MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE

MADANAPALLE

(UGC-AUTONOMOUS)

www.mits.ac.in

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE)

Course Structure

&

Detailed Syllabi

For the students admitted to

B. Tech. Regular Four Year Degree Programme from the Academic Year 2023-24

and

B. Tech. Lateral Entry Scheme from the Academic Year 2024-25

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE)

Vision and Mission of the Institution

Vision	To become a globally recognized research and academic institution and thereby contribute to technological and socio-economic development of the nation
Mission	To foster a culture of excellence in research, innovation, entrepreneurship, rational thinking and civility by providing necessary resources for generation, dissemination and utilization of knowledge and in the process create an ambience for practice-based learning to the youth for success in their careers.

Vision and Mission of the Department

Vision	To develop socially responsible, globally competent and skilled professionals with ethics through education and research in the field of Artificial intelligence.
Mission	➢ To educate the students in fundamental principles of Mathematics, Statistics and Artificial Intelligence with required infrastructure and well qualified faculty. ➢ To provide state-of-the art computing laboratory facilities for strengthening innovation, research & development. ➢ To motivate students to emerge as entrepreneurs with self-learning abilities, team spirit and leadership qualities through continuous industry-institute interaction.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To demonstrate proficiency in applying Artificial Intelligence methodologies to solve complex real-world problems across various domains, utilizing a wide range of techniques such as Statistics, Image Processing, Machine Learning, Deep Learning and Artificial Intelligence.

PEO2: To Excel with professional skills and cutting-edge technologies to pursue careers as AI researchers or entrepreneurs.

PEO3: To exhibit professionalism, ethics, and social awareness, while demonstrating teamwork, communication, and leadership.

PROGRAM OUTCOMES (POs)

At the end of the programme, graduate will be able to

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: 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.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norm of the engineering practice.

PO9: Individual and teamwork: 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 t h e 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.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: 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)

PSO1: Apply the skills in the diverse fields of Artificial Intelligence including Health Care, Environment, Agriculture and more.

PSO2: Ability to employ modern AI Tools and platforms enables the creation of innovative career paths as an entrepreneur and fosters a continuous learning.

PSO3: Design and implement AI-powered solutions using learning algorithms and methods for societal benefits.

MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE, MADANAPALLE

B. Tech Four Year Curriculum Structure

Branch: COMPUTER SCIENCE AND ENGINEERING

(ARTIFICIAL INTELLIGENCE)

Total Credits	163 Credits for 2023(Regular) & 123 Credits 2024(Lateral Entry) Admitted Batch onwards

I. Induction Program and Holistic Development Activities

Sl.No	Title	Duration
1	Induction Program (Mandatory)	Three weeks' duration at the start of First Year

R23 - Curriculum Structure
I Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	HSMC	23ENG101	Communicative English	2	0	0	2	2
2	BSC	23MAT101	Linear Algebra and Calculus	3	0	0	3	3
3	BSC	23CHE102	Chemistry	3	0	0	3	3
4	ESC	23CME101	Basic Civil and Mechanical Engineering	3	0	0	3	3
5	ESC	23CSE101	Introduction to Programming	3	0	0	3	3
6	HSMC	23ENG201	Communicative English Laboratory	0	0	2	2	1
7	BSC	23CHE202	Chemistry Laboratory	0	0	2	2	1
8	ESC	23CSE201	Computer Programming Laboratory	0	0	3	3	1.5
9	ESC	23ME201	Engineering Workshop	0	0	3	3	1.5
10	HSMC	23HUM201	Health and Wellness, Yoga and Sports	-	-	1	1	0.5
Total				**14**	**0**	**11**	**25**	**19.5**

I Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	BSC	23MAT102	Differential Equations and Vector Calculus	3	0	0	3	3
2	BSC	23PHY101	Engineering Physics	3	0	0	3	3
3	ESC	23EEE101	Basic Electrical and Electronics Engineering	3	0	0	3	3
4	ESC	23ME101	Engineering Graphics	1	0	4	5	3
5	PCC	23CSE102	Data Structures	3	0	0	3	3
6	BSC	23PHY201	Engineering Physics Laboratory	0	0	2	2	1
7	ESC	23EEE201	Electrical and Electronics Engineering Workshop	0	0	3	3	1.5
8	ESC	23CSE202	IT Workshop	0	0	2	2	1
9	PCC	23CSE203	Data Structures Laboratory	0	0	3	3	1.5
10	HSMC	23HUM202	NSS / NCC / Scouts and Guides / Community Service	-	-	1	1	0.5
Total				**13**	**0**	**15**	**28**	**20.5**

(L = Lecture, T = Tutorial, P = Practical, C = Credit

R23 - Curriculum Structure
II Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	HSMC	23HUM101	Universal Human Values	2	1	0	3	3
2	HSMC	23HUM102	Economics and Financial Accounting For Engineers	2	0	0	2	2
3	BSC	23MAT107	Probability and Statistics for Computer Science	3	0	0	3	3
4	PCC	23CAI101	Principles of Artificial Intelligence	3	0	0	3	3
5	PCC	23CAI102	Advanced Data Structures and Algorithms Analysis	2	1	0	3	3
6	PCC	23CAI104	Database Management Systems	3	0	0	3	3
7	PCC	23CAI201	Advanced Data Structures and Algorithms Analysis Laboratory	0	0	3	3	1.5
8	PCC	23CAI202	Database Management Systems Laboratory	0	0	3	3	1.5
9	SEC		**Skill Enhancement Course – I** *(Refer ANNEXURE - VI)*	1	0	2	3	2
Total				**16**	**2**	**8**	**26**	**22**

II Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	BSC	23MAT108	Discrete Mathematical Structures	3	0	0	3	3
2	ESC	23CAI103	Digital Logic and Computer Organization	3	0	0	3	3
3	ESC		**Design Thinking and Innovation Related Courses** *(Refer ANNEXURE - II)*	1	0	2	2	2
4	PCC	23CAI105	Machine Learning	2	1	0	3	3
5	PCC	23CAI106	Object-Oriented Programming Through JAVA	3	0	0	3	3
6	PCC	23CAI203	Artificial Intelligence and Machine Learning Laboratory	0	0	3	3	1.5
7	PCC	23CAI204	Object-Oriented Programming Through JAVA Laboratory	0	0	3	3	1.5
8	SEC		**Skill Enhancement Course – II** *(Refer ANNEXURE - VI)*	1	0	2	3	2
9	Audit Course	23CHE901	Environmental Science	2	0	0	2	-
Total				**15**	**1**	**10**	**25**	**19**

(L = Lecture, T = Tutorial, P = Practical, C = Credit

R23 - Curriculum Structure
III Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PCC	23CAI107	Big Data Analytics and AI Applications	3	0	0	3	3
2	PCC	23CAI108	Cloud Computing for AI	2	1	0	3	3
3	PCC	23CAI109	Deep Learning	3	0	0	3	3
4	ESC	23PHY102	Introduction to Quantum Technologies and Applications	3	0	0	3	3
5	PE		**Professional Elective-I** *(Refer ANNEXURE - IV)*	3	0	0	3	3
6	OE		**Open Elective – I** *(Refer ANNEXURE - III)*	3	0	0	3	3
7	PCC	23CAI205	Big Data Analytics Laboratory	0	0	3	3	1.5
8	PCC	23CAI206	Deep Learning Laboratory	0	0	3	3	1.5
9	SEC		**Skill Enhancement Course – III** *(Refer ANNEXURE - VI)*	1	0	2	3	2
10	AUC	23ENG901	Technical Paper Writing and IPR	2	0	0	2	-
11	PROJ	23CAI701	Summer Internship I	0	0	4	4	2
Total				**20**	**1**	**12**	**33**	**25**

III Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PCC	23CAI110	Computer Vision and Image Processing	3	0	0	3	3
2	PCC	23CAI111	Natural Language Processing	3	0	0	3	3
3	PCC	23CAI112	Exploratory Data Analysis with Python	2	1	0	3	3
4	PE		**Professional Elective - II** *(Refer ANNEXURE - IV)*	3	0	0	3	3
5	PE		**Professional Elective - III** *(Refer ANNEXURE - IV)*	3	0	0	3	3
6	OE		**Open Elective - II** *(Refer ANNEXURE - III)*	3	0	0	3	3
7	PCC	23CAI207	Computer Vision Laboratory	0	0	3	3	1.5
8	PCC	23CAI208	Natural Language Processing Laboratory	0	0	3	3	1.5
9	SEC		**Skill Enhancement Course – IV** *(Refer ANNEXURE - VI)*	1	0	2	3	2
10	ESC	23ECE501	Tinkering Laboratory	0	0	2	2	1
11	MC	23CAI901	Workshop*	0	0	0	0	0
Total				**18**	**1**	**10**	**29**	**24**

(L = Lecture, T = Tutorial, P = Practical, C = Credit

*Domain specific workshop should be completed at the end of III Year I Semester

Tentative Structure for Final Year:

R23 - Curriculum Structure
IV Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PCC	23CAI113	Generative AI and Prompt Engineering	3	0	0	3	3
2	MC		**Management Course** *(Refer ANNEXURE - V)*	2	0	0	2	2
3	PE		**Professional Elective – IV** *(Refer ANNEXURE - IV)*	3	0	0	3	3
4	PE		**Professional Elective – V** *(Refer ANNEXURE - IV)*	3	0	0	3	3
5	OE		**Open Elective - III** *(Refer ANNEXURE - III)*	3	0	0	3	3
6	OE		**Open Elective – IV** *(Refer ANNEXURE - III)*	3	0	0	3	3
7	SEC		**Skill Enhancement Course – V** *(Refer ANNEXURE - VI)*	1	0	2	3	2
8	AUC	23HUM901	Gender Sensitization	2	0	0	2	-
9	PROJ	23CAI702	Summer Internship II	0	0	4	4	2
Total				**20**	**0**	**6**	**26**	**21**

IV Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PROJ	23CAI703	Project Work and Internship	0	0	24	24	12
Total				**0**	**0**	**24**	**24**	**12**

(L = Lecture, T = Tutorial, P = Practical, C = Credit

ANNEXURE - I

THREE WEEK MANDATORY INDUCTION PROGRAMME

- Yoga and Meditation
- Sports and Games
- NSS
- NCC
- MITS Social Responsibility Club
- Management module
- Design Thinking
- Spoken and Written Communication

- ***Proficiency modules***

  - Basic Computer Proficiency
  - Interpersonal skills
  - Computer Graphics
  - Web programming
  - Mobile Apps
  - Vocabulary enhancement

HOLISTIC DEVELOPMENT ACTIVITIES

Description of Activities

1. Physical and Health
2. Culture
3. Literature and Media
4. Social Service
5. Self-Development
6. Nature and Environment
7. Innovation

ANNEXURE - II

DESIGN THINKING AND INNOVATION RELATED COURSES (To be offered under MOOC's Category from SWAYAM – NPTEL)		
Sl. No.	**Course Code**	**Course Title**
1	23IIC5M01	Design, Technology and Innovation
2	23IIC5M02	Introduction on Intellectual Property to Engineers and Technologists
3	23IIC5M03	Product Engineering and Design Thinking
4	23IIC5M04	Intellectual Property Rights and Competition Law
5	23IIC5M05	Innovation, Business Models and Entrepreneurship
6	23IIC5M06	Understanding Incubation and Entrepreneurship
7	23IIC5M07	Intellectual Property
8	23IIC5M08	Roadmap for Patent Creation
Any new Innovation and Incubation Course offered by SWAYAM NPTEL can be appended in future.		

ANNEXURE - III

OPEN ELECTIVE – I (To be offered under Conventional Mode)			
Sl. No.	**Course Code**	**Course Title**	**Course Offered by Department of**
1	23HUM301	Indian Knowledge System	Humanities
2	23MAT301	Advanced Numerical Methods	Mathematics
3	23MAT302	Engineering Optimization	Mathematics
4	23PHY301	LASER Physics and Advanced LASER Technology	Physics
5	23PHY302	Thin Film Technology and its Applications	Physics
6	23PHY303	Waste To Sustainable Energy and Energy Systems	Physics
7	23CHE301	Chemistry of Polymers and its Applications	Chemistry
8	23CHE302	Green Chemistry and Catalysis for Sustainable Environment	Chemistry
9	23CHE303	Chemistry of Energy Systems	Chemistry
10	23CE301	Disaster Management	Civil
11	23CE302	Green Buildings	Civil
12	23ME301	Materials Science for Engineers	Mechanical
13	23ME302	Sustainable Energy Technologies	Mechanical
14	23EEE301	Electrical Safety Practices and Standards	EEE
15	23EEE302	Introduction to MEMS	EEE
16	23ECE301	Bio-Medical Electronics	ECE
17	23ECE302	VLSI Design	ECE
Any new Interdisciplinary Course can be appended in future.			

OPEN ELECTIVE – II

(To be offered under MOOC's Category from SWAYAM – NPTEL)

Sl. No.	Course Code	Course Title	Course Offered by Department of
1	23HUM3M01	English Language for Competitive Exams	Humanities and Social Sciences
2	23HUM3M02	Public Speaking	Humanities and Social Sciences
3	23HUM3M03	Indian Business History	Humanities and Social Sciences
4	23HUM3M04	Indian Economy: Some Contemporary Perspectives	Humanities and Social Sciences
5	23MG3M01	E – Business	Management
6	23MG3M02	AI in Human Resource Management	Management
7	23MG3M03	AI in Marketing	Management
8	23CE3M01	Plastic Waste Management	Civil
9	23CE3M02	Safety in Construction	Civil
10	23ME3M01	Operations Management	Mechanical
11	23EEE3M01	Transducers For Instrumentation	EEE
12	23ECE3M01	Microprocessors and Interfacing	ECE
13	23ECE3M02	Microprocessors and Microcontrollers	ECE
14	23MD3M01	Research Methodology	Multidisciplinary

Any new Interdisciplinary Course offered by SWAYAM NPTEL can be appended in future.

OPEN ELECTIVE – III

(To be offered under MOOC's Category from SWAYAM – NPTEL)

Sl. No.	Course Code	Course Title	Course Offered by Department of
1	23HUM3M05	Indian Society: Sociological Perspectives	Humanities and Social Sciences
2	23MAT3M01	Foundations of R Software	Mathematics
3	23MAT3M02	Foundations of R Software (in Hindi Language)	Mathematics
4	23MGM05	HR Analytics	Management
5	23MG3M06	Management Information System	Management
6	23MG3M07	Business Analytics & Text Mining Modeling using Python	Management
7	23CE3M03	Building Materials and Composites	Civil
8	23ME3M02	Power Plant Engineering	Mechanical
9	23EEE3M02	Design of Photovoltaic Systems	EEE
10	23ECE3M03	System Design Through Verilog	ECE
11	23MD3M03	Learning Analytics Tools	Multidisciplinary
Any new Interdisciplinary Course offered by SWAYAM NPTEL can be appended in future.			

OPEN ELECTIVE – IV

(To be offered under Conventional Mode)

Sl. No.	Course Code	Course Title	Course Offered by Department of
1	23PHY304	Smart Materials and Devices	Physics
2	23CHE304	Introduction to Nano Science and Technology	Chemistry
3	23CHE305	Water Pollution and its Management	Chemistry
4	23CE303	Environmental Impact Assessment	Civil
5	23CE304	Ground Improvement Techniques	Civil
6	23CE305	Sustainability in Engineering Practice	Civil
7	23ME303	Total Quality Management	Mechanical
8	23ME304	3D Printing Technologies	Mechanical
9	23EEE303	Robotics	EEE
10	23ECE303	Embedded Systems	ECE
11	20ECE304	DSP Architecture	ECE
12	20ECE305	Community Radio Technology	ECE
Any new Interdisciplinary Course can be appended in future.			

ANNEXURE – V

List of Professional Elective

Professional Elective – I (To be offered under MOOC's Category from SWAYAM – NPTEL)		
Sl. No.	**Course Code**	**Course Title**
1.	23CAI4M01	Operating System Fundamentals
2.	23CAI4M02	Introduction to Internet of Things
3.	23CAI4M03	Introduction to Soft Computing
4.	23CAI4M04	Introduction to Operating Systems
5.	23CAI4M05	Human Computer Interaction (in English)
6.	23CAI4M06	Human Computer Interaction (in Hindi)
Any other new Disciplinary Course which doesn't exist in the Curriculum can be appended in future.		

Professional Elective – II		
Sl. No.	**Course Code**	**Course Title**
1.	23CAI401	Graph Neural Networks
2.	23CAI402	Recommender Systems
3.	23CAI403	Predictive Analytics
4.	23CAI404	Blockchain for AI
Any advanced courses can be appended in future.		

Professional Elective – III		
Sl. No.	**Course Code**	**Course Title**
1.	23CAI405	AI for Finance
2.	23CAI406	Malware Analysis
3.	23CAI407	Social Network Analysis
4.	23CAI408	Cybersecurity and AI-driven Threat Detection
Any advanced courses can be appended in future.		

Professional Elective – IV		
Sl. No.	**Course Code**	**Course Title**
1.	239AI409	Explainable AI and Model Interpretability
2.	23CAI410	AI for Robotics
3.	23CAI411	AI in Cybersecurity
4.	23CAI412	AI Driven Software Engineering and DevOps
Any advanced courses can be appended in future.		

Professional Elective –V		
Sl. No.	**Course Code**	**Course Title**
1	23CAI413	AI for Smart Cities and IOT Systems
2	23CAI414	MLOps and AI Model Deployment
3	23CAI415	Data Wrangling
4	23CAI416	Healthcare AI
Any advanced courses can be appended in future.		

ANNEXURE – V

MANAGEMENT COURSE		
Sl. No.	**Course Code**	**Course Title**
1	23HUM103	Business Ethics and Corporate Governance
2	23HUM104	Principles of Management
3	23HUM105	Human Resource Development
4	23HUM106	Management Science
5	23HUM107	National Cadet Corps

ANNEXURE – VI

List of Skill Enhancement Courses

Skill Enhancement Course – I		
Sl. No.	**Course Code**	**Course Title**
1.	23CAI601	Python programming
Any Courses in Communication Skills can be appended in future.		

Skill Enhancement Course – II		
Sl. No.	**Course Code**	**Course Title**
1.	23CAI602	Full Stack Development I
Any Courses can be appended in future.		

Skill Enhancement Course – III		
Sl. No.	**Course Code**	**Course Title**
1.	23CAI603	Full Stack Development II
2.	23CAI604	System Software Programming
Any Courses can be appended in future.		

Skill Enhancement Course – IV		
Sl. No.	**Course Code**	**Course Title**
1.	23ENG601	Soft Skills
Any Courses can be appended in future.		

Skill Enhancement Course – V		
Sl. No.	**Course Code**	**Course Title**
1.	23CAI605	Prompt Engineering
Any Courses can be appended in future.		

ANNEXURE – VII

Minor in Computer Science and Engineering (Artificial Intelligence)

(Applicable to CE, EEE, ME and ECE)

Stream Name: Artificial Intelligence

SI.No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact Hours	
III Year I Semester								
1	Professional Core Course	23MDCAI101	Fundamentals of Artificial Intelligence	3	0	0	3	3
2	Professional Core Course	23MDCAI102	Design and Analysis of Algorithms	3	0	0	3	3
3	Professional Core Course	23MDCAI201	Fundamentals of Artificial Intelligence Laboratory	0	0	3	3	1.5
III Year II Semester								
4	Professional Core Course	23MDCAI103	Computer Vision	3	0	0	3	3
5	Professional Core Course	23MDCAI104	Deep Learning Techniques	3	0	0	3	3
6	Professional Core Course	23MDCAI202	Computer Vision Laboratory	0	0	3	3	1.5
IV Year I Semester								
7	Professional Core Course	23MDCAI105	Natural Language Processing	3	0	0	3	3
			Total	**15**	**0**	**6**	**21**	**18**

Minor in Quantum Computing

(Applicable to CE, EEE, ME, ECE, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

Stream Name: Quantum Computing

Sl. No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact Hours	
III Year I Semester								
1	Professional Core Course	23MDINS101	Introduction to Quantum Computing	3	0	0	3	3
2	Professional Core Course	23MDINS102	Mathematical Foundations for Quantum Computing	3	0	0	3	3
3	Professional Core Course	23MDINS201	Quantum Programming and Simulation Laboratory	0	0	3	3	1.5
III Year II Semester								
4	Professional Core Course	23MDINS103	Quantum Algorithms	3	0	0	3	3
5	Professional Core Course	23MDINS104	Quantum Information and Communication	3	0	0	3	3
6	Professional Core Course	23MDINS202	Quantum Algorithms Laboratory	0	0	3	3	1.5
IV Year I Semester								
7	Professional Core Course	23MDINS105	Quantum Machine Learning (QML)	3	0	0	3	3
			Total	**15**	**0**	**6**	**21**	**18**

Minor in Quantum Technologies

(Applicable to CE, EEE, ME, ECE, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

Stream Name: Quantum Technologies

Sl. No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact Hours	
III Year I Semester								
1	Professional Core Course	23MDINS106	Foundations of Quantum Technologies	3	0	0	3	3
2	Professional Core Course	23MDINS107	Solid State Physics for Quantum Technologies	3	0	0	3	3
3	Professional Core Course	23MDINS203	Quantum Devices and Materials Laboratory	0	0	3	3	1.5
III Year II Semester								
4	Professional Core Course	23MDINS108	Introduction to Quantum Communication	3	0	0	3	3
5	Professional Core Course	23MDINS109	Introduction to Quantum Sensing	3	0	0	3	3
6	Professional Core Course	23MDINS204	Quantum Communication and Sensing Laboratory	0	0	3	3	1.5
IV Year I Semester								
7	Professional Core Course	23MDINS110	Quantum Optics Prerequisites for Quantum Technologies	3	0	0	3	3
			Total	**15**	**0**	**6**	**21**	**18**

ANNEXURE – VIII

Honors in Computer Science and Engineering (Artificial Intelligence)

SI.No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact Hours	
III Year I Semester								
1	Professional Core Course	23HDCAI101	Cognitive Science and Analytics	3	0	0	3	3
2	Professional Core Course	23HDCAI102	Business Intelligence	3	0	0	3	3
3	Professional Core Course	23HDCAI201	Cognitive Science and Analytics Laboratory	0	0	3	3	1.5
III Year II Semester								
4	Professional Core Course	23HDCAI103	Data Warehousing and Mining	3	0	0	3	3
5	Professional Core Course	23HDCAI104	Expert System	3	0	0	3	3
6	Professional Core Course	23HDCAI202	Data Warehousing and Mining Laboratory	0	0	3	3	1.5
IV Year I Semester								
7	Professional Core Course	23HDCAI105	Federated Machine Learning	3	0	0	3	3
			Total	**15**	**0**	**6**	**21**	**18**

I Year I Semester

B. Tech I Year I Semester

23ENG101 COMMUNICATIVE ENGLISH

L	T	P	C
2	0	0	2

Pre-requisite: None

Course Objectives:

The main objective of introducing this course, Communicative English, is to facilitate effective listening, Reading, Speaking and Writing skills among the students. It enhances the same in their comprehending abilities, oral presentations, reporting useful information and providing knowledge of grammatical structures and vocabulary. This course helps the students to make them effective in speaking and writing skills and to make them industry ready.

UNIT I Lesson: HUMAN VALUES: Gift of Magi (Short Story) 6 hours

Listening: Identifying the topic, the context and specific pieces of information by listeningto short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home,family, work, studies and interests; introducing oneself and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces ofinformation.

Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.

Grammar: Parts of Speech, Basic Sentence Structures-forming questions

Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNIT II Lesson: NATURE: The Brook by Alfred Tennyson (Poem) 6 hours

Listening: Answering a series of questions about main ideas and supporting ideas afterlistening to audio texts.

Speaking: Discussion in pairs/small groups on specific topics followed by short structuretalks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to linkthe ideas in a paragraph together.

Writing: Structure of a paragraph - Paragraph writing (specific topics)

Grammar: Cohesive devices - linkers, use of articles and zero article; prepositions.

Vocabulary: Homonyms, Homophones, Homographs.

UNIT III Lesson: BIOGRAPHY: Elon Musk 6 hours

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groups and reporting what

isdiscussed

Reading: Readinga text in detail by making basic inferences -recognizing and interpretingspecific context clues; strategies to use text clues for comprehension.

Writing: Summarizing, Note-making, paraphrasing

Grammar: Verbs - tenses; subject-verb agreement; Compound words, Collocations
Vocabulary: Compound words, Collocations

UNIT IV Lesson: INSPIRATION: The Toys of Peace by Saki **6 hours**

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.
Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.
Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.
Writing: Letter Writing: Official Letters, Resumes
Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice
Vocabulary: Words often confused, Jargons

UNIT V Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay) **6 hours**

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.
Speaking: Formal oral presentations on topics from academic contexts
Reading: Reading comprehension.
Writing: Writing structured essays on specific topics.
Grammar: Editing short texts –identifying and correcting common errors in grammar andusage (articles, prepositions, tenses, subject verb agreement)
Vocabulary: Technical Jargons

Course Outcomes:

CO1: Understand the topic, context, and pieces of specific information from personal , professional and social situations
CO2: Apply discourse markers to speak clearly in formal discussions
CO3: Analyze and apply grammatical structures to formulate contextualized phrases and sentences
CO4: Analyze texts and images to write summaries based on global comprehension
CO5: Draft coherent paragraphs and structured essays

Text Books:

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023 (Units 1,2 & 3)
2. Empowering with Language by Cengage Publications, 2023 (Units 4 & 5)

Reference Books:

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

Web Resources

Grammer

1 www.bbc.co.uk/learningenglish
2 https://dictionary.cambridge.org/grammar/british-grammar/
3 www.eslpod.com/index.html
4 https://www.learngrammar.net/
5 https://english4today.com/english-grammar-online-with-quizzes/

VOCABULARY

1 https://www.youtube.com/c/DailyVideoVocabulary/videos
2 https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year I Semester

23MAT101 LINEAR ALGEBRA AND CALCULUS

L	T	P	C
3	0	0	3

Course Objectives:

To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

UNIT I MATRICES 9 hours

Rank of a matrix by echelon form, normal form. Cauchy–Binet formulae (without proof). Inverse of non-singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Jacobi and Gauss Seidel Iteration Methods.

UNIT II EIGENVALUES, EIGENVECTORS AND ORTHOGONAL TRANSFORMATION 9 hours

Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem,Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonicalforms by Orthogonal Transformation.

UNIT III CALCULUS 9 hours

Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

UNIT IV PARTIAL DIFFERENTIATION AND APPLICATIONS (MULTI VARIABLE CALCULUS) 9 hours

Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, Functional dependence, maxima and minima of functionsof two variables, method of Lagrange multipliers.

UNIT V MULTIPLE INTEGRALS (MULTI VARIABLE CALCULUS) 9 hours

Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Course Outcomes:

At the end of the course, the student will be able to

CO1: Solve the system of linear equations and apply the matrix algebra techniques in practical applications.

CO2: Utilize the Eigenvalues, Eigenvectors and applications of diagonalization in the field of Science and Technology.

CO3: Relate the results of mean value theorems in real life problems.

CO4: Apply the functions of several variables to evaluate the rates of change with respect to time and space variables in engineering.

CO5: Compute the area and volume by interlinking them to appropriate double and triple integrals.

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition

2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

Reference Books:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14^{th} Edition.
2. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, AlphaScience International Ltd., 2021 5^{th} Edition(9th reprint).
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5^{th}Edition.
4. Advanced Engineering Mathematics, Micheael Greenberg, Pearson publishers, 9^{th}edition
5. Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications, 2014, Third Edition (Reprint 2021)

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year I Semester

23CHE102 CHEMISTRY

L	T	P	C
3	0	0	3

Course Objectives:

1. To familiarize engineering chemistry and its applications
2. To train the students on the principles and applications of electrochemistry and polymers
3. To introduce instrumental methods, molecular machines and switches.

UNIT I STRUCTURE AND BONDING MODELS 9 hours

Fundamentals of Quantum mechanics, Schrodinger Wave equation, significance of Ψ and Ψ2, particle in one dimensional box, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of N2, O2 and NO, CO π-molecular orbitals of butadiene and benzene, calculation of bond order.

UNIT II MODERN ENGINEERING MATERIALS 9 hours

Semiconductors – Introduction, basic concept, role of doping agents, applications
Super conductors -Introduction, basic concept, applications.
Supercapacitors: Introduction, Basic Concept-Classification – Applications.
Nano materials: Introduction, classification, properties and applications of Fullerenes, carbon nano tubes and Graphene nanoparticles.

UNIT III ELECTROCHEMISTRY AND APPLICATIONS 9 hours

Electrochemical cell, Nernst equation, cell potential calculations and numerical problems, potentiometry- potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations).
Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with examples.
Primary cells – Zinc-air battery, Sodium-air battery, Secondary cells –lithium-ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen fuel cell– working of the cells. Polymer Electrolyte Membrane Fuel cells (PEMFC).

UNIT IV POLYMER CHEMISTRY 9 hours

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, with specific examples and mechanisms of polymer formation, Poly Dispersity Index (PDI) & it's significance
Plastics –Thermo and Thermosetting plastics, Preparation, properties and applications of – PVC, Teflon, Bakelite, Nylon-6,6, carbon fibres.
Elastomers–Buna-S, Buna-N–preparation, properties and applications.
Conducting polymers – polyacetylene, polyaniline, – mechanism of conduction and applications.
Bio-Degradable polymers - Poly Glycolic Acid (PGA), Poly Lactic Acid (PLA).

UNIT V INSTRUMENTAL METHODS AND APPLICATIONS 9 hours

Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. UV-Visible Spectroscopy, electronic transition, Instrumentation, IR spectroscopy, fundamental modes and selection rules, Instrumentation. Chromatography-Basic Principle, Classification-HPLC: Principle, Instrumentation and Applications.

Course Outcomes:

At the end of the course, the students will be able to:

CO1: Explain the foundations of Quantum mechanics and concept of bonding in homo and hetero diatomic molecules like O2, CO etc.

CO2: Apply the principle of Band diagrams in the application of conductors and semiconductors. Properties and applications of nanomaterials.

CO3: Compare the materials of construction for battery, its working principles, fuel cells & electrochemical sensors.

CO4: Explain the preparation, properties, and applications of thermoplastics & thermosetting & elastomers conducting polymers.

CO5: Explain the principles of spectrometry, technique of HPLC in separation of solid and liquid mixtures. Summarize the concepts of Instrumental methods.

Text Books:

1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.

2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e,Oxford University Press, 2010.

3. G V Subba Reddy, K N Jayaveera, C Ramachandraiah, Engineering Chemistry, McGraw-Hill; First Edition, 2019.

Reference Books:

1. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.

2. J.D. Lee, Concise Inorganic Chemistry, 5th Edition, Wiley Publications, Feb.2008

3. Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year I Semester

23CME101 BASIC CIVIL AND MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

Course Objectives:

4. Get familiarized with the scope and importance of Civil Engineering sub-divisions.
5. Introduce the preliminary concepts of surveying.
6. Acquire preliminary knowledge on Transportation and its importance in nation's economy.
7. Get familiarized with the importance of quality, conveyance and storage of water.
8. Introduction to basic civil engineering materials and construction techniques.

PART A: BASIC CIVIL ENGINEERING

UNIT I BASICS OF CIVIL ENGINEERING 8 hours

Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

UNIT II SURVEYING 8 hours

Objectives of Surveying- Horizontal Measurements- Angular Measurements- Introduction to Bearings Levelling instruments used for levelling -Simple problems on levelling and bearings-Contour mapping.

UNIT III TRANSPORTATION ENGINEERING 8 hours

Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering.

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

Course Outcomes:

CO1: Identify various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society.

CO2: Measure of distances, angles and levels through surveying.

CO3: Identify various transportation infrastructures, sources of water and various water conveyance, storage structures like dams and reservoirs.

Text Books:

1. Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt.Ltd. Fourth Edition.
2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers.2022. First Edition.
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.

Reference Books:

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. FifthEdition.
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, KhannaPublishers, Delhi. 2016
3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, KhannaPublishers, Delhi 2023. 38th Edition.
4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.
5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012.

PART B: BASIC MECHANICAL ENGINEERING

Course Objectives:

The students after completing the course are expected to

- Get familiarized with the scope and importance of Mechanical Engineering in different sectors and industries.
- Explain different engineering materials and different manufacturing processes.
- Provide an overview of different thermal and mechanical transmission systems and introduce basics of robotics and its applications.

UNIT I **8 hours**

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries andSociety-Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

UNIT II **8 hours**

Manufacturing Processes: Principles of Casting**,** Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

Thermal Engineering – working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

UNIT III **8 hours**

Power plants – working principle of Steam, Diesel, Hydro, Nuclear power plants. Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics - Joints & links, configurations, and applications of robotics.

(Note: The subject covers only the basic principles of Civil and Mechanical Engineering systems. The evaluation shall be intended to test only the fundamentals of the subject)

Course Outcomes:

On completion of the course, the student should be able to

CO1: Understand the role and importance of mechanical engineering and engineering materials

CO2: Identify the different manufacturing processes for engineering applications and explain the basics of thermal engineering and its applications.

CO3: Explain the working of different mechanical power transmission systems, power plants and robotics.

Text Books:

1. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India)Pvt. Ltd.

2. A Tear book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications,(India) Pvt. Ltd.

3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengagelearning India Pvt. Ltd.

Reference Books:

1. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I

2. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak MPandey, Springer publications

3. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt.Ltd.

4. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, TataMcGraw Hill publications (India) Pvt. Ltd.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year I Semester

23CSE101 INTRODUCTION TO PROGRAMMING

L	T	P	C
3	0	0	3

Course Objectives:

- Comprehensive knowledge to computer systems, programming languages, and problem-solving techniques.
- Know the concept of control structures and their usage in programming.
- Introduce to the arrays, memory models, and basic string concepts
- Gain a knowledge from the concept of functions, including declaration, definition, and various aspects of function usage.
- Acquire the advanced programming concepts, including user-defined data types, pointers, and file handling.

UNIT I INTRODUCTION TO PROGRAMMING AND PROBLEM SOLVING **9 hours**

History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program- Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting. Problem solving techniques: Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

UNIT II CONTROL STRUCTURES **9 hours**

Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, do- while) Break and Continue.

UNIT III ARRAYS AND STRINGS **9 hours**

Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings, String Operations and String functions.

UNIT IV POINTERS & USER DEFINED DATA TYPES **9 hours**

Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, User-defined data types-Structures and Unions, Dynamic memory allocation.

UNIT V FUNCTIONS & FILE HANDLING **9 hours**

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scope and Lifetime of Variables, Basics of File Handling

Note: The syllabus is designed with C Language as the fundamental language of implementation**.**

Course Outcomes:

A student after completion of the course will be able to

CO1: Illustrate the basic computer concepts and programming principles of C language.

CO2: Develop programs using various control structures in 'C'.

CO3: Design applications using arrays and basic string manipulation.

CO4: Demonstrate the applications of pointers, user-defined types and dynamic memory allocation.

CO5: Design various applications using functions and file concepts.

Text Books:

1. C Programming, A Problem Solving Approach, Forouzan, Gilberg,Prasad, CENGAGE, 3rd edition.

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-HillEducation, 2008.

2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition

3. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall, 1988

4. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education,1996

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year I Semester

23ENG201 COMMUNICATIVE ENGLISH LABORATORY

L	T	P	C
0	0	2	1

Course Objectives:

The main objective of introducing this course, Communicative English Laboratory, is to expose the students to a variety of self-instructional, learner friendly modes of language learning. The students will get trained in basic communication skills and also make them ready to face job interviews.

List of Topics:

1. Vowels & Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing
6. Resume Writing, Cover letter, SOP
7. Group Discussions-methods & practice
8. Debates - Methods & Practice
9. PPT Presentations/ Poster Presentation
10. Interviews Skills

Course Outcomes:

CO1: Understand the English speech sounds, stress, rhythm, intonation and syllabic division for better listening and speaking
CO2: Apply communication strategies and implement them in language learning activities.
CO3: Analyze and enhance job-relevant writing skills
CO4: Evaluate and exhibit professionalism in debates and group discussions.
CO5: Make effective presentations by developing public speaking abilities

Suggested Software:

1. Walden Infotech
2. Young India Films

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. *Technical Communication*. Oxford Press.2018.

2. Taylor Grant: *English Conversation Practice*, Tata McGraw-Hill Education India,2016

3. Hewing's, Martin. Cambridge *Academic English* (B2). CUP, 2012.
4. J. Sethi & P.V. Dhamija. *A Course in Phonetics and Spoken English*, (2nd Ed),Kindle, 2013

Web Resources:

Spoken English:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com/
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. https://www.youtube.com/c/ArnelsEverydayEnglish/featured
8. https://www.youtube.com/c/engvidAdam/featured
9. https://www.youtube.com/c/EnglishClass101/featured
10. https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw

Voice & Accent:

1. https://www.youtube.com/user/letstalkaccent/videos
2. https://www.youtube.com/c/EngLanguageClub/featured
3. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
4. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year I Semester

23CHE202 CHEMISTRY LABORATORY

L	T	P	C
0	0	2	1

Course Objectives:

9. Verify the fundamental concepts with experiments.

List of Experiments:

1. Measurement of 10Dq by spectrophotometric method
2. Conductometric titration of strong acid vs. strong base
3. Conductometric titration of weak acid vs. strong base
4. Determination of cell constant and conductance of solutions
5. Potentiometry - determination of redox potentials and emfs
6. Determination of Strength of an acid in Pb-Acid battery
7. Preparation of a Bakelite
8. Verify Lambert-Beer's law
9. Wavelength measurement of sample through UV-Visible Spectroscopy
10. Identification of functional groups in simple organic compounds by IR
11. Preparation of nanomaterials by precipitation method
12. Estimation of Ferrous Iron by Dichrometry

Course Outcomes:

At the end of the course, the students will be able to
CO1: Determine the cell constant and conductance of solutions.
CO2: Prepare advanced polymer Bakelite materials.
CO3: Measure the strength of an acid present in secondary batteries.
CO4: Measure the wavelength of absorption of some organic compounds using UV-Vis spectroscopy.
CO5: Determine the EMF & redox potentials using potentiometric titrations.

Reference Books:

1. Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publications by J. Mendham, R.C.Denney, J.D.Barnes and B. Sivasankar

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year I Semester

23CSE201 COMPUTER PROGRAMMING LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

10. Provide hands-on experience in programming fundamentals, algorithm design, and basic problem-solving techniques.
11. Enable students to implement control structures for program flow control in practical scenarios.
12. Reinforce understanding of arrays, memory models, and string manipulation through practical exercises
13. Provide hands-on practice with functions, function calls, and parameter manipulation using pointers.
14. Offer practical exposure to advanced programming concepts, including user-defined data types, file handling, and pointer operations.

UNIT I

WEEK 1

Objective: Getting familiar with the programming environment on the computer and writingthe first program.

Suggested Experiments/Activities:

Tutorial 1: Problem-solving using Computers.

Lab1: Familiarization with programming environment

i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.
ii) Exposure to Turbo C, gcc
iii) Writing simple programs using printf(), scanf()

WEEK 2

Objective: Getting familiar with how to formally describe a solution to a problem in a seriesof finite steps both using textual notation and graphic notation.

Suggested Experiments /Activities:

Tutorial 2: Problem-solving using Algorithms and Flow charts.

Lab 1: Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs

i) Sum and average of 3 numbers
ii) Conversion of Fahrenheit to Celsius and vice versa
iii) Simple interest calculation

WEEK 3

Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

Suggested Experiments/Activities:
Tutorial 3: Variable types and type conversions:

Lab 3: Simple computational problems using arithmetic expressions.
Problems to Practice:

i) Finding the square root of a given number
ii) Finding compound interest
iii) Area of a triangle using heron's formulae
iv) Distance travelled by an object

UNIT II

WEEK 4
Objective: Explore the full scope of expressions, type-compatibility of variables & constantsand operators used in the expression and how operator precedence works.

Suggested Experiments/Activities:

Tutorial4: Operators and the precedence and as associativity:
Lab4: Write C program to solve Simple computational problems using the operator' precedence and associativity
Problems to Practice:

i) Evaluate the following expressions.
    a. A+B*C+(D*E) + F*G
    b. A/B*C-B+A*D/3
    c. A+++B---A
    d. J= (i++) + (++i)
ii) Find the maximum of three numbers using conditional operator
iii) Take marks of 5 subjects in integers, and find the total, average in float

WEEK 5
Objective: Explore the full scope of different variants of "if construct" namely if-else, null-else, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for "if construct".

Suggested Experiments/Activities:
Tutorial 5: Branching and logical expressions:
Lab 5: Write C program for Problems involving if-then-else structures.
Problems to Practice:

i) Write a C program to find the max and min of four numbers using if-else.
ii) Write a C program to generate electricity bill.
iii) Find the roots of the quadratic equation.
iv) Write a C program to simulate a calculator using switch case.
v) Write a C program to find the given year is a leap year or not.

WEEK 6
Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and

for loop in addition to structured jump constructs like break and continue including when eachof these statements is more appropriate to use.

Suggested Experiments/Activities:
Tutorial 6: Loops, while and for loops
Lab 6: Write a C program for Iterative problems e.g., the sum of series
Problems to Practice:

i) Find the factorial of given number using any loop.
ii) Find the given number is a prime or not.
iii) Compute sine and cos series
iv) Checking a number palindrome
v) Construct a pyramid of numbers.

UNIT III

WEEK 7:
Objective: Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

Suggested Experiments/Activities:
Tutorial 7: 1 D Arrays: searching.
Lab 7:Write a C program to solve 1D Array manipulation, linear search
Problems to Practice:

i) Find the min and max of a 1-D integer array.
ii) Perform linear search on1D array.
iii) The reverse of a 1D integer array
iv) Find 2's complement of the given binary number.
v) Eliminate duplicate elements in an array.

WEEK 8:
Objective: Explore the difference between other arrays and character arrays that can be usedas Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

Suggested Experiments/Activities:
Tutorial 8: 2 D arrays, sorting and Strings.
Lab 8: Write a C program to solve Matrix problems, String operations, Bubble sort
Problems to Practice:

i) Addition of two matrices
ii) Multiplication two matrices
iii) Sort array elements using bubble sort
iv) Concatenate two strings without built-in functions
v) Reverse a string using built-in and without built-in string functions

UNIT IV

WEEK 9:

Objective: Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array and memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gainexperience processing command-line arguments received by C

Suggested Experiments/Activities:
Tutorial 9: Pointers, structures and dynamic memory allocation
Lab 9: Write a C program for Pointers and structures, memory dereference.
Problems to Practice:

i) Write a C program to find the sum of a 1D array using malloc()
ii) Write a C program to find the total, average of n students using structures
iii) Enter n students data using calloc() and display failed students list
iv) Read student name and marks from the command line and display the student details alongwith the total.
v) Write a C program to implement realloc()

WEEK 10:

Objective: Experiment with C Structures, Unions, bit fields and self-referential structures(Singly linked lists) and nested structures

Suggested Experiments/Activities:
Tutorial 10: Bitfields, Self-Referential Structures, Linked lists
Lab10 : Bitfields, linked lists
Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the samewithout using bit- fields

i) Create and display a singly linked list using self-referential structure.
ii) Demonstrate the differences between structures and unions using a C program.
iii) Write a C program to shift/rotate using bitfields.
iv) Write a C program to copy one structure variable to another structure of the same type.

UNIT V

WEEK 11:

Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration

Suggested Experiments/Activities:
Tutorial 11: Functions, call by value, scope and extent,
Lab 11: Write a C program to solve Simple functions using call by value, solving differential equations using Eulers theorem.
Problems to Practice:

i) Write a C function to calculate NCR value.
ii) Write a C function to find the length of a string.

iii) Write a C function to transpose of a matrix.
iv) Write a C function to demonstrate numerical integration of differential equations using Euler'smethod

WEEK 12:

Objective: Explore how recursive solutions can be programmed by writing recursive functionsthat can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

Suggested Experiments/Activities:

Tutorial 12: Recursion, the structure of recursive calls

Lab 12: Write C program for Recursive functions.

Problems to Practice:

i) Write a recursive function to generate Fibonacci series.
ii) Write a recursive function to find the lcm of two numbers.
iii) Write a recursive function to find the factorial of a number.
iv) Write a C Program to implement Ackermann function using recursion.
v) Write a recursive function to find the sum of series.

WEEK 13:

Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers

Suggested Experiments/Activities:

Tutorial 13: Call by reference, dangling pointers

Lab 13: Write a C program to solve Simple functions using Call by reference, Dangling pointers.

Problems to Practice:

i) Write a C program to swap two numbers using call by reference.
ii) Demonstrate Dangling pointer problem using a C program.
iii) Write a C program to copy one string into another using pointer.
iv) Write a C program to find no of lowercase, uppercase, digits and othercharacters using pointers.

WEEK14:

Objective: To understand data files and file handling with various file I/O functions. Explore thedifferences between text and binary files.

Suggested Experiments/Activities:

Tutorial 14: File handling

Lab 14: Write a C program to handle File operations.

Problems to Practice:

i) Write a C program to write and read text into a file.
ii) Write a C program to write and read text into a binary file using fread() and fwrite()
iii) Copy the contents of one file to another file.
iv) Write a C program to merge two files into the third file using command-linearguments.
v) Find no. of lines, words and characters in a file.

Write a C program to print last n characters of a given file.

Course Outcomes:

CO1: Implement coding and debugging the simple programs, create algorithms, and practice problem solving strategies using programming languages.

CO2: Demonstrate programs that incorporate conditional statements, loops, and break/continue statements to control program execution.

CO3: Apply coding for real time examples with arrays, array indexing, and manipulate strings in programming tasks.

CO4: Create, call, and debug functions, modify function parameters using pointers, and gain practical knowledge of variable scope within functions.

CO5: Apply user-defined data types, manipulate files, pointer operations to solve real-world programming challenges.

Textbooks:

1. Ajay Mittal, Programming in C: A practical approach, Pearson.

2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice-Hall of India

2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw Hill

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year I Semester

23ME201 ENGINEERING WORKSHOP

L	T	P	C
0	0	3	1.5

Course Objectives:

To familiarize students with wood working, sheet metal operations, fitting and electrical house wiring skills

1. **Demonstration**: Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints.
   a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridlejoint
3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.
   a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing
4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.
   a) V-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire punctureand change of two-wheeler tyre
5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and make the following connections.
   a) Parallel and series b) Two-way switch c) Godown lighting
   d) Tube light e) Three phase motor f) Soldering of wires
6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
7. **Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

Course Outcomes:

CO1: Identify workshop tools and their operational capabilities.
CO2: Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding.
CO3: Apply fitting operations in various applications.
CO4: Apply basic electrical engineering knowledge for House Wiring Practice

Textbooks:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, MediaPromoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; AtulPrakashan, 2021-22.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year I Semester

23HUM201 HEALTH AND WELLNESS, YOGA AND SPORTS

L	T	P	C
0	0	1	0.5

Course Objectives:

The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

UNIT I **5 hours**

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index(BMI) of all age groups.

Activities:

i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

UNIT II **5 hours**

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT III **5 hours**

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
ii) Practicing general and specific warm up, aerobics
iii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Course Outcomes:

After completion of the course the student will be able to

CO1: Understand the importance of yoga and sports for Physical fitness and sound health.
CO2: Demonstrate an understanding of health-related fitness components.
CO3: Compare and contrast various activities that help enhance their health.
CO4: Assess current personal fitness levels.
CO5: Develop Positive Personality

Reference Books:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning,2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty,
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. HumanKinetics, Inc.2014

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as manyas Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting vivavoce on the subject.

I Year II Semester

B. Tech I Year II Semester

23MAT102 DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

L	T	P	C
3	0	0	3

Course Objectives:

- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

UNIT I DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE **9 hours**

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits.

UNIT II LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER (CONSTANT COEFFICIENTS) **9 hours**

Definitions, homogenous and non-homogenous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS **9 hours**

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

UNIT IV VECTOR DIFFERENTIATION **9 hours**

Scalar and vector point functions, vector operator Del, Del applies to scalar point functions- Gradient, Directional derivative, del applied to vector point functions-Divergence and Curl, vector identities.

UNIT V VECTOR INTEGRATION **9 hours**

Line Integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and related problems.

Course Outcomes:

At the end of the course, the student will be able to

CO1: Find the solution of engineering problems formulated in the form of linear first order differential equations.

CO2: Solve the linear higher order differential equations related to various engineering fields.

CO3: Determine the solutions for linear partial differential equations that model the physical processes.

CO4: Interpret the physical meaning of different operators such as gradient, curl and divergence.

CO5: Estimate the work done against field, circulation and flux using vector calculus.

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10thEdition.

Reference Books:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, PearsonPublishers, 2018, 14th Edition.
2. Advanced Engineering Mathematics, Dennis G. Zill and Warren S. Wright, Jones andBartlett, 2018.
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018,5th Edition.
4. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha ScienceInternational Ltd., 2021 5th Edition (9th reprint).
5. Higher Engineering Mathematics, B. V. Ramana, , McGraw Hill Education, 2017

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year II Semester

23PHY101 ENGINEERING PHYSICS

L	T	P	C
3	0	0	3

Course Objectives:

To bridge the gap between the Physics in school at 10+2 level and UG level engineering courses by identifying the importance of the optical phenomenon like interference, diffraction etc, enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors.

UNIT I WAVE OPTICS 9 hours

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colours in thin films- Newton's Rings, Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative). Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT II CRYSTALLOGRAPHY AND X-RAY DIFFRACTION 9 hours

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods

UNIT III QUANTUM MECHANICS AND FREE ELECTRON THEORY 9 hours

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution - Density of states - Fermi energy

UNIT IV SEMICONDUCTORS 9 hours

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation – Hall effect and its applications.

UNIT V DIELECTRIC AND MAGNETIC MATERIALS 9 hours

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - complex dielectric constant – Frequency dependence of polarization – dielectric loss

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility

and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

Course Outcomes:

CO1: Apply the knowledge of Interference, Diffraction and Polarization techniques for materials testing and explore their applications in both science and technology.

CO2: Explain the crystal structure in terms of atomic positions, unit cells, and crystal symmetry and also relate the crystal symmetry to the symmetry observed in a diffraction pattern.

CO3: Evaluate the Schrodinger wave equations for simple potentials and explain the concept of conductivity of different types of materials.

CO4: Distinguish the semiconductors using Fermi level and identify the type of semiconductors using Hall effect.

CO5: Explain the origin of fundamental magnetic phenomena and types of magnetic materials. Understand the induced fields in dielectrics, and electrical behaviour of dielectrics.

Text Books:

1. A Text book of Engineering Physics, M. N. Avadhanulu, P.G.Kshirsagar & TVS ArunMurthy, S. Chand Publications, 11th Edition 2019.

2. Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press (2015)

Reference Books:

1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021.

2. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.

3. Engineering Physics" - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press.2010

4. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

Web Resources: https://www.loc.gov/rr/scitech/selected-internet/physics.html

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year II Semester

23ME101 ENGINEERING GRAPHICS

L	T	P	C
1	0	4	3

Course Objectives:

- To enable the students with various concepts like dimensioning, conventions and standards related to Engineering Drawing.
- To impart knowledge on the projection of points, lines and plane surfaces
- To improve the visualization skills for better understanding of projection of solids
- To develop the imaginative skills of the students required to understand Section of solids and Developments of surfaces.
- To make the students understand the viewing perception of a solid object in Isometric and Perspective projections.

UNIT I **9 hours**

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.
Curves: construction of ellipse, parabola and hyperbola by general, Cycloids, Involutes, Normal and tangent to Curves.
Scales: Plain scales, diagonal scales and vernier scales.

UNIT II **9 hours**

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.
Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes
Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

UNIT III **9 hours**

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

UNIT IV **9 hours**

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.
Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

UNIT V **9 hours**

Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Computer graphics: Creating 2D&3D drawings ofobjects including PCB and Transformations using Auto CAD (Not for end examination).

Course Outcomes:

Students will use the Auto CAD software and will be able to

CO1: Construct the geometrical constructions, engineering curves and scales.

CO2: Draw the projections of points, straight lines and planes

CO3: Draw the projections of solids in various positions

CO4: Sketch the sections of solids and developments of surfaces

CO5: Draw the conversion of the isometric views to orthographic views and vice versa.

Text Books:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.

2. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc,2009.

3. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, TataMcGraw Hill, 2017.

Mode of Evaluation: Day-to-day Evaluation, Mid Term Tests and End Semester Examination.

B. Tech I Year II Semester

23EEE101 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P	C
3	0	0	3

Course Objectives:

- To expose to the field of electrical & electronics engineering, laws and principles of electrical/ electronic engineering and to acquire fundamental knowledge in the relevant field.

PART A: BASIC ELECTRICAL ENGINEERING

UNIT I DC & AC CIRCUITS 8 hours

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

UNIT II MACHINES AND MEASURING INSTRUMENTS 8 hours

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge.

UNIT III ENERGY RESOURCES, ELECTRICITY BILL & SAFETY MEASURES 8 hours

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops,Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricitytariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker(MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types,Safety Precautions to avoid shock

Course Outcomes:

After the completion of the course students will be able to

CO1: Infer the basic AC and DC electrical circuits.

CO2: Analyze construction and operation of AC and DC machines, different electrical measuring instruments.

CO3: Illustrate operation of various power generating stations, energy consumption and electrical safety.

Text Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, FirstEdition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti,Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, ThirdEdition

Reference Books:

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019,Fourth Edition
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford UniversityPress, 2017
4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications, 2018, Second Edition.

Web Resources:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076
3.

PART B: BASIC ELECTRONICS ENGINEERING

Course Objectives:

This course provides the student with the fundamental skills to understand the principles of digital electronics, basics of semiconductor devices like diodes & transistors, characteristics and its applications.

UNIT I SEMICONDUCTOR DEVICES 8 hours

Introduction - Evolution of electronics – Vacuum tubes to nano electronics - Characteristics of PN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor - CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amplifier.

UNIT II BASIC ELECTRONIC CIRCUITS AND INSTRUMENTTAION 8 hours

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

UNIT III DIGITAL ELECTRONICS 8 hours

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of BooleanAlgebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adder, Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only)

Course Outcomes:

After the completion of the course students will be able to

CO1: Explain the theory, construction, and operation of electronic devices.

CO2: Apply the concept of science and mathematics to explain the working of diodes, transistors, and their applications.

CO3: Analyze logic gates and its applications in design of combinational circuits.

Text Books:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, PearsonEducation, 2021.

2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

Reference Books:

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.

2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.

3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version,Pearson Education,2009.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year II Semester

23CSE102 DATA STRUCTURES

L	T	P	C
3	0	0	3

Course Objectives:

- To attain proficiency in essential knowledge and skills for effectively employing linear data structures and making informed decisions when utilizing them to tackle real-world practical challenges.
- To gain a comprehensive understanding of linked lists, including their different types, operations, and practical applications.
- To explore stacks properties, operations and how stacks are utilized for the evaluation of mathematical expressions, including infix, postfix, and prefix notations.
- To understand the concepts of queues, their operations, and their applications in areas like breadth-first search and scheduling.
- To Provide an overview of Trees and Hashing as a technique for data organization.

UNIT I **9 hours**

Introduction to Linear Data Structures: Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation, Overview of time and space complexity analysis for linear data structures. Searching Techniques: Linear & Binary Search, Sorting Techniques: Bubble sort, Selection sort, Insertion Sort.

UNIT II **9 hours**

Linked Lists: Singly linked lists: representation and operations, doubly linked lists and circular linked lists, Comparing arrays and linked lists, Applications of linked lists

Stacks: Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists

UNIT III **9 hours**

Applications of stacks in expression evaluation, backtracking, reversing list etc.

Queues: Introduction to queues: properties and operations, implementing queues using arrays and linked lists, Applications of queues in breadth-first search, scheduling, etc.

Deques: Introduction to deques (double-ended queues), Operations on deques and their applications.

UNIT IV **9 hours**

Trees: Introduction to Trees, Binary Tree, Tree Traversal, Binary Search Tree – Insertion, Deletion & Traversal, Height Balanced Trees, Heap Tree, Heap Sort

UNIT V **9 hours**

Graphs: Representations, Biconnected components, Topological sort.

Hashing: Brief introduction to hashing and hash functions, Collision resolution techniques: chaining and open addressing, Hash tables: basic implementation and operations, Applications of hashing in unique identifier generation, caching, etc.

Course Outcomes:

At the end of the course, Student will be able to

CO1: Apply their knowledge and skills in the context of linear data structures, algorithmic analysis, searching, and sorting, enabling them to solve practical problems.

CO2: Implement linked lists, stack and their applications.

CO3: Implement queues and its applications.

CO4: Implement tree operations for binary tree, binary search tree, height balanced trees and heap tree.

CO5: Design graph and analyse various collision resolution techniques for hashing.

Text Books:

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2nd Edition.

2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, 2008

Reference Books:

1. Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and PeterSanders

2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E.Hopcroft

3. Problem Solving with Algorithms and Data Structures" by Brad Miller and DavidRanum

4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, and Clifford Stein

5. Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching,and Graph Algorithms" by Robert Sedgewick

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year II Semester

23PHY201 ENGINEERING PHYSICS LABORATORY

L	T	P	C
0	0	2	1

Course Objectives:

To study the concepts of optical phenomenon like interference, diffraction etc., recognize the importance of energy gap in the study of conductivity and Hall effect in semiconductors and study the parameters and applications of dielectric and magnetic materials by conducting experiments.

List of Experiments:

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings.
2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
3. Verification of Brewster's law
4. Determination of dielectric constant using charging and discharging method.
5. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
6. Determination of wavelength of Laser light using diffraction grating.
7. Estimation of Planck's constant using photoelectric effect.
8. Determination of the resistivity of semiconductors by four probe methods.
9. Determination of energy gap of a semiconductor using p-n junction diode.
10. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
11. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.
12. Determination of temperature coefficients of a thermistor.
13. Determination of acceleration due to gravity and radius of Gyration by using a Compound pendulum.
14. Determination of magnetic susceptibility by Kundt's tube method.
15. Determination of rigidity modulus of the material of the given wire using Torsional pendulum.
16. Sonometer: Verification of laws of stretched string.
17. Determination of young's modulus for the given material of wooden scale by non-uniform bending (or double cantilever) method.
18. Determination of Frequency of electrically maintained tuning fork by Melde's experiment.

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.

Course Outcomes:

CO1: Know the various phenomena of light practically and gain knowledge about various optical technique methods.
CO2: Verify the theoretical concepts of optics, magnetism and dielectrics by hands on experiment.
CO3: Apply the scientific process in the conduct of semiconductor experiments and report the experimental findings.
CO4: Understand mechanical phenomena by instruments and apply them in real time applications.
CO5: Acquire and interpret experimental data to examine the physical laws.

Web Resources:

www.vlab.co.in
https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

Reference Books:

1. A Textbook of Practical Physics - S. Balasubramanian, M.N. Srinivasan, S. Chand Publishers, 2017.
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; AtulPrakashan, 2021-22.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year II Semester

23EEE201 ELECTRICAL AND ELECTRONICS ENGINEERING WORKSHOP

L	T	P	C
0	0	3	1.5

Course Objectives:

To impart knowledge on the fundamental laws & theorems of electrical circuits, functions of electrical machines and energy calculations.

Activities:

1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set,wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
   - Provide some exercises so that hardware tools and instruments are learned to be usedby the students.
2. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
   - Provide some exercises so that measuring instruments are learned to be used by thestudents.
3. Components:
   - Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, colour coding package, symbol, cost etc.
   - Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

PART A: ELECTRICAL ENGINEERING LABORATORY

List of experiments:

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger
7. Calculation of Electrical Energy for Domestic Premises

Note: Minimum Six Experiments to be performed.

Course Outcomes:

At the end of the course, the student will be able to

CO1: Analyze basic DC circuits.

CO2: Understand the usage of common electrical & electronic measuring instruments.

CO3: Understand the basic characteristics of electrical machines and perform energy calculations.

PART B: ELECTRONICS ENGINEERING LABORATORY

Course Objectives:

- To impart knowledge on the principles of digital electronics and fundamentals of electron devices & its applications.

List of Experiments:

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifier.
4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gatesusing ICs.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Tools / Equipment Required: DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters,AC Voltmeters, CROs, all the required active devices.

Note: Minimum Six Experiments to be performed. All the experiments shall be implemented using Hardware / Software.

Course Outcomes:

At the end of the course, the student will be able to
CO1: Plot and discuss the characteristics of various electron devices.
CO2: Explain the operation of a digital circuit.

Reference Books:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, PearsonEducation, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version,Pearson Education,2009.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year II Semester

23CSE202 IT WORKSHOP

L	T	P	C
0	0	2	1

Course Objectives:

- To introduce the internal parts of a computer, peripherals, I/O ports, connecting cables
- To demonstrate configuring the system as Dual boot both Windows and other Operating Systems Viz. Linux, BOSSTo teach basic command line interface commands on Linux.
- To teach the usage of Internet for productivity and self-paced life-long learning
- To introduce Compression, Multimedia and Antivirus tools and Office Tools such as Word processors, Spread sheets and Presentation tools.

PC Hardware & Software Installation

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Task 2: Every student should disassemble and assemble the PC back to working condition. Labinstructors should verify the work and follow it up with a Viva. Also students need to go throughthe video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Labinstructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

Task 5: Every student should install BOSS on the computer. The system should be configuredas dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

Internet & World Wide Web

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finallystudents should demonstrate, to the instructor, how to access the websites and email. If there isno internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD
Task 1 – Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeXand word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

Task 2: Using La TeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word.

Task 3: Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 4: Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

EXCEL
Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.
Task 1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

Task 2: Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function,

LOOKUP/VLOOKUP
Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

POWER POINT
Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

AI TOOLS – ChatGPT
Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.

- Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas

- Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.

- Ex:Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Course Outcomes:

CO1: Gain expertise in computer hardware, assembly, and dual-boot OS configuration, enhancing their ability to manage and troubleshoot computer systems effectively.
CO2: Learn to connect to the LAN, configure browsers, use search engines effectively, and practice cyber hygiene for secure internet use.
CO3: Create well-formatted documents and presentations using Microsoft Office and Latex
CO4: Gain proficiency in using Excel or its FOSS equivalent for tasks like scheduling, GPA calculation, data manipulation, and formatting.
CO5: Craft effective and tailored inputs to obtain desired responses from AI tools like ChatGPT.

Reference Books:

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech,2013, 3rd edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
5. LaTeX Companion, Leslie Lamport, PHI/Pearson.
6. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and KenQuamme. – CISCO Press, Pearson Education, 3rd edition
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCOPress, Pearson Education, 3rd edition

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year II Semester

23CSE203 DATA STRUCTURES LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

The course aims to strengthen the ability of the students to identify and apply the suitable data structure for the given real-world problem. It enables them to gain knowledge in practical applications of data structures.

List of Experiments:

Exercise 1: Array Manipulation

i) Write a program to reverse an array.
ii) C Programs to implement the Searching Techniques – Linear & Binary Search
iii) C Programs to implement Sorting Techniques – Bubble, Selection and Insertion Sort

Exercise 2: Linked List Implementation

i) Implement a singly linked list and perform insertion and deletion operations.
ii) Develop a program to reverse a linked list iteratively and recursively.
iii) Solve problems involving linked list traversal and manipulation.

Exercise 3: Linked List Applications

i) Create a program to detect and remove duplicates from a linked list.
ii) Implement a linked list to represent polynomials and perform addition.
iii) Implement a double-ended queue (deque) with essential operations.

Exercise 4: Double Linked List Implementation

i) Implement a doubly linked list and perform various operations to understand its properties and applications.
ii) Implement a circular linked list and perform insertion, deletion, and traversal.

Exercise 5: Stack Operations

i) Implement a stack using arrays and linked lists.
ii) Write a program to evaluate a postfix expression using a stack.
iii) Implement a program to check for balanced parentheses using a stack.

Exercise 6: Queue Operations

i) Implement a queue using arrays and linked lists.
ii) Develop a program to simulate a simple printer queue system.
iii) Solve problems involving circular queues.

Exercise 7: Stack and Queue Applications

i) Use a stack to evaluate an infix expression and convert it to postfix.
ii) Create a program to determine whether a given string is a palindrome or not.
iii) Implement a stack or queue to perform comparison and check for symmetry.

Exercise 8: Binary Tree & Binary Search Tree

i) Implement Binary tree using array and linked list.
ii) Implement BST using Linked List.
iii) Traversing of BST.

Exercise 9: Hashing

i) Implement a hash table with collision resolution techniques.
ii) Write a program to implement a simple cache using hashing.

Course Outcomes:

At the end of the course, Student will be able to

CO1: Implement different types of sorting and searching algorithms using array.

CO2: Demonstrating the different types of linked lists with its basic operations and applications.

CO3: Develop programs using stacks to handle evaluating expressions and solve related problems.

CO4: Apply queue-based algorithms for efficient task scheduling and other related real world problems.

CO5: Implement trees, graph and recognize scenarios where hashing is advantageous and design hash-based solutions for specific problems.

Text Books:

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2nd Edition.

2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, 2008

Reference Books:

1. Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and PeterSanders

2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E.Hopcroft

3. Problem Solving with Algorithms and Data Structures" by Brad Miller and DavidRanum

4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, and Clifford Stein

5. Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching,and Graph Algorithms by Robert Sedgewick.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year II Semester

23HUM202 NSS/NCC/SCOUTS AND GUIDES/COMMUNITY SERVICE

L	T	P	C
0	0	1	0.5

Course Objectives:

The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

UNIT I ORIENTATION **5 hours**

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, careerguidance.

Activities:

i) Conducting –ice breaking sessions-expectations from the course-knowing personaltalents and skills
ii) Conducting orientations programs for the students –future plans-activities-releasingroad map etc.
iii) Displaying success stories-motivational biopics- award winning movies on societalissues etc.
iv) Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT II NATURE & CARE **5 hours**

Activities:

i) Best out of waste competition.
ii) Poster and signs making competition to spread environmental awareness.
iii) Recycling and environmental pollution article writing competition.
iv) Organising Zero-waste day.
v) Digital Environmental awareness activity via various social media platforms.
vi) Virtual demonstration of different eco-friendly approaches for sustainable living.
vii) Write a summary on any book related to environmental issues.

UNIT III COMMUNITY SERVICE **5 hours**

Activities:

i) Conducting One Day Special Camp in a village contacting village-area leaders-Surveyin the village, identification of problems- helping them to solve via media-authorities-experts-etc.
ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
iii) Conducting consumer Awareness. Explaining various legal provisions etc.
iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and PopulationEducation.
v) Any other programmes in collaboration with local charities, NGOs etc.

Course Outcomes:

After completion of the course the students will be able to

CO1: Understand the importance of discipline, character and service motto.
CO2: Solve some societal issues by applying acquired knowledge, facts, and techniques.
CO3: Explore human relationships by analyzing social problems.
CO4: Determine to extend their help for the fellow beings and downtrodden people.
CO5: Develop leadership skills and civic responsibilities.

Reference Books:

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme*
2. Vol;.I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
3. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, DirectorateGeneral of NCC, Ministry of Defence, New Delhi
4. Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering",McGraw Hill, New York 4/e 2008
5. Masters G. M., Joseph K. and Nagendran R. "Introduction to EnvironmentalEngineering and Science", Pearson Education, New Delhi. 2/e 2007

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities.
2. Institutes are required to provide instructor to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting vivavoce on the subject.

II Year I Semester

B. Tech II Year I Semester

23HUM101 UNIVERSAL HUMAN VALUES

L	T	P	C
2	1	0	3

Course Prerequisite: None or Universal Human Values I (desirable)

Course Description :

The course has 28 lectures and 14 tutorials in 5 Units. The lectures and tutorials are of 1-hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions. The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

Course Objectives: None. Universal Human Values-I (desirable)

The main objectives of the course is to

1. help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure happiness and prosperity in continuity, which are the core aspirations of all human beings.
2. facilitate the development of a Holistic perspective among students towards life and profession based on right understanding of the Human reality, family, society and the rest of nature. Such holistic perspective forms the basis of Universal Human Values (UHV) and movement towards value-based living in a natural way.
3. highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4. aid the students to realize their full human potential and act accordingly.
5. assist the students to live with feeling of relationship, harmony and co-existence.

UNIT I INTRODUCTION TO VALUE EDUCATION 9 hours

Lecture 1: Understanding Value Education
Lecture 2: self-exploration as the Process for Value Education
Tutorial 1: Practice Session PS1 - Sharing about Oneself
Lecture 3: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 - Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 - Exploring Natural Acceptance

UNIT II HARMONY IN THE HUMAN BEING 9 hours

Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 - Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 - Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 - Exploring Harmony of self with the body

UNIT III HARMONY IN THE FAMILY AND SOCIETY **9 hours**

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 - Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 - Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 - Exploring Systems to fulfil Human Goal

UNIT IV HARMONY IN THE NATURE/EXISTENCE **9 hours**

Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 - Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 - Exploring Co-existence in Existence.

UNIT V IMPLICATIONS OF THE HOLISTIC UNDERSTANDING – A LOOK AT PROFESSIONAL ETHICS **9 hours**

Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 - Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 - Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 - Exploring Steps of Transition towards Universal Human Order

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the Natural Acceptance and basic human aspiration.
CO2: Aware of themselves and self-regulation.
CO3: Recognize human-human relationship (Justice) and identify human goals in the society.
CO4: Appreciate the harmony in the nature and existence.
CO5: Develop as socially and ecologically responsible engineers in handling problems with sustainable solutions (user-friendly and eco-friendly).

Text Books:

1. R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

2. R R Gaur, R Asthana, G P Bagaria,Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Online Learning Resources

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf
8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

10. https://uhv.org.in/
11. https://www.youtube.com/@UniversalHumanValues/playlists
12. https://fdp-si.aicte-india.org/index.php

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year I Semester

23HUM102 ECONOMICS AND FINANCIAL ACCOUNTING FOR ENGINEERS

L	T	P	C
2	0	0	2

Course Prerequisite: NIL

Course Description:

The Engineering Economics and Financial Accounting aims to provide an insight into production, cost analysis, market structure, Accounting Basic concepts and financial Statement Analysis. The course is designed to give emphasis on the application of real life examples on various fundamental issues of economics and accounts. This course introduces the accounting system, principles, types of accounts, and financial statements etc. The ratio analysis and financial analysis are useful to know the positions of financial statements are explained to know the analysis of financial matters.

Course Objectives:

This course enables students to

1. Describe the nature of engineering economics in dealing with the issues of scarcity;

2. Know the supply, demand, production and cost analysis to analyze the impact of economic events on markets;

3. Explain the different market structures and price determination in various market conditions.

4. Explain the accounting principles, types of accounting and preparation of final accounts; and

5. Describe the financial statement analysis and investment evaluation through ratios and capital budgeting techniques.

UNIT I DEMAND ANALYSIS 6 hours

Scope and Significance of Economics- Elements of market Economy: Demand, Supply and Market Equilibrium- Theory of Demand, Elasticity of Demand, Supply and Law of Supply.

UNIT II PRODUCTION AND COST ANALYSIS 6 hours

Production Function – Short-run and long-run production – Cost Analysis: Cost concepts - Cost Structure of Firms and Output Decision- Break-Even Analysis (BEA) – significance and Limitations of BEA - Determination of Break Even Point (Simple Problems).

UNIT III MARKET STRUCTURE AND PRICING 6 hours

Classification of Markets - General Equilibrium and efficiency of Perfect competition, Monopoly, Monopolistic – Price determination under Perfect, Monopoly, and Monopolistic Competition, Pricing objectives- Pricing Strategies.

UNIT IV BASICS OF ACCOUNTING 6 hours

Accounting - Double Entry System - Accounting Principles - Classification of Accounts - Rules of Debit & Credit- Accounting Cycle: Journal, Ledger, Trial Balance. Final Accounts: Trading Account - Profit & Loss Account - Balance Sheet with Adjustments, (Simple Problems).

UNIT V FINANCIAL RATIO ANALYSIS AND CAPITAL BUDGETING 6 hours

Ratio Analysis - Liquidity, Solvency, Activity and Profitability Ratios - Capital Budgeting. (Simple Problems).

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand Engineering economics basic concepts,

CO2: Analyze the concepts of demand, elasticity, supply, Production, Cost Analysis and its essence in floating of an organization,

CO3: Compare various different market structures and identify suitable market,

CO4: Demonstrate an understanding and analyzing the accounting statements, and

CO5: Exhibit the ability to apply knowledge of ratio analysis and capital budgeting techniques in financial statement analysis and investment evaluation respectively.

Text Books:

1. Case E. Karl & Ray C. Fair, "Principles of Economics", Pearson Education, 8th Edition, 2007
2. Aryasri: Business Economics and Financial Analysis, 4/e. MGH.
3. Financial Accounting, S. N. Maheshwari, Sultan Chand, 2009
4. Varshney & Maheswari: Management Economics, Sultan Chand
5. Financial Statement Analysis, Khan and Jain, PHI, 2009
6. Financial Management, Prasanna Chandra, T.M.H, 2009

Reference Books:

1. Lipsey, R. G. & K. A. Chrystal , "Economics", Oxford University Press, 11th Edition, 2007
2. Samuelson P. A. & Nordhaus W. D. "Economics", Tata McGraw-Hill 18th Edition, 2007
3. Financial Management and Policy, Van Horne, James, C., Pearson, 2009.
4. Financial Management, I. M. Pandey, Vikas Publications

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year I Semester

23MAT107 PROBABILITY AND STATISTICS FOR COMPUTER SCIENCE

L	T	P	C
3	0	0	3

Course Prerequisite: 23MAT101, 23MAT102

Course Description:

This course provides an introduction to probability, distributions and statistics with applications. Topics include: Conditional probability, Random variables, Probability distributions, Joint densities, Bayesian inference, descriptive statistics, Correlation and Regression, Estimation, Confidence intervals, Hypothesis testing.

Course Objectives:

This course enables students to

1. To extend and formalize knowledge of the theory of probability and random variables.
2. To solve real time problems in engineering and science by using discrete and continuous distributions
3. To analyze and interpret basic summary and modeling techniques for Multi-variate data
4. To analyze the data by using descriptive statistics for decision making
5. To apply the statistical inference involving confidence interval and hypothesis testing in data analysis.

UNIT I PROBABILITY **9 hours**

Introduction to Probability, Sample space and events, axioms of probability, theorems on probability, conditional probability, multiplication theorem and independence of events, Baye's theorem.

Random variables (discrete and continuous), probability density functions, distribution function, mathematical expectation, properties. moment generating function.

UNIT II PROBABILITY DISTRIBUTIONS **9 hours**

Discrete probability distributions - Binomial, Poisson, Geometric and their properties

Continuous probability distributions - Uniform, Exponential, Gamma, Normal distributions and their properties, Chebychev's inequality.

UNIT III JOINT DISTRIBUTIONS **9 hours**

Joint densities and Independence - Marginal distributions (discrete & continuous)- Expectation and Covariance, Correlation, Conditional densities and Regression, Curves of regression, Transformation of random variables.

UNIT IV STATISTICS FOR DATA ANALYSIS **9 hours**

Data Visualization, Moments, skewness, kurtosis, correlation, correlation coefficient, rank correlation, principle of least squares, lines of regression, regression coefficients and their properties.

UNIT V STATISTICAL INFERENCE **9 hours**

Population, sampling, Estimation, Point estimation, MLE, formulation of null hypothesis, alternative hypothesis, level of significance, types of errors and power of the test. Large Sample Tests: Test for single mean, single proportion, difference of means, difference of proportions, Confidence interval for parameters in one sample and two sample problems, t test for single mean, difference of means, test for ratio of variances.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the probability concepts and their importance in engineering.
CO2: Apply discrete and continuous probability distributions to solve various engineering problems.
CO3: Get an idea about joint density functions, distribution functions to the random variables and analyse the multivariate problems in engineering
CO4: Apply the method of least squares to estimate the parameters of a regression model.
CO5: Perform Test of Hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases.

Text Books:

1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
2. Dr.B.S.Grewal, " Higher Engineering Mathematics", Khanna Publications, 42nd Edition.

Reference Books:

1. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012.
3. Dean G. Duffy, "Advanced Engineering Mathematics with MATLAB", CRC Press, Third Edition 2013.

E Books:

1. http://nptel.ac.in/courses/IIT-MADRAS/Principles_of_Communication1/Pdfs/1_5.pdf
2. https://www.khanacademy.org

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year I Semester

23CAI101 PRINCIPLES OF ARTIFICIAL INTELLIGENCE

L	T	P	C
3	0	0	3

Course Objectives:

1. The student should be made to study the concepts of Artificial Intelligence.
2. The student should be made to learn the methods of solving problems using Artificial Intelligence.
3. The student should be made to introduce the concepts of Expert Systems.
4. To understand the applications of AI, namely game playing, theorem proving, and machine learning.
5. To learn different knowledge representation techniques

UNIT I **9 hours**

Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

UNIT II **9 hours**

Searching- Searching for solutions, Uninformed search strategies – Breadth First Search, Depth First Search. Search with Partial Information (Heuristic search) Hill climbing, A*, AO* Algorithms, Problem reduction. Games : Game Playing- Adversial search, Minimax algorithm, Optimal Decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions.

UNIT III **9 hours**

Representation of Knowledge: Knowledge representation issues, Predicate Logic- Logic Programming, Semantic Nets- Frames and Inheritance, Constraint Propagation, representing knowledge using rules, Rule based Deduction Systems. Review of Bayes' Theorem, Reasoning under Uncertainty, Bayes' probabilistic interferences and Dempster-Shafer theory.

UNIT IV **9 hours**

Logic concepts: First order logic. Inference in first order logic, Propositional vs. First Order Inference, Unification & Lifting Forward Chaining, Backward Chaining, Resolution, Learning from Observation Inductive learning, Decision trees, Explanation based Learning, Statistical Learning methods, Reinforcement Learning.

UNIT V **9 hours**

Expert Systems: Architecture of expert systems, Roles of expert systems – Knowledge Acquisition Meta knowledge Heuristics. Typical expert systems – MYCIN, DART, XCON: Expert systems shells.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the fundamental concepts of Artificial Intelligence.
CO2: Apply methods for solving problems using Artificial Intelligence techniques.
CO3: Explain the concepts and structure of Expert Systems.
CO4: Analyze AI applications such as game playing, theorem proving, and machine learning.
CO5: Utilize different knowledge representation techniques in AI systems.

Text Books:

1. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", SecondEdition, Pearson Education
2. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill

Reference Books:

1. David Poole, Alan Mackworth, Randy Goebel,"Computational Intelligence: a logical approach", Oxford University Press.
2. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problemsolving", Fourth Edition, Pearson Education.
3. J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers.
4. Artificial Intelligence, SarojKaushik, CENGAGE Learning.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B.Tech II Year I Semester

23CAI102 ADVANCED DATA STRUCTURES AND ALGORITHMS ANALYSIS

L	T	P	C
3	0	0	3

Course Objectives:

The main objectives of the course are to

1. Introduce the concepts of algorithm analysis, Tree and Graph applications.
2. Discuss various algorithm design strategies with examples.
3. Introduce NP-Hard and NP-Complete problem concepts.

UNIT I **9 hours**

Introduction to Algorithm Analysis, Space and Time Complexity Analysis, Asymptotic Notations.

AVL Trees – Creation, Insertion, Deletion Operations and Applications.
B-Trees – Creation, Insertion, Deletion operations and Applications.
Graphs – Basic search and Traversals.

UNIT II **9 hours**

Divide and Conquer: The General Method, Quick Sort, Merge Sort, Strassen's matrix multiplication.
Greedy Method: General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees.

UNIT III **9 hours**

Dynamic Programming: General Method, All pairs shortest paths, Single Source Shortest Paths– General Weights (Bellman-Ford Algorithm), 0/1 Knapsack, Travelling Salesperson problem.

UNIT IV **9 hours**

Backtracking: General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring.
Branch and Bound: The General Method, 0/1 Knapsack Problem, Travelling Salesperson problem.

UNIT V **9 hours**

NP-Hard and NP-Complete Problems: Basic Concepts, Cook's theorem.
NP-Hard Graph Problems: Clique Decision Problem (CDP), Chromatic Number Decision Problem (CNDP).
NP-Hard Scheduling Problems: Scheduling Identical Processors, Job Shop Scheduling.

Course Outcomes:

After completion of the course, students will be able to

CO1.Illustrate the working of the advanced tree and graph data structures and their applications.
CO2.Design Divide and Conquer strategy and Greedy method for different problems.
CO3.Demonstrate Dynamic programming method to solve problems.
CO4.Apply Backtracking and Branch & bound strategy to solve problems.
CO5.Understand NP-Hard and NP-Complete problems.

Text Books:

1. Data Structures and program design in C, Robert Kruse, Pearson Education Asia
2. Fundamentals of Computer Algorithms, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Second Edition University Press, 2008.

Reference Books:

1. An introduction to Data Structures with Applications, Trembley& Sorenson, McGraw Hill
2. The Art of Computer Programming, Vol.1: Fundamental Algorithms, Donald E Knuth, Addison-Wesley, 1997.
3. Data Structures using C & C++: Langsam, Augenstein &Tanenbaum, Pearson, 1995
4. Algorithms + Data Structures & Programs, N. Wirth, PHI
5. Fundamentals of Data Structures in C++: Horowitz Sahni& Mehta, Galgotia Pub.
6. Data structures in Java, Thomas Standish, Pearson Education Asia

Online Learning Resources:

1. https://www.tutorialspoint.com/advanced_data_structures/index.asp
2. http://peterindia.net/Algorithms.html
3. https://www.youtube.com/playlist?list=PLDN4rrl48XKpZkf03iYFl-O29szjTrs_O

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year I Semester

23CAI104 DATABASE MANAGEMENT SYSTEMS

L	T	P	C
3	0	0	3

Course Objectives:

1. To understand the concept of DBMS and ER Modeling.
2. To explain the normalization, Query optimization and relational algebra.
3. To have an introductory knowledge about the storage and query processing techniques and the basic concepts of Information retrieval techniques
4. To learn about the internal storage structures using different file and indexing techniques which will help in physical DB design
5. To apply the concurrency control, recovery, security and indexing for the real time data.

UNIT I DATABASE SYSTEMS CONCEPTS AND DATA MODELING 9 hours

Introduction to Databases- File System Vs Database System - Data Models- Schemas and Instances - DBMS Architecture- Centralized - Client Server - Database Applications, Types of Databases.
Entity Relationship Model: Types of Attributes, Entities and Entity set, Relationship, Structural Constraints - Relational Model, Relational model Constraints - Mapping ER model to a relational schema - Integrity Constraints, Specialization and generalization using ER Diagrams.

UNIT II SQL 9 hours

The Database Language SQL – Simple Queries in SQL – Queries Involving More than One Relation, SQL functions (Data & Time, String conversion, Sub Queries, aggregate operators, null values, complex integrity constraints, triggers, views and indexes, Dynamic SQL, Cursors, Introduction to JDBC, Stored Procedures.

UNIT III NORMALIZATION 9 hours

Translating SQL Queries into Relational Algebra and Relational Calculus, Guidelines for Relational Schema – Functional dependency; Normalization, Boyce Codd Normal Form, Multi-valued dependency and Fourth Normal form; Join dependency and Fifth Normal form.

UNIT IV DATA STORAGE AND TRANSACTION MANAGEMENT 9 hours

Storage strategies: Indices, B-trees, B^+-trees, hashing. Two-Phase Locking Techniques for Concurrency Control -ACID Property– Concurrency Control based on timestamp – Recovery Concepts – Recovery based on deferred update – Recovery techniques – Buffer management.

UNIT V DATABASE SECURITY AND RECENT TRENDS 9 hours

Database Authentication, Authorization and access control, DAC, MAC and RBAC models, SQL injection. Introduction, Need of NoSQL, CAP Theorem and Recent trends.

Course Outcomes:

At the end of this course students will demonstrate the ability to
CO1: Construct an ER model and derive the relational schemas from the model.
CO2: Understand the conceptual and logical database design using SQL queries.
CO3: Apply Normalization to improve database design.
CO4: Interpret the basic issues of storage and transaction management.
CO5: Analyse the fundamental security concepts for database.

Text Books:

1. A. Silberschatz, H. F. Korth S. Sudershan, Database System Concepts, McGraw Hill, 7thEdition 2021.
2. R. Elmasri S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 2015.

Reference Books:

1. Raghu Ramakrishnan, Database Management Systems, Mcgraw-Hill,4th edition,2015.
2. Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management,6th Edition,2012.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year I Semester

23CAI201 ADVANCED DATA STRUCTURES AND ALGORITHM ANALYSIS LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

The objectives of the course are to

1. Learn how to analyze a problem &design the solution for the problem.
2. Strengthen the ability to identify and apply the suitable algorithm strategy for the given real-world problem.
3. Develop the optimal solution, i.e., time complexity & space complexity is low.

List of Experiments:

List of Programs:

1. Construct an AVL tree for a given set of elements which are stored in a file. And implement insert and delete operations on the constructed tree. Write the contents of the tree into a new file using in-order.
2. Construct a B-Tree in an order of 5 with a set of 100 random elements stored in an array. Implement searching, insertion, and deletion operations.
3. Implement Graph traversals.
   (a) BFT (b) DFT
4. Implement Quick Sort and Merge Sort and observe the execution time for various input sizes (Average, Worst, and Best cases).
5. Implement Job Sequencing with Deadlines using Greedy strategy
6. Implement the Knapsack Problem using the Greedy method.
7. Construct Minimum Spanning Tree using
   (a) Prim's Method (b) Kruskal's Method
8. Implement All Pairs Shortest Paths using Dynamic Programming method
9. Implement Single Source Shortest Paths using Dynamic Programming method
10. Write a program to solve 0/1 Knapsack problem Using Dynamic Programming.
11. Implement the Travelling Salesperson problem using Dynamic Programming.
12. Implement N-Queens Problem Using Backtracking Strategy.
13. Implