word Patterns and Tokenizing.
2. Getting Started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams.
3. Accessing Text Corpora using NLTK in Python.
4. Write a function that Finds the 50 Most Frequently Occurring Words of a Text that are not Stop Words.
5. Implement the Word2Vec Model Text.
6. Use a transformer for Implementing Classification.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze natural language structures and apply advanced text preprocessing and feature engineering techniques to prepare textual data for machine learning models	Analyze
CO2: Evaluate various word embedding techniques and deep learning models, such as Word2Vec, GloVe, RNNs, and Transformers, for their effectiveness in text classification tasks	Evaluate
CO3: Design components of question answering and dialogue systems using retrieval-based and knowledge-based approaches, incorporating appropriate evaluation strategies	Create
CO4: Construct text-to-speech synthesis and automatic speech recognition systems using signal processing, statistical models, and modern deep learning techniques	Evaluate

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, 3rd Edition, Pearson Education, 2022.

Reference Book(s):

R1. Dipanjan Sarkar, “Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data”, APress, 2019.

R2. Tanveer Siddiqui, Tiwary U S, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.

R3. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, “Fundamentals of Speech Recognition”, 1st Edition, Pearson, 2009.

Web References:

1. Nptel Course Natural Language Processing: https://nptel.ac.in/downloads/111102011/.

2. Geeksforgeeks Tutorial: https://www.geeksforgeeks.org/natural-language-processing-overview/

Course Code: 23ADE032		Course Title: Image and Video 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 provide knowledge on understanding image representation, analyzing image properties, and applying image pre-processing techniques.

Module I Image Preprocessing and Machine Learning Method 18 Hours

Computer Vision: Computer Vision - Image Representation and Image Analysis Tasks - Image Representations - Digitization - Properties - Color Images - Data Structures for Image Analysis - Levels of Image Data Representation - Traditional and Hierarchical Image Data Structures.

Image Pre-Processing: Local Pre-Processing - Image Smoothing - Edge Detectors - Zero Crossings of the Second Derivative - Scale in Image Processing - Canny Edge Detection - Parametric Edge Models - Edges in Multi-Speralct Images - Local Pre-Processing in the Frequency Domain - LineDetection by Local Pre-Processing Operators - Image Restoration.

Object Detection Using Machine Learning Method: Object Detection - Object Detection Methods - Deep Learning Framework for Object Detection - Bounding Box Approach- Intersection Over Union (Iou) - Deep Learning Architectures - R- CNN - Attention Mechanism.

Module II Face Recognition Methodologies 12 Hours

Deep Learning Methods: Faster R - CNN - You Only Look Once(YOLO) - Salient Features - Loss Functions - YOLO Architectures.

Face Recognition and Gesture Recognition: Face Recognition - Introduction - Applications of Face Recognition - Process of Face Recognition - Deep Face Solution by Face Book - Face Net for Face Recognition - Implementation using Face Net - Gesture Recognition.

Video Analytics: Video Processing - Use Cases of Video Analytics - Vanishing Gradient and Exploding Gradient Problem - Rest Net Architecture - Rest Net and Skip Connections - Inception Network - Google Net Architecture

List of Experiments: **30 Hours**

1. Write a Program that Computes the T-Pyramid of an Image
2. Develop Programs for the Following Geometric Transforms: (A) Rotation (B) Change of Scale (C) Skewing (D) Affine Transform Calculated from Three Pairs of Corresponding Points (E) Bilinear Transform Calculated from Four Pairs of Corresponding Points
3. Write a Program that Derives the Quad Tree Representation of an Image using the Homogeneity Criterion of Equal Intensity
4. Develop a Program for Facial Detection and Recognition
5. Develop a Program to Implement Object Detection and Recognition
6. Develop a Program for Event Detection in Video Surveillance System

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply various image representation techniques, data structures, and pre-processing methods to enhance image quality and prepare visual data for analysis	Apply
CO2: Evaluate object detection models and deep learning frameworks using metrics like Intersection over Union (IoU) to assess performance and accuracy	Evaluate
CO3: Design face recognition and gesture recognition systems using state-of-the-art models such as FaceNet and DeepFace, applying them to real-world scenarios	Create
CO4: Develop deep learning-based video analytics applications using advanced architectures like ResNet, Inception, and GoogleNet, addressing challenges like vanishing gradients	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4th Edition, Thomson Learning, 2013.

T2. Vaibhav Verdhan, “Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras”, Apress, 2021.

Reference Book(s):

R1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2011.

R2. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, “Video Analytics for Business intelligence”, Springer, 2012.

R3. D. A. Forsyth, J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2003.

Web References:

1.https://www.taylorfrancis.com/books/edit/10.1201/9781003053262/intelligent-image-video-analytics-el-sayed-el-alfy-george-bebis-mengchu-zhou

2.https://books.google.co.in/books/about/Intelligent_Image_and_Video_Analytics.html?id=4Hm2EAAAQBAJ&redir_esc=y

Vertical V

Course Code: 23ADE033		**Course Title: Fuzzy Logic and Neural Computing**	
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 Developing feed forward neural networks using supervised learning, associative memory-based neural networks, competitive unsupervised learning networks, fuzzy rule-based inference systems, and genetic algorithms for optimization.

Module I Fuzzy Systems, Genetic Algorithms, and Neural Networks 25 Hours

Fuzzy Systems: Classical Sets - Fuzzy Sets - Classical Relations - Fuzzy Relations - Membership Functions - Defuzzification - Fuzzy Rules - Fuzzy Reasoning - Fuzzy Inference Systems - Neuro-Fuzzy Systems

Genetic Algorithms: Introduction - Traditional Optimization and Search Techniques - Genetic Algorithm and Search Space - Simple Genetic Algorithm - Operators in Genetic Algorithm - Solving Travelling Salesman Problem.

Supervised Learning Networks: Evolution of Computing - Soft Computing Constituents - Biological Neural Networks - Artificial Neurons - Applications. Supervised Learning Networks: Activation Functions - Learning Rules - Perceptron Networks - Adaline - Madaline - Back Propagation Networks.

Module II Associative Memory Networks And Unsupervised Learning 20 Hours

Associative Memory Networks: Associative Memories - Auto Associative Memory Network - Hetero Associative Memory Network - Bi-Directional Associative Memory - Discrete Hopfield Network.

Unsupervised Learning Networks: Introduction - Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps - Learning Vector Quantization - Counter Propagation Networks - Adaptive Resonance Theory Network.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design a fuzzy inference system with appropriate membership functions and rules for real-time decision-making	Create
CO2: Evaluate the effectiveness of genetic algorithm operators in optimizing various search spaces	Evaluate
CO3: Analyze the learning behavior and convergence of supervised neural networks for different activation functions	Analyze
CO4: Analyze associative memory networks for pattern recognition and assess their applicability in AI systems	Analyze

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. S.N. Sivanandam, S.N. Deepa, “Principles of Soft Computing”, 3rd Edition, John Wiley & Sons, 2019.

Reference Book(s):

R1. Hitoshi Iba, Nasimul Noman, “Deep Neural Evolution: Deep Learning with Evolutionary Computation”, Springer, 2020.

R2. N.P. Padhy, S.P. Simon, “Soft computing with matlab programming”, Oxford University Press, 2015.

R3. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley, 2016.

Web References:

1. NPTEL: Introduction to Soft Computing

URL: https://onlinecourses.nptel.ac.in/noc22_cs54/preview

2. Soft Computing IIT Kharagpur:

URL: https://cse.iitkgp.ac.in/dsamanta/courses/sca/index.html

3. Fuzzy Sets, Logic and Systems & Applications:

URL: https://onlinecourses.nptel.ac.in/noc22ee21/preview

Course Code: 23ADE034		Course Title: Optimization Techniques in AI	
Course Category: Major		Course Level: Advanced	
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 how to produce optimized solutions using linear and non-linear programming, and compute critical paths for project management.

Module I Linear Programming and Network Models 22 Hours

Modeling with Linear Programming: Overview of OR, Analytics, AI and ML in Decision Making - Two Variable LP Model - Graphical LP Solution - Computer Solution with Solver and AMPL - Linear Programming Applications - Simplex Method - Special Cases in the Simplex Method - Sensitivity Analysis.

Duality and Post-Optimal Analysis and Transportation Model and its Variants: Definition of the Dual Problem - Primal Dual Relationships - Economic Interpretation of Duality - Post Optimal Analysis - Nontraditional Application of the Transportation Model - The Transportation Algorithm - The Assignment Algorithm - The Transshipment Model

Network Models: Scope and Definition of Network Models - Minimum Spanning Tree Algorithm - Shortest Route Problem - Maximal Flow Model - CPM And PERT - Minimum Cost Capacitated Flow Problem .

Module II Integer Programming and Classical Optimization 23 Hours

Integer Linear Programming: Illustrative Applications **-** Branch and Bound (B&B) Algorithms - Heuristic Programming: Greedy Heuristics - Metaheuristics - Travelling Salesperson Problem(TSP): Exact TSP Algorithms - Local Search Heuristics.

Classical Optimization Theory: Unconstrained Problem: Necessary and Sufficient Conditions - Newton-Raphson Method - Constrained Problems: Equality Constraints - Inequality Constraints - Nonlinear Programming Algorithms: Constrained and Unconstrained Algorithms - Markov Chains: Definition of a Markov Chain - Classification of the States in a Markov Chain

Markovian Decision Process and Queuing Systems :Scope of the Markovian Decision Process - Finite-Stage Dynamic Programming Model - Infinite-Stage Model - Elements of a Queuing Model , Role of Exponential Distribution , Pure Birth and Death Models - General Poisson Queuing Model - Specialized Poisson Queues -- Queuing Decision Models - Case Study: Optimization of Heart Valves Production - Optimizing Trailer Payloads at PFG Building Glass.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Solve optimization problems using linear and nonlinear programming to build efficient AI models and support decision-making	Apply
CO2: Analyze optimization algorithms like gradient methods, heuristics, and constraint techniques to solve complex AI problems	Analyze
CO3: Formulate integer programming, transportation, assignment, and network flow models to optimize real-world systems in logistics, manufacturing, and project management	Apply
CO4: Apply probabilistic models such as Markov chains, Markov decision processes, and queuing theory to model uncertainty and improve decision-making in dynamic environments	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Taha H.A., “Operations and Research - An Introduction”, Pearson Education, 11th Edition, 2022.

Reference Book(s):

R1. Richard Johannes Boucherie, Henk Tijms, Aleida Braaksma, “Operations Research: Introduction to Models and Methods”, World Scientific Publishing Company, 2021.

R2. Fouad Bennis, Rajib Kumar Bhattachariya, “Nature-Inspired Methods for Metaheuristics Optimization”, Springer, 2020.

