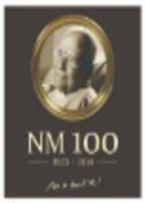


Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
Udumalai Road, Pollachi, Coimbatore District - 642003
Established in 1998 ♦ Approved by AICTE ♦ Affiliated to Anna University
(A DIVISION OF NIA EDUCATIONAL INSTITUTIONS)

NAAC A++ GRADE
Cycle 3 (2023-2030)
The Highest Grade

Curriculum and Syllabi

B.E. Computer Science and Engineering

(Artificial Intelligence and Machine Learning)

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 Computer Science and Engineering (Artificial Intelligence and Machine Learning)

Vision

To develop skilled professionals in the field of AI & ML with global employability, entrepreneurship capability, research focus and social responsibility.

Mission

- To develop competent professionals who are skilled in the area of AI and ML by providing state of art academic environment and industry driven curriculum.
- Motivate students to become entrepreneurs and to take higher studies in the field of AI and ML.
- To enrich the department through committed and technically sound faculty team with research focus in thrust areas of AI and ML.
- To provide intelligent solutions for interdisciplinary problems through technical innovations and projects in association with the industry, society and professional bodies.

Dr. Mahalingam College of Engineering and Technology, Pollachi 642003.
(An autonomous institution approved by AICTE and affiliated to Anna University)

Programme: B.E Computer Science and Engineering (Artificial Intelligence and Machine Learning)

Program Educational Objectives (PEOs) - Regulations 2023

PEO1. To graduates will have a strong foundation and knowledge in basics of computer science and advanced AI and ML technologies.
PEO2. The graduates will be able to design and develop novel products and provide innovate solutions to real world problems using principles of AI and ML.
PEO3. The graduates will be ethically socially responsible and have ability to adopt to new technologies with effective communication skills.

Program Outcomes (POs) - Regulations 2023

PO 1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
PO 2. Problem analysis: Identify, formulate, research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
PO 4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities

relevant to the professional engineering practice.

PO 7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

PO 8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

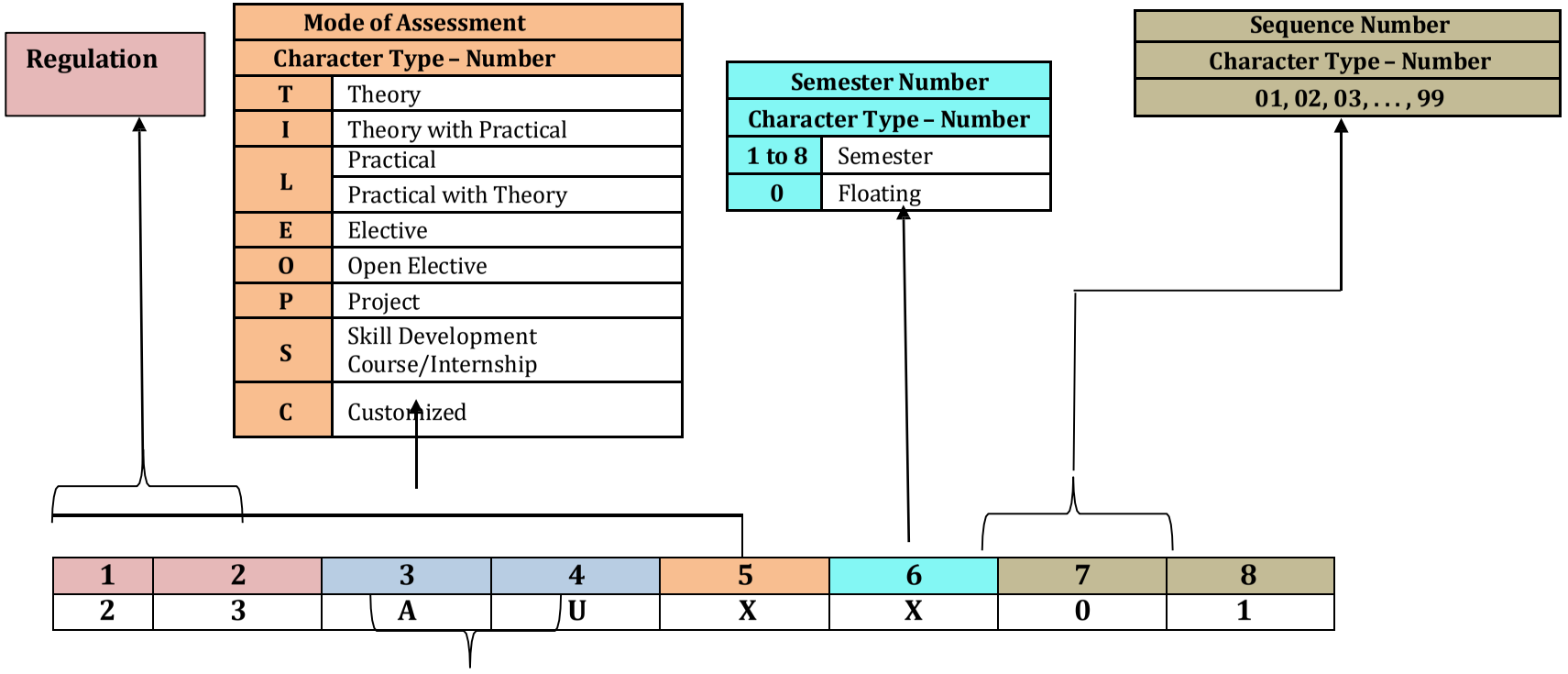
Program Specific Outcomes (PSOs) - Regulations 2023

PSO1. Ability to design and develop models and solutions using innovative AI and ML tools and techniques for real world multidisciplinary problems.

PSO2. Ability to do research innovate new tools and technologies to meet the need of the industry and society.

Dr. Mahalingam College of Technology, Pollachi

2023 Regulations - Course Code Generation Procedure for UG Courses



Board/Department/Programme/Course Type			
Character Type – Alphabet			
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.E. Computer Science and Engineering
(Artificial Intelligence and Machine Learning)
2023 Regulations (For 2023 Batch Only)
Curriculum for Semester I & II

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

Semester I

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
AEC	23ENI101	Communication Skills I	2	0	2	3	100	ALL
Minor	23MAI103	Linear Algebra and Infinite Series	3	0	2	4	100	AD,AM,CS,IT&SC
Major	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
Multi - Disciplinary	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	தமிழர்மரபு /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

Course Category	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 Languages- Japanese	3	0	0			
	23FLT202	Foreign Languages- 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
Multi - Disciplinary	23EEI201	Digital System Design	2	0	2	3	100	AD,AM,CS,IT&SC
Multi - Disciplinary	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	தமிழரும்தொழில் நுட்பமும் / Tamils and Technology	1	0	0	1	100	ALL
Multi - Disciplinary	23CHT202	Environmental Sciences	1	0	0	-	100	ALL
AEC	23SAL201	Studio Activities	0	0	2	-	-	-
		Total	**13**	**0**	**20**	**21**	**1000**	

Programme: B.E. Computer Science and Engineering
(Artificial Intelligence and Machine Learning)
2023 Regulations (From 2024 Batch Onwards)
Curriculum for Semester I to IV

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

Semester I

Course Category	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
Multi Disciplinary	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	தமிழர்மரபு /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

Course Category	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 Languages- Japanese	3	0	0			
	23FLT202	Foreign Languages- 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
Multi Disciplinary	23EEI201	Digital System Design	2	0	2	3	100	AD,AM,CS,IT&SC
Multi Disciplinary	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	தமிழரும்தொழில்நுட்பமும் / Tamils and Technology	1	0	0	1	100	ALL
Multi Disciplinary	23CHT202	Environmental Sciences	1	0	0	-	100	ALL
AEC	23SAL201	Studio Activities	0	0	2	-	-	-
		Total	**13**	**0**	**20**	**21**	**1000**	

Semester III

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Minor	23MAT305	Discrete Mathematics	3	1	0	4	100	AM,CS,IT&SC
Major	23SCI301	Object Oriented Programming	3	0	2	4	100	AM & SC
Major	23SCT301	Computer Organization and Architecture	3	0	0	3	100	AM & SC
Major	23AMT301	Principles of Artificial Intelligence & Soft Computing	3	0	0	3	100	-
Major	23SCI302	Database Design	3	0	2	4	100	AM & SC
Major	23SCL301	Programming using Python Laboratory	0	0	4	2	100	AM & SC
SEC	23ESL301	Professional Skills 2: Problem solving skills & Logical Thinking 2	0	0	2	1	100	ALL
VAC	23VAT301	Universal Human Values 2: Understanding Harmony	2	1	0	3	100	ALL
AEC	23SAL301	Studio Activities	0	0	2	-	-	ALL
		Total	**17**	**2**	**12**	**24**	**800**	

Semester IV

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Minor	23MAI401	Probability and Statistics	3	1	0	4	100	AM,AU,CS,EC,EE, EV,ME, IT & SC
Major	23SCI401	Basics of Operating Systems	3	0	2	4	100	AM & SC
Major	23AMT401	Machine Learning Algorithms and Application	3	0	0	3	100	-
Major	23AMT402	Neural Computing in Machine Learning	3	0	0	3	100	-
Major	23AML401	Machine Learning Laboratory	0	0	3	1.5	100	-
Major	23AML402	AI Laboratory	0	0	3	1.5	100	-
SEC	23ESL401	Professional Skills 3: Professional Development and Ediquity	0	0	2	1	100	-
AEC	23SAL401	Studio Activities	0	0	2	-	-	ALL
		Total	**12**	**1**	**12**	**18**	**700**	

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

Tentative Curriculum for Semester V to VIII

Semester V

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23AMT501	Deep Learning and Application	3	0	0	3	100	-
Major	23AMT502	Embedded Systems and IoT	3	0	0	3	100	-
Major	23AMT503	Software Engineering in AI	3	0	0	3	100	-
Major	23AME501	Professional Elective – I	3	0	0	3	100	-
Major	23AME502	Professional Elective – II	2	0	2	3	100	-
Major	23AML501	Deep Learning and Application Laboratory	0	0	3	1.5	100	-
Major	23AML502	Embedded Systems and IoT Laboratory	0	0	3	1.5	100	-
SEC	23XXXXXX	Professional Skills 4: Communication Skills and Interview Essentials	0	0	2	1	100	-
Project	23XXXXXX	Reverse Engineering Project	1	0	6	3	100	-
AEC	23SAL501	Studio Activities	0	0	2	-	-	ALL
		Total	**16**	**0**	**16**	**22**	**900**	

Semester VI

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23AMT601	AI Natural Language Processing	3	0	0	3	100	-
Major	23AMT602	Vision and Image Processing	3	0	0	3	100	-
Major	23AML601	AI Natural Language Processing Laboratory	0	0	3	1.5	100	-
Major	23AML602	Vision and Image Processing Laboratory	0	0	3	1.5	100	-
Major	23XXXXXX	Professional Elective - III	3	0	0	3	100	-
Major	23XXXXXX	Professional Elective - IV	2	0	2	3	100	-
Major	23XXXXXX	Open Elective - I	3	0	0	3	100	-
SEC	23XXXXXX	Professional Skills 5: Campus to Corporate	0	0	2	1	100	ALL
AEC	23SAL601	Studio Activities	0	0	2	-	-	ALL
		Total	**15**	**0**	**10**	**19**	**800**	

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

Semester VII

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23AMT701	Big data Technology	3	0	0	3	100	-
Major	23AMT702	Visual Data Analysis	3	0	0	3	100	-
Major	23AME701	Professional Elective – V	3	0	0	3	100	-
Major	23AME702	Professional Elective – VI	2	0	2	3	100	-
Major	23AMO701	Open Elective – II	3	0	0	3	100	-
Major	23AML701	Big data Technology Laboratory	0	0	3	1.5	100	-
Major	23AML702	Visual Data Analysis Laboratory	0	0	3	1.5	100	-
Project	23XXXXXX	Project Phase - I	0	0	8	4	100	-
Total			**15**	**0**	**14**	**22**	**800**	

Semester VIII

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Project	23AMP801	Project Phase - II	0	0	12	6	200	-
SEC	23AMS801	Internship –3/ Skill Development	8 Weeks			4	100	-
Total			**0**	**0**	**12**	**10**	**300**	

Total Credits: 160

Vertical wise Electives

Vertical I Data Science and AI							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
23AME001	Multivariate Data Analysis	3	0	0	3	100	-
23AME002	Data Mining for Business Intelligence	3	0	0	3	100	-
23AME003	Intelligent Recommendation Systems	2	0	2	3	100	-
23AME004	Recommendation Solutions	2	0	2	3	100	-
23AME005	Advanced Data and Visual Analytics in AI	3	0	0	3	100	-
23AME006	Text and Voice Intelligence	3	0	0	3	100	-
23AME007	Business Analytics	2	0	2	3	100	-
23AME008	Knowledge Based Systems Design	3	0	0	3	100	-

Vertical II AI in Cyber Security							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
23AME009	Cryptographic Techniques and Protocols for Security	3	0	0	3	100	-
23AME010	Computer Network and Security	3	0	0	3	100	-
23AME011	Intrusion Detection and Prevention Techniques	3	0	0	3	100	-
23AME012	Software Vulnerability Analysis	3	0	0	3	100	-
23AME013	Cybercrime Forensics and Digital Forensics	3	0	0	3	100	-
23AME014	Distributed System Security	3	0	0	3	100	-
23AME015	Ethical Hacking	2	0	2	3	100	-
23AME016	Engineering Secure Software Systems	2	0	2	3	100	-

Vertical III IOT and Cloud							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
23AME017	IOT Architecture and Protocols	3	0	0	3	100	-
23AME018	Data Science for IOT	3	0	0	3	100	-
23AME019	IOT Security	3	0	0	3	100	-
23AME020	Edge Computing	3	0	0	3	100	-
23AME021	Storage Technologies	3	0	0	3	100	-
23AME022	Data Warehousing	2	0	2	3	100	-
23AME023	Security and Privacy in Cloud	2	0	2	3	100	-
23AME024	Cloud Computing	2	0	2	3	100	-

Vertical IV Full stack Development							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
23AME025	Web Technologies	3	0	0	3	100	-
23AME026	App Development	2	0	2	3	100	-
23AME027	UI and UX Fundamentals	2	0	2	3	100	-
23AME028	Software Testing and Automation	3	0	0	3	100	-
23AME029	Principles of Programming languages	3	0	0	3	100	-
23AME030	DevOps	3	0	0	3	100	-
23AME031	Security in Web Technologies	2	0	2	3	100	-
23AME032	Essentials of Business Management	3	0	0	3	100	-

Vertical V Emerging Technologies							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
23AME033	Augmented Reality/Virtual Reality	2	0	2	3	100	-
23AME034	Robotic Process Automation	2	0	2	3	100	-
23AME035	Solve Business Problems with AI	3	0	0	3	100	-
23AME036	Dynamic Cyber Protection	3	0	0	3	100	-
23AME037	Computational Quantum Mechanics	3	0	0	3	100	-
23AME038	Crypto Currency and Block Chain Technologies	2	0	2	3	100	-
23AME039	Game Programming and Design	3	0	0	3	100	-
23AME040	3D Printing and Design	3	0	0	3	100	-

Diversified Electives

Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
23SCE050	Cyber security	3	0	0	3	100	ALL
23AUE051	Design Thinking and Innovation	3	0	0	3	100	ALL
23AUE050	Entrepreneurship Development	3	0	0	3	100	ALL
23MEE008	PLM for Engineers	2	0	2	3	100	ALL
23ITE047	Intellectual Property Rights	3	0	0	3	100	-
23ITE044	AWS Services with Devops Tools	2	0	2	3	100	AD,AM,CS,IT & SC
23ITE043	Integrated Big Data Solutions	3	0	0	3	100	AD,AM,CS,IT & SC
23AME041	Responsible AI	3	0	0	3	100	-

Open Electives (Offered to Other Programmes)

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
23AMO001	AI in Data Warehousing	3	0	0	3	100
23AMO002	Introduction to Machine Learning	3	0	0	3	100
23AMO003	AI Foundations and Techniques	3	0	0	3	100
23AMO004	Foundations of Machine Learning in Python	3	0	0	3	100
23AMO005	AI for Everyone	3	0	0	3	100
23AMO006	Introduction to Neural Networks and Deep Learning	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

Pre–requisites

- NIL

Course Objectives

The course is intended to:

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

List of Activities:

1. History of Institution and Management: Overview on NIA Educational Institutions – Growth of MCET – Examination Process –OBE Practices –Code of Conduct – Centre ofExcellence.
2. Lectures, interaction sessions and Motivational Talks by Eminent people, Alumni, Employer and Industry Experts
3. Familiarisation of Department / Branch:HoD's & Senior Interaction- Department Association
4. Universal Human Value Modules: Aspirations and concerns, Self-Management, 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 Uk, 2004.

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

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

Web References:

1. https://youtube.com/playlist?list=PLYwzG2fd7hzc4HerTNkc3pS_IvcCfKznV
2. https://www.youtube.com/watch?v=P4vjfEVk&list=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, South Asia Edition, 2022.

T2. Jack C. Richards, Jonathan Hull, and Susan Proctor, “Interchange - Student’s Book 1”, 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, fiberoptics, display devices and introduce the concepts of integrated circuits, nanotechnology and quantum computing

Module I **22 Hours**

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

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

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

Module II **23 Hours**

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

Integrated Circuits: Introduction to semiconductors: Intrinsic and extrinsic Semiconductors- Advantages of Integrated circuits (ICs) over discrete components- IC classification- Construction of bipolar transistor: Silicon Wafer Preparation - Epitaxial growth - Oxidation- Photolithography- Isolation diffusion - Base diffusion - Emitter diffusion

- Contact mask- Aluminium metallization – Passivation- Structures of integrated PNP transistor.

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

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply the basic concepts of laser, fiber optics and nanotechnology to solve different optical parameters.	Apply
CO2: Perform as a member of team in 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., New Delhi, 2018.

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

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

Reference Book(s):

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

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

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

Web References:

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

Course Code: 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 Passiveelements – 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 Deltaand Delta to Star transformation- circuit simplification.

AC Fundamentals: Magnetic Circuits: Definition of magnetic quantities — Law ofelectromagnetic 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
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, 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.ChandLimited, 2022.

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

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

Web References:

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

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

Course Objectives:

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

Module I **23 Hours**

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

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

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

Module II **22 Hours**

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

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

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

List of Experiments **30 Hours**

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

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply the basic laws and simplification techniques in electrical engineering using electric circuits.	Apply
CO2: Make use of the basic laws and principles of electric circuits in analysis of the electrical machines viz., Motors & transformers, UPS and SMPS	Analyze
CO3: Analyse the Diodes, Transistors, Opto-Electronic Devices and Transducers	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 spect ral lines of mercury spectrum usinggrating.
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 physicsexperiment	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. Engineering Physics Laboratory Manual, Dr. R. Jayaraman, V. Umadevi, S. Maruthamuthu, B. Saravanakumar, Pearson India Education ServicesPvt. Ltd, 2022.

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

Web References:

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

Course Code: 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. Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying „NO"
– Managing procrastination.

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

Module II **15 Hours**

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

Practices for Mental Wellness

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

Food & sleep for wellness: balanced diet - good food habits for better health (anatomic

therapy) — hazards of junk food - food and the gunas.

Putting Into Practice

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

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
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	Valuing

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(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, Aug 1997

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

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

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

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

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 ContactHours:60	Max Marks:100

Course Objectives

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

Module I **20 Hours**

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

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

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

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

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

Module II **20 Hours**

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

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

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

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

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

List of Experiments: **20 Hours**

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

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

Course Articulation Matrix

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

High-3; Medium-2;Low-1

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: 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 objectives intended to:

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

UNIT I Introduction to Japan and greetings 9 Hours

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

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

UNIT II Building vocabulary 9 Hours

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

Listening: Listening for Specific Information: Directions, Family Members, Parts of body Speaking: Introducing one's family.

UNIT III Writing systems 9 Hours

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

Listening: Listening to Japanese Alphabet Pronunciation, Simple Conversation. Speaking: Pair Activity (Day to day situational conversation)

UNIT IV Kanji and preposition 9 Hours

Katakana script and related vocabulary – Basic kanjis: naka, ue, shita, kawa , yama , numbers (1- 10, 100, 1000, 10,000 and yen) , person, man, woman, child, tree , book , hidari, migi, kuchi , 4 directions - Usage of particles wa, no, mo and ka and exercises - Usage of kore, sore, are, kono, sono, ano, arimasu and imasu - Particles – ni (location) and ga , donata and

dare - Particles ni (time), kara, made , ne , koko, soko, asoko and doko - Directions : kochira, sochira, achira and dochira , associated vocabulary (mae, ushiro, ue, shita, tonari, soba, etc.)
Listening: Listening to conversation with related particles

UNIT V Verb forms 9 Hours

Introduction to Verbs - Verbs –Past tense, negative - i-ending and na-ending adjectives introduction - ~masen ka, mashou - Usage of particles de, e , o, to, ga(but) and exercises - Adjectives (present/past – affirmative and negative) – Counters - ~te form
Listening: Listening to different counters, simple conversations with verbs and adjectives.
Speaking: Pair Activity (Explaining one's daily routine by using appropriate particles and verbs)

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

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

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

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

Reference 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)

Total:45 Hours

Course Outcomes **At the end of this course, students will be able to:**	**Cognitive Level**
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. Netzwerk, “Deutsch als Fremdsprache” by Stefanie Dengler, Paul Rusch, Helen Schmitz published by Goyal Publishers & Distributors Pvt Ltd;

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

Reference Book(s)

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

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

Course Objectives:

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

Module I **23 Hours**

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

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

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

Module II **22 Hours**

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

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

List of Experiments (Using 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 – Expression Trees — Binary Search Tree: Implementation

Module II **23 Hours**

AVL Trees: Implementation -Single Rotation – Double Rotation.

Binary Heap: Min Heap-Max Heap

Graphs: Definitions – Representation of Graphs – Graph Traversals: Breadth First Search – Depth First Search -Topological Sort

Shortest Path Algorithms: Unweighted Shortest Paths –Dijkstra's Algorithm – Critical Path

All Pairs Shortest Path: Floyds Algorithm

Minimum Spanning Tree: Prim's Algorithm – Krushkal's Algorithm.

Internal Sorting:-Insertion Short-Shell Sort-Merge Sort-Quick sort

External sorting: Simple Algorithm-Multiway Merge

Hashing: Hash Functions-Separate Chaining-Open Addressing-Rehashing-Extendible hashing

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

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	2	-	-	-	-	-	-	-
CO6	-	-	3	2	-	-	-	3	3	3	3	3

High-3; Medium-2; Low-1

Text Book(s):

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

Reference Book(s):

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

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

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

Web References:

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

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

Course Objectives:

The course is intended to impart knowledge on basics of logic gates, number system and different types of 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 logiccircuits.	Create
CO4: Analyze the sequential logic circuit and infer the results.	Analyze
CO5: Analyze and interpret the digital circuits by performing hardware implementations and report the inference as a team or individual.	Evaluate

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

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

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

Reference Book(s):

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

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

R3. S.Salivahanan and S. Arivazhagan, Digital Circuits and Design, Oxford UniversityPress, 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 3 D drawings such as points, lines,planes and solids on first quadrant.

Module I **8 Hours**

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

Projection of Points, Lines: First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces by rotating object method.

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

Module II **7 Hours**

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

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

Isometric Projection: Principles of isometric projection — Isometric scale –Isometric projections ofsimple 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
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-
CO6	-	3	-	-	3	-	-	-	1	1	-	1

High-3; Medium-2; Low-1

Text Book(s):

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

Reference Book(s):

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

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

R3. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, Gujarat, 54rd 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 structuresusing 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
CO1	3	-	-	-	2	-	-	-	-	-	-	-
CO2	-	2	-	3	3	-	-	-	-	-	-	-
CO3	-	-	2	3	3	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Reference Book(s):

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

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

Web References:

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

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Reference(s):

R1. Peter Abel, Niyaz Nizamuddin, “IBM PC Assembly Language and Programming”, Pearson Education, 2007.

R2. Harvey M. Deitel, Paul J. Deitel,“Internet and World Wide Web — How to Program”, 4th Edition, Pearson Education Asia, 2009.

R3. David Wolber, Hal Abelson, Ellen Spertus, Liz Looney, “App Inventor 2: Create Your Own Android Apps”, 2nd Edition, O'Reilly Media, 2014.

Web References:

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

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

Course Objectives:

- To enhance the students' numerical, analytical and logical reasoning ability.
- To make them prepare for various public and private sector exams and placement drives.

Module I Quantitative Ability **20 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, New Delhi, 2018.

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

Reference Book(s):

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

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

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

Web References:

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

SEMESTER III

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

Course Objectives:

The objective of the course is 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.

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

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply propositional and predicate logic to solve engineering problems 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 solve system of linear congruence equations using Chinese Remainder Theorem.	Apply
CO4: Demonstrate a deepened understanding of fundamental concepts such as sets, relations, functions and combinatorics covered in lectures through guided practice.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
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, July 2017.

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

Reference Book(s):

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

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

Web References:

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

Course Code: 23SCI301		Course Title: Object Oriented Programming (Common to AM &SC)	
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 provide knowledge about Object Oriented Programming concepts, basics of Java programming language and make students to develop java applications.

Module I **22 Hours**

Introduction to OOP and Java:

Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java – Defining classes in Java – Constructors - Methods -Access specifiers - Static members- JavaDoc comments.

Inheritance, Packages and Interfaces:

Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces.

Exception Handling:

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception.

Module II **23 Hours**

Multithreading:

Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication Suspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.

I/O, Generics, String Handling:

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.

JAVAFX Event Handling, Controls and Components:

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Layouts – FlowPane – HBox and VBox . Menus – Basics – Menu – Menu bars – MenuItem.

Module III **30 Hours**

List of Experiments

1. Develop a java application using class and objects.
2. Solve the above problem using an interface.
3. Implement exception handling and creation of user defined exceptions.
4. Write a java program to implements a multi-threaded application.
5. Write a java program to perform file operations.
6. Develop applications using JavaFX controls, layouts and menus.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Differentiate structured programming and object oriented programming and know object oriented concepts like classes, objects, inheritance etc.	Apply
CO2: Develop solutions for problems by applying object oriented programming features and concepts	Create
CO3: Function as a team and built and manage software projects for a problem	Apply
CO4: Develop ethical solutions considering its social environmental impact	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Textbooks:

T1. Herbert Schildt, “Java: The Complete Reference”, 11th Edition, McGraw Hill Education, New Delhi, 2019

Reference Book(s):

R1. Herbert Schildt, “Introducing JavaFX 8 Programming”, 1st Edition, McGraw Hill Education, New Delhi, 2015.

R2. Cay S. Horstmann, “Core Java Fundamentals”, Volume 1, 11th Edition, Prentice Hall.2018.

Web Reference(s):

1. https://www.javatpoint.com/java-tutorial
2. https://codingbat.com/java https://vtucsenotes.wordpress.com
3. https://www.w3schools.com/java

Course Code: 23SCT301		Course Title: Computer Organization and Architecture (Common to AM &SC)	
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 teach students to use the functional components and build a computing systems and also make them to build storage systems. The course also teaches the concept of pipelining to design RISC and CISC processors and use the characteristics of processor inter communication and shared memory to build multiprocessors.

Module I **22 Hours**

Functional Units – Basic Operational Concepts – Number Representation and Arithmetic Operations – Character Representation - Performance – Memory Locations and Addresses- Addressing Modes – Instruction Sets – CISC Vs. RISC - Accessing I/O Devices – Interrupts – Bus Structure- Bus Operation – Instruction Execution – Hardware Components – Instruction Fetch and Execution Steps- Control Signals – Hardwired Control - Semiconductor RAM Memories – Read-only Memories – Direct Memory Access – Cache Memory – Mapping Functions- Performance Considerations – Virtual Memory – Memory Management Requirements.

Module II **23 Hours**

Pipeline Organization – Pipelining Issues – Data Dependencies –Memory Delays – Branch Delays –Resource Limitations – Performance Evaluation- Superscalar Operation- Pipelining in CISC and RISC Processors. Characteristics of Multiprocessors – Interconnection Structures – Inter Processor Arbitration – Inter Processor Communication and Synchronization- Cache Coherence- Shared Memory Multiprocessors..

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Demonstrate an understanding of the design of the functional units of a digital computer system.	Apply
CO2: Demonstrate the functionality of semiconductor memories to build a storage system.	Apply
CO3: Design a pipeline for consistent execution of instructions with minimum hazards.	Apply
CO4: Identify suitable characteristics of inter process communication and memory structure to build multiprocessors.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, and Naraig Manjikian “Computer Organization and Embedded Systems”, Mcgraw Hill Education, 6th edition, 2011.

Reference Book(s):

R1. M.Morris Mano, “Computer System Architecture”, Pearson Publication, 2007.

R2. William Stallings, “Computer Organization and Architecture”, 7th Edition PHI, 2010.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_cs88/preview
2. https://www.w3.org/standards/agents/authoring

Course Code: 23AMT301	Course Title: Principles of Artificial Intelligence and Soft Computing		
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 artificial intelligence principles, informed, uninformed search strategies and strategies to build and perform reasoning on knowledge based agents. The course also teaches the fundamentals of soft computing optimization strategies.

Module I **22 Hours**

Introduction to Artificial Intelligence

Introduction to AI Agents and Environments – Nature of Environments – Structure of Agent - Problem solving by searching: Problem-solving agents - Example problems - Search for solutions - Uninformed search strategies and informed search strategies - Types. -Game – Optimal Decisions in Games – Alpha-Beta Pruning.

Knowledge Representation and Reasoning

Knowledge Based Agents – Introduction to Propositional Logic First Order Logic: Representation – syntax -Inference in First Order Logic- Forward chaining – Backward Chaining – Resolution.

Module II **23 Hours**

Neural Networks

Fundamentals of neural networks - Neural Network Architectures –. Types of neural network – Back propogation Learning– Introduction to Associative memory.

Fuzzy Logic and Genetic Algorithms

Crisp and Fuzzy set properties Crisp logic and Fuzzy Logic – Defuzzification – Application - Fundamentals of Genetic Algorithm – Encoding – Crossover - Mutation Operator– Application.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Identify a suitable artificial intelligent agents for a given environment.	Apply
CO2: Analyze various informed and uninformed search strategies and find a best solutions for a search problem.	Apply
CO3: Construct knowledge base and reasoning mechanism for a real application.	Apply
CO4: Built solutions for optimization problems using soft computing.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Textbooks:

T1. Stuart Russell And Peter Norvig," Artificial Intelligence: A Modern Approach", 4th Edition, Pearson Paperback publication 2022.

T2. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications", 2nd Edition, PHI Learning Pvt.Ltd, Newdelhi -2017.

Reference Book(s):

R1. Dr.C.K.Venugopal,"Artificial Intelligence And Machine Learning", Pacific Books International 2019.

R2. Robert J Schalkoff, "Artificial Neural Networks", McGraw-Hill International Edition, 2011.

R3. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, PearsonEducation 2004.

Web References:

1. https://nptel.ac.in/courses/106105077

2 .https://onlinecourses.nptel.ac.in/noc22_cs56/preview

Course Code: 23SCI302	Course Title: Database Design (Common to AM &SC)

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 make students to design and build efficient data storage structures for a given problem and extract required information by using Structured Query Language.

Module I **23 Hours**

Introduction:

Database System- Terminologies - Need for DBMS - Data Models and its types - Functions of DBMS- DBMS Architecture- Key issues and Challenges in Database Systems.

Relational Model:

Structure of Relational Databases-Database Schema-Keys-Schema Diagrams-Relational Query Languages-The Relational Algebra.

SQL:

Introduction to SQL- Data Definition – Data Manipulation -Functions and Procedures- Embedded & Dynamic SQL Triggers- NOSQL - MONGO DB

Module II **23 Hours**

Relational Database Design:

Decomposition Using Functional Dependencies- Normal Forms-Functional-Dependency Theory-Algorithms for Decomposition Using Functional Dependencies- Decomposition Using Multivalued Dependencies.

Transaction Management:

Transactions: Transaction Model-ACID Properties- Serializability- Transactions as SQL Statement-Concurrency Control: Lock -Based Protocols- Deadlock Handling- Timestamp-Based Protocols - Validation-Based Protocols -Recovery System: Recovery and Atomicity - Recovery Algorithm.

Query Processing and Optimization: Measures of Query Cost - Selection Operation - Sorting - Join Operation - Evaluation of Expressions-Transformation of Relational Expressions

Module III **30 Hours**

List of Experiments

1. Construct a database using an ER diagram.
2. Implement DDL and DML commands using SQL queries.
3. Implement joins and nested queries in an existing employee database.
4. Implement triggers and cursors.
5. Design database tables to comply with specific normal forms for a given problem.
6. Implement transaction management: commit, rollback, and save points.

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, 7th Edition, Tata McGraw Hill, March 2019.

Reference Book(s):

R1. Raghu Ramakrishnan, “Database Management Systems”, 4th Edition, McGraw-Hill Publications, 2015

R2. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, 6th Edition, Pearson, 2011.

Web References:

1. https://archive.nptel.ac.in/courses/106/105/106105175/
2. https://onlinecourses.nptel.ac.in/noc22_cs91/preview
3. https://www.geeksforgeeks.org/introduction-of-dbms-database-management-system-set-1/

Course Code: 23SCL301	Course Title: Programming using Python Laboratory (Common to AM &SC)		
Course Category: Major		Course Level: Intermediate	
L:T:P (Hours/Week)0:0:4	Credits:2	Total Contact Hours:30	Max Marks: 100

Course Objectives

The course is intended to teach basic programming structures, Python data structures, file management and application development using various libraries. Additionally, teach game development using Pygame.

List of Experiments: **30 Hours**

1. Implementation of data types, operators and expressions.
2. Implementation of string.
3. Implementation of list, tuple and dictionary.
4. Implementation of functions.
5. Implementation of file handling techniques.
6. Implementation of class and objects with exception handling.
7. Implementation of polymorphism.
8. Implementation of Inheritance.
9. Implementation of python libraries numpy, pandas, scipy and matplotlib.
10. Implementation of python program to simulate bouncing ball using pygame.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop Python programs for real world problems with suitable techniques	Apply
CO2: Analyze the logical decision making problems and apply the Python library data structures.	Apply
CO3: Apply the Object Oriented Programming concepts to build simple intelligent applications.	Apply
CO4: Develop strategic applications to simulate Python games with libraries.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Reference Book(s):

R1. Michael Knapp, “Python: Programming for Advanced: Learn the Fundamentals of Python”, 2nd June 2017.

R2. Richard Ozer, “Advanced Python Programming: The Insider Guide to Advanced Python Programming Systems” 8th November 2017.

R3. Meenu Kohli, “Basic Core Python Programming A Complete Reference Book to Master Python with Practical Applications”, Bpb Publications, 2021.

Web References:

1. https://nptel.ac.in/courses/106106145
2. https://www.udemy.com/course/python-game-development-using-pygame-and-python-3/
3. https://onlinecourses.nptel.ac.in/noc24_cs57/preview

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: Intermediate**		
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**

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 Reasoning Ability **10 Hours**

Number & Alpha series- Odd Man Out-Coding and Decoding-Syllogisms- -Problems on Cubes and Dices- Logical Venn diagram -Visual Reasoning- Element & logical Series-Analogies- Self-Learning.

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, New Delhi, 2018.

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

Reference Book(s):

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

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

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

Web References:

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

Course Code: 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 fulfilment among the four orders of nature; Existence as Co-existence at all levels; Holistic perception of harmony in existence.

UNIT V - Harmony on Professional Ethics **9 Hours**

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

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

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

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

Reference Book(s):

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

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

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

Web References:

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

SEMESTER IV

Course Code: 23MAT401		Course Title: Probability and Statistics (Common to AM, AU, CS, EC, EE, EV, ME, IT & SC)	
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:

This course aims at providing the student to acquire the knowledge on random variables and probability distributions. They gain knowledge regarding hypothesis testing for data.

Module I **22 + 8 Hours**

Probability and Random Variables: Axioms of Probability- Conditional Probability- Total Probability -Baye's Theorem- Random Variables - One Dimensional Random variables- Probability Mass Function- Probability Density Functions- Properties - Moments- Moment generating functions 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.

Standard Distributions: Discrete Distributions - Binomial- Poisson- Properties, Moment generating functions -Continuous Distributions - Uniform –Exponential- Normal Distributions and their properties.

Module II **23 + 7 Hours**

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

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

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Demonstrate the concepts of probability theory to engineering problems.	Understand
CO2: Calculate the expected values, variances and correlation coefficient of random variables	Apply
CO3: Use the theoretical discrete and continuous probability distributions in the relevant application areas.	Apply
CO4: Apply the concepts of testing the hypothesis and design of experiments to solve real life problems.	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	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Veerajan T, “Probability, Statistics and Random process”, 3rd Edition, Tata McGraw-Hill, New Delhi, 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, Asia, 2013.

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

R3. Morris DeGroot, Mark Schervish, “Probability and Statistics”, 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: 23SCI401		Course Title: Basics of Operating Systems	
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 provide knowledge about basics of operating systems Process Management, and its services. The course imparts the fundamental concepts of Memory management and file systems for various administrative tasks in Linux environment

Module I **22 Hours**

Introduction: 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

Module II **23 Hours**

Memory Management: Main Memory: Contiguous Memory Allocation, Paging, Structure of Page Table and Swapping –Virtual Memory: Demand paging, Copy-on-write, Page Replacement Algorithms, Allocation of Frames and Thrashing.

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.

List of Exercise **30 Hours**

1. Implementation of Process and I/O System calls.
2. Implementation of CPU Scheduling Algorithms.
3. Implementation of Classical Synchronization problems using semaphores.
4. Implementation of Memory Allocation Strategies.
5. Implementation of Page Replacement Algorithms.
6. Implementation of Disk Scheduling Algorithms.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Demonstrate the working principle of operating system components and its system calls	Apply
CO2: Solve process scheduling and synchronization problems using algorithms	Apply
CO3: Compare different memory management techniques using allocation schemes	Apply
CO4: Develop solutions for free space management using file systems and disk scheduling concepts.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

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

T2. Andrew S. Tanenbaum, “Modern Operating Systems”, 4th Edition, Pearson Education, 2015.

Reference Book(s):

R1. William Stallings, “Operating Systems Internals and Design Principles”, 9th Edition, Pearson Education, 2018

Web References:

1. https://nptel.ac.in/courses/106/105/106105214
2. https://archive.nptel.ac.in/courses/111/105/111105041/

Course Code: 23AMT401		Course Title: Machine Learning Algorithms and Application	
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 intended to teach preprocessing techniques for preparing application data for performing machine learning tasks on the data. Provide ability to apply supervised and unsupervised learning algorithms for providing solutions to various domain problems.

Module I **23 Hours**

Introduction: Introduction to Machine Learning – Data and Features – Machine Learning Pipeline - Data Pre- processing: Standardization, Normalization, missing data problem, Data imbalance problem – Data visualization - Setting up training, development and test sets – Cross validation – Problem of Over fitting, Bias vs. Variance.

Supervised Learning: Supervised learning - Regression: Linear regression, logistic regression – Classification: K- Nearest Neighbor, Naïve Bayes, Decision Tree, Support Vector Machine, Perceptron, Error analysis.

Module II **22 Hours**

Unsupervised Learning: Unsupervised learning – Clustering: K-means, Hierarchical, Spectral, subspace clustering, Gaussian Mixture Model, Hidden Markov Model, Parameter Estimation: MLE and Bayesian Estimate, Expectation Maximization, Dimensionality Reduction Techniques, Principal component analysis, Linear Discriminant Analysis.

Advanced Learning Algorithms: Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Types and Task – Q –Learning – Temporal Difference Learning - Ensemble Learning - Random Forest – Bagging - Boosting - Stacking - AdaBoost – Gradian Boosting. Machine Learning Applications.

AI Applications: Computer Vision – Driverless Cars - Speech Regeneration - Text Mining – Industrial Applications – Health Care Systems.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze and prepare data for machine learning applications through the utilization of various pre-processing techniques.	Analyze
CO2: Compare and select suitable machine learning algorithms on diverse datasets for predictive modeling.	Apply
CO3: Apply and evaluate the unsupervised machine learning models through various clustering algorithms.	Apply
CO4: Apply the machine learning algorithm to evaluate model performance and design solutions for real-world applications.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Kevin P. Murphey, “Machine Learning, a probabilistic perspective”, The MIT Press Cambridge, Massachusetts, 2012.

T2. Christopher M Bishop,” Pattern Recognition and Machine Learning”, Springer 2010.

Reference Book(s):

R1. Andrew Ng, Machine learning yearning, URL: http://www. mlyearning.org/(96) 139 (2017).

Web References:

1. https://nptel.ac.in
2. https://www.coursera.org/specializations/machine-learning-algorithms-real- world

Course Code: 23AMT402		Course Title: Neural Computing in Machine Learning	
Course Category: Major		Course Level: Intermediate	
L: T: P (Hours/Week) 3: 0: 0	Credits:3	Total Contact ours:45	Max. Marks:100

Course Objectives:

The course is intended to Impart knowledge on both single and multi-layer feed forward and also Feedback networks and their implementation proficiency. Teach the fundamentals and implementation details of associative memory and self-organized networks.

Module I **22 Hours**

Single Layer Perceptron Model: Single-layer perceptron classifiers: Classification model - Features and decision regions, Discriminant functions - Linear machine and Minimum distance classification - Non-parametric training concept - Training and Classification using the Discrete perceptron: algorithm and example - Single layer continuous Perceptron networks for linearly separable classifications

Multi-Layer Feed Forward Networks: Multilayer feed forward Networks: Linearly separable Pattern classification - Delta learning rule for Multi perceptron model - Generalized Delta learning rule - Feed forward recall and error back propagation training.

Single Layer Feedback Networks: Single-layer Feedback Networks: Basic concepts of dynamic systems - Mathematical foundations of Discrete time Hopfield Networks - Mathematical foundations of Gradient type Hopfield networks - Associative memories: Basic concepts - Linear Associator.

Module II **23 Hours**

Associative Memory: Bidirectional associative memory - associative memory for spatio-temporal patterns - Case study: Implementation of NN in any simulator. Self-Learning: Bidirectional Associative memory.

Self Organized Network: UN supervised learning of clusters - winner-take-all learning recall mode - Initialization of weights, seperability limitations.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the concept of single layer perceptron model.	Understand
CO2: Design a suitable multilayer feed forward network for a given problem.	Apply
CO3: Implement single layer feedback networks.	Apply
CO4: Construct Associative memory based network models for given problem.	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	-	-	3	-	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Jacek M.Zurada, “Introduction to Artificial Neural Systems”, Jaico Publ.House, 1994.

T2. Robert J. Schalkoff, “Artificial Neural”, McGraw-Hill, 1997.

Reference Book(s):

R1. Simon Haykin, “Neural Networks – A Comprehensive formulation”, AW, 1998.

R2. Koko, “Neural Networks”, PHI, 1992.

R3. N.K. Bose, P.Liang, “Neural Network Fundamentals”, M.H, 2002.

Web References:

1. https://www.mygreatlearning.com/academy/learn-for-free/courses/introduction-to-neural-networks-and-deep-learning
2. https://onlinecourses.nptel.ac.in/noc23_ee87/preview

Course Code: 23AML401		Course Title: Machine Learning Laboratory	
Course Category: Major		Course Level: Intermediate	
L: T: P(Hours/Week) 0: 0 :2	Credits: 2	Total Contact Hours: 30	Max Marks: 100

Course Objectives:

The course is intended to make students proficient in usage of. Python libraries like Numpy, Pandas, Matplotlib and Scipy. To make the students to build classification models for any given problem of various domains..

List of Experiments:

1. Implementation of Python Basic Libraries such as Math, Numpy and Scipy.
2. Implementation of Python Libraries for Ml application such as Pandas and Matplotlib.
3. Write a python program to create and load different datasets.
4. Write a python program to compute Mean, Median, Mode, Variance and Standard Deviation using Datasets.
5. Write a Python program to Reshape, Filter, Merge the data, and handle missing values in datasets.
6. Write a Python program to implement Random forest algorithm using decision tree.
7. Write a Python program to implement Simple Linear Regression and plot the graph.
8. Write a Python program to implement Logistic Regression using sklearn.
9. Write a Python program to implement navie bayes classifier algorithm.
10. Write a Python program to implement SVM classification.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the mathematical and statistical prospective of machine learning algorithms through python programming.	Apply
CO2: Develop an appropriate machine learning model and provide solutions for real world problems.	Apply
CO3: Document and explain the developed model to the stack holders for efficient usage.	Apply
CO4: Learn and apply appropriate models developed for their accuracy and chose an optimized model.	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	-	-	-	-	-	-	3	2	-	-	-
CO4	-	-	3	-	3	-	-	-	-	-	-	2	-	-

High-3; Medium-2;Low-1

Reference Book(s):

R1. Giuseppe Bonaccorso, “Machine Learning Algorithms”, Packet Publishing, 2017.

R2. Yuxi (Hayden) Liu, “Python Machine Learning By Example”, Packet Publishing,2017

R3. Simon Haykin, “Neural Networks and Learning Machines”, 3rd Edition, Pearson India Education ServicesPvt.Ltd,, 2018

R4. Scikit-learn, and Tensor Flow “Machine Learning and Deep Learning with Python”, 2nd illustrated reprint edition, Packt Publishing, 2017.

Web References:

1. https://onlinecourses.nptel.ac.in/noc23_cs18/preview
2. https://nptel.ac.in
3. https://www.coursera.org/specializations/machine-learning-algorithms-real-world

Course Code: 23AML402		Course Title: AI Laboratory	
Course Category: Major		Course Level: Intermediate	
L: T: P(Hours/Week) 0: 0 :4	Credits: 2	Total Contact Hours: 45	Max Marks: 100

Course Objectives:

The course is intended to make students proficient in prolog to build expert systems. To make the students to build AI applications for various domain.

List of Experiments:

1. Study of PROLOG Programming language and its functions.
2. Implementation of Depth First Search for Water jug problem.
3. Implementation of Breath First Search for Tic-Tac-Toe Problem.
4. Implementation of backtracking technique or N-Queen Problem.
5. Implementation of Traveling Salesman Problem.
6. Develop a simple AI application (Build a chatbot, spam filtering in email, speech recognition).
7. Develop a snake game with user interface using AI Mechanism.
8. Implementation of Perceptron class in sklearn.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design a knowledge base using prolog constructs.	Apply
CO2: Construct solutions by applying search algorithms to solve a problem.	Apply
CO3: Develop a simple AI application and its social ethical implications for a given environment.	Apply
CO4: Design a perceptron model by working as a team.	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Reference Book(s):

R1. Hoon Heng The, “Neural Logic Networks: A New Class of Neural Networks”, World Scientific Publishing Company, 1995.

R2. Yuxi (Hayden) Liu, “Python Machine Learning by Example”, Packet Publishing, 2017.

R3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, 1st Edition, MIT Press, 2018.

R4. Sebastian Raschka, Vahid Mirjalili “Machine Learning and Deep Learning with Python, Scikit-learn, and TensorFlow”, 2nd illustrated reprint edition, Packt Publishing, 2017.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_cs90/preview
2. https://www.gatevidyalay.com/tag/cryptography-and-network-security-tutorial/

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-

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. Peggy Post &Peter Post, “The Etiquette Advantage in Business: Personal Skills for Professional Success”, 2nd edition (May 3, 2005), William Morrow.

Reference Book(s):

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

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

Web References:

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

Semester V

Course Code: 23AMT501		Course Title: DEEP LEARNING AND APPLICATION	
Course Category: Major		Course Level: Intermediate	
L: T: P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks: 100

Course Objectives:

This course aims to provide a solid foundation in deep learning and Neural Networks concepts, including in-depth knowledge in CNN architectures and generative modeling, while developing their practical skills in designing and implementing deep learning applications.

Module I **23 Hours**

Introduction to Deep Learning and Neural Networks: Deep Networks: Definition, Motivation, Applications; Principal Component Analysis; Restricted Boltzmann Machine; Sparse Auto-encoder.

Convolutional Neural Networks (CNN) and Advanced Techniques: Convolution Neural Network (CNN): Basic architecture, Activation functions, Pooling, Handling vanishing gradient problem, Dropout, Greedy Layer-wise Pre-training, Weight initialization methods, Batch Normalization; Different CNN Models: Alex Net, VGG Net, Google Net, Res Net, Dense Net.

Graphical Models: Graphical Model: Bayes Net, Variational Auto-encoders. Sequence Learning: 1D CNN, Recurrent Neural Network (RNN), Gated RNN, Long short-term memory (LSTM).

Module II **22 Hours**

Generative Modelling: Generative Modeling: Generative adversarial network. Zero Shot Learning. Applications. Overview of MIL, Highway Network, Fractal Network, Siamese Net.

Deep Learning Applications: Image Processing: Applications in image recognition - Video analytics: Application in object detection - Natural Language Processing (NLP) Applications in modelling and sentiment analysis - Healthcare and Biomedical: Applications in medical image analysis and diagnostics.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Demonstrate the construction and working of deep neural networks using key components and architectures.	Apply
CO2: Analyze the effectiveness of various deep learning models including CNNs and RNNs for real-world tasks.	Analyze
CO3: Demonstrate the ability to work in teams to implement generative models and advanced deep learning techniques for domain-specific applications.	Apply
CO4: Examine deep learning applications in domains such as computer vision, NLP, and healthcare to evaluate their impact and performance..	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	2	2	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	2	1	-	-	-	1
C04	-	2	-	-	2	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press 2016.

T2. Indranath Chatterjee, “Machine Learning and Its Application A Quick Guide for Beginners”, Bentham Science Publishers, December 2021.

Reference Book(s):

T1. Michael A. Nielsen, “Neural Networks and Deep Learning”, Determination Press, 2015.
T2. Yoshua Bengio,” Learning Deep Architectures for AI”, now Publishers Inc., 2009.

Web References:

1. https://onlinecourses.nptel.ac.in/noc20_cs62/preview

Course Code: 23AMT502	Course Title: EMBEDDED SYSTEMS AND IOT		
Course Category: Major		Course Level: Intermediate	
L: T: P (Periods/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Course Objectives:

The course is intended to provide knowledge about the architecture of embedded processors and teach embedded C program. The course imparts the fundamental concepts of designing simple embedded applications and provide understanding about the communication models in IOT using Arduino/ Raspberry Pi/ open platform.

Module I **23 Hours**

8-BIT EMBEDDED PROCESSOR: 8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Times and Serial Port – Interrupt Handling.

EMBEDDED C PROGRAMMING: Memory and I/O Devices Interfacing – Programming Embedded Systems in C – Need for RTOS – Multiple Tasks and Processes – Context Switching – Priority Based Scheduling Policies.

IOT AND ARDUINO PROGRAMMING: Introduction to the Concept of IOT Devices – IOT Devices Versus 94 Computers – IOT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/ Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.

Module II **22 Hours**

IOT COMMUNICATION AND OPEN PLATFORMS: IOT Communication Models and APIs – IOT Communication Protocols – Bluetooth – WiFi – ZigBee– GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

APPLICATIONS DEVELOPMENT: Complete Design of Embedded Systems – Development of IOT Applications – Home Automation – Smart Agriculture – Smart Cities – Smart Healthcare.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the architecture of embedded processors.	Understand

CO3: Design and implement simple embedded applications and different communication models using IoT device programming.	Apply
CO4: Implement IOT applications using Arduino/Raspberry Pi /open platform	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	3	-	-	2	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2nd Edition, 2014.

T2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IOT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.

Reference Book(s):

R1. Michael J. Pont, "Embedded C", Pearson Education, 2007.

R2. Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.

Web References:

1. https://nptel.ac.in/courses/108102045
2. https://onlinecourses.nptel.ac.in/noc22_cs53/preview

Course Code: 23AMT503		Course Title: SOFTWARE ENGINEERING in AI	
Course Category: Major		Course Level: Intermediate	
L: T: P (Periods/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives:

The course aims to provide a comprehensive understanding of software engineering principles, practices, and methodologies. It also introduces AI-enhanced tools and techniques across various phases of the software development life cycle.

Module I **22 Hours**

SOFTWARE PROCESS AND AGILE DEVELOPMENT: Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models –Introduction to Agility-Agile Process-Extreme programming-XP Process-Case Study.

REQUIREMENTS ANALYSIS AND SPECIFICATION: Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Data Flow Diagram- AI Tools for requirement analysis.

Module II **23 Hours**

SOFTWARE DESIGN: Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles.

SOFTWARE TESTING AND MAINTENANCE: Testing - Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking, AI in testing- Benefits, tools: Test.ai, Diffblue.

PROJECT MANAGEMENT: Software Project Management- Software Configuration Management - Project Scheduling-DevOps: Motivation-Cloud as a Platform-Operations-Deployment Pipeline: Overall Architecture Building and Testing-Deployment- Tools- Case Study.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Demonstrate the ability to apply software process models and agile practices in software development projects.	Apply
CO2: Analyze requirements using formal methods and explore the use of AI tools for improving requirement analysis.	Analyze
CO3: Apply appropriate design patterns and architectural styles to create modular and maintainable software solutions.	Apply
CO4: Evaluate testing strategies and project management practices, including the integration of AI tools in testing and DevOps.	Analyze

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Bernd Bruegge and Allen H. Dutoit, “Object-Oriented Software Engineering: Using UML, Patterns and Java”, 3rd Edition, Pearson Education, 2009

T2. Roger S. Pressman, “Object-Oriented Software Engineering: An Agile Unified Methodology”, 1st Edition, Mc Graw-Hill International Edition, 2014.

Reference Book(s):

R1. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, “Fundamentals of Software Engineering”, 2nd Edition, PHI Learning Pvt. Ltd., 2010.

R2. Craig Larman,” Applying UML and Patterns”, 3rd Edition, Pearson Education, 2005.

Web References:

1. 1. https://onlinecourses.nptel.ac.in/noc20_cs68/preview

Course Code: 23AML502		Course Title: EMBEDDED SYSTEMS AND IOT LABORATORY	
Course Category: Major		Course Level: Intermediate	
L: T: P(Periods/Week) 0: 0 :3	Credits: 1.5	Total Contact Hours: 45	Max Marks: 100

Course Objectives:

The course is intended to make students in implementation of assembly language experiments using simulator. Make students to implement basic and arithmetic programs using Embedded C and train students for designing an IOT based system.

List of Experiments: **45 Hours**

1. Write 8051 Assembly Language experiments using simulator.
2. Test data transfer between register and memory.
3. Perform ALU operations.
4. Write Basic and arithmetic Programs Using Embedded C.
5. Introduction to Arduino platform and programming.
6. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth).
7. Introduction to Raspberry PI platform and python programming.
8. Design an IOT based system.
9. Build a real time application for innovative ideas with all necessary components(15 Periods).

Couse Outcomes	Cognitive Level
At the end of this course, student will be able to:	
CO1: Design an IOT based system for a given problem.	Apply
CO2: Consider ethical social and environment implications while designing an IOT based solutions.	Apply
CO3: Analyze and adopt latest IOT devices and techniques while developing a solution for a problem.	Analyze
CO4: Communicate and explain the solution to the stockholders for effective usage of the created model.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Reference Book(s):

R1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, “The 8051 Microcontroller and Embedded Systems”, Pearson Education, 2nd Edition, 2014.

R2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017.

R3. Michael J. Pont, “Embedded C”, Pearson Education, 2007.

Web References:

1. https://nptel.ac.in/courses/128108016

Course Code: 23AML501		Course Title: DEEP LEARNING AND APPLICATION LABORATORY	
Course Category: Major		Course Level: Intermediate	
L: T: P(Periods/Week) 0: 0 :3	Credits: 1.5	Total Contact Hours: 45	Max Marks: 100

Course Objectives:

The course is intended to make students proficient in building deep networks for simple problems and teach how to build models using CNN for image processing and to apply RNN and its variants for text analysis problems and knowledge for designing augment data using generative models.

List of Experiments: **45 Hours**

1. Solving XOR problem using Multilayer perceptron.
2. Implement character and Digit Recognition using ANN.
3. Implement the analysis of X-ray image using auto encoders.
4. Implement Speech Recognition using NLP.
5. Develop a code to design object detection and classification for traffic analysis using CNN.
6. Implement online fraud detection of share market data using any one of the data.
7. Implement image augmentation using deep RBM.
8. Implement Sentiment Analysis using LSTM for a real world problem as team.
9. Mini Project(15 Periods).

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design and decide up on a deep learning technique and built solutions for a given problem.	Apply
CO2: Evaluate the performance of CNN models using appropriate metrics and visualizations.	Apply
CO3: Document and communicate the developed deep learning model to the concerned stack holder.	Apply
CO4: Perform team responsibilities in an effective manner while developing a team-based solutions.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Reference Book(s):

R1. Stone, James, " Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning", Sebtel Press, United States, 2019.

R2. Wani, M.A., Raj, B., Luo, F., Dou, D. (Eds.), "Deep Learning Applications", Volume 3, Springer Publications 2022.

R3. Indranath Chatterjee, “Machine Learning and Its Application A Quick Guide for Beginners”, Bentham Science Publishers, December 2021.

Web References:

1. https://onlinecourses.nptel.ac.in/noc23_ee87/preview

Semester VI

Course Code: 23AMT601		Course Title: AI NATURAL LANGUAGE PROCESSING	
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 provide foundational knowledge and practical understanding of natural language processing techniques. It also introduces classical and deep learning-based models for analyzing and processing human language.

Module I **23 Hours**

Introduction and word representation: Introduction to NLP Tokenization, Stemming and Lemmatization, spell correction, normalization, One-hot encoding, Bag-of-Words (BoW) Term Frequency – Inverse Document Frequency (TF-IDF), Word2vec, Glove and Fast text.

Language Modelling and Syntax: N-grams, smoothing techniques, Statistical Models - HMM (Hidden Markov Model), MEMM (Maximum Entropy Markov Model), CRF (Conditional Random Fields).

Syntactic and Dependency parsing: Syntactic Parsing: Regular and Context-Free Languages, Context-Free Parsing, CKY Algorithm; Dependency Parsing: Dependency Grammar, Graph-based dependency parsing, Transition-based dependency parsing.

Module II **22 Hours**

Machine learning and deep learning for NLP: Sequence to sequence modelling and Attention mechanism, Transformer Networks – BERT, Reinforcement learning for NLP.

NLP Applications: Basics of sentiment analysis. Text classification techniques. Machine Translation and Question Answering, Text Summarization and Emerging Trends.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply fundamental techniques in text preprocessing and word representation for natural language tasks.	Apply
CO2: Apply statistical and machine learning models to perform language modeling and syntactic parsing.	Apply
CO3: Implement neural network architectures and attention mechanisms for various NLP applications	Apply
CO4: Analyze the effectiveness of NLP solutions in addressing real-world problems such as sentiment analysis, text classification, and machine translation.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-	2	-
CO3	-	-	3	-	-	1	-	-	-	-	-	2	2	-
CO4	-	2	-	-	2	-	-	-	-	-	-	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" , Pearson, 2023

T2. Jason Brownlee, “Deep Learning for Natural Language Processing”, Machine learning Mastery 2020.

Reference Book(s):

R1. Christopher D. Manning, Hinrich Schiitze,”Foundations of Statistical Natural Language Processing”, MIT Press, 2000.

R2. J. Eisenstein, “Introduction to Natural Language Processing”, MIT Press, 2019.

R3. Nitin Indurkhya Fred J. Damerau, “Handbook of Natural Language Processing, Chapman & Hall/CRC Taylor & Francis group,2010.

Web References:

1. http://nptel.ac.in/courses/106106211
2. https://nptel.ac.in/courses/106105158

Course Code: 23AMT602		Course Title: VISION AND IMAGE PROCESSING	
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:

This course focuses on geometric primitives, transformations, and photometric formation in computer vision. Students will learn image enhancement techniques, feature detection for alignment, and motion estimation algorithms. They will gain expertise in recognition tasks and context understanding.

Module I **23 Hours**

Introduction and Image formation: Introduction, Image Formation – geometric primitives and transformations, photometric image formation, digital camera

Image Processing and segmentation: Image Processing-point operators, linear filtering, neighborhood operators, Fourier transforms, Segmentation-Active contours, split and merge, mean shift and mode, finding, Normalized cuts

Feature Detection and Matching: Feature Detection and Matching – points and patches, edges, lines, Feature-based Alignment-2D, 3D feature-based alignment, pose estimation.

Module II **22 Hours**

Dense motion estimation and image stitching: Dense motion estimation – Optical flow – layered motion, parametric motion, Structure from Motion. Image Stitching-motion models, global alignment, compositing.

Recognition: Recognition – object detection, face recognition, instance recognition, category recognition, context and scene understanding.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply geometric primitives, transformations, and photometric formation in computer vision.	Apply
CO2: Analyze the effectiveness of point operations, filtering, and segmentation techniques for image enhancement..	Analyze
CO3: Use feature detection and matching techniques to achieve image alignment and pose estimation.	Apply
CO4: Implement dense motion estimation and image stitching algorithms effectively.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Textbooks:

T1. Szeliski R., “Computer Vision: Algorithms and Applications”, Springer, 2010.
T2. Forsyth D. A. and Ponce J., “Computer Vision – A Modern Approach”, 2nd Edition, Pearson Education, 2012.

Reference Book(s):

R1. Shapiro L. G. and Stockman G., “Computer Vision”, Prentice Hall, 2001.
R2. Davies E. R., “Machine Vision: Theory, Algorithms, Practicalities”, Morgan Kaufmann,

Web Reference(s):

1. https://onlinecourses.nptel.ac.in/noc23_ee39/preview
2. https://www.coursera.org/courses?query=image%20processing

Course Code: 23AML601		Course Title: AI NATURAL LANGUAGE PROCESSING 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 aims to introduce NLP techniques, develop practical solutions, and enhance Python skills for NLP applications.

List of Experiments **45 Hours**

1. Implement tokenization, stemming, and lemmatization on a dataset.
2. Implement N-gram models on a given corpus.
3. Implement a syntactic parser using CKY algorithm.
4. Implement a sequence-to-sequence model (encoder-decoder) for a specific NLP task.
5. Implement a transformer network for a specific NLP task.
6. Implement a sentiment analysis model using a dataset.
7. Implement a basic machine translation model.
8. Implement a text summarization model using a dataset.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply fundamental NLP techniques and word representation methods in practical scenarios.	Apply
CO2: Apply machine learning and deep learning models for NLP tasks.	Apply
CO3: Build advanced NLP models for real world problems.	Apply
CO4: Analyze and organize the components of built solutions to present them in a clear and effective manner.	Analyze

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	1	1	1	1
CO4	-	2	-	-	2	-	-	-	1	2	1	-	1	1

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", Pearson,2023.

T2. Jason Brownlee, “Deep Learning for Natural Language Processing”, Machine learning Mastery 2020.

Reference Book(s):

R1. Christopher D. Manning, Hinrich Schiitze,” Foundations of Statistical Natural Language processing”, MIT Press, 2000.

R2. J. Eisenstein, “Introduction to Natural Language Processing”, MIT Press, 2019.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_cs98/preview
2. https://onlinecourses.nptel.ac.in/

Course Code: 23AML602	Course Title: VISION AND IMAGE PROCESSING 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 aims to equip students with the ability to apply advanced techniques for analyzing visual data, including segmentation, recognition, and stitching. Students will learn to create solutions for various computer vision tasks, such as object, face, and instance recognition, as well as contextual scene understanding.

List of Experiments **45 Hours**

1. Implement geometric primitives, transformations, and basic image processing using point operators.
2. Implement linear filtering techniques
3. Implement segmentation methods, including active contours, split and merge, mean shift, and mode finding.
4. Implement feature detection and matching techniques, covering points, patches, edges, and lines.
5. Implement optical flow for dense motion estimation, covering layered motion and parametric motion models.
6. Implement image stitching techniques, including motion models, global alignment, and compositing.
7. Implement algorithms for object detection, face recognition, and instance recognition.
8. Implement recognition techniques for category recognition, context understanding, and scene understanding.

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO1: Apply advanced techniques to analyze visual data effectively.	Apply
CO2: Analyze different segmentation methods to extract and interpret image regions effectively.	Analyze
CO3: Apply recognition techniques for object, face, and instance recognition problems.	Apply
CO 4: Design and implement complex image stitching techniques, and analyze their effectiveness in producing seamless image compositions.	Apply

Text Book(s):

T1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2nd Edition, 2014

T2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.

Reference Book(s):

R1. Forsyth D. A. and Ponce J., "Computer Vision – A Modern Approach", 2nd Edition, Pearson Education, 2012.

R2. Shapiro L. G. and Stockman G., "Computer Vision", Prentice Hall, 2001.

Web References:

1.https://onlinecourses.nptel.ac.in/noc23_ee39/preview

2. https://onlinecourses.nptel.ac.in/

Course Articulation Matrix:

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

High-3; Medium-2; Low-1

SEMESTER VII

Course Code: 23AMT701	Course Title: Big Data Technology		
Course Category: Professional Core		Course Level: Mastery	
L: T: P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives:

The course is intended to introduce the basic foundation of big data analytics and teaches appropriate techniques and tools to solve big data problems by applying mining techniques for big data problems. It also provide students ability to build mining models for data stream applications and teaches to Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

Module I **22 hours**

Introduction to big data: Introduction to Big Data Platform, Traits of Big data, Challenges of Conventional Systems, Web Data, Evolution of Analytic Scalability, Analysis vs Reporting, Statistical Concepts: Sampling Distributions, Re-Sampling, Statistical Inference, Prediction Error.

Basic data analysis and data analytic methods using R: Regression Modelling, Multivariate Analysis, Bayesian Modelling, Inference and Bayesian Networks, Support Vector and Kernel Methods, Analysis of Time Series: Linear Systems Analysis, Nonlinear Dynamics and Rule Induction.

Module II **23 hours**

Frequent item sets and clustering: Mining Frequent item sets: Market Based Model, Apriori Algorithm, Handling Large Data Sets in Main Memory, Limited Pass Algorithm and Counting Frequent item sets in a Stream - Clustering Techniques: Hierarchical, K-Means, Frequent Pattern based Clustering Methods.

Mining data streams: Introduction to Streams Concepts: Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream: Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window.

Framework, technologies, tools and visualization: Map Reduce: Hadoop, Hive, MapR, Sharding, NoSQL Databases: S3, Hadoop Distributed File Systems.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply appropriate analytical methods and tools to solve problems involving large-scale data.	Understand
CO2: Implement data mining techniques for extracting useful patterns and insights from big data.	Apply
CO3: Analyze the structure and flow of big data to identify challenges and opportunities in data processing.	Analyze
CO4: Use big data technologies and platforms to manage, process, and visualize complex datasets.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Nina Zumel & John Mount, "Practical Data Science with R" , Manning Publications, 2021.

T2. Udit Agarwal, “Big Data Analytics: Tools and Technology for Effective Planning, Prediction, and Marketing”, CRC Press, 2022.

T3. Sridhar Alla, “Big Data Analytics with Hadoop 3”, Packt Publishing, 2021.

Reference Book(s):

R1. Byron Ellis,” Real-Time Analytics: Techniques to Analyze and Visualize Streaming Data”, Manning Publications, 2021.

R2. Sandy Ryza et al., “Advanced Analytics with Spark: Patterns for Learning from Data at Scale”, O'Reilly Media, 2021 (Updated Edition).

Web Reference(s):

1. https://onlinecourses.nptel.ac.in/noc20_cs92/preview

2. https://archive.nptel.ac.in/courses/106/104/106104189/

Course Code: 23AMT702	Course Title: Visual Data Analysis		
Course Category: Professional Core		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 introduce the principles of visual perception for effective data representation. It enables students to identify and analyze patterns in time-series, ranking, deviation, and multivariate data. It also guides the creation of insightful dashboards through critical design practices for optimal data communication.

Module I **23 hours**

Introduction to visual analysis: Information visualization– visual perception –making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales.

Time-Series, Ranking and Deviation Analysis: Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns — part-to-whole and ranking displays — best practices — deviation analysis – deviation analysis displays – deviation analysis best practices.

Distribution, Correlation and Multivariate Analysis: Distribution analysis – describing distributions – distribution patterns – distribution displays – correlation analysis — describing correlations — correlation patterns — correlation displays — multivariate analysis– multivariate displays – multivariate analysis techniques and best practices.

Module II **22 hours**

Basics of Dashboard Design: Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

Advancements in Dashboard Design: Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting it all together- Unveiling the dashboard.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop appropriate visualization techniques for presenting complex datasets effectively.	Apply
CO2: Identify time-series patterns, interpret part-to-whole and ranking displays, and effectively communicate and analyze deviations in data.	Apply
CO3: Exhibit knowledge in distribution, correlation, and multivariate analysis in data visualization	Apply
CO4: Design information dashboards, graphic libraries that meet user needs and visual perception principles.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Tamara Munzner, “Visualization Analysis and Design”, AK Peters Visualization Series, CRC Press, Nov. 2014.

T2. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.

Reference Book(s):

R1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.

R2. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.

Web Reference(s):

1. https://elearn.nptel.ac.in/shop/iit-workshops/completed/data-visualization-with-r/

Course Code: 23AML701	Course Title: Big Data Technology Laboratory		
Course Category: Professional Core		Course Level: Practice	
L: T: P (Hours/Week) 0: 0: 3	Credits: 1.5	Total Contact Hours: 30	Max Marks:100

Course Objectives:

The course is intended to provide the ability to implement MapReduce programs for efficient big data processing. It focuses on enabling effective data storage using MongoDB for handling large datasets. The course also covers big data analysis through machine learning techniques such as decision tree classification and clustering.

List of Experiments:

1. Install, configure and run python, numPy and Pandas
2. Install, configure and run Hadoop and HDFS.
3. Visualize data using basic plotting techniques in Python.
4. Implement NoSQL Database Operations: CRUD operations, Arrays using MongoDB.
5. Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB.
6. Implement word count / frequency programs using MapReduce.
7. Implement a MapReduce program that processes a dataset.
8. Implement clustering techniques using SPARK.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Use Python libraries such as NumPy and Pandas for basic data manipulation and visualization tasks.	Apply
CO2: Demonstrate the ability to perform CRUD operations and data aggregation using MongoDB for NoSQL data management.	Apply
CO3: Develop MapReduce programs to process and analyze large datasets in a distributed computing environment.	Apply
CO4: Implement clustering techniques to discover patterns in large datasets using appropriate big data tools.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Wani, M.A., Raj, B., Luo, F., Dou, D. (Eds.), "Deep Learning Applications", Volume 3, Springer Publications 2022.

T2. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2020.

Reference Book(s):

R1. Stone, James. (2019), " Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning", Sebtel Press, United States, 2019

Web Reference(s):

1. https://onlinecourses.nptel.ac.in/noc20_cs92/preview

Course Code: 23AML702	Course Title: Visual Data Analysis Laboratory		
Course Category: Professional Core		Course Level: Practice	
L: T: P (Hours/Week) 0: 0: 3	Credits: 1.5	Total Contact Hours: 30	Max Marks:100

Course Objectives:

The course is intended to enable data acquisition, cleaning, and preprocessing for statistical analysis and clustering. It covers time-series forecasting using ARIMA and LSTM, and effective data visualization with Tableau. The course also includes real-time dashboard creation and multivariate analysis for insightful data interpretation.

List of Experiments:

1. Acquiring and plotting data.
2. Statistical Analysis-such as Multivariate Analysis, PCA, LDA, Correlation, regression and analysis of variance.
3. Financial analysis using Clustering, Histogram and HeatMap.
4. Time-series analysis stock market.
5. Visualization of various massive dataset - Finance – Healthcare.
6. Visualization of various massive dataset- Census –Geospatial.
7. Visualization on Streaming dataset (Stock market dataset).
8. Visualization on Streaming dataset (weather forecasting)

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Use appropriate tools to acquire, clean, and visualize data for statistical and time-series analysis.	Apply
CO2: Apply multivariate analysis techniques such as PCA, LDA, and regression to explore complex datasets.	Apply
CO3: Demonstrate clustering and heatmap techniques for insightful financial data analysis and visualization.	Apply
CO4: Build real-time visualizations using streaming datasets from domains like stock markets and weather forecasting.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014.

T2. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.

Reference Book(s):

R1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.

R2. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.

Web Reference(s):

1. https://elearn.nptel.ac.in/shop/iit-workshops/completed/data-visualization-with-r/

Vertical I

(Data Science and AI)

Course Code: 23AME001		Course Title: Multivariate Data Analysis	
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 covers sophisticated strategies to perform comprehensive, perceptive analysis as well as multivariate data analysis tools for business research. It equips students to use deep analysis and latent variable approaches to solve problems in the real world. In the end, it improves decision-making by utilizing sophisticated data analytics methods.

Module I **22 Hours**

Introduction: Uni-variate, Bi-variate and Multi-variate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation.

Preparing for multivariate analysis: Conceptualization of research model with variables, collection of data –-Approaches for dealing with missing data – Testing the assumptions of multivariate analysis.

Multiple Linear Regression Analysis, Factor Analysis: Multiple Linear Regression Analysis – Inferences from the estimated regression function – Validation of the model - Approaches to factor analysis – interpretation of results.

Module II **23 Hours**

Latent Variable Techniques: Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation models, Longitudinal studies.

Advanced multivariate techniques: Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis, multidimensional scaling**.**

Course Outcomes	Cognitive

At the end of this course, students will be able to:	**Level**
CO1: Demonstrate a sophisticated understanding of multivariate techniques to provide constructive guidance in decision-making.	Apply
CO2: Use advanced techniques to conduct thorough and insightful analysis, and prepare data for multivariate analysis.	Apply
CO3: Conduct deep analysis using regression methods and draw reasonable conclusions with sufficient explanation and elaboration.	Apply
CO4: Apply latent variable techniques for business decision-making.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., "Multivariate Data Analysis", 7th Edition, Pearson Education, 2010.

T2. Sharma, Subhash, "Applied Multivariate Techniques", 1st Edition, John Wiley & Sons, 1996.

Reference Book(s):

R1. Tabachnick, B.G., and Fidell, L.S., "Using Multivariate Statistics", 6th Edition, Pearson, 2012.

R2. Rencher, A.C., "Methods of Multivariate Analysis", 2nd Edition, Wiley-Interscience, 2002.

Web References:

1. https://www.sciencedirect.com/topics/mathematics/multivariate-analysis
2. https://towardsdatascience.com/understanding-multivariate-analysis-51d8a6a9a5e3

Course Code: 23AME002		Course Title: Data Mining for Business Intelligence	
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 aims to introduce data mining techniques for various domains, covering processes, functions, and prediction methods. It also teaches students to implement supervised and unsupervised learning techniques, along with optimization algorithms.

Module I **22 Hours**

Introduction to data mining and business intelligence: Introduction to Data mining - Data Mining Functionalities - Classification of Data Mining Systems - Integration of a Data Mining - Major Issues in Data Mining - Introduction to Business Intelligence definitions and concepts - Frame work - Basics of Data Integration Introduction to Business Metrics and KPI.

Data mining process: Data Pre-processing - Data Summarization - Data Cleaning - Data Integration and Transformation, Reduction, Discretization - KDD, CRISP-DM, SEMMA, Prediction performance measures.

Data mining algorithms: Classification: Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification CART - Association rule mining - Cluster Analysis: Partitioning Methods, Hierarchical Methods - regression, anomaly detection.

Module II **23 Hours**

Tools for business intelligence: Tool for BI: Microsoft SQL server: Introduction to Data Analysis using SSAS tools Introduction to data Analysis using SSIS tools - Introduction to Reporting Services using SSRS tools - Data Mining Implementation Methods.

Data mining for business applications: Balanced Scorecard, Fraud Detection, Click stream Mining, Market Segmentation, retail industry, telecommunications industry, banking & finance and CRM - Data Analytics Life Cycle: Introduction to Big data Business Analytics – Main phases of life cycle - Developing core deliverables for stakeholders.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Learn to apply data mining techniques into various area of different domains.	Understand
CO2: Discus various data mining processes and their functions.	Understand
CO3: Create solutions using prediction techniques for business problems.	Apply
CO4: Build mining models with supervised and unsupervised learning techniques.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Textbooks:

T1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2011.

Reference Book(s):

R1. Ralph Kimball and Richard Merz, The data warehouse toolkit, John Wiley, 3rd

R2.Michel Berry and Gordon Linoff, Data mining techniques for Marketing, Sales and Customer support, John Wiley, 2011

Web Reference(s):

https://onlinecourses.nptel.ac.in/noc21_cs06/preview

Course Code: 23AME003		Course Title: Intelligent Recommendation Systems	
Course Category: Major		Course Level: Intermediate	
L:T:P (Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objectives:

The course provides an overview of exploratory data analysis, teaching data visualization with Matplotlib. It covers univariate, bivariate, multivariate, and time series data exploration and analysis techniques. Students will learn to apply these data exploration and visualization methods effectively.

Module I **23 Hours**

Exploratory data analysis: EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.

EDA using python: Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.

Univariate analysis: Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality.

Module II **22 Hours**

Bivariate analysis: Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines.

Multivariate and time series analysis: Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time based indexing visualizing – Grouping – Resampling.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Understand the fundamentals of exploratory data analysis.	Understand
CO2: Implement data visualization using Matplotlib.	Apply
CO3: Perform univariate data exploration and analysis.	Apply
CO4: Apply bivariate data exploration and analysis.	Apply

Course Articulation Matrix:

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

High-3; Medium-2; Low-1

Textbooks:

T1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020.

T2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", 1st Edition, O Reilly, 2017.

T3. Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008.

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 Reference(s):

https://onlinecourses.nptel.ac.in/noc19_cs59/preview

Course Code: 23AME004	Course Title: Recommendation Solutions		
Course Category: Major		Course Level: Intermediate	
L:T:P (Hours/Week) : 2:0:2	Credits: 3	Total Contact Hours:45	Max Marks:100

Course Objectives:

The course introduces the foundations of recommender systems, covering content-based and collaborative filtering methods with implementation. Students will learn to design attack-resistant recommender systems and evaluate their performance.

Module I **23 Hours**

Introduction: Introduction and 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, and Classification algorithms.

Collaborative filtering: A systematic approach, Nearest-neighbour collaborative filtering (CF), user-based and item-based CF, components of neighbourhood methods (rating normalization, similarity weight computation, and neighbourhood selection

Module II **22 Hours**

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

Practical Exercises

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

5. Implement collaborative filter techniques
6. Create an attack for tampering with recommender systems
7. Implement accuracy metrics like Receiver Operated Characteristic curves

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the basic functionality of recommender system.	Apply
CO2: Implement content-based recommender systems.	Apply
CO3: Design and implement an attack-resistant recommender system.	Apply
CO4: Evaluate the performance of recommender systems.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.

T2. Dietmar Jannach, Markus Zanker, Alexander Felfernig and Gerhard Friedrich, Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.

Reference Book(s):

R1. Francesco Ricci, Lior Rokach, Bracha Shapira, Recommender Sytems Handbook, 1st edition, Springer (2011).

R2. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.

Web Reference(s):

1. https://onlinecourses.nptel.ac.in/noc24_mg16/preview

Course Code: 23AME005	Course Title: Advanced Data and Visual Analytics in AI		
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 introduces basic techniques and algorithms for graphic design, covering principles of the graphics pipeline, aesthetics, and perception. It provides knowledge in visualization design techniques and teaches the use of multidimensional relational operations for databases, along with graph visualization and navigation techniques for social networks.

Module I **23 Hours**

Introduction: Data for Graphics - Design principles - Value for visualization – Categorical – time series - and statistical data graphics - Introduction to Visualization Tools

Graphics Pipeline, Aesthetics and Perception: Introduction - Primitives: vertices – edges – triangles -Model transforms: translations, rotations, scaling - View transform - Perspective transform - window transform - Graphical Perception Theory – Experimentation and the Application - Graphical Integrity - Layering and Separation - Color and Information -Using Space

Visualization Design: Visual Display of Quantitative Information - Data-Ink Maximization - Graphical Design - Exploratory Data Analysis and Heat Map

Module II **23 Hours**

Multidimensional Data and Interaction: Query - Analysis and Visualization of Multi-Dimensional Relational Databases - Interactive Exploration – tSNE - Interactive Dynamics for Visual Analysis - Visual Queries - Finding Patterns in Time Series Data - Trend visualization – Animation – Dashboard - Visual Storytelling

Collaboration: Graph Visualization and Navigation - Online Social Networks - Social Data Analysis -Collaborative Visual Analytics – Text - Map and Geospatial data

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply fundamental concepts and algorithms of graphical visualization to create meaningful and effective visual representations of data. .	Apply
CO2: Explain the concepts of Graphics Pipeline, Aesthetics, and Perception, along with techniques for Visualization Design	Apply
CO3: Use multidimensional relational operations to perform database operations.	Apply
CO4: Apply graph visualization and navigation techniques for social networks.	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	2	-	-	-	-	-	-	-	-	-	-
CO4	-	3	3	-	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. E. Tufte, “The Visual Display of Quantitative Information”, Graphics Press, 2nd Edition, 2001

T2. J. Koponen, J. Hildén, “Data Visualization Handbook”,,CRC Press, 2019

Reference Book(s):

R1. R. Tamassia, “Handbook of Graph Drawing and Visualization”, CRC Press, 2013

Web Reference(s):

1.https://onlinecourses.nptel.ac.in/noc22_cs56/preview

Course Code: 23AME006	Course Title: Text and Voice Intelligence		
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 introduces the basics of natural language processing, teaching the application of classification algorithms to text documents. It covers building question-answering and dialogue systems, along with performing text-to-speech synthesis and developing speech recognition system.

Module I

Natural language basics: Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stopwords – 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 – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models

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 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.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Understand the basics of natural language processing.	Understand
CO2: Develop applications for classifying text documents using appropriate classification algorithms.	Apply
CO3: Build question-answering and dialogue systems for specific applications.	Apply
CO4: Construct applications to perform text-to-speech synthesis and develop a speech recognition system.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	3	-	-	-	-	-	-	-	-	2	1
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	2	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, 2022

T2. Dipanjan Sarkar, “Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data”, APress,2018

Reference Book(s):

R1. Tanveer Siddiqui, Tiwary U S, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.

R2. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, “Fundamentals of Speech Recognition” 1st Edition, Pearson, 2009.

R3. Steven Bird, Ewan Klein, and Edward Loper, “Natural language processing with Python”, O’REILLY.

Web Reference(s):

https://onlinecourses.nptel.ac.in/noc23_hs91/preview

Course Code: 23AME007	Course Title: Business Analytics		
Course Category: Major	Course Level: Intermediate		
L:T:P (Hours/Week) 2:0:2	Credits:3	Total Contact Hours:45	Max Marks: 100

Course Objectives

The course teaches the Analytics Life Cycle and helps students comprehend the process of acquiring Business Intelligence. It covers various types of analytics for business forecasting and provides the ability to model supply chain management for analytics.

Module I

Introduction to business analytics

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration.

Business intelligence

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions

Business forecasting

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics

Module II

HR & Supply chain analytics

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain - Applying HR Analytics to make a prediction of the demand for hourly employees for a year

Marketing & sales analytics

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales

LIST OF EXPERIMENTS:

Use MS-Excel and Power-BI to perform the following experiments using a Business data set, and make presentations.

Students may be encouraged to bring their own real-time socially relevant data set.

I Cycle – MS Excel

1. Explore the features of Ms-Excel.
2. (i) Get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND)

(ii) Perform data import/export operations for different file formats.

3. Perform statistical operations - Mean, Median, Mode and Standard deviation, Variance, Skewness, Kurtosis
4. Perform Z-test, T-test & ANOVA
5. Perform data pre-processing operations i) Handling Missing data ii) Normalization
6. Perform dimensionality reduction operation using PCA, KPCA & SVD
7. Perform bivariate and multivariate analysis on the dataset.
8. Apply and explore various plotting functions on the data set.

II Cycle – Power BI Desktop

9. Explore the features of Power BI Desktop
10. Prepare & Load data
11. Develop the data model
12. Perform DAX calculations
13. Design a report
14. Create a dashboard and perform data analysis
15. Presentation of a case study

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain real-world business problems and model them with analytical solutions.	Understand
CO2: Identify business processes for extracting Business Intelligence.	Apply
CO3: Apply predictive analytics for business forecasting and use analytics for marketing and sales.	Apply
CO4: Apply analytics for supply chain and logistics management.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017

T2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016

T3. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016

Reference Book(s):

R1. VSP RAO, “Human Resource Management”, 3rd Edition, Excel Books, 2010

R2. Mahadevan B, “Operations Management -Theory and Practice”, 3rd Edition, Pearson Education,2018.

Web Reference(s):

https://onlinecourses.nptel.ac.in/noc20_mg11/preview

Course Code: 23AME008	Course Title: Knowledge Based Systems Design		
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 introduces the basics of Knowledge Engineering and describes methodologies and modeling for agent design and development. It provides in-depth knowledge for designing and developing ontologies, applying reasoning with ontologies and rules, and understanding learning and rule learning.

Module I

Reasoning under uncertainty

Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods - Evidence-based reasoning.

Methodology and modeling

Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis –Evidence-based Assessment– Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.

Ontologies – design and development

Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching. Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification.

Module II

Reasoning with ontologies and rules

Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.

Learning and rule learning

Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal Definition of Generalization. Modelling, Learning and Problem Solving – Rule learning and Refinement – Overview – Rule Generation and Analysis – Hypothesis Learning.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Understand the basics of Knowledge Engineering.	Understand
CO2: Apply methodologies and modeling for agent design and development.	Apply
CO3: Design and develop ontologies, and apply reasoning with ontologies and rules.	Apply
CO4: Implement the machine and rule learning with modelling with real time applications.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, “Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning”, Cambridge University Press, 1st Edition, 2016.

Reference Book(s):

R1. Ronald J. Brachman, Hector J. Levesque, “Knowledge Representation and Reasoning”, Morgan Kaufmann, 2004.

R2. Ela Kumar, “Knowledge Engineering”, I K International Publisher House, 2018

Web Reference(s):

https://onlinecourses.nptel.ac.in/noc24_cs14/preview

Course Code: 19AMEN1009	Course Title: Cryptographic Techniques and Protocols for Security		
Course Category: Professional Elective		Course Level : Intermediate	
L: T: P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives

This course aims to provide a foundational understanding of cryptographic protocols, including their design principles, definitions, and proof techniques. It equips students with the ability to analyze and evaluate security protocols, particularly in the context of authenticated key exchange. Students will explore key agreement methods and pairing-based cryptography.

Module I **22 Hours**

Cryptography protocols: Protocols for identification and login: Interactive protocols, ID protocols, Password protocols, Challenge-response protocols, Schnorr's identification protocol.

Authenticated Key Exchange : Goals for authentication and Key Establishment, encryption-based protocol and its attacks, Perfect forward secrecy, Protocol based on ephemeral encryption, Attacks on Insecure variations, Identity protection, One-sided authenticated key exchange.

Module II **23 Hours**

Classes of Key Agreement protocols: Diffie Hellman Key Agreement, MTI Protocols, Diffie Hellman-Based Protocols. Protocols not based on Diffie Hellman.

Pairing based cryptographic protocol: ID based encryption schemes, Boneh and Franklin's Scheme, Shamir's encryption and signature schemes.

Conference Key Protocols: Security goals, Static and dynamic groups, Generalizing Diffie_ Hellman key agreement.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Acquire an overview and understanding of the problems, notions, definitions, design principles and proof techniques for selected cryptographic protocols.	Understand
CO 2: Apply authentication key exchange protocol for secure data exchange.	Apply
CO 3: Apply Key Agreement protocols, Pairing based cryptographic protocol for secure communication	Apply
CO4: Implement the generalized Diffie-Hellman key agreement protocol to enable secure multi-party communication	Apply

Text Book(s):

T1. Boyd, Colin, Anish Mathuria, and Douglas Stebila -" Introduction to Authentication and Key Establishment. Protocols for Authentication and Key Establishment" Springer, Berlin, Heidelberg; 2020.

T2. Boneh, Dan, and Victor Shoup – "A graduate course in applied cryptography" Draft 0.5; 2020.

Reference Book(s):

R1. David Wong - "Real World Cryptography" ,Eighth edition - Publisher: Pearson Education, 2022.

Web Reference(s):

https://onlinecourses.nptel.ac.in/noc22_cs03/preview
https://www.coursera.org/learn/introduction-to-applied-cryptography

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Course Code: 19AMEN1011	Course Title: Intrusion Detection and Prevention Techniques		
Course Category: Professional Elective		Course Level : Intermediate	
L: T: P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives

This course equips students with the knowledge to identify vulnerabilities and detect various cyber-attacks. It covers network intrusion detection and prevention mechanisms along with countermeasures for different security threats. Students will also gain the ability to design or apply intrusion detection systems to protect information assets.

Module I **22 Hours**

Intrusion Detection System Principles - History of Intrusion detection, Audit, Concept and definition, Internal and external threats to data, attacks, Key functions of IDPS technologies - Common Detection Methodologies Signature & Anomaly based Detection, Stateful protocol analysis Types of IDS, Information sources Host based information sources, Network based information sources.

IDS Technologies - Components & Architecture-Typical components, Network Architectures Security capabilities - Information gathering capabilities, logging capabilities, detection & prevention capabilities. Intrusion Prevention Systems, Network protocol based IDS, Hybrid IDS, Analysis schemes, thinking about intrusion. A model for intrusion analysis, techniques Responses requirement of responses, types of responses mapping responses to policy Vulnerability analysis, credential analysis non credential analysis.

Module II **23 Hours**

Network based IDs : Networking Overview-OSI layers. Components and Architecture - Typical components, Network architectures and sensor locations. Security capabilities Wireless IDPS- Wireless Networking overview-WLAN standards & components. Components Network Behavior analysis system.

Host based IDs - Components and Architecture-Typical components, Network architectures, Agent locations, host architectures. Security capabilities - Logging, detection, prevention and other capabilities. Using & Integrating multiple IDPS technologies - Need for multiple IDPS technologies, Integrating different IDPS technologies - Direct & Indirect IDPS integration Other

technologies with IDPS capabilities Network Forensic Analysis Tool, Anti-malware technologies, Firewalls and Routers, Honeypots.

Introduction to Snort, Working with Snort Rules, Snort configuration, Snort with MySQL, Running Snort on Multiple Network Interfaces, Snort Modes Snort Alert Modes, Snarf with Snort, Agent development for intrusion detection, Architecture models of IDS and IPS.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Develop a conceptual understanding of IDPS by applying its architecture and methodologies to classify different intrusion detection types.	Apply
CO2: Apply various intrusion analysis techniques and response strategies to detect, prevent, and respond to security threats effectively.	Apply
CO3: Demonstrate the deployment of Network-based and Host-based Intrusion Detection Systems (IDS) and their integration with other security technologies.	Apply
CO4: Apply and configure intrusion detection tools such as Snort for real-time network monitoring, analysis, and threat detection.	Apply

Text Book(s):

T1. Ali A. Ghorbani, Wei Lu, Mahbod Tavallaee -" Network Intrusion Detection & Prevention" Springer, 2010.

T2. Carl Endorf, Eugene Schultz and Jim Mellander ¯ Intrusion Detection & Prevention, 1st Edition, Tata McGraw-Hill, 2006.

Reference Book(s):

R1. Karen Scarfone, Peter Mell," Guide to Intrusion Detection and Prevention Systems (IDPS)", NIST special publication, 2007.

R2. Kerry J Cox, Christopher Gerg," Managing Security with Snort and IDS Tools", O'Reilly, 2007.

R3. Rafeeq Rehman : Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID, 1st Edition, Prentice Hall , 2003

Web Reference(s):

https://www.coursera.org/learn/introduction-to-intrusion-detection-systems-ids
https://onlinecourses.swayam2.ac.in/cec20_cs09/preview

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Course Code: 19AMEN1012	Course Title: Software Vulnerability Analysis		
Course Category: Professional Elective		Course Level : Intermediate	
L: T: P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives

This course intends to equip students with practical skills required for identifying, analyzing, and mitigating security vulnerabilities in networks, applications, and operating systems. To teach the implications of common vulnerabilities and recommend ways and techniques such as vulnerability assessment, sniffing, SQL injection, penetration testing with tools like Metasploit and Armitage, reverse engineering of Android apps to rectify or mitigate them.

Module I **23 Hours**

Vulnerability Assessment : Introduction to vulnerability assessment, Foot printing & Social engineering Information gathering methodologies- Competitive Intelligence- DNS Enumerations- Social Engineering attacks. Scanning & Enumeration Port Scanning.

Sniffers and SQL: Sniffers & SQL Injection Active and passive sniffing- ARP Poisoning- Session Hijacking DNS Spoofing- Conduct SQL Injection attack - Countermeasures. Introduction to Metasploit: Metasploit framework, Metasploit Console, Payloads, Meterpreter.

Armitage: Introduction to Armitage, Installing and using Kali Linux Distribution, Introduction to penetration testing tools in Kali Linux. Case Studies of recent vulnerabilities and attacks.

Module II **22 Hours**

Reverse Enginering: Introduction to Reverse Engineering of Android Apps- Introduction to Android OS and App Development - Architecture, Types of Applications, Building an App, Understanding Activities, Activity Lifecycle, Managing State.

Enumeration and Vulnerability analysis: Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities.

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Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze and illustrate different attack types, attackers, and vulnerabilities by performing basic vulnerability assessments.	Analyze
CO2: Apply appropriate tools to mitigate or prevent penetration attacks.	Apply
CO3: Implement reverse engineering concept for developing apps	Apply
CO4: Perform enumeration and vulnerability analysis	Apply

Text Book(s):

T1. Baloch, R., “Ethical Hacking and Penetration Testing Guide”, CRC Press; 2015..

T2. Abhinav Mishra ,“ Mobile App Reverse Engineering: Get started with discovering, analyzing, and exploring the internals of Android and iOS apps”, Packt Publishing; 1st edition ,2022.

Reference Book(s):

R1. Shakeel Ali and Tedi Heriyanto, “Backtrack -4: Assuring security by penetration testing”, PACKT Publishing; 2011.

R2. Kerry J Cox, Christopher Gerg," Managing Security with Snort and IDS Tools", O’Reilly, 2007.

Web Reference(s):

https://www.coursera.org/learn/packt-vulnerability-types-and-concepts-aczer

https://www.classcentral.com/subject/vulnerability-analysis

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Course Code: 19AMEN1013	Course Title: Cybercrime Forensics and Digital Forensics		
Course Category: Professional Elective		Course Level : Intermediate	
L: T: P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives

This course intends to equip students with practical skills required for identifying, analyzing, and mitigating security vulnerabilities in networks, applications, and operating systems. To teach the implications of common vulnerabilities and recommend ways and techniques such as vulnerability assessment, sniffing, SQL injection, penetration testing with tools like Metasploit and Armitage, reverse engineering of Android apps to rectify or mitigate them.

Module I **23 Hours**

Computer Forensics: Standard procedure - Incident verification - System identification - Recovery of coed and damaged data - Disk imaging and preservation.- Data encryption and compression -Automated search techniques - Forensic software - Digital forensic framework - Digital forensic models.

Network Forensics 'Tracking network traffic - Reviewing network logs, Tools - Performing acquisitions - Order of volatility - Standard procedure. Internet forensics: Internet and world wide web threats (Email, Chat-rooms, Search engines) - Domain name ownership investigation - Reconstructing past internet activities and events.

Internet Forensics: Email forensics: E-mail analysis - Email headers and spoofing - Laws against email crime. Messenger forensics: AOL, Yahoo, MSN, and Chats. Browser forensics: Analyzing cache and temporary Internet files - Cookie storage and analysis. File system forensic.

Module II **22 Hours**

Data acquisition: authorization to collect the evidence - Acquisition of evidence - Authentication of the evidence -Analysis of the evidence - Reporting on the findings - Testimony. Collecting and analyzing mobile phone - Analyzing CD, DVD, Flash memory, and other storage devices. Advanced Forensics techniques: Digital camera forensics - Reconstructing users activities -

Recovering and reconstructing deleted data. Memory data collection and examination - Extracting and examining processes. Steganography tools and tricks - Data hiding and data recovery.

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Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Demonstrate the ability to apply computer, network, and internet forensic techniques for investigating digital incidents, including data recovery, disk imaging, log analysis, and email/browser forensics.	Apply
CO2: Apply and utilize forensic tools, models, and procedures to track cybercrimes, reconstruct digital activities, and ensure evidence integrity for legal and investigative purposes.	Apply
CO3: Apply procedures for acquiring, analyzing, and reporting digital evidence from various devices.	Apply
CO4: Demonstrate advanced forensic techniques such as activity reconstruction, data recovery, steganography analysis, and memory forensics to support digital investigations and incident response.	Apply

Text Book(s):

T1. Thomas J. Holt ,Adam M. Bossler ,Kathryn C. Seigfried-spellar , “Cybercrime and digital forensics:An introduction”, 3rd edition ,Routledge publication, 2022.

T2. Ali Baladi, “Advanced Forensic Techniques:: A Guide for Forensic Analyst”, Sindh Park Publishing Company,2024.

Reference Book(s):

R1. Anders Flaglien, Inger Marie Sunde Addison-Wesley, “Digital Forensics”, PACKT Publishing; 2005.

R2. Linda Volonino," Computer Forensics: Principles and Practices ", Pearson, 2014.

R3. Sherri Davidoff, Jonathan Ham,” Network Forensics:Tracking Hackers through Cyberspace”, Pearson publication,2012.

Web Reference(s):

https://www.geeksforgeeks.org/computer-networks/digital-forensics-in-cyber-security/

https://onlinecourses.swayam2.ac.in/cec20_lb06/preview

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Course Code: 19AMEN1014	Course Title: Distributed System Security		
Course Category: Professional Elective		Course Level : Intermediate	
L: T: P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives

The course aims to equip students with knowledge of authentication methods, access control, network protocol vulnerabilities, malware types, software security flaws, and effective countermeasures for securing systems and applications.

Module I **23 Hours**

User Authentication: Password- based, Task based, Biometric based, Remote User Authentication, Security issues, Biometrics-Key elements- Types of Biometrics- Finger print Hand Geometry- Face and Voice Recognition- Eye Biometrics.

Access control: Principles, Subjects, Objects and Access Rights, Discretionary Access Control, Example- Unix File Access Control, Role-based Access Control, Case study-RBAC System for a bank.

Non cryptographic protocol vulnerabilities: Session Hijacking and Spoofing- ARP Spoofing- Pharming Attacks- Attack on DNS- DNSSEC- Tools-Wireless LAN Vulnerabilities.

Module II **22 Hours**

Malicious software: Types, Propagation- Infected Content, Viruses, Vulnerability Exploit Worms, Social Engineering-Spam, E-mail, Trojans, Payload-system corruption, Attack agent, Zombie, Bots, Information theft- Key loggers, Phishing, Spyware, Steal thing, Backdoors, Root kits, Countermeasures- Mobile Malware.

Software Vulnerabilities: Buffer overflow- Stack overflows -Defending against Buffer Overflows- Other Forms- Format String Attacks- Cross-site Scripting-XSS vulnerabilities Overcoming XSS-SQL Injection.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	

CO1: Demonstrate the ability to apply computer, network, and internet forensic techniques for investigating digital incidents, including data recovery, disk imaging, log analysis, and email/browser forensics.	Apply
CO2: Apply and utilize forensic tools, models, and procedures to track cybercrimes, reconstruct digital activities, and ensure evidence integrity for legal and investigative purposes.	Apply
CO3: Apply procedures for acquiring, analyzing, and reporting digital evidence from various devices.	Apply
CO4: Demonstrate advanced forensic techniques such as activity reconstruction, data recovery, steganography analysis, and memory forensics to support digital investigations and incident response.	Apply

Text Book(s):

T1. W. Stallings,Lawrie Brown “Computer Security: Principles and Practice,” Pearson education, 2018.

T2. Bernard Menezes, “Network Security and Cryptography”, 1/e, Cengage Learning India, 2010.

T3. Alexey Kleymenov ,Amr Thabet ,“Mastering Malware Analysis - Second Edition: A malware analyst's practical guide to combating malicious software, APT, cybercrime, and IoT attacks ”, Packt Publishing, 2022.

Reference Book(s):

R1. M. Stamp, “Information Security: Principles and Practice,” 2nd Edition, Wiley, ISBN: 0470626399, 2011.

R2. Linda Volonino," Computer Forensics: Principles and Practices ", Pearson, 2014.

R3. Sherri Davidoff, Jonathan Ham,” Network Forensics:Tracking Hackers through Cyberspace”, Pearson publication,2012.

Web Reference(s):

https:// https://www.geeksforgeeks.org/ethical-hacking/security-in-distributed-system/

Course Articulation Matrix

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

CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	1	-	-	2	-	-	-	-	-	-	-	-	-	-

Course Code: 19AMEN1015	Course Title: Ethical Hacking		
Course Category: Professional Elective		Course Level : Intermediate	
L: T: P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives

This course intends to equip students with practical skills required for identifying, analyzing, and mitigating security vulnerabilities in networks, applications, and operating systems. To teach the implications of common vulnerabilities and recommend ways and techniques such as vulnerability assessment, sniffing, SQL injection, penetration testing with tools like Metasploit and Armitage, reverse engineering of Android apps to rectify or mitigate them.

Module I **23 Hours**

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

Footprinting: Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts.

NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities.

Module II **22 Hours**

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking.

Access Control Lists - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - NetworkBased and Host - Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.

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Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe ethical hacking, penetration testing, security measures, and malware protection, footprinting, reconnaissance techniques, and network scanning tools for information gathering.	Apply
CO2: Analyze network services to assess system vulnerabilities and evaluate associated security risks..	Analyze
CO3: Demonstrate web server and wireless network hacking, vulnerability identification, exploitation.	Apply
CO4: Configure and analyze network protection systems, firewalls, IDS/IPS, incident response.	Apply

Text Book(s):

T1. Thirumalesh, “The Complete Ethical Hacking Book: A Comprehensive Beginner's Guide to Learn and Master in Ethical Hacking”, Orange book publication, 2022.

T2. The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.

Reference Book(s):

R1. Dafydd Stuttard and Marcus Pinto, “The Web Application Hacker’s Handbook: Finding and Exploiting Security Flaws”, , 2011.

Web Reference(s):

https:// https://archive.nptel.ac.in/courses/106/105/106105217/

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Course Code: 19AMEN1016	Course Title: Engineering Secure Software Systems		
Course Category: Professional Elective		Course Level : Intermediate	
L: T: P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives

To equip students with the knowledge and skills to develop secure software by understanding software security threats, secure design principles, risk management, and security testing techniques, including penetration testing and enterprise security frameworks.

Module I **23 Hours**

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Memory-Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks

Requirements Engineering for secure software - SQUARE process Model - Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content - Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection – Session Hijacking - Secure Design - Threat Modeling and Security Design Principles Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management.

Module II **22 Hours**

Traditional Software Testing – Comparison - Secure Software Development Life Cycle - Risk Based Security Testing – Prioritizing Security Testing with Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation -Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice.

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Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze software security issues and memory-based attacks to evaluate vulnerabilities and apply secure design principles and threat modeling techniques.	Analyze
CO2: Apply risk management techniques to analyze and mitigate software security risks.	Apply
CO3: Perform security testing including penetration testing and vulnerability analysis.	Apply
CO4: Use appropriate tools and frameworks to secure software in the software development lifecycle.	Apply

Text Book(s):

T1. Erik Fretheim, “Secure Software Systems”, O’Reilly, 2023.
T2. Evan Wheeler, “Security Risk Management: Building an Information Security Risk Management.”,2011.

Reference Book(s):

R1. C Warren,” Engineering Safe and Secure Software Systems -Artech House Information Security and Privacy”,Artech house publishers, 2012.

Web Reference(s):

https:// https://archive.nptel.ac.in/courses/106/105/106105217/

Course Articulation Matrix

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

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

High-3; Medium-2; Low-1

Vertical III

(IOT and Cloud)

Course Code:19AMEN1017		Course Title: Iot Architecture and Protocols	
Course Category: Major		Course Level : Intermediate	
L: T: P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Periods:45	Max. Marks:100

Course Objectives:

This course covers the architectural overview and reference architecture of IoT, along with real-world design constraints. It also provides knowledge and applications of various IoT protocols across different layers (Datalink, Network, Transport, Session, Service).

Module I **22 Hours**

IoT-An Architectural Overview:

Building an architecture - Main design principles and needed capabilities - An IoT architecture outline - standards considerations - M2M and IoT Technology Fundamentals - Devices and gateways - Local and wide area networking - Data management.

Reference Architecture:

IoT Architecture - State of the Art – Reference Model and architecture - IoT reference Model - IoT Reference Architecture - Introduction- Functional View - Information View - Deployment and Operational View - Other Relevant architectural views - Real-World Design Constraints.

IOT Data Link Layer & Network Layer Protocols:

PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15) - WirelessHART, ZWave - Bluetooth Low Energy - Zigbee Smart Energy - DASH7 - Network Layer: IPv4 - IPv6 - 6LoWPAN - 6TiSCH – ND – DHCP – ICMP – RPL – CORPL – CARP.

Module II **23 Hours**

Transport & Session Layer Protocols

Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP) - (TLS, DTLS) – Session Layer : HTTP - CoAP – XMPP – AMQP – MQTT

Service Layer Protocols & Security

Service Layer : oneM2M - ETSI M2M – OMA - BBF – Security in IoT Protocols : MAC 802.15.4 - 6LoWPAN – RPL - Application Layer

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand,StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press,2014.

T2. Peter Waher, “Learning Internet of Things”, PACKT publishing, BIRMINGHAM –MUMBAI Ltd., 2010.

Reference Book(s):

R1. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5e ISBN 978-3-642-19157-2, Springer

R2. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347-4, Willy Publications.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview

Course Code: 23AME018		Course Title: Data Science for IoT	
Course Category: Major		Course Category: Intermediate	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives:

This course covers IOT analytics basics, data preprocessing, visualization techniques, and data organizing strategies. It aims to equip students with the skills to perform data analytics.

Module I **22 Hours**

Introduction to Data Analytics: Defining IoT Analytics and Challenges: The situation - Defining IoT analytics - IoT analytics challenges - Business value concerns - IoT Analytics for the Cloud. Types of Analytics: Streaming Analytics – Spatial Time Series and Prescriptive Analytics.

Data Collection: Getting to know your data - Types of Data - Data collection strategies - Data Pre-processing - Feature engineering with IoT data - Exploratory Data Analytics - Descriptive Statistics – Deviation - Skewness and Kurtosis.

Data Visualization and Representation: Model Development Simple and Multiple Regression - Model Evaluation using Visualization - Residual Plot - Distribution Plot - Polynomial Regression and Pipelines - Measures for In-sample Evaluation - Prediction and Decision Making - Box Plots - Pivot Table - Heat Map.

Module II **23 Hours**

Strategies to Organize Data for Analytics: Linked Analytical Datasets - Linking together datasets - Managing data lakes - Data retention strategy - Economics of IoT Analytics - Cost considerations for IoT analytics - Thinking about revenue opportunities - The economics of predictive maintenance example - Data Analytics Life Cycle.

Application of Analytics in IoT : IoT based applications – Healthcare – Marketing – Finance - Smart cities - Cyber security - video surveillance - Agriculture and Weather Forecasting and other domains: Real Time IoT based data analysis.

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Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Define IoT Analytics and Challenges.	Understand
CO2: Perform preprocessing and data reduction strategies for any given data set.	Apply
CO3: Apply different data visualization and representation techniques.	Apply
CO4: Apply organizing strategies for data analytics.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. JojoMoolayil, “Smarter Decisions : The Intersection of IoT and Data Science”, PACKT, 2016.

T2.Cathy O’Neil and Rachel Schutt , “Doing Data Science”, O’Reilly, 2015.

T3.David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big data Analytics”, EMC 2013.

Reference Book(s):

R1. Andrew Minteer, “Analytics for the Internet of Things (IoT)” 1st Edition, Packt Publishing, ISBN 978-1787120730, 2017.

R2. HwaiyuGeng, Internet of Things and Data Analytics Handbook 1st Edition, Wiley, ISBN 978-1119173649, 2017.

Web References:

1. https://onlinecourses.nptel.ac.in/noc19_cs65/preview

Course Code: 23AME019		Course Title: IoT Security	
Course Category: Major		Course Level: Intermediate	
L: T: P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course introduces IoT security fundamentals, techniques, and protocols, with a focus on gaming models and blockchain applications like Bitcoin. It also covers essential IoT components and privacy challenges

Module I **23 Periods**

Introduction to IoT security: Fundamentals of IoT and Security and its need - Prevent Unauthorized Access to Sensor Data - Block ciphers - Introduction to Blockchain - Introduction of IoT devices - IoT Security Requirements - M2M Security - Message integrity - Modeling faults and adversaries - Difference among IoT devices – computers - and embedded devices.

Techniques and Protocols: IoT and cyber-physical systems RFID Security - Authenticated encryption Byzantine Generals problem sensors and actuators in IoT - IoT security (vulnerabilities, attacks, and countermeasures) - Cyber Physical Object Security - Hash functions - Consensus algorithms and their scalability problems- Accelerometer – photoresistor - buttons.

Module II **22 Periods**

Application of blockchain technology: Security engineering for IoT development Hardware Security - Merkle trees and Elliptic curves digital signatures - verifiable random functions - Zero-knowledge systems motor – LED –vibrator - IoT security lifecycle - Front-end System Privacy Protection – Management - Secure IoT Databases - Public-key crypto (PKI) – blockchain - the challenges - and solutions - analog signal vs. digital signal.

Components of IoT: Data Privacy Networking Function Security Trees signature algorithms proof of work - Proof of stake - Networking in IoT - Device/User Authentication in IoT IoT Networking Protocols - Crypto-currencies - alternatives to Bitcoin consensus - Bitcoin scripting language and their use Real-time communication.

Security and privacy challenges of IoT: Introduction to Authentication Techniques Secure IoT Lower Layers - Bitcoin P2P network - Ethereum and Smart Contracts - Bandwidth efficiency - Data Trustworthiness in IoT Secure IoT Higher Layers - Distributed consensus - Smart Contract Languages and verification challenges data analytics in IoT - simple data analyzing methods.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe the fundamentals, various attacks and importance of Security aspects in IoT.	Understand
CO2: Explain the techniques, protocols and some idea on security towards gaming models.	Understand
CO3: Explain the operations of Bitcoin, blockchain, crypto-currency as application of blockchain technology	Understand
CO4: Describe the essential components of IoT.	Understand

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Kevin P. Murphey, “Machine Learning, a probabilistic perspective”, The MIT Press Cambridge, Massachusetts, 2012.

T2. Christopher M Bishop,” Pattern Recognition and Machine Learning”, Springer 2010.

Reference Book(s):

R1. A. Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies,” O’Reilly, 2014

R2. T. Alpcan and T. Basar, “Network Security: A Decision and Game-theoretic Approach,”Cambridge University Press, 2011.

Web References:

1. https://onlinecourses.nptel.ac.in/noc19_cs65/preview

Course Code: 23AME20		Course Title: Edge Computing	
Course Category: Major		Course Level: Mastery	
L:T:P (Periods/Week) 3: 0: 0	Credits:3	Total Contact Periods:45	Max. Marks:100

Course Objectives:

The course covers the evolution and principles of edge computing, recent advances inhardw are and software, and practical applications through case studies. It also addressessecurity challenges and strategies for optimizing resources and anticipating future trends.

Module I **22 Hours**

Introduction to Edge Computing: Introduction to edge computing, Historical Evolution, Motivations for Adoption, Real-world Applications, Challenges and Opportunities, Industry Impact

Advances in Edge Computing Technologies: Hardware and Software Developments, Integration of Edge AI, Blockchain, and 5G, Implications on Scalability and Performance, Case Studies of Implementations

Computing Applications: Practical Applications across Domains, Industry-specific applications(e.g., Healthcare, IoT), Benefits and Challenges, Case Studies of Applications.

Module II **23 Hours**

Security and Privacy in Edge Computing: Security Challenges, Privacy Considerations and Regulations, Security Measures and Best Practices, Data Protection Implications, Analysis of Real-world Security Incidents.

Optimization in Edge Computing: Strategies for Resource and Workload Optimization, Techniques for Energy Efficiency, Current Trends and Future Developments, Ethical Considerations and Societal Impacts, Evolving Role in the Technological Landscape.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the concept of single layer perceptron model.	Understand
CO2: Design a suitable multilayer feed forward network for a given problem.	Apply
CO3: Implement single layer feedback networks.	Apply
CO4: Construct Associative memory based network models for given problem.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Jacek M.Zurada, “Introduction to Artificial Neural Systems”, Jaico Publ.House, 1994.

T2. Robert J. Schalkoff, “Artificial Neural”, McGraw-Hill, 1997.

Reference Book(s):

R1. Simon Haykin, “Neural Networks – A Comprehensive formulation”, AW, 1998.

R2. Koko, “Neural Networks”, PHI, 1992.

R3. N.K. Bose, P.Liang, “Neural Network Fundamentals”, M.H, 2002.

Web References:

1. https://onlinecourses.nptel.ac.in/noc24_cs66/preview

Course Code: 23AME021		Course Title: Storage Technologies	
Course Category: Major		Course Level: Mastery	
L:T:P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Periods:45	Max. Marks:100

Course Objectives:

The course is intended to explore the functionalities of logical and physical storage components, various storage networking and virtualization technologies, and backup and recovery strategies. It also covers common storage management activities and solutions, aiming to provide a comprehensive understanding of storage systems.

Module I **22 Hours**

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

Intelligent Storage Systems and Raid: Components of an intelligent storage system - Components – addressing and performance of hard disk drives and solid-state drives RAID - Types of intelligent storage systems - Scale-up and scaleout storage.

Storage Networking Technologies and Virtualization: Block-Based Storage System - File-Based Storage System - Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking - FC SAN components and architecture - FC SAN topologies - link aggregation - and zoning - Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol - network components - and connectivity - Link aggregation - switch aggregation - and VLAN - FCIP protocol - connectivity - and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN - FCoE SAN connectivity - Converged Enhanced Ethernet - FCoE architecture.

Module II **23 Hours**

Backup, Archive and Replication: Introduction to Business Continuity - Backup architecture - Backup targets and methods - Data deduplication - Cloud-based and mobile device backup - Data archive - Uses of replication and its characteristics - Compute based - storage-based - and network-based replication - Data migration - Disaster Recovery as a Service (DRaaS).

Securing Storage Infrastructure: Information security goals - Storage security domains - Threats to a storage infrastructure - Security controls to protect a storage infrastructure - Governance - risk - and compliance - Storage infrastructure management functions - Storage infrastructure management processes.

Course Outcomes	**Cognitive Level**
At the end of this course - students will be able to:	
CO1: Explain the fundamentals of information storage management and various models of cloud infrastructure services and deployment.	Understand
CO2: Utilize advanced intelligent storage systems and RAID configurations for effective data management.	Apply
CO3: Design and implement various storage networking architectures, including SAN, and apply storage virtualization techniques.	Apply
CO4: Implement disaster recovery and remote replication technologies to ensure data availability and business continuity.	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, "Introduction to Storage Area Networks", 9th Edition, IBM - Redbooks, December 2017.

T2. EMC Corporation, "Information Storage and Management", Wiley, India, 2012.

Reference Book(s):

R1. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein, "Storage Networks Explained", 2nd Edition, Wiley, 2009.

Web References:

1. https://nptel.ac.in/courses/106108058

Course Code: 23AME022		Course Title: Data Warehousing	
Course Category: Major		Course Level: Mastery	
L:T:P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Periods:45	Max. Marks:100

Course Objectives:

The course covers data warehouse architecture, OLAP technology, and partitioning strategies. It teaches schema differentiation and clarifies the roles of process and system managers.

Module I **22 Hours**

Introduction to Data Warehouse: Data warehouse Introduction - Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture - Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse.

ETL and OLAP Technology: What is ETL – ETL Vs ELT – Types of Data warehouses - Data Warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP - Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP.

Meta Data, Data Mart and Partition Strategy: Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management - Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Cost of Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting – Horizontal Partition.

Module II **23 Hours**

Dimensional Modeling and Schema: Dimensional Modeling- Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact Constellation Schema- Schema Definition - Process Architecture- Types of Data Base Parallelism – Data warehouse Tools.

System and Process Managers: Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager - System Event Manager - System Database Manager - System Backup Recovery Manager - Data Warehousing Process Managers: Load Manager – Warehouse Manager- Query Manager – Tuning – Testing.

Practical Exercises:

1. Data exploration and integration with WEKA.
2. Apply weka tool for data validation.
3. Plan the architecture for real time application.

4. Write the query for schema definition.
5. Design data ware house for real time applications.
6. Analyse the dimensional Modeling.
7. Case study using OLAP.
8. Case study using OTLP.
9. Implementation of warehouse testing.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1: Design data warehouse architecture for various Problems	Understand
CO 2: Apply the OLAP Technology	Apply
CO 3: Analyse the partitioning strategy	Apply
CO 4: Critically analyze the differentiation of various schema for given problem	Apply

Course Articulation Matrix

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

High-3; Medium-2;Low-1

Text Book(s):

T1. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Thirteenth Reprint 2008.

Reference Book(s):

R1. Ralph Kimball, “The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling”, 3rd Edition, 2013.

R2. Paul Raj Ponniah, “Data warehousing fundamentals for IT Professionals”, 2012.

R3. K.P. Soman, ShyamDiwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.

Web References:

1. https://onlinecourses.nptel.ac.in/noc21_ee32/preview

Course Code: 23AME023		Course Title: Security and Privacy in Cloud	
Course Category: Major		Course Level: Intermediate	
L:T:P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Periods:45	Max Marks:100

Course Objectives:

This course covers cloud computing terminology, security design, and architectural considerations. It teaches identity and access control, best practices for cloud security, and skills to monitor and audit cloud applications.

Module I **22 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 **23 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.

Monitoring, Auditing and Management

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management. Body language - Social – Email – Telephonic – Dining – Classroom - Business.

Practical Exercises:

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

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1: Describe the cloud concepts and fundamentals	Understand
CO 2: Explain about security challenges in the cloud	Understand
CO 3: Define cloud policy and Identity and Access Management	Understand
CO4: Discuss various risks, audit and monitoring mechanisms in the cloud.	Understand

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Textbook(s):

T1. Raj Kumar Buyya , James Broberg, andrzejGoscinski, “Cloud Computing”, Wiley 2013.

T2. Dave shackleford, “Virtualization Security‖, SYBEX a wiley Brand 2013.

Reference Book(s):

R1. Mark C. Chu-Carroli “Code in the cloud” CRC Press 2011.

R2. RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi “Mastering Cloud Computing Foundations and Applications Programming” .

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_me108/preview

Course Code: 23AME024		Course Title: Cloud Computing	
Course Category: Professional Elective		Course Level: Intermediate	
L: T: P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course covers cloud architecture principles, models and infrastructure, focusing on virtualization and virtual machines. It includes exploring cloud deployment environments and understanding security mechanisms for various attacks.

Module I **23 Periods**

Cloud Architecture Models and Infrastructure: Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges.

Virtualization Basics: Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.

Virtualization Infrastructure and Docker: Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories

Module II **22 Periods**

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

Cloud Security: Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyper jacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice.

Practical Exercises:

1. Install Virtualbox/VMware/ Equivalent open source cloud Workstation with different flavours of Linux or Windows OS on top of windows 8 and above.
2. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs
3. Install Google App Engine. Create a hello world app and other simple web applications using python/java.
4. Use the GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Install Hadoop single node cluster and run simple applications like wordcount.
8. Creating and Executing Your First Container Using Docker.
9. Run a Container from Docker Hub

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Understand the design challenges in the cloud.	Understand
CO2: Apply the Concept of Virtualization and its types.	Apply
CO3: Experiment with virtualization of hardware resources and Docker.	Apply
CO4: Develop and deploy services on the cloud and set up a cloud environment.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1.James Turnbull, “The Docker Book”, O’Reilly Publishers, 2014.

Reference Book(s):

R1. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.

R2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, “Cloud Security and Privacy: an enterprise perspective on risks and compliance”, O’Reilly Media, Inc., 2009.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_me108/preview

Vertical IV

(Full stack Development)

Course Code: 23AME025		Course Title: Web Technologies	
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week) : 3:0:0	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Course Objectives:

The objective of the course is aimed to equip engineering students to build dynamic web page with validation using HTML, CSS, Java Script objects and by applying different event handling mechanisms.

Module I **23 Hours**

Website basics, HTML 5, CSS 3, WEB 2.0: Web Essentials: Clients, Servers and Communication – The Internet – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements – Drag and Drop – Audio – Video controls - CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations. Bootstrap Framework.

CLIENT-SIDE programming: 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.

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

Module II **22 Hours**

PHP and XML: An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation. XML: Basic XML- Document Type Definition- XML Schema, XML Parsers and Validation, XSL.

Introduction to angular and web applications frameworks Directives: 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.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Construct a basic website using HTML and Cascading Style Sheets.	Apply
CO2: Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.	Apply
CO3: Develop server-side programs using Servlets and JSP.	Apply
CO4: Develop simple web pages in PHP and to represent data in XML format.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Deitel and Deitel and Nieto, Internet and World Wide Web - How to Program, Prentice Hall, 5th Edition, 2011

T2. Jeffrey C and Jackson, Web Technologies A Computer Science Perspective, Pearson Education, 2011

T3. Angular 6 for Enterprise-Ready Web Applications, Doguhan Uluca, 1st edition, Packt Publishing

Reference Book(s):

R1. Stephen Wynkoop and John Burke "Running a Perfect Website", QUE, 2nd Edition,1999

R2. Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley Publications, 2009

Web References:

1. https://nptel.ac.in/courses/106105084

2. https://www.javatpoint.com/server-side-scripting-vs-client-side-scripting

Course Code: 23AME026		Course Title: App Development	
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 provide knowledge about Native applications with GUI Components, Native applications with GUI Components, cross-platform applications with location and data storage capabilities, web applications with cloud database access.

Module I **22 Hours**

Fundamentals of mobile & web application development: Basics of Web and Mobile Application Development – Native App – Hybrid App – Cross-platform App – What is Progressive Web App – Responsive Web Design

Native app development using java: Native App Development Using Java – Native Web App – Benefits of Native App – Scenarios to Create Native App – Tools for Creating Native App – Cons of Native App – Popular Native App Development Frameworks – Java & Kotlin for Android

Hybrid app development: Hybrid App Development – Hybrid Web App – Benefits of Hybrid App – Criteria for Creating Native App – Tools for Creating Hybrid App – Cons of Hybrid App – Popular Hybrid App Development Frameworks – Ionic – Apache Cordova.

Module II **23 Hours**

Cross-platform app development using react-native: What is Cross-platform App – Benefits of Cross-platform App – Criteria for Creating Cross-platform App – Tools for Creating Cross-platform App – Cons of Cross-platform App – Popular Cross-platform App Development Frameworks – Flutter – Xamarin – React-Native – Basics of React Native – Native Components – JSX – State – Props

Non-functional characteristics of app frameworks: Comparison of Different App Frameworks – Build Performance – App Performance – Debugging Capabilities – Time to Market – Maintainability – Ease of Development – UI/UX

Practical Exercises:

1. Using react native, build a cross platform application for a BMI calculator.
2. Build a cross platform application for a simple expense manager which allows entering expenses

and income on each day and displays category wise weekly income and expense.

3. Develop a cross platform application to convert units from imperial system to metric system (km to miles, kg to pounds etc.,)
4. Design and develop a cross platform application for day to day task (to-do) management.
5. Design an android application using Cordova for a user login screen with username, password, reset button and a submit button. Also, include header image and a label. Use layout managers.
6. Design and develop an android application using Apache Cordova to find and display the current location of the user.
7. Write programs using Java to create Android application having Databases
   - For a simple library application.
   - For displaying books available, books lend, book reservation. Assume that student information is available in a database which has been stored in a database server.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Develop Native applications with GUI Components	Apply
CO2: Develop hybrid applications with basic event handling	Apply
CO3: Implement cross-platform applications with location and data storage capabilities	Apply
CO4: Implement cross platform applications with basic GUI and event handling	Apply
CO5: Develop web applications with cloud database access.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Textbooks:

T1. Dawn Griffiths, “Head First Android Development”, O’Reilly, 1st Edition, 2015.

T2. Raymond K. Camden, Manning, “Apache Cordova in Action”, 2015.

T3. Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing.

Reference Book(s):

R1. Android Programming for Beginners, John Horton, Packt Publishing, 2nd Edition.

R2. Shaun Lewis, Mike Dunn “Native Mobile Development”.

R3. Pawan Lingras, Matt Triff, Rucha Lingras, “Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach”.

R4. John M Wargo, “Apache Cordova 4 Programming”, 2015.

R5. UttamK.Roy, “Web Technologies”, Oxford University Press, 2011.

Web Reference(s):

1. https://www.startechup.com/blog/app-development-with-java/
2. https://www.geeksforgeeks.org/learn-java-for-android-app-development-a-complete-guide/

Course Code: 23AME027		Course Title: UI and UX Fundamentals	
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 aims to provide a comprehensive understanding of UI and UX, emphasizing their importance and various research methods in design. Students will gain knowledge in UI and UX, as well as skills for creating wireframes and prototypes. Also the course prepares students to effectively design user-centered interfaces.

Module I **23 Hours**

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

Foundations of UI design: Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides

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

Module II **22 Hours**

Wireframing, prototyping and testing: Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests

Research, Designing, Ideating, & Information Architecture: Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture.

Practical Exercises:

1. Designing a Responsive layout for an societal application.
2. Exploring various UI Interaction Patterns.
3. Developing an interface with proper UI Style Guides.
4. Developing Wireflow diagram for application using open source software.

5. Exploring various open source collaborative interface Platform.

6. Hands on Design Thinking Process for a new product.

7. Brainstorming feature for proposed product.

8. Defining the Look and Feel of the new Project.

9. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles).

10. Identify a customer problem to solve.

11. Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping.

12. Sketch, design with popular tool and build a prototype and perform usability testing and identify improvements.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Build UI for user Applications.	Apply
CO2: Evaluate UX design of any product or application.	Apply
CO3: Demonstrate UX Skills in product development.	Apply
CO4: Implement Sketching principles.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Joel Marsh, “UX for Beginners”, O’Reilly, 2022.

T2. Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021.

Reference Book(s):

R1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3rd Edition, O’Reilly, 2020.

R2. Steve Schoger, Adam Wathan “Refactoring UI”, 2018.

R3. Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, 3rd Edition, 2015.

Web References:

1. https://www.nngroup.com/articles/
2. https://www.interaction-design.org/literature.

Course Code: 23AME028	Course Title: Software Testing and Automation		
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 introduces the fundamentals of software testing, covering effective testing strategies and planning. Students will learn to build and execute test cases while gaining a comprehensive understanding of various testing aspects. Additionally, the course provides insights into test automation and the tools used in this process.

Module I **22 Hours**

Foundations of software testing: Black-Box Testing and White-Box Testing – Software Testing Life Cycle – V-model of Software Testing – Program Correctness and Verification – Reliability versus Safety – Failures, Errors, and Faults (Defects) – Software Testing Principles – Stages of Testing: Unit Testing, Integration Testing, System Testing

Test planning: The Goal of Test Planning – High-Level Expectations – Intergroup Responsibilities – Test Phases – Test Strategy – Resource Requirements – Tester Assignments – Test Schedule – Test Cases – Bug Reporting – Metrics and Statistics.

Module II **23 Hours**

Test design and execution: Test Objective Identification – Test Design Factors – Requirement Identification – Testable Requirements – Modeling a Test Design Process – Modeling Test Results – Boundary Value Testing – Equivalence Class Testing – Path Testing – Data Flow Testing.

Advanced testing concepts: Performance Testing – Load Testing – Stress Testing – Volume Testing – Fail-Over Testing – Recovery Testing – Configuration Testing – Compatibility Testing – Usability Testing – Testing the Documentation – Testing in the Agile Environment – Testing Web and Mobile Applications

Test automation and tools: Automated Software Testing – Automate Testing of Web Applications – Selenium: Introducing Web Driver and Web Elements – Locating Web Elements – Actions on Web Elements – Different Web Drivers – Understanding Web Driver Events – Testing: Understanding Testing.xml – Adding Classes, Packages, Methods to Test – Test Reports.

Course Outcomes	Cognitive Level

At the end of this course, students will be able to:	
CO1: Understand the basic concepts of software testing and the need for software testing.	Understand
CO2: Design Test planning and different activities involved in test planning.	Apply
CO3: Design effective test cases that can uncover critical defects in the application.	Apply
CO4: Implement advanced types of testing.	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	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO4	-	-	3	1	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Textbooks:

T1. Yogesh Singh, “Software Testing”, Cambridge University Press, 2012.

T2. Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" – 2nd Edition 2018.

Reference Book(s):

R1. Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc.

R2. Paul C. Jorgensen, Software Testing: A Craftsman’s Approach, 4th, 2014, Taylor & Francis Group.

R3. Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.

Web References:

1. https://www.javatpoint.com/automation-testing-tool
2. https://www.geeksforgeeks.com/ testing-tool

Course Code: 23AME029	**Course Title: Principles of Programming Languages**

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 aims to provide a comprehensive understanding of programming languages, syntax and semantics of programming languages, data types, and basic statements. Students will explore call-return architecture, object-orientation, concurrency, and event handling, gaining insights into the structure and behavior of programs.

Module I **23 Hours**

Syntax and semantics: Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing

Data, data types, and basic statements: Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements

Subprograms and implementations: Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping

Module II **22 Hours**

Object-orientation, concurrency, and event handling: Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling.

Functional and logic programming languages: Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog

– multi-paradigm languages.

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Robert W. Sebesta, “Concepts of Programming Languages”, 12th Edition (Global Edition), Pearson, 2022.

T2. Michael L. Scott, “Programming Language Pragmatics”, 4th Edition, Elsevier, 2018.

T3. R. Kent Dybvig, “The Scheme programming language”, 4th Edition, Prentice Hall, 2011

T4. Jeffrey D. Ullman, “Elements of ML programming”, 2nd Edition, Pearson, 1997.

T5. W. F. Clocksin and C. S. Mellish, “Programming in Prolog: Using the ISO Standard”, 5th Edition, Springer, 2003.

Web References:

1. https://archive.nptel.ac.in/courses/106/105/106105175/
2. https://www.geeksforgeeks.org/principles-of-programming-languages-gq/

Course Code: 23AME030		Course Title: DevOps	
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 introduces DevOps terminology and concepts, covering version control tools like Git and Mercurial. Students will learn about Continuous Integration, Testing, Deployment, and configuration management with Ansible, along with the benefits of cloud-based DevOps tools for real-world challenges.

Module I **23 Hours**

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

Compile and build using maven & gradle: Introduction – Installation of Maven – POM Files – Maven Build Lifecycle – Build Phases (Compile, Build, Test, Package) – Maven Profiles – Maven Repositories (Local, Central, Global) – Maven Plugins – Maven Create and Build Artifacts – Dependency Management – Installation of Gradle – Understanding Build Using Gradle.

Continuous integration using jenkins: Install & Configure Jenkins – Jenkins Architecture Overview – Creating a Jenkins Job – Configuring a Jenkins Job – Introduction to Plugins – Adding Plugins to Jenkins – Commonly Used Plugins – Configuring Jenkins to Work with Java, Git, and Maven – Creating a Jenkins Build and Jenkins Workspace.

Module II **22 Hours**

Configuration management using ansible: Ansible Introduction – Installation – Ansible Master/Slave Configuration – YAML Basics – Ansible Modules – Ansible Inventory Files – Ansible Playbooks – Ansible Roles – Ad-Hoc Commands in Ansible.

Building devops pipelines using azure: Create GitHub Account – Create Repository – Create Azure Organization – Create a New Pipeline – Build a Sample Code – Modify azure-pipelines.yaml File.

Course Outcomes	

At the end of this course, students will be able to:	**Cognitive Level**
CO1: Understand different actions performed through Version control tools like Git.	Understand
CO2: Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins.	Apply
CO3: Perform Automated Continuous Deployment.	Apply
CO4: Perform configuration management using Ansible and leverage Cloud-based DevOps tools using Azure DevOps.	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	-	-	2	-	1	-	-	-	-	-	-	-	-	-
CO4	-	3	2	-	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, 2nd Edition, Kindle Edition, 2016.

T2. Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014.

Reference Book(s):

R1. Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc.

R2. Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing.

R3. Paul C. Jorgensen, Software Testing: A Craftsman’s Approach, 4th Edition, Taylor & Francis Group, 2014.

R4. Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, Packt Publishing, 2018.

Web References:

1. https://azuredevopslabs.com/labs/vstsextend/azuredevopsprojectdotnet/
2. https://www.javatpoint.com/azure-devops-pipeline

Course Code: 23AME031	Course Title: Security in Web Technologies		
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 aims to provide a comprehensive understanding of web application security fundamentals, focusing on secure development and deployment practices. Students will learn how to build secure APIs and grasp the basics of vulnerability assessment and penetration testing. Additionally, the course will offer insights into hacking techniques and tools used in the field.

Module I **23 Hours**

Fundamentals of web application security: The History of Software Security – Recognizing Web Application Security Threats – Web Application Security – Authentication and Authorization – Secure Socket Layer – Transport Layer Security – Session Management – Input Validation

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

Practical Exercises:

1. Install wireshark and explore the various protocols
   a. Analyze the difference between HTTP vs HTTPS
   b. Analyze the various security mechanisms embedded with different protocols.
2. Identify the vulnerabilities using OWASP ZAP tool
3. Create simple REST API using python for following operation
   GET
   a. PUSH
   b. POST
   c. DELETE
4. Install Burp Suite to do following vulnerabilities:

SQL injection

a. cross-site scripting (XSS)

5. Attack the website using Social Engineering method.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply the basic concepts of web application security and the need for it	Apply
CO2: Achieve secure development and deployment of web applications using Maven & Gradle.	Apply
CO3: Acquire the skill to design and develop Secure Web Applications that use Secure APIs	Apply
CO4: Perform out vulnerability assessment and penetration testing AND Acquire the skill to think like a hacker and to use hackers tool sets.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Textbooks(s):

T1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, 1st Edition, 2020, O'Reilly Media, Inc

T2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw- Hill Companies Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.

Reference Book(s):

R1. Michael Cross, "Developer's Guide to Web Application Security", Syngress Publishing, Inc, 2007.

R1. Michael Cross, “Developer’s Guide to Web Application Security”, Syngress Publishing, 2007.
R2. Ravi Das and Greg Johnson, “Testing and Securing Web Applications”, Taylor & Francis Group, LLC, 2021.
R3. Prabath Siriwardena, Advanced API Security, A press Media LLC, USA, 2020.
R4. Malcom McDonald, “Web Security for Developers”, No Starch Press, Inc, 2020.
R5. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking, “The Ethical Hacker’s Handbook”, 3rd Edition, The McGraw-Hill Companies, 2011.

Web References:

1. https://www.udemy.com/course/ethical-hacking-pentesting-tools/
2. https://www.geeksforgeeks.org/5-common-hacking-techniques-used-by-hackers/

Course Code: 23AME032		Course Title: Essentials of Business Management	
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 aims to outline the evolution of management and teach its functions and principles. Students will learn how to apply these principles in organizations and explore various HR-related activities.

Module I **23 Hours**

Introduction to management and organizations: Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

Planning: Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process

Module II **22 Hours**

Organising: Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

Directing: Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

Controlling: System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Discuss of managerial functions like planning, organizing, staffing, leading & controlling.	Understand
CO2: Use planning and decision-making tools to support strategic and operational goals.	Apply
CO3: Analyze organizational structures and HR practices to determine their impact on team efficiency and workflow.	Analyze
CO4: Illustrate effective techniques in leadership, motivation, communication, and control within business environments.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. David S. Bright, Anastasia H. Cortes, Eva Hartmann, “Principles of Management”, Independently Publlication, 2023.

T2. Harold Koontz and Heinz Weihrich “Essentials of management” Tata McGraw Hill,1998.

T3. Stephen P. Robbins and Mary Coulter, “Management”, Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

Reference Book(s):

R1. Robert Kreitner and MamataMohapatra, “ Management”, Biztantra, 2008.

R2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011.

R1. Robert Kreitner and MamataMohapatra, “ Management”, Biztantra, 2008.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_mg104/preview
2. https://elearn.nptel.ac.in/shop/nptel/principles-of-management/?v=c86ee0d9d7ed

Vertical V

(Emerging Technologies)

Course Code: 23AME033		Course Title: Augmented Reality and Virtual Reality	
Course Category: Professional Elective		Course Level: Mastery	
L: T: P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Course Objectives:

This course aims to impart the fundamental aspects, principles of AR/VR technologies. The course imparts various hardware & software components, technologies involved in development of AR/VR enabled applications.

Module I **24 Periods**

Introduction: Introduction - Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

VR Modeling: Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants – Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Mapping – Behavior Modeling – Model Management.

VR Programming: VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D.

Module II **21 Periods**

Applications: Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.

Augmented Reality: Introduction to Augmented Reality - Computer vision for AR –Interaction - Modelling and Annotation - Navigation - Wearable devices.

PRACTICAL EXERCISES:

1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection types by handling camera.
3. Download objects from asset store and apply various lighting and shading effects.
4. Model three dimensional objects using various modelling techniques and apply textures over them.
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
9. Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.
10. Develop simple MR enabled gaming applications.

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018.

Reference Book(s):

R1. Thomas H. Cormen,Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, 3rd Edition, MIT Press and McGraw-Hill Publications,2009.

R2. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson Education Asia, New Delhi, 2011.

R3. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran,”Fundamentals of Computer Algorithms”, 2nd Edition, Galgotia Publications, NewDelhi 2008.

Web References:

1. https://archive.nptel.ac.in/courses/111/105/111105090/
2. https://archive.nptel.ac.in/courses/111/105/111105041/

Course Code: 23AME034		Course Title: Robotic Process Automation	
Course Category: Professional Elective		Course Level: Mastery	
L: T: P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to provide knowledge about basics concepts of robotic automation and exposure to hey RPA design and development strategies and methodologies. The students can explore the Exception Handling, Debugging, deployment and maintenance of software bot.

Module I **24 Periods**

Introduction: 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. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files

Automation Process Activities VR Modeling: 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, Explorer, Handling Events

APP Integration, Recording and Scraping: App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, scraping data from website and writing to CSV. Process Mining.

Module II **21 Periods**

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, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Articulate the key distinctions between RPA and existing automation techniques and platforms	Apply
CO2: Implement design control flows and work flows for the target process, recording, web scraping and process mining by automation	Apply
CO3: Detect and handle exceptions in automation processes	Apply
CO4: Develop automated bots and processes.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. 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. Richard Murdoch, “Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant”, Amazon Asia-Pacific Holdings Private Limited, 2018.

Web References:

1.https://www.uipath.com/rpa/robotic-process-automation

2.https://www.academy.uipath.com

Course Code: 23AME035		Course Title: Solve Business Problem With AI	
Course Category: Professional Elective		Course Level: Mastery	
L: T: P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to provide ability to relate with the practical uses of AI in day-to-day businesses and cautions need to be observed while working with AI. To make students to apply AI concepts to boost business productivity.

Module I **25 Periods**

Introduction to AI in Business: AI applications for business optimization - Cost minimization strategies with AI solutions Deep Q-learning and action selection policies.

Applying AI and ML to Business Problems: Identifying data-driven emerging technologies - Data hierarchy, big data, and data mining in business- Challenges and solutions in AI/ML applications - Machine learning models and workflow overview.

Choosing the Right AI Tools: Importance of tool selection in AI applications - Hardware requirements: Parallel processors, GPUs, and cloud platforms -Overview of cloud hosting services: AWS, Azure, Google TPUs -Exploration of open-source and proprietary AI tools.

Module II **20 Periods**

Data Privacy and Ethical Practices: Introduction to data protection and privacy laws - Privacy by design principles in AI applications Addressing bias, prejudice, and discrimination challenges -Ethics in NLP and considerations for unintended data use.

Case Studies in AI Application: Real-world case studies illustrating successful AI implementations in diverse business scenarios like - Customer Segmentation in E-Commerce, Healthcare Diagnostics with Image Recognition.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain practical uses of AI in day-to-day businesses.	Understand
CO2: Chose and apply right AI tools for building applications and to boost business productivity.	Apply
CO3: Apply ethical practices and data privacy principles in real-world computing scenarios. .	Apply

CO4: Apply AI Tools and Technologies for different application domain	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. M.C. Trivedi ," A Classical Approach to Artificial Intelligence", Khanna Book Publishing.

T2. Matt Ward, " Artificial Intelligence in Practice by Bernard Marr ", O'Reilly, 2019.

References.

Reference Book(s):

R1. Steven Finlay, "Artificial Intelligence and Machine Learning for Business: A No Nonsense Guide to Data Driven Technologies by Steven Finlay", Relativistic publishers, 2017.

Web References:

1. https://www.coursera.org/learn/solve-problems-ai-machine-learning

Course Code: 23AME036		Course Title: Dynamic Cyber Protection	
Course Category: Professional Elective		Course Level: Mastery	
L: T: P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to teach foundations of cybercrime and cyber law while covering cyber-attacks and tools used to gather different information gathering techniques. To make students develop intrusion detection techniques and to implement firewalls and prevention systems.

Module I **24 Periods**

Introduction: CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment

Attacks and Countermeasures: OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Counter measures.

Reconnaissance: Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology..

Module II **21 Periods**

Intrusion Detection: Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

Intrusion Prevention: Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the foundations of cybercrime and cyberlaw	Understand
CO2: Summarize various cyber-attacks, tools and develop different information gathering techniques.	Apply
CO3: Experiment with different intrusion detection techniques..	Apply
CO4: Build firewalls and Intrusion Prevention Systems	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021.

Reference Book(s):

R1. David Kim, Michael G. Solomon, “Fundamentals of Information Systems Security”, Jones and Bartlett Learning Publishers, 2013.

R2. Patrick Engebretson, “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing made easy”, Elsevier, 2011.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_me108/preview

Course Code: 23AME037		Course Title: Computational Quantum Mechanics	
Course Category: Professional Elective		Course Level: Mastery	
L: T: P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to introduce the concepts of classical and quantum computing to make students to gain knowledge on hardware and mathematical models needed for quantum computation. To teach the basics of quantum information theory and quantum cryptography

Module I **24 Periods**

Quantum Computing Basic Concepts: Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits – Superpositions

Quantum Gates and Circuits: Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction.

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

Module II **21 Periods**

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

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

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Describe the basics of quantum computing and articulate the background of quantum mechanics.	Understand
CO 2: Discuss principles of quantum algorithms .	Understand
CO 3: Describe principles of various quantum information theorem.	Understand
CO 4: Demonstrate knowledge in quantum cryptography.	Understand

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Parag K Lala, Mc Graw Hill Education, “Quantum Computing, A Beginners Introduction”, First Edition, 2020.

T2. Michael A. Nielsen, Issac L. Chuang, “Quantum Computation and Quantum Information”,Tenth Edition, Cambridge University Press, 2010.

Reference Book(s):

R1. Chris Bernhardt, “Quantum Computing for Everyone”, The MIT Press; Reprint edition 2020.

R2. Scott Aaronson, “Quantum Computing Since Democritus”, Cambridge University Press,2013.

Web References:

1. https://nptel.ac.in/courses/106106232

Course Code: 23AME038		Course Title: Crypto Currency and Block Chain Technologies	
Course Category: Professional Elective		Course Level: Mastery	
L: T: P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to introduce basics of blockchain including different protocols and consensus algorithms needed for implementation. To make students explain and experiment with blockchain applications using the Hyperledger fabric, Ethereum networks.

Module I **24 Periods**

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

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

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

Module II **21 Periods**

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

Blockchain Applications: Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance, etc- Case Study.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply abstract models of Blockchain Technology to explore solutions for challenges in the cryptocurrency domain.	Apply
CO2: Demonstrate how Blockchain secures distributed ledgers through its core functions and mechanisms.	Apply
CO3: Experiment with Hyperledger Fabric and Ethereum networks to implement and test blockchain functionalities..	Apply
CO4: Apply hyperledger Fabric and Ethereum platform to implement the blockchain Application.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021.

Reference Book(s):

R1. David Kim, Michael G. Solomon, “Fundamentals of Information Systems Security”, Jones and Bartlett Learning Publishers, 2013.

R2. Patrick Engebretson, “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing made easy”, Elsevier, 2011.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_me108/preview

Course Code: 23AME039		Course Title: Game Programming and Design	
Course Category: Professional Elective		Course Level: Mastery	
L: T: P(Periods/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to teach basics of 2D,3D graphics and stages involved in game development. To provide knowledge about game engine and various toolkits available to develop simple games using Pygame environment.

Module I **23 Periods**

3D Graphics For Game Design: Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation.

Game Design Principles: Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production.

Game Engine Design: Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine – Collision Detection – Game Logic – Game AI – Path finding.

Module II **22 Periods**

Overview of Gaming Platforms And Frameworks: Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and Multi-Player games.

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 – Overview of Isometric and Tile Based arcade Games – Puzzle Games.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the concepts of 2D,3D Graphics and principles involved in game Designing.	Understand
CO2: Implement Game Engines	Apply
CO3: Identify environments and frameworks for developing Games.	Apply
CO4: Implement a simple game in Python.	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Text Book(s):

T1. Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison Wesley, 2013.

Reference Book(s):

R1. Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress,2007.

Web References:

1. https://onlinecourses.nptel.ac.in/noc21_me76/preview

Course Code: 23AME040		Course Title: 3D Printing and Design	
Course Category: Professional Elective		Course Level: Mastery	
L: T: P (Periods/Week) 3: 0: 0	Credits:3	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to introduce the basics of 3D printing and principles involved in it. To make the students to implement 3D printing for industrial applications by understanding Inkjet and Laser technology.

Module I **24 Periods**

Introduction: Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File formats.

Principle: Processes – Extrusion, Wire, Granular, Lamination, Photo polymerisation; Materials - Paper, Plastics, Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene; Material Selection - Processes, applications, limitations.

Inkjet Technology: Printer - Working Principle, Positioning System, Print head, Print bed, Frames, Motion control; Print head Considerations – Continuous Inkjet, Thermal Inkjet, Piezoelectric Drop-On-Demand; Material Formulation for jetting; Liquid based fabrication – Continuous jet, Mulitjet; Powder based fabrication –Colour jet.

Module II **21 Periods**

Laser Technology: Light Sources – Types, Characteristics; Optics – Deflection, Modulation; Material feeding and flow –Liquid, powder; Printing machines – Types, Working Principle, Build Platform, Print bed Movement, Support structures.

Industrial Applications: Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology; Displays; Future trends.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Outline the basic concepts of 3D printing technology and examine the workflow.	Understand
CO 2: Explain the concepts and working principles of 3D printing using inkjet technique.	Understand
CO 3: Explain the characteristics and working principles of 3D printing using laser technique.	Apply
CO 4: Develop application using 3D printing .	Apply

Course Articulation Matrix

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

High-3; Medium-2; Low-1

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