Web References:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc23_me40
2. NPTEL: https://onlinecourses.nptel.ac.in/noc23_ma29
3. Udemy: https://www.udemy.com/course/geneticalgorithm/
4. Coursera: https://in.coursera.org/learn/operations-research-modeling

Course Code: 23ADE035		Course Title: Information Retrieval Methods	
Course Category: Major		Course Level: Advanced	
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 text retrieval systems based on the Boolean retrieval model and to deploy an algorithm for indexing using suitable index construction and compression methods. Use web crawling and indexes to develop IR-based web applications.

Module I Text Retrieval Systems and Indexing Techniques 22 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.

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.

Module II Query Expansion and Web Search In Information Retrieval 23 Hours

Query Expansion: Relevance Feedback - Pseudo Relevance Feedback - Query Reformulation - Review of Basic Probability Theory - Probability Ranking Principle - Binary Independence Model - Language Models Information Retrieval.

Web Search Basics and IR Applications: Web Characteristic - Crawling - Distributing Indexes - Connectivity Servers - Web as a Graph - Page Rank - Hubs and Authorities - Information Extraction - Question Answering - Opinion Summarization - Social Network.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze different text retrieval models including Boolean retrieval and postings list optimizations to design efficient retrieval systems	Analyze
CO2: Deploy an algorithm for indexing using suitable index construction and compression methods for a given database	Apply
CO3: Evaluate the vector space model for any given document using different evaluation techniques	Apply
CO4: Design query expansion strategies and web search algorithms to enhance retrieval accuracy and handle real-world information needs	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Christopher D. Manning and Prabhakar Raghavan, “Introduction to Information Retrieval”, Cambridge University Press, 2009.

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, 2011.

Web References:

1. Text Retrieval and Search Engines URL: https://www.coursera.org/learn/text-retrieval?

2. Search Engines: Information Retrieval in Practice URL: https://ciir.cs.umass.edu/irbook/

3. Introduction to Information Retrieval URL: http://nlp.stanford.edu/IR-book /html / htmledition/ irbook.html

Course Code: 23ADE036		Course Title: Reinforcement Learning in AI	
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 Reinforcement Learning tasks and the core principles of Markov Decision process and Monte Carlo methods.

Module I Foundations of Reinforcement Learning 22 Hours

Reinforcement Learning: Introduction to Reinforcement Learning - History of Reinforcement Learning - Elements of Reinforcement Learning - Limitations and Scope - Tic-Tac-Toe.

Tabular Solution Methods: Multi-armed Bandits - Finite Markov Decision Processes: The Agent-Environment Interface, Goals & Rewards, Returns and Episodes, Optimal Policies and Optimal Value Functions - Dynamic Programming - Policy evaluation - Policy Improvement - Policy Iteration - Value Iteration.

Module II Advanced Reinforcement Learning Techniques 23 Hours

Temporal Difference Learning Techniques: Monte Carlo Methods - Monte Carlo prediction - Monte Carlo control - Incremental Implementation - Temporal Difference Learning: TD prediction, Advantages. Optimality of TD-Q-Learning: Games, After states, and Other Special Cases -n-step Bootstrapping.

Integrating Planning with Learning: Planning and Learning with Tabular Methods - Models and Planning - Prioritized Sweeping - Trajectory Sampling - Heuristic Search - Rollout Algorithms.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Formulate an application problem as a reinforcement learning algorithms	Apply
CO2: Analyze reinforcement-learning algorithms on the metrics such as regret, sample complexity, computational complexity, empirical performance, and convergence	Analyze
CO3: Compare the convergence behavior and performance of tabular solution methods versus Monte Carlo and Temporal-Difference approaches on finite MDPs	Analyze
CO4: Evaluate the effect of different exploration and planning, learning strategies	Evaluate

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Richard.S.Sutton and Andrew G.Barto, Reinforcement Learning, MIT Press, 2nd Edition, 2018

Reference Book(s):

R1. Csaba Szepesvári, “Algorithms for Reinforcement Learning”, Morgan & Claypool, 2013.

R2. Kevin Murphy , “Machine Learning - A Probabilistic Perspective” , MIT press, 2012

R3. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2016.

R4. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, 2020.

Web References:

1. https://onlinecourses.nptel.ac.in/noc20_cs74/preview
2. https://archive.nptel.ac.in/courses/106/106/106106143/

Course Code: 23ADE037		Course Title: Fundamentals of Virtualization	
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 offers a comprehensive overview of virtualization and cloud computing, covering hardware virtualization, hypervisors, server and desktop virtualization, and modern containerization technologies like Docker and Kubernetes.

Module I Basics of Virtualization and Cloud Computing 15 hours

Virtualization and Cloud Computing - Need of Virtualization: Cost, Administration, Fast Deployment, Reduced Infrastructure Cost, Limitations - Types of Hardware Virtualization: Full Virtualization, Para virtualization - Types of Hypervisors - Edge Computing and its Integration With Virtualization - Virtual Machine Basics - Types of Virtual Machines - Understanding Server Virtualization - Types of Server Virtualization - Uses of Virtual Server Consolidation - Selecting Server Virtualization Platform - Desktop Virtualization - Types of Desktop Virtualization - Containerization (Docker, Kubernetes) and its Comparison with Traditional VMS.

Module II Advanced Virtualization Techniques And Tools 15 Hours

Network Virtualization - Advantages of Network Virtualization - Functions of Network Virtualization - Tools for Network Virtualization - VLAN - Software-Defined Networking (SDN) and Network Functions Virtualization (NFV) - Memory Virtualization - Types Of Storage Virtualization: Block, File, Address Space Remapping - Risks of Storage Virtualization - SAN, NAS, Raid - Cloud Storage Solutions (AWS S3, Azure Blob Storage) and their Virtualization Aspects - Vmware - Amazon Aws - Microsoft Hyperv - Oracle VM Virtual Box - IBM Powervm - Docker, Kubernetes, Openshift - Case Study.

List of Experiments: **30 Hours**

1. Setting up a Virtual Machine (VM) - Install and configure a Virtual Machine using a hypervisor (e.g., VMware, Virtual Box) and explore the concept of full and Para virtualization.
2. Deploying a Container using Docker - Install Docker and deploy a containerized application. Compare the container with traditional VM setups.
3. Exploring Edge Computing with Virtualization - Set up a basic edge computing environment and integrate it with a virtualized environment (e.g., a small edge server running VMs).
4. Network Virtualization using VLAN and SDN - Create a virtualized network using VLANs and implement Software-Defined Networking (SDN) for managing network traffic.
5. Storage Virtualization with SAN, NAS, and RAID Configuration - Set up a storage virtualization environment using SAN/NAS and configure RAID to explore storage virtualization techniques.
6. Cloud Storage with AWS S3 and Azure Blob - Use AWS S3 and Azure Blob Storage to configure and use cloud storage services with virtualization.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Analyze different virtualization techniques and their roles in reducing infrastructure costs and improving deployment efficiency	Analyze
CO2: Design server and desktop virtualization architectures, including containerization, for scalable computing environments	Evaluate
CO3: Develop advanced network, memory, and storage virtualization solutions using industry-standard tools and platforms	Apply
CO4: Assess cloud storage and virtualization technologies, integrating them with virtualization strategies to solve real-world cloud infrastructure challenges	Analyze

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Rajkumar Buyya, James Broberg, Andrzej Goscinski, “Cloud Computing (Principles and Paradigms)”, John Wiley & Sons, 2011.

T2. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, “Cloud Computing Concepts, Technology & Architecture”, Pearson Education, 2013.

Reference Book(s):

R1. Arshdeep Bahga, Vijay Madisetti, “Cloud Computing: A Hands-on Approach”, Universities Press (India) Pvt. Ltd, 2014.

R2. Anthony T.Velte, Toby J. Velte Robert Elsenpeter, “Cloud computing a practical approach”, TATA McGraw Hill, 2010.

R3. Arshdeep Bahga, Vijay Madisett, **“**Cloud Computing Solutions Architect: A Hands-On Approach”, Virtual Publishing Technologies, 2019.

Web References:

1. Amazon Web Services (AWS): https://docs.aws.amazon.com/
2. Microsoft Azure: https://learn.microsoft.com/en-us/azure/
3. Google Cloud Platform (GCP): https://cloud.google.com/docs

Course Code: 23ADE038		Course Title: Natural Language Processing 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 designed to provide learners with the skills to perform word and sentence recognition, an essential foundation in Natural Language Processing.

Module I Language Modeling, Word Analysis, and Syntax Parsing 15 Hours

Language Modeling: Knowledge in Speech and Language Processing - Ambiguity - Regular Expressions Finite State Automata - Morphology - Finite State Transducers - Large Language Models (LLMs): Architecture, pre-training, and fine-tuning- Word and Sentence Tokenization - Detecting and Correcting Spelling Errors - Minimum Edit Distance.

Word Level Analysis: N-grams - Unsmoothed N-grams - Perplexity - Smoothing - Word Classes - Part-of-Speech Tagging - Rule-based, Stochastic and Transformation based tagging - Evaluation and issues in PoS tagging - Markov chains - Hidden Markov Model - Forward, Viterbi, Forward - Backward algorithms.

Syntax Analysis: Context-Free Grammars - Grammar rules - Treebanks - Dependency Grammars - Parsing as Search - Ambiguity - Dynamic Programming parsing - Partial parsing - Probabilistic CFG - Probabilistic CKY parsing - Probabilistic Lexicalized CFGs.

Module II Semantics and Pragmatics in Natural Language Processing 15 Hours

Semantics: First Order Logic -Description Logics - Syntax-driven semantic analysis - Word Senses - Relations between Senses -Semantic roles – Word Sense Disambiguation: Supervised, Dictionary & Thesaurus methods - Word Similarity: Thesaurus and Distributional methods - LLMs for Semantic Analysis: Using transformer models like BERT, GPT for semantic roles and disambiguation.

Pragmatics and Applications: Discourse segmentation - Text Coherence - Reference, Anaphora and Co-reference resolution -Named Entity Recognition - Relation Detection and Classification - Information Retrieval - Factoid Question Answering - Summarization.

List of Experiments: **30 Hours**

1. Download nltk and packages. Use it to print the tokens in a document and the sentences from it. Include custom stop words and remove them and all stop words from a given document using nltk or spaCY package
2. Implement a stemmer and a lemmatizer program
3. Implement a simple Part-of-Speech Tagger
4. Write a program to calculate TFIDF of documents and find the cosine similarity between any two documents
5. Use nltk to implement a dependency parser
6. Implement a semantic language processor that uses WordNet for semantic tagging

The given experiments to be implemented using Python with NLTK /spaCy /scikit learn

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Analyze the core principles of language modeling, word tokenization, morphology, and finite-state methods to address ambiguity in natural language	Analyze
CO2: Apply probabilistic techniques like N-grams, HMMs, and POS tagging algorithms to perform effective word-level analysis and tagging	Apply
CO3: Evaluate syntactic structures and parsing techniques using CFGs, dependency grammars, and probabilistic models for accurate syntactic analysis	Evaluate
CO4: Create semantic and pragmatic applications using LLMs and techniques such as semantic role labeling, word sense disambiguation, NER, and summarization	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Daniel Jurafsky and James H.Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition with language models”,3rd Edition, Pearson, 2020 (Module I)

T2. U. S. Tiwary and Tanveer Siddiqui, “Natural Language Processing and information Retrieval”, Oxford University Press, 2008. (Module I, II)

Reference Book(s):

R1. Nitin Indurkhya, Fred J. Damerau, “Handbook of Natural Language Processing”, 2nd Edition, Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover, 2010

R2. Mohamed Zakaria Kurdi “Natural Language Processing and Computational Linguistics: Speech, Morphology and Syntax (Cognitive Science)”, ISTE Ltd., 2016

Web References:

1. https://nptel.ac.in/courses/106101007/
2. https://nlp.stanford.edu/software/
3. https://www.ibm.com/topics/natural-language-processing

Course Code: 23ADE39		Course Title: Web Services and DevOps	
Course Category: Major		Course Level: Advanced	
L:T:P(Hours/Week) 2:0:2	Credits:3	Total Contact Hours:60	Max Marks:100

Course Objectives:

This course teaches students to use cloud tools like AWS for AI and data science projects. They will learn to store data, train models, and automate tasks using Python and PowerShell. It also covers DevOps tools like Git, Docker, and Jenkins for managing projects efficiently.

Module I Cloud Platforms and Python Tools for AI Applications 15 Hours

Cloud Platforms and Services for AI Applications: AWS Overview and Account Setup - IAM (Identity and Access Management) - EC2 for AI/ML Model Hosting - S3 for Dataset and Model Storage - RDS and DynamoDB for Structured and NoSQL Storage - Boto3 and AWS CLI for Python - Based Automation - SageMaker for Model Training and Deployment - AWS Lambda for Serverless Inference - CloudWatch for Monitoring ML Workloads - CloudTrail for Auditing and Logging

Python-Based Tools and Visualization: Python Integration with AWS Services - Streamlit and Flask for Building ML Dashboards - Reading/Writing Data from Cloud Storage using Python - Pandas and NumPy for Cloud-Based Data Handling - Plotly and Seaborn for Visualizing AI Results

Module II 15 Hours

DevOps Tools and Infrastructure as Code: DevOps Concepts and CI/CD for ML Projects - Git and GitHub for Code and Model Versioning - Docker for Containerizing Data Science Applications - Jenkins for Continuous Integration of ML Pipelines - GitHub Actions for Workflow Automation - Kubernetes Basics and EKS (Elastic Kubernetes Service) Overview - Building MLOps Pipelines with Jenkins and Docker - Automating Model Retraining and Deployment - Dependency Management and Dockerfiles

IaC and Scripting Essentials: PowerShell Basics for Cloud Admin Automation - YAML Syntax and Configuration for Pipelines - Introduction to Terraform for Infrastructure as Code - Automating EC2 and S3 with Terraform Scripts - Overview of CloudFormation Templates for AWS Automation

List of Experiments: **30 Hours**

1. Create and Use an S3 Bucket for Dataset Storage via Python (Boto3)
2. Build and Push a Docker Image for a Data Science App
3. Create a CI/CD Pipeline using GitHub Actions and Docker
4. Train and Deploy a Model using AWS SageMaker
5. Set Up a Serverless Prediction API using AWS Lambda and API Gateway
6. Implement Monitoring and Automated using AWS CloudWatch and CloudTrail.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Evaluate AWS cloud services and Python tools to design scalable AI/ML application architectures.	Evaluate
CO2: Apply advanced Python libraries to develop automated AI/ML workflows with effective data handling and visualization.	Apply
CO3: Implement DevOps-based CI/CD pipelines using containerization and automation tools for AI/ML project delivery.	Create
CO4: Develop Infrastructure as Code scripts and orchestrate cloud infrastructure provisioning to automate resource management.	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	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	3	-	-	2	1	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Andreas Wittig, Michael Wittig, "Amazon Web Services in Action", Manning Publications, 3rd Edition, 2022.

T2. Gene Kim, Jez Humble, Patrick Debois, John Willis, and Nicole Forsgren, "The DevOps Handbook", IT Revolution Press, 2nd Edition, 2021.

Reference Book(s):

R1. Nigel Poulton, "Docker Deep Dive", Leanpub, 2025.

R2. Yevgeniy Brikman, "Terraform: Up and Running", O'Reilly Media, 3rd Edition, 2022.

Web References:

1. https://docs.aws.amazon.com
2. https://docs.docker.com
3. https://developer.hashicorp.com/terraform
4. https://docs.github.com/en/actions
5. https://www.jenkins.io/doc/
6. https://aws.amazon.com/blogs/machine-learning/

Course Code: 23ADE040		Course Title: Edge Analytics	
Course Category: Major		Course Level: Advanced	
L:T:P(Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max Marks:100

Course Objectives:

The course is intended to understand fundamental concepts, explore computing models, study edge computing architectures and apply edge computing in IoT and IIoT.

Module I Edge Computing **15 Hours**

Edge Computing: Concept - Basic Characteristics and Attributes - Edge - Real Time-Benefits of Edge Computing - Cross Value of Edge Computing - Collaboration of Edge Computing and Cloud Computing - Fog Computing and Edge Computing

Computing Models: Shared and Central Resources Versus Exclusive and Local Computation - IOT Disrupts the Cloud-Characteristics of New Computing Model-Blueprint of Edge Computing Intelligence.

Architecture of EC: Edge Computing Reference Architecture: Model-Driven - Multi_View Display - Concept_View Display - Edge Computing Domain Models - Function View - Edge Computing Network - Development Service Framework - Deployment Operation Service Framework (Smart Services).

Module II Edge Intelligence **15 Hours**

Edge Computing in The IoT: Introduction - Mobile Operation IoT Edge - Key Benefits of Edge for the IoT - Unique Requirements of Edge for the Iot - Use Cases for IoT Edge - Device Management, Security-Service Enablement - Message Prioritization - Data Replication - Cloud Enablement - IoT Solutions.

Edge Computing in The IoT: Standards for Self_Organization, Self_Configuration, Self_Discovery - Trust/Decentralized Trust - IIOT Using Edge Computing - Use Cases - Technical Analytics.

List of Experiments: **30 Hours**

1. Set up the Arduino IDE for ESP8266-12 module and Installation tools to create and manage ECN's.
2. Implement any two Communications protocols.
3. Deploy modules to a Windows IoT Edge device.
4. Create an IoT hub.
5. Register an IoT Edge device to IoT hub.
6. Remotely deploy a module to an IoT Edge device and send telemetry.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the concepts, architecture, and benefits of Edge Computing, including its integration with Cloud and Fog computing models	Analyze
CO2: Evaluate different Edge Computing models and architectures with respect to IoT and IIoT applications	Evaluate
CO3: Design solutions applying Edge Intelligence for real-time IoT applications considering device management, security, and message prioritization	Create
CO4: Develop strategies for implementing Edge Computing frameworks in industrial IoT (IIoT) use cases including decentralized trust and analytics	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Ajit Singh, “Edge Computing Simply In Depth”, 2nd Edition, 2020

Reference Book(s):

R1. Cao, Jie, Zhang, Quan, Shi, Weisong, “Edge Computing: A Primer”, Pearson Education, Springer, 2018

R2. Rajkumar Buyya, Satish Narayana Srirama, “Fog and Edge Computing: Principles and Paradigms”, Wiley, 2019

Web References:

1. NPTEL Edge Computing Course: https://onlinecourses.nptel.ac.in/noc24_cs66/preview

2. IBM - Edge Computing, Concepts and Technologies: https://www.ibm.com/cloud/learn/edge-computing

3. Hewlett Packard Enterprise (HPE) - Edge Computing: The Future of the Internet of Things (IoT): https://www.hpe.com/us/en/what-is/edge-computing.html

Vertical VI

Course Code: 23ADE041		**Course Title: Drone Technologies**	
Course Category: Major		**Course Level: Advanced**	
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 fundamentals of drone design, manufacturing, and programming, with a focus on understanding and applying drone operation and flight techniques.

Module I Introduction to Drone Technology and Programming 22 Hours

Introduction to Drone Technology: Understanding Drones' Impact on Various Industries, Drones' Role in Modern Technology and Applications.

Drone Design, Fabrication: Exploring Drone Hardware: Frames, Motors, Propellers, Electronic Speed Controllers, Flight Controllers, Sensors, and Communication Modules.

Drone Programming: Programming Languages with Drone SDKs: DJI, PX4, ArduPilot, Study of IoT Sensors on the Ground (e.g., temperature, humidity sensors), Linked Mobile Devices and Applications.

Module II AI, Machine Learning, and Regulations in Drone Systems 23 Hours

AI and Machine Learning in Drone Systems: The Convergence of AI and Drone Intelligence, Drones with IoT Connectivity, YOLO: Detect and Segment Objects in Real-Time from Drone Footage.

Computer Vision and Object Detection: Integrating Cameras for Computer Vision, Image Processing, Segmentation for Object Detection and Tracking, Implementing Path Planning Algorithms.

Legal and Regulatory Considerations: Understanding Drone Regulations: FAA, EASA, CAAS, Drone Registration and Licensing, Navigating Airspace 2Rules and Flight Restrictions.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the key components and hardware of drone systems and their roles in various industry applications	Analyze
CO2: Design drones using SDKs and IoT sensors for real-time data acquisition and communication	Create
CO3: Implement AI and machine learning techniques, including computer vision algorithms, for intelligent drone operation	Apply
CO4: Evaluate legal, regulatory, and ethical considerations affecting drone operations across different jurisdictions	Evaluate

Course Articulation Matrix

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

High,3; Medium,2;Low,1

Text Book(s):

T1. Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, John Wiley & Sons, Inc., 2021

T2. Terry Kilby and Belinda Kilby, “Make: Getting Started with Drones “, Maker Media, Inc, 2016.

Reference Book(s):

R1. John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016.

R2. Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.

R3. Sachi Nandan Mohanty, J. V. R. Ravindra, G. Surya Narayana, Chinmaya Ranjan Pattnaik, Y. Mohamed Sirajudeen, “Drone Technology”, Wiley-Scrivener, 2023.

Web References:

1. https://www.coursera.org/courses?query=drone
2. https://onlinecourses.swayam2.ac.in/ntr24_ed12/preview
3. https://www.udemy.com/course/make_a_drone/

Course Code: 23ADE042		Course Title: Robotic Automation Technology	
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 RPA, its applications and methods, understand and recognize image, text, and data table automation also manage user events and different kinds of exceptions and tactics.

Module I Introduction to RPA and Workflow Automation 23 Hours

Introduction to Robotic Process Automation: Emergence of Robotic Process Automation (RPA) - Evolution of RPA - Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA - Components of RPA - RPA Platforms. RPA Tools.

Automation Process Activities: Sequence - Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision Making - Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management - File Operations Controls: Finding the Control, Waiting for A Control - Act on a Control.

App Integration, Recording and Scraping: App Integration - Recording - Scraping - Selector - Workflow Activities - Process Mining.

Module II Exception Handling, Code Management, and RPA Deployment 22 Hours

Exception Handling and Code Management: Exception Handling - Common Exceptions, Logging - Debugging Techniques - Collecting Crash Dumps - Error Reporting.

Code management and maintenance: Project Organization - Nesting Workflows - Reusability - Templates - Commenting Techniques - State Machine.

Deployment and Maintenance: Publishing Using Publish Utility, Orchestration Server, Control Bots, Orchestration Server to Deploy Bots, License Management, RPA Vendors, Future of RPA.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the architecture, components, and real-world applications of Robotic Process Automation (RPA) platforms	Analyze
CO2: Design automated workflows using control flows, data handling, and integration tools within RPA platforms	Create
CO3: Evaluate exception handling, debugging, and code organization techniques for robust RPA solutions	Evaluate
CO4: Deploy RPA bots using orchestration tools, and assess licensing, scalability, and emerging trends	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Tom Taulli, “The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems”, Apress publications, 2020.

T2. Alok Mani Tripathi, “Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath”, Packt Publishing,2018.

Reference Book(s):

R1. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, “Introduction to Robotic Process Automation: a Primer”, Institute of Robotic Process Automation, Amazon Asia Pacific Holdings Private Limited, 2018

R2. Murdoch, Richard, “Robots, Automate Repetitive Tasks & Become an RPA Consultant”, Amazon Asia Pacific Holdings Private Limited, 2018

R3. A Gerardus Blokdyk, “Robotic Process Automation RPA a Complete Guide “, 2020

Web References:

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com
3. https://nptel.ac.in/courses/112105249

Course Code: 23ADE043		Course Title: Robot Operating Systems	
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 fundamentals of the Robot Operating System and students are able to understand the installation and applications of ROS and Robot navigation through Simulations.

Module I ROS Laws and Raspberry PI 22 Hours

Introduction to ROS: Introduction to Robotics: Laws of Robotics, Different Types of Robots, Applications of Robotics, Review of Sensors Control Actions and Actuators, Robot Kinematics and Dynamics, Trajectory Planning Approaches. Learning Basics of Ubuntu/Linux: Linux Basic Commands for Robotics, Linux IDE & Text Editor: VS Code, Nano, Gedit, Linux and I/O Board Communication: USB to Serial Communication, Linux and Camera Interfacing, Linux Kernel Customization, Raspberry Pi and Linux Overview, Linux Commands, GPIO Handling

Robot Simulator: Getting Started with Robot Simulator Concepts, Overview of Different Robotic Simulators: Webots, Ignition, Gazebo & Coppeliasim, Robot Programming: Getting Started with ROS, ROS Equation, Utility and Applications of ROS

Module II File Systems And Turtlesim 23 Hours

ROS Architecture and Concepts Various File Systems of ROS, ROS Coding Styles, IDE, ROS Hello World, ROS Turtlesim, ROS Workspace and Package, ROS Client Libraries: Roscpp & Rospy, Understanding Roslaunch, Rosbag, Rviz, Rqt. Applications of ROS in Robotics

Learning ROS Programming Using Turtlesim: Understanding ROS Concepts using Turtlesim, Moving Turtlesim using ROS Programming, Understanding Transformation and Frames, working with TF Broadcaster and Listener, Creating TF for Your Robot, working with ROS TF Tools, Turtlesim Projects, draw your Caricature using Turtlesim, Object Tracking using Turtlesim.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the laws of robotics and control actions to plan robot motion using trajectory planning techniques	Apply
CO2: Demonstrate the use of Linux-based systems and Raspberry Pi for basic I/O control and hardware interfacing	Apply
CO3: Implement robotic simulations using tools such as Webots,Gazebo, or Coppelia Sim for basic robot tasks	Apply
CO4: Develop ROS-based TurtleSim applications to control robot motion, transformations, and object tracking	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Nikolaus Correll, Bradley Hayes, David Coleman, “Introduction to Autonomous Robots”, Correll Robotics Lab, 2022.

Reference Book(s):

R1. Peter Corke, "Robotics, Vision and Control: Fundamental Algorithms in MATLAB”, 2nd Edition, Springer, 2017.

R2. Doug Abbott, “Linux for Embedded and Real-Time Applications”, 4th Edition, Newnes, 2017.

Web References:

1.Writting Listener:https://docs.ros.org/en/jazzy/Tutorials/Intermediate/Tf2/Writing-A-Tf2-Listener-Cpp.html

2. ROS Tutorial: https://manual.coppeliarobotics.com/en/ros1Tutorial.html

3.Rasberry PI: https://www.raspberrypi.com/documentation/

Course Code: 23ADE044		Course Title: Collaborative Robotics	
Course Category: Major		Course Level: Advanced	
L:T:P(Hours/Week) 3 : 0 : 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objectives:

The course is designed to provide a thorough understanding of collaborative robots, their technological applications, and their limitations.

Module I Anatomy, Programming, and AI-Driven Applications 22 Hours

Introduction to Cobots: Definition - Comparison with Traditional Robots - Advantages - Limitations - Cobot Anatomy: Sensors - Actuators - Control Systems - Safety Features - Applications across Industries: Manufacturing, Healthcare, Logistics, Retail - HRI Principles for Cobots: NLP - Gesture Recognition - Shared Workspace Modeling - Case Studies of Successful Cobot Implementations.

Cobot Programming and Control: Introduction to Cobot Programming Languages and Environments - Motion Planning and Trajectory Generation for Cobots - Force Control and Sensor - based Interaction - Safety Programming and Error Handling - Interfacing Cobots with Other Systems: PLCs - MES - Cloud Platforms.

Cobot Applications in AI & Data Science: Robotics for Data Acquisition and Manipulation - Collaborative Robots for Machine Learning Tasks - Cobots for Anomaly Detection and Predictive Maintenance - Integration with Computer Vision and Deep Learning - Case Studies of Cobot-Driven AI & DS Solutions.

Module II Human-Robot Collaboration 23 Hours

Roboethics: Social and Ethical Implication of Robotics: Risk Assessment and Hazard Identification for HRC - Collaborative Robot Safety Standards Compliance - Design Principles for Safe Human - Robot Workplaces - Human Factors and Ergonomics: Training - User Interfaces - Cognitive Workload - Ethical Considerations for Cobot Deployment.

Safety and Standards for Cobot Systems: Advancements in Cobot Technology: Soft Robotics - Bio-inspired Designs - AI-powered Cobots- Integration with IoT and Industry 4.0 - Human-Robot Co-creation and Collaborative Intelligence - Challenges and Opportunities for HRC in the Future - Emerging Research Areas in Cobot Technology and Applications.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the anatomy, sensors, and control systems of collaborative robots and their applications across industries.	Analyze
CO2: Design cobots for safe and efficient human-robot collaborative tasks using motion planning and sensor integration.	Create
CO3: Apply AI and machine learning techniques to enhance cobot capabilities, including computer vision and predictive maintenance.	Apply
CO4: Evaluate ethical, safety, and ergonomic considerations to develop compliant and secure human-robot work environments.	Evaluate

Text Book(s):

T1. Peter Matthews, Steven Greenspan, “Automation and Collaborative Robotics: A Guide to the Future of Work”, Apress, 2020

T2. Pamela Hinds, Nadine Lampert, Jean-Marc Mirenda, Mehran Moallem, “Robots and Human Interaction: An Introduction”, Cambridge University Press, 2016.

Reference Book(s):

R1. Anupam Jena, Amit Kumar Pandey, “Human-Robot Interaction”, CRC Press, 2023.

R2. Alessandro De Luca, Bruno Siciliano, “Robot Programming: A Guide to Control, Planning, and Self-Motion”, Springer, 2018.

R3. Rodney Brooks, Anita K. Goel, “Introduction to AI Robotics”, MIT Press, 2017

Web References:

1.The Cobot Guide: https://www.universal-robots.com/blog/guide-to-ur-cobot-implementation/

2. Universal Robots Academy: https://academy.universal-robots.com/

3.ABBRoboticsLearningPortal: https://new.abb.com/products/robotics/robots/articulated-robots/irb-1200

Course Code: 23ADE045		Course Title: Sensors and Instrumentation	
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 help learners understand the fundamental concepts of measurement technology.

Module I Sensor Technologies and Calibration **15 Hours**

Sensor Calibration Techniques: Basics of Measurement - Classification of Errors - Error Analysis - Static and Dynamic Characteristics of Transducers - Performance Measures of Sensors - Classification of Sensors - Sensor Calibration Techniques - Sensor Output Signal Types - Sensor Data Interpretation Using AI.

Mechanical and Electromechanical Sensors: Inductive Sensors - Electromagnetic Transducer - Magnetostrictive Transducer - Capacitive Sensors - Serrated Plate Capacitive Sensor - Electrostatic Transducer - Piezoelectric Elements - Piezoelectric Materials - Deformation Modes and Multimorphs - Ultrasonic Sensors

Force, Magnetic and Heading Sensors: Strain Gage - Load Cell - Magnetic Sensors Types - Principle - Requirements and Advantages: Magneto Resistive - Hall Effect - Current Sensor Heading Sensors - Compass - Gyroscope - Inclinometers.

Module II Advanced Sensing Technologies and Signal Conditioning 15 Hours

Optical, Pressure and Temperature Sensors: Photoconductive Cell - Photo Voltaic - Photo Resistive - LDR - Fiber Optic Sensors - Pressure - Diaphragm - Bellows - Piezoelectric - Tactile Sensors - Temperature - IC- Thermistor - RTD - Thermocouple. Acoustic Sensors - Flow and Level Measurement - Radiation Sensors - Smart Sensors and AI Integration- Film Sensors - MEMS & Nano Sensors - LASER Sensors - AI Technologies for IoT Devices.

Signal Conditioning and Data Processing: Amplification - Filtering - Converter - Compensation: Nonlinearity - Information Coding / Processing - Data Communication - Applications: On-Board Automobile - Aerospace - Home Appliances - Sensors for Manufacturing - Sensors for Environmental Monitoring.

List of Experiments: **30 Hours**

1. Determination of Load, Torque and Force using Strain Gauge
2. Determination of the characteristics of Pressure Sensor and Piezoelectric Force Sensor
3. Determination of Displacement using LVDT
4. Determine the Characteristics of Various Temperature Sensors
5. Determine the Characteristics of Various Light Detectors (Optical Sensors)
6. Distance Measurement using Ultrasonic and Laser Sensor

The Given experiments are implemented using LabVIEW / MATLAB / Python

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Analyze the performance characteristics and calibration techniques of various mechanical and electromechanical sensors.	Analyze
CO2: Evaluate advanced sensor technologies (e.g., MEMS, optical, acoustic, smart sensors) for specific industrial and environmental applications.	Evaluate
CO3: Design appropriate signal conditioning and data processing systems to ensure accurate sensor output and integration.	Create
CO4: Apply AI-based methods to interpret sensor data for use in real-time decision-making and smart 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	-	-	-	-	-	-	-	-	-	
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	3
CO4	3	-	-	-	-	3	-	-	-	-	-	-	3	-

High-3; Medium-2;Low-1

Text Book(s):

T1. DVS Murthy, “Transducers and Instrumentation”, PHI Learning Private Limited, 2nd Edition 2013

T2. D Patranabis, “Sensors and Transducers”, PHI Learning Private Limited, 2nd Edition 2013.

Reference Book(s):

R1. Richard Zurawski, “Industrial Communication Technology Handbook”, 2nd Edition, CRC Press, 2015.

R2. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI Learning Private Limited, 2011.

R3. Hans Kurt Tönshoff (Editor), Ichiro, “Sensors in Manufacturing” Volume 1, Wiley-VCH, 2001

Web References:

1.Process Instrumentation and sensors : https://www.controleng.com/process-instrumentation-sensors/:Process Instrumentation and sensors

2. https://www.sciencedirect.com/book/9780750683081/instrumentation-reference-book

3. https://www.elliotscientific.com/Sensors-and-Instrumentation

Course Code: 23ADE046		Course Title: Embedded Computing 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 provide a comprehensive understanding of the types of embedded systems and the various devices within an ARM processor.

Module I Embedded Systems and ARM Processor 22 Hours

Embedded Computing: Introduction to Embedding Computers - List of Embedded System Devices - Characteristics of Embedded Computing Applications - Challenges in Embedded Computing System Design - Performance in Embedded Computing - The Embedded System Design Process - Formalisms for System Design - Model Train Controller

ARM Processor Interfacing Techniques: Processor and Memory Organization - Data Operations - Flow of Control - TI C55x DSP - FIR filter for the ARM - Procedure calls in ARM - Memory-mapped I/O on ARM - Interrupts in ARM - Power-saving modes of the Strong ARM SA-1100 - AMBA Bus

Bus-Based Computer Systems: The CPU Bus - Memory Devices - I/O Devices - Component Interfacing - Designing with Microprocessors - Development and Debugging - System-Level Performance Analysis - Design Example: Alarm Clock - System Architecture - Component Design and Testing - System Integration and Testing

Module II Program Design and Analysis and Multiprocessors 23 Hours

Program Design and Analysis: Components for Embedded Programs - Models of Programs - Assembly, Linking, and Loading - Basic Compilation Techniques - Program Optimization - Program-Level Performance Analysis - Software Performance Optimization - Program-Level Energy and Power Analysis and Optimization

Multiprocessors: CPUs and Accelerators - Multiprocessor Performance Analysis - Consumer Electronics Architecture - Design Examples: Compact DISCs and DVDs - Digital Still Cameras - Video Accelerator - Cell Phones.

List of Experiments: **30 Hours**

1. Write a program that uses a circular buffer to perform FIR filtering
2. Write the programs in Embedded C for Buzzer and Relay Interface
3. Write the programs in Embedded C for Stepper Motor Interface
4. Write the programs in Embedded C for Time delay program using built in Timer / Counter feature
5. Write the programs based on RTOS,
    a. Blinking two different LEDs
6. Write the programs based on RTOS,
    a. Reading temperature from LM 35 interface and plot the temperature vs Time graph using Graphics LCD - Study Experiment

The Given experiments are implemented using MPLAB IDE (for PIC), Atmel Studio (for AVR), Arduino IDE (for ATmega328P).

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Analyze embedded system architectures and design challenges, including processor and memory organization in ARM-based systems.	Analyze
CO2: Evaluate interfacing techniques and bus-based communication for efficient embedded system integration and performance.	Evaluate
CO3: Design embedded programs focusing on compilation, linking, and energy-efficient execution.	Create
CO4: Assess multiprocessor architectures and their impact on system performance and application design in embedded computing.	Create

Text Book(s):

T1. UWayne Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Morgan Kaufman Publishers, 2016.

T2. Rajkamal, “Embedded Systems”, 4th Edition, Tata McGraw-Hill, 2020.

Reference Book(s):

R1. Jonathan W. Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, 3rd Edition, Cengage Learning, 2012.

R2. K.V.K.Prasad, “Embedded /Real-Time Systems: Concepts, Design and programming”, Dream Tech, Wiley, 2013

Web References:

1.LPC214x User manual: http://www.nxp.com/documents/user_manual/UM10139.pdf

2.NPTEL - Embedded Systems: https://nptel.ac.in/courses/106/105/106105193/

3.Coursera - Real-Time Embedded Systems Concepts and Practices: https://www.coursera.org/learn/real-time-embedded-systems-concepts- practices

Course Code: 23ADE047		Course Title: Mobile Robotics	
Course Category: Major		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 introduce students to mobile robotic technology, providing a detailed overview of its various types. Learners will explore the different categories of mobile robots, such as autonomous, tele operated, wheeled, and legged robots.

Module I Robot Locomotion and Perception 15 Hours

Robot Locomotion: Introduction - Locomotion of the Robots - Key Issues on Locomotion - Legged Mobile Roots - Configurations and Stability - Wheeled Mobile Robots - Design Space and Mobility Issues - Unmanned Aerial and Underwater Vehicles.

Robot Kinematics: Kinematic Models - Representation of Robot - Forward Kinematics - Wheel and Robot Constraints - Degree of Mobility and Steer ability - Manoeuvrability - Workspace - Degrees of Freedom - Path and Trajectory Considerations - Motion Controls - Holonomic Robots.

Perception for Mobile Robots: Sensor for Mobile Robots - Classification and Performance Characterization - Wheel / Motor Sensors - Heading Sensors - Ground-Based Beacons - Active Ranging – Motion / Speed Sensors - Camera - Visual Appearance based Feature Extraction.

Module II Localization, Navigation and Collaboration 15 Hours

Localization: Localization Based Navigation Versus Programmed Solutions - Map Representation - Continuous Representations - Decomposition Strategies - Probabilistic Map-Based Localization - Landmark-Based Navigation - Globally Unique Localization - Positioning Beacon Systems - Route-Based Localization - Autonomous Map Building - Simultaneous Localization and Mapping (SLAM)

Planning, Navigation and Collaborative Robots: Introduction - Competences for Navigation: Planning and Reacting - Path Planning - Obstacle Avoidance - Navigation Architectures - Control Localization - Techniques for Decomposition -Case Studies - Collaborative Robots - Swarm Robots.

List of Experiments: **30 Hours**

1. Implement the Locomotion of the Robots.
2. Implementation of Kinematic Model Robots.
3. Apply the sensors for Mobile Robots and evaluate the performance
4. Implementation of different Localization techniques.
5. Apply the SLAM techniques in real-time environment.
6. Develop a Swarm Robot

The Given experiments are implemented using Python with OpenCV and NumPy, robodk

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Analyze various locomotion mechanisms and kinematic models to evaluate their suitability for different mobile robot applications	Analyze
CO2: Evaluate sensor technologies and perception systems to design robust environment sensing for mobile robots	Evaluate
CO3: Develop localization and navigation strategies, including map representation and SLAM algorithms, for autonomous mobile robots	Create
CO4: Design path planning, obstacle avoidance, and collaborative behaviors in multi-robot systems and swarms	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Roland Siegwart and Illah R.Nourbakish, “Introduction to Autonomous Mobile Robots” MITPress, Cambridge, 2011.

T2. Dragomir N. Nenchev, Atsushi Konno, TeppeiTsujita, “Humanoid Robots: Modelling and Control”, Butterworth-Heinemann, 2018.

Reference Book(s):

R1. MohantaJagadish Chandra, “Introduction to Mobile Robots Navigation”, LAP Lambert Academic Publishing, 2015.

R2. Alonzo Kelly, Mobile Robotics: Mathematics, Models, and Methods, Cambridge University Press, 2013.

R3. Xiao Qi Chen, Y.Q. Chen and J.G. Chase, “Mobile Robots - State of the Art in Land, Sea, Air, and Collaborative Missions”, Intec Press, 2009.

Web References:

1.Research Article on Advanced Mobile Robotics: https://www.mdpi.com/books/book/2067-advanced-mobile-robotics-volume-1

2.Research Article on Introduction to Mobile Robot Control: https://www.academia.edu/11985316/Introduction_to_Mobile_Robot_Control

Course Code: 23ADE048		Course Title: Agricultural Robotics	
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 determine the areas involved in the agricultural process, pinpoint different mechanisms in agricultural robotics.

Module I Robotics Mechanisms 15 Hours

Introduction: Agricultural and Field Robotics, Color Imaging and Basics of Image Processing, 3D Sensing Techniques and Systems, Spectral Sensing and Data Analysis. Crop Scouting and Surrounding Awareness for Specialty Crops, Crop Sensing and Its Application in Precision Agriculture and Crop Phenotyping.

Mechanisms: Robotic Manipulation and Optimization for Agricultural and Field Applications, End-Effector Technologies.

Module II Agricultural Robotics 15 Hours

Dynamics and Control: Control Techniques in Robotic Harvesting, Guidance, Auto-Steering Systems and Control, Automated Infield Sorting and Handling of Apples, Modeling, Simulation, and Visualization of Agricultural and Field Robotic Systems, Case studies.

Emerging Topics in Agricultural and Field Robotics: Advanced Learning and Classification Techniques for Agricultural and Field Robotics, Digital Farming and Field Robotics using Internet of Things, Cloud Computing, and Big Data, Human-Machine

List of Experiments: 30 Hours

1. Develop a program that uses an appropriate database to identify crop diseases
2. Develop a program for a weather prediction model utilising any LangChain, LLMs, and machine learning
3. Using an appropriate database, create a program for the identification of plant species
4. Develop an automated livestock (pig) counting program
5. Using an appropriate database, create a software for predicting the impact of a drought.
6. Create a program for Predictive Analytics for Crop Yield

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze sensing and imaging technologies (e.g., spectral, 3D, and color imaging) used in precision agriculture and crop monitoring	Analyze
CO2: Design robotic mechanisms and end-effector systems optimized for crop manipulation and field operations	Create
CO3: Develop control systems and autonomous navigation strategies for field robotics and automated harvesting	Create
CO4: Integrate digital agriculture tools (IoT, cloud computing, big data) with field robotics to enable smart farming solutions	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Manoj Karkee, Qin Zhang, “Fundamentals of Agricultural and Field Robotics “, Agriculture Automation and Control, Springer International Publishing, 2021.

T2. Myer Kutz, "Handbook of Farm, Dairy and Food Machinery Engineering", AcademicPress, 2019.

Reference Book(s):

R1. S. K. R. Yadav, S. Kumar, and P. Choudhary, "Advanced Technologies for Sustainable Development of Urban Green Spaces", Springer, 2020.

R2. S. S. Pathak, A. Tiwari, and S. K. Tiwari, "Agricultural Drones: A Peaceful Pursuit", CRC Press, 2020.

R3. Qin Zhang, Francis J. Pierce, "Agricultural Automation Fundamentals and Practices", CRC Press, 2016.

Web References:

1.https://onlinecourses.nptel.ac.in/noc24_ag14/preview

2.https://online.illinois.edu/online-programs/programs/automation-and-robotics-in-digital-agriculture

3.Udemy: https://www.udemy.com/course/ai-farming-unleashing-the-future-of-agriculture/?couponCode=NVDIN35

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 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	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO4	-	-	3	-	-	-	-	-	1	1	-	-	1	-

High-3; Medium-2; Low-1

Course Code: 23ITE043		**Course Title: Integrated Big Data Solutions (Common to AD,AM,CS,IT & SC)**	
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	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	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. (Module I)

T2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013. (Module II)

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, 2017.

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: 23AUE050		Course Title: Entrepreneurship Development	
Course Category: Minor		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 Entrepreneurial Mindset and Opportunity Validation 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 Business Models, Pitching and Ecosystems 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	Analyze
CO5: Evaluate the role and components of the entrepreneurial ecosystem to identify and engage the right ecosystem partners and funding models for startup success	Analyze

Reference Book(s):

R1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha "Entrepreneurship", McGrawHill, 11th Edition, 2020.

R2. Ries, E, "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses", Crown Business, 2011.

R3. Blank, S. G., & Dorf, B, "The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company", K&S Ranch, 2012.

R4. Roy, R, "Indian Entrepreneurship: Theory and Practice", Oxford University Press, 2017.

R5. Osterwalder, A & Pigneur, Y, "Business Model Generation: A Handbook for Visionaries, Game Changers and Challengers", John Wiley & Sons, 2010.

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	-	-	-	-	-	1	1	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	1
CO5	-	-	-	2	-	-	-	-	-	-	1	1	-	-

High-3; Medium-2; Low-1

Course Code: 23AUE051	Course Title: Design Thinking and Innovation		
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 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 hrs)**

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 hrs)**

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

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 Articulation Matrix

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

High-3; Medium-2; Low-1

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: Protectable 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	-	-	-	-
CO4	-	2	-	-	3	-	-	-	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. Party,"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: 23ADO001		Course Title: Data Mining and Warehousing	
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 intends to impart knowledge on Identifying the types of data to be pre-processed for the given dataset for applications of data ware housing.

Module I Introduction to Database Systems and Data Mining 22 Hours

Database Systems: Database System Applications - Data Models - Database Languages - Database Users and Administrators - Database System Structure - Entity - Relationship Model - Constraints - Keys - Design Issues - ER diagram - Weak Entity Sets - Design of an ER Database Schema.

Data Mining: Kinds of Data - Kinds of Patterns - Technologies - Applications - Issues

Data Preprocessing: Data Cleaning - Data Integration - Data Reduction - Data Transformation - Data Discretization - Data Visualization.

Module II Data Warehousing and Pattern Mining Techniques 23 Hours

Data Warehousing: Data Warehousing and Online Analytical Processing: Data Warehouse Basic Concepts - Data Warehouse Modeling - Data Cube and OLAP - Data Warehouse Design and Usage - Data Warehouse Implementation - Data Generalization by Attribute - Oriented Induction - ETL, Fact Table and Dimension Table.

Association: Mining Frequent Patterns - Associations and Correlations: Basic Concepts and Methods: Frequent Item Set Mining Method - Pattern Evaluation Methods - Pattern Mining: A Road Map - Multidimensional Space - Constraint - Based Frequent Pattern Mining - Applications Pattern Mining.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the database schemas using ER modeling and relational database concepts to address complex application requirements	Analyze
CO2: Evaluate diverse datasets for effective data mining by applying techniques such as data cleaning, integration, and transformation	Evaluate
CO3: Design efficient data warehousing solutions with OLAP operations for multidimensional data analysis	Create
CO4: Apply the pattern mining techniques, including frequent itemset mining and association rule mining, to extract actionable knowledge	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Silberschatz, Korth, Sudarshan, "Database System Concepts", 6th Edition, McGraw HillInternational Edition, New Delhi 2010.

T2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 4th Edition, Elsevier, 2022.

Reference Book(s):

R1. Jure Leskovec, Anand Rajaraman, Jeffery David Ullman, "Mining of Massive Datasets", 2nd Edition, Cambridge University Press, 2014.

R2. IanH. Witten, Eibe Frank, MarkA.Hall, "Data Mining: Practical Machine Learning Tools and Techniques", 3rd Edition, Elsevier, 2011.

R3. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons 2013.

Web References:

1. Weka tool documentation: http://www.cs.waikato.ac.nz/ml/weka/documentation.html

2.Cran R-program: https://cran.r-project.org/manuals.html

3.UCI Machine learning repository: https://archive.ics.uci.edu/ml/index.html

Course Code: 23ADO002		Course Title: Data Science using Python	
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 gain knowledge in the basic concepts of Data Analysis and to acquire skills in data preparatory tools and packages in Python for data science.

Module I Data Science Process 22 Hours

Overview of Data Science: Introduction - Benefits and Uses - Facets of Data - Data Science Process: Retrieving Data - Cleansing and Integrating - Transforming Data - Exploratory Data Analysis - Build the Models - Presenting and Building Applications.

Describing Data I: Frequency Distributions - Outliers - Types of Frequency Distributions - Frequency Distributions for Qualitative Data - Graphs - Averages - Describing Variability: Range, Variance, Standard Deviation - Interquartile Range - Variability for Qualitative and Ranked Data.

Numpy arrays: Basics of Numpy Arrays - Aggregations - Computations on Arrays - Comparisons, Masks,Boolean Logic

Module II Data Handling and Data Visualization 23 Hours

Python for Data Handling: Fancy Indexing - Structured Arrays - Data Manipulation with Pandas: Data Indexing and Selection - Operating on Data and Missing Data - Hierarchical Indexing and Combining Datasets: Aggregation and Grouping, Pivot Tables.

Describing Data II: Normal Distributions - Z Scores - Normal Curve Problems - Proportions - Scores - Correlation - Scatter Plots - Correlation Coefficient for Quantitative Data - Regression.

Python for Data Visualization: Visualization with matplotlib: Line Plots, Scatter Plots - Visualizing Errors - Density and Contour Plots - Histograms, Binnings, and Density - Three Dimensional Plotting - Geographic Data - Data Analysis Using Statmodels and Seaborn - Graph Plotting Using Plotly - Interactive Data Visualization Using Bokeh.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the complete data science process, including data retrieval, cleansing, integration, and exploratory analysis	Analyze
CO2: Apply statistical techniques to describe and summarize data distributions, variability, and correlations for informed decision-making	Apply
CO3: Develop efficient data handling workflows using Python libraries such as NumPy and Pandas for advanced data manipulation and aggregation	Create
CO4: Design advanced visualizations using Python tools (matplotlib, seaborn, Plotly, Bokeh) to communicate complex data insights interactively	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	3	-	-	2	-	-	-	-	-	-	-
CO2	4	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	-	-	2	1	-	-	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Module I)

T2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017. (Module II)

T3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016. (Module II)

Reference Book(s):

R1. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.

R2. Claus O. Wilke, “Fundamentals of Data Visualization”, O’reilly publications, 2019.

Web References:

1. Coursera content on Exploratory Data : https://www.coursera.org/learn/exploratory-data-analysis

2. https://nptel.ac.in/downloads/111102011/

3. Online courses for EDA: https://analyticsindiamag.com/8-online-courses-for-exploratory-data-analysis/

Course Code: 23ADO003		Course Title: Foundations of Business Analytics	
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 Information Technology Applications and design a Dashboard and Scorecard.

Module I Foundations of Business Intelligence and IT Applications 22 Hours

Introduction: Business View of IT Applications - Key Purpose of using It in Business - Enterprise Applications and Bespoke IT Applications - Types of Digital Data

OLTP and OLAP: OLTP - OLAP - Different OLAP Architecture - OLTP and OLAP - Data Models for OLTP and OLAP - Role of OLTP Tools in BI Architecture.

BI Concepts: BI- Evolution of BI and Role of DSS, EIS, MIS, and Digital Dashboards - BI users - BI Roles and Responsibilities.

Module II Data Integration, Multidimensional Modeling, and Enterprise Reporting 23 Hours

Data Integration: Need for Data Warehouse - Data Mart - ETL - Data Integration Technologies - Data Quality.

Multidimensional Data Modeling: Data Modeling Basics- Types of Data Model - Data Modelling Techniques - Fact Table - Dimensional Table - Typical Dimensional Models - KPI usage in Companies.

Enterprise Reporting: Reporting Perspectives Common to All Levels of Enterprise - Report Standardization and Presentation Practices- Balanced Scorecard – Dashboards - Scrorecards Vs Dashboards.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the role and impact of IT applications and digital data types in supporting business processes and decision-making	Analyze
CO2: Evaluate OLTP and OLAP architectures and their roles in Business Intelligence systems to optimize data processing and analytics	Evaluate
CO3: Implement effective data integration solutions including ETL processes and data quality techniques for enterprise data management	Create
CO4: Develop Enterprise reporting tools such as dashboards and balanced scorecards for strategic business insights	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. RN Prasad, Seema Acharya, "Fundamentals of Business Analytics", 2nd Edition, Wiley, 2016.(Module I)

T2. Ramesh Sharda, Dursun Delen, Efraim Turban, "Business Intelligence and Analytics, Systems for Decision Support", 10th Edition, Pearson Education Inc, 2015. (Module II)

Reference Book(s):

R1. David Loshin, "Business Intelligence: The Savvy Manager's Guide", 2nd Edition, Morgan Kaufman, 2012.

R2. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley, 2009

Web References:

1. Business Intelligence: https://cloud.google.com/learn/what-is-business-intelligence
2. Data warehousing: https://www.geeksforgeeks.org/data-warehousing/
3. Nptel course in Business Anaytics for Management Decision: https://onlinecourses.nptel.ac.in/noc20_mg11/preview

Course Code: 23ADO004		Course Title: Cognitive Science	
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 exploring the integration of different disciplines like psychology, neuroscience, linguistics, philosophy, computer science, and anthropology in understanding cognition.

Module I Modeling Tools 22 Hours

Historical Landmarks: The Challenge of Cognitive Science - The Discipline Matures: Three Milestones - The Turn to the Brain- Physical Symbol Systems and the Language of Thought - Neural Networks and Distributed Information Processing.

Models and Tools: Applying Dynamical Systems Theory to Model the Mind - Bayesianism in Cognitive Science - Modules and Architectures - Strategies for Brain Mapping.

Application: Models of Language Learning - Object Perception and Folk Physics - Machine Learning: From Expert Systems to Deep Learning - Exploring Mindreading - Robotics: From GOFAI to Situated Cognition and Behavior - Based Robotics - The Cognitive Science of Consciousness.

Module II Artificial Intelligence Approach 23 Hours

Cognitive Roboscience: Artificial Intelligence I: Definitional Perspective: Historical and Philosophical Roots- defining - AI Methodologies - tools - Programming - Alan Turing and the Great Debate - Artificial Intelligence II: Operational Perspective: Approaches to the Design of Intelligent Agents - Machine Representation - Reasoning: Machine - Logical - Inductive - Expert Systems - Fuzzy Logic.

Natural Language Processing: Speech recognition - Syntactic Analysis - Semantic Analysis - Pragmatic Analysis - Computer Language Programs and IBM's Watson - Evaluation of NLP.

Emotional Approach: Basic Emotions - Emotions and Neuro Science - Hot and Cold: Emotion - Cognition Interactions - Emotion and Memory - Emotions and Artificial Intelligence: Affective Computing - Overall Evaluation of the Emotional Approach.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Use dynamical systems theory to model cognitive processes, illustrate model to represent the mind as a complex system	Analyze
CO2: Evaluate the evolution and methodologies of Artificial Intelligence, including logical reasoning, expert systems, and fuzzy logic	Evaluate
CO3: Apply AI techniques such as machine learning, natural language processing, and affective computing to solve complex cognitive problems	Apply
CO4: Design cognitive and AI-based models integrating emotional and behavioral perspectives to advance intelligent system capabilities	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Jose Luis Bermúdez, “Cognitive Science - An Introduction to the Science of the Mind”, Cambridge University Press, 2020.(Module I)

T2. Jay Friedenberg, Gordon Silverman, “Cognitive Science - An Introduction to the Study of Mind”, Sage publication, 2006. (Module II)

Reference Book(s):

R1. Noah D. Goodman, Andreas Stuhlmuller, “The Design and Implementation of Probabilistic Programming Languages”, dippl.org, 2016.

R2. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, 2nd Edition, 2016.

Web References:

1. https://www.problang.org/chapters/app-06-intro-to-webppl.html

2. https://onlinelibrary.wiley.com/journal/5839

Course Code: 23ADO005		Course Title: Total Quality Management Principles	
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 describe the fundamentals of total quality management and to choose the appropriate TQM methodologies for applying in the various performance measures.

Module I Principles and Evolution of Total Quality Management 22 Hours

Evolution of Quality: Need for Quality - Evolution of Quality - Definition of Quality - Dimensions of Manufacturing and Service Quality - Basic Concepts of TQM - Definition of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM.

TQM Principles: Leadership - Strategic Quality Planning, Quality Statements - Customer Focus, Customer Orientation - Customer Satisfaction - Customer Complaints, Customer Retention - Employee Involvement: Motivation and Empowerment, Team and Teamwork - Recognition and Reward, Performance Appraisal - Continuous Process Improvement - PDSA Cycle - 5S - Kaizen - Supplier Partnership - Partnering - Supplier Selection and Supplier Rating.

Module II TQM Tools, Techniques, and Quality Systems 23 Hours

TQM Tools & Techniques I: The Seven Traditional Tools of Quality - New Management Tools - Six-Sigma: Concepts, Methodology - Applications to Manufacturing - Service Sector Including IT, Bench Marking - Reason to Bench Mark - Bench Marking Process - FMEA - Stages and Types.

TQM Tools & Techniques II: Quality Circles - Quality Function Deployment (QFD) - Taguchi Quality Loss Function - TPM: Concepts - Improvement Needs - Cost of Quality - Performance Measures.

Quality Systems: Need for ISO 9000 - ISO 9000-2000 Quality System - Elements - Documentation - Quality Auditing: QS9000, ISO 14000 - Concepts, Requirements and Benefits - Capability Maturity Model for Software Industry.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the evolution and fundamental principles of Total Quality Management, including leadership, customer focus, and continuous improvement	Analyze
CO2: Evaluate the roles of key contributors and the barriers to successful TQM implementation in manufacturing and service sectors	Evaluate
CO3: Apply TQM tools and techniques such as Six Sigma, benchmarking, FMEA, and quality circles to improve organizational quality processes	Apply
CO4: Design quality management systems including ISO standards and capability maturity models for effective quality assurance	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Dale H. Besterfield, Carol Besterfield, “Total Quality Management”, 3rd Edition, Pearson Education Asia, Indian Reprint, 2011.

Reference Book(s):

R1. James R. Evans, William M. Lindsay, “The Management and Control of Quality”, 6th Edition, South-Western (Thomson Learning), 2005.

R2. Oakland J.S., “TQM - Text with Cases”, Butterworth - Heinemann Ltd., 3rd Edition, Oxford, 2003.

R3. Suganthi L, Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006.

R4. Janakiraman B, Gopal R.K, “Total Quality Management - Text and Cases”, Prentice Hall (India)Pvt. Ltd, 2015.

Course Code: 23ADO006		Course Title: Professional Ethics	
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 discuss the ethical issues related to engineering and realize the responsibilities and rights in the society and to apply the Ethics in real world.

Module I Human Values and Engineering Ethics 22 Hours

Human Values: Morals, values and Ethics - Integrity, Work ethic - Service learning - Civic virtue: Respect for others - Living peacefully - Caring, Sharing - Honesty, Courage, Valuing time - Cooperation, Commitment - Empathy, Self-confidence - Character, Spirituality - Introduction to Yoga and Meditation for Professional Excellence and Stress Management.

Engineering Ethics: Senses of Engineering Ethics - Variety of Moral Issues - Types of Inquiry: Moral Dilemmas - Moral Autonomy - Kohlberg ‘s Theory - Gilligan ‘s Theory - Consensus and Controversy - Models of Professional Roles - Theories About Right Action: Self-interest - Customs and Religion - Uses of Ethical Theories.

Module II Engineering Ethics, Safety, and Global Issues 23 Hours

Engineering as Social Experimentation: Engineering as Experimentation - Engineers as responsible Experimenters - Codes of Ethics - A Balanced Outlook on Law.

Safety, Responsibilities and Rights: Safety and Risk - Assessment of Safety and Risk - Risk Benefit Analysis and Reducing Risk - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional Rights and Employee Rights - Intellectual Property Rights (IPR) and Discrimination.

Global Issues: Multinational Corporations - Environmental Ethics - Computer Ethics - Weapons Development - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Moral Leadership and Code of Conduct - Corporate Social Responsibility.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze human values such as integrity, empathy, and social responsibility, and apply them for professional and personal excellence	Analyze
CO2: Evaluate ethical theories, moral dilemmas, and professional role models to resolve engineering ethics challenges critically	Evaluate
CO3: Apply codes of ethics, safety principles, and risk assessment techniques to ensure responsible engineering practice and workplace safety	Apply
CO4: Assess global and societal issues including environmental ethics, intellectual property rights, and corporate social responsibility to promote ethical engineering leadership	Evaluate

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, 2003. (Module I)

T2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, 2004. (Module II)

Reference Book(s):

R1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.

R2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics - Concepts and Cases”, Cengage Learning, 2009.

R3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003

R4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

R5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility”, Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.

Web References:

1. edulearn.net.in: https://www.edulearn.net.in/

2.Free Engineering Ethics course: https://pdh-pro.com

Course Code: 23ADO007		Course Title: Ethical Hacking Essentials	
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 elucidate the various types of attacks, security threats and vulnerabilities and to explore the options for network protection.

Module I Ethical Hacking and Network Security 22 Hours

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

Foot Printing, Reconnaissance and Scanning Networks: Foot printing Concepts - Foot Printing through Search Engines - Competitive Intelligence - Foot printing through Social Engineering - Foot printing Tools - Network Scanning Concepts - Port and Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall.

Enumeration: NetBIOS Enumeration - SNMP, LDAP - NTP, SMTP - DNS Enumeration

Module II Vulnerability Analysis & Network Defence 23 Hours

Vulnerability Analysis: Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows - Linux OS Vulnerabilities

System Hacking: Hacking Web Servers - Web Application Components - Vulnerabilities - Tools for Web Attackers and Security Testers - Hacking Wireless Networks - Components of a Wireless Network - War driving - Wireless Hacking - Tools of the Trade.

Network Protection Systems: Access Control Lists - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection - Prevention Systems - Network-Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams - Honeypots.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze network protocols, attack methodologies, and penetration testing techniques to identify security vulnerabilities effectively	Analyze
CO2: Evaluate various vulnerability assessment tools and system hacking methods to understand risks in different operating systems	Evaluate
CO3: Apply ethical hacking skills including footprinting, scanning, enumeration, and wireless hacking to assess network security	Apply
CO4: Design network protection strategies using firewalls, IDS/IPS, access control, and incident response techniques	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Michael T. Simpson, Kent Backman, and James E. Corley, “Hands-On Ethical Hacking and Network Defense, Course Technology”, Delmar Cengage Learning, 2010. (Module I)

T2. “The Basics of Hacking and Penetration Testing - Patrick Engebretson”, SYNGRESS, Elsevier, 2013. (Module II)

T3. Dafydd Stuttard and Marcus Pinto, “The Web Application Hacker’s Handbook: Finding and Exploiting Security Flaws”, 2011. (Module II)

Reference Book(s):

R1. Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz, 2014.

Web Reference :

1. NPTEL Courses on Ethical Hacking:

https://onlinecourses.nptel.ac.in/noc22_cs13/preview

2. COURSERA Courses on Ethical Hacking Esssentials:

https://www.coursera.org/learn/ethical-hacking-essentials-ehe

Course Code: 23ADO008		Course Title: Data Visual Exploration	
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 graphics software standards and primitive operations to implement and manipulate basic graphical elements.

Module I 2D Graphics and OpenGL Basics 22 Hours

Graphics Software Standards and Primitives: 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. Line Drawing Algorithms - DDA Line Drawing Algorithm - Point Attributes - Line Attributes - Fill Area Attributes - Character Attributes - OpenGL Functions.

2D Transformation and Viewing: Basic Transformations - Homogeneous Representation - Composite Transformation - Other Transformations - OpenGL Functions. Viewing Pipeline - Clipping Window - Window to Viewport Transformation - OpenGL 2D Viewing Functions

Module II 3D Graphics and Visualization Techniques 23 Hours

3D Transformations and Viewing: 3D Object Representation - OpenGL Functions - Quadric and Cubic Surfaces - Bezier and Spline Curves - 3D Transformation - OpenGL Functions - 3D Viewing - 3D Viewing Concepts - 3D Viewing Pipeline - Projection Transformations - Orthogonal Projections - Oblique Parallel Projections - Perspective Projections.

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 - Oct Tree Method - Comparison.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze 2D graphics primitives, coordinate systems, and transformations using OpenGL functions for effective graphic rendering	Analyze
CO2: Apply 2D and 3D transformation techniques, including composite and viewing transformations, in computer graphics applications	Apply
CO3: Evaluate various 3D object representation methods, projection techniques, and visible surface detection algorithms	Evaluate
CO4: Design 2D and 3D visualization techniques using OpenGL for complex graphical scenes	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Donald D. Hearn, M. Pauline Baker, Warren Carithers, “Computer Graphics with OpenGL”, 4th Edition, Pearson Education, 2016. (Module I)

T2. Matthew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations, Techniques, Applications”, 2010. .(Module II)

Reference Book(s):

R1. D. F. Rogers and J. A. Adams, “Mathematical Elements for Computer Graphics”, 2nd Edition, McGraw-Hill International Edition, 2017.

R2. Edward Angel, “Interactive Computer Graphics: A Top-Down Approach with OpenGL”, 5th Edition, Addison-Wesley, 2012.

R3. Shalini Govil Pai, “Principles of Computer Graphics Theory and Practice Using OpenGLand Maya”, Springer, 2010.

Web References:

1. NPTEL Course: https://nptel.ac.in/noc/courses/noc21/SEM2/noc21-cs97/

2.The Official Guide to Learning OpenGL: http://www.glprogramming.com/re

3. OpenGL Reference Manual : http://www.glprogramming.com/blue/

Course Code: 23ADO009		Course Title: Foundations of Marketing Analytics	
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 marketing analytics in decision-making processes to acquire knowledge of various machine learning algorithms and their applications in marketing research.

Module I Introduction to Marketing and Descriptive Analytics 22 Hours

Introduction to Marketing and Descriptive Analytics: Introduction - Marketing Research - Marketing Analytics - Marketing Analytics Data - Web Analytics - Online and Offline Data - Type of Media and DataType: Structured, Semi - Structured, Unstructured Data Introduction - Key Ideas in the World of R - Taste of R - Summarizing data - Generating an Overall Data Summary - Summarizing Numeric Variables - Summarizing Categorical Variables - Exploring Relationships Between Numeric Variables and categorical Variables Plotting data

Module II Machine Learning and Social Media Data 23 Hours

Machine Learning and Social Media Data: Introduction - Supervised Learning - Unsupervised Learning - Reinforcement Learning - Key Steps in Building Machine Learning Models. Introduction - Media Budget Decisions - Advertising Effectiveness - Consumer Perception and Preference - Cluster Analysis - Multi-Dimensional Scaling - Correspondence Analysis – Correlation - Regression. Overview of Social Media Platforms - Social Media APIs - Observable aspects of Consumer Behavior on Social Media - Workflow for Social Media Data Collection.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze different types of marketing data (structured, semi-structured, unstructured) using R for descriptive statistics and visualization	Analyze
CO2: Apply machine learning techniques including supervised, unsupervised, and reinforcement learning to solve marketing problems	Apply
CO3: Evaluate marketing analytics models such as cluster analysis, regression, and multi-dimensional scaling for consumer behavior insights	Evaluate
CO4: Design workflows for social media data collection and analytics using APIs to support marketing decision-making	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Moutusy Maity and Pavankumar Gurazada, “Marketing Analytics for Strategic decision making”, Oxford University press, 1st Edition, 2021. (Module I)

T2. Chuck hemann and Ken Burbary, “Digital marketing analytics: Making Sense of consumer Data in a Digital World”, QUE Publication, 2nd Edition, 2018. (Module II)

Reference Book(s):

R1. Wayne L. Winston, “Marketing Analytics: Data-Driven Techniques with Microsoft Excel”, Wiley Publication,1st Edition, January 2014.

R2. Chuck hemann and Ken Burbary, “Digital marketing analytics: Making Sense of consumer Data in a Digital World”, QUE Publication, 2nd Edition, May 2018.

R3. Rajkumar Venkatesan, Paul W. Farris, and Ronald T. Wilcox, “Marketing Analytics Essential Tools for Data-Driven Decisions” , 1st Edition, January 2021

Web References:

1. Web analytics: https://www.hotjar.com/web-analytics/
2. R programming: https://www.geeksforgeeks.org/r-tutorial/
3. Nptel courses: https://onlinecourses.nptel.ac.in/noc20_mg30/preview

Course Code: 23ADO010		Course Title: Information Extraction and Text Mining	
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 Information Extraction and Text mining using various NLP applications.

Module I Speech & Language Fundamentals 22 Hours

Introduction: Knowledge in Speech and Language Processing - Ambiguity

Regular Expression and Automata: Regular Expressions Finite State Automata

Morphology and Finite State Transducers: Morphology - Finite-State Morphological Parsing - Human Morphological Parsing

Computational Phonology and Text-to-Speech: Speech Sounds and Phonetic Transcription - The phoneme and Phonological Rules - Advanced issues in Phonology

Module II Probabilistic Models & Speech Recognition 23 Hours

Probabilistic Models of Pronunciation and Spelling: Dealing with Spelling Errors - Spelling Error Patterns - Probabilistic Models - Applying the Bayesian Method to Spelling - Minimum Edit Distance - The Bayesian Method for Pronunciation - Weighted Automata

N-grams: Counting Words in Corpora - Smoothing - Backoff - Entropy

HMMs and Speech Recognition: Speech Recognition Architecture - Acoustic Processing of Speech - Human Speech Recognition

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze foundational concepts of speech and language processing including ambiguity, morphology, and phonology using automata theory	Analyze
CO2: Apply computational techniques such as finite-state transducers and phonological parsing for processing linguistic data	Apply
CO3: Evaluate probabilistic models including Bayesian methods and minimum edit distance for handling pronunciation and spelling errors	Evaluate
CO4: Design speech recognition systems using n-gram models, HMMs, and acoustic processing techniques	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”,Prentice Hall, 2nd Edition, 2008. (Module I)

T2. U. S. Tiwary and TanveerSiddiqui, “Natural Language Processing and information Retrieval”, Oxford University Press, 2008. (Module II)

Reference Book(s):

R1. Christopher Manning, “Foundations of Statistical Natural Language Processing”, MIT Press, 2009.

R2. Nitin Indurkhya, Fred J. Damerau, “Handbook of Natural Language Processing”, 2nd Edition, Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover, 2010.

Web References:

1. NPTEL Course on Natural Language Processing: https://nptel.ac.in/courses/106101007

2. NLTK tool tutorial: https://nlp.stanford.edu/software

Course Code: 23ADO011		Course Title: Drone Technology	
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 basics of drone concepts, assembling, and troubleshooting a drone.

Module I Introduction to Drone Technology and Assembly 22 Hours

Introduction: Drone- Types of motors used for Drones - Radio Transmitter and Receiver - Battery - Connectors.

Assembling your Drone: Assembling the Frame - Connecting the RC Receiver and Transmitter - Connecting the Battery - Binding Transmitter to the Receiver - Know the Aerodynamics Needed for Flying a Drone - Saving from Crashing.

Module II Building, Operating, and Maintaining Drones 23 Hours

Building a Drone: Follow Me Drone - Mission Control Drone - Surveying with A Drone - A Drone to Take Selfies and Videos - Photography Drones - Assembling the Photography Drone - Controlling the Camera - Flying and Taking Shots.

Building Prototype Drones: Gliding Drones - Racing drones.

Maintaining and Trobleshooting your Drone: Safety of the Drone - Be careful about the battery - Storage of the drone - Carrying a drone - Troubleshooting your drone - Diagnosing problems using logs.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze the components and aerodynamics principles essential for assembling and operating various types of drones	Analyze
CO2: Apply practical skills to assemble drone frames, connect systems, and configure radio transmitters for flight readiness	Apply
CO3: Evaluate different types of drones and their specific uses in photography, surveying, and racing applications	Evaluate
CO4: Design maintenance and troubleshooting protocols to ensure drone safety and operational efficiency	Create

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Daniel Tal, John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, John Wiley & Sons Inc., 2021.

Reference Book(s):

R1. John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones”, UAVs,and ROVs”, Que Publishing, 2016.

R2. Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.

Web References:

1. Drone Technology Future trend and practical application: https://onlinelibrary.wiley.com/doi/book/10.1002/9781394168002:
2. Nptel: NOC:Design of fixed wing Unmanned Aerial Vehicles: https://nptel.ac.in/courses/101104073

Course Code: 23ADO012		Course Title: Agri-Robotics	
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 to Identify the areas in agricultural process Build sensor and system and to Develop suitable robotic system for specific agricultural tasks.

Module I Agri Robotics Structures 22 Hours

Mechanized Agriculture Structure: History of Mechanized Agriculture - Farming Operations and Related Machines - Tillage - Planting Cultivation - and Harvesting - Agricultural Automation - Agricultural Vehicle Robot.

Precision Agriculture: Sensors - types and agricultural applications - Global Positioning System (GPS) - GPS for Civilian Use - Differential GPS - Carrier-phase GPS - Real-time kinematic GPS - Military GPS – Geo Graphic Information System - Variable Rate Applications and Controller Area Networks.

Traction and Testing: Hitching- Control of hitches -Tires and Traction models - Traction predictor spread sheet - Soil Compaction - Traction Aids - Tractor Testing.

Module II Agri Robotics Management System 23 Hours

Soil Tillage and Weed Management: Tillage Methods and Equipment - Mechanics of Tillage Tools - Performance of Tillage Implements - Hitching of Tillage Implements - Weed Management - Conventional Cropping Systems –Tools - Crop Rotation - Mechanical Cultivation.

Machinery Selection: Screw Conveyors - Pneumatic Conveyors - Bucket Elevators - Forage Blowers and Cellaneous Conveyors - Machinery Selection - Field Capacity and Efficiency - Draft and Power Requirements - Machinery Costs.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze mechanized agricultural structures, sensor technologies, and GPS applications for precision agriculture	Analyze
CO2: Apply concepts of traction, soil compaction, and tillage mechanics to optimize agricultural vehicle robot performance	Apply
CO3: Evaluate weed management techniques, tillage equipment performance, and cropping system tools for efficient agricultural practices	Evaluate
CO4: Design appropriate machinery selection strategies considering field capacity, power requirements, and cost-effectiveness in agri-robotics	Create

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Ajit K. Srivastava, Carroll E. Goering, Roger P. Rohrbach, Dennis R. buckmaster, "Engineering Principles of Agricultural Machines", ASABE Publication, 2012.

Reference Book(s):

R1. Qin Zhang, FrancisJ.Pierce, "Agricultural Automation Fundamentals and practices", CRC Press, 2016.

R2. Stephen L Young, Francis J. Pierce, "Automation: The Future of Weed Control in Cropping Systems", Springer, Dordrecht Heidelberg New York London, 2014.

R3. Myer Kutz, "Handbook of Farm, Dairy and Food Machinery Engineering", Academic Press, 2019.

Web References:

1.https://www.amazon.in/Robotics-Automation-Improving-Agriculture-Agricultural/dp/1786762722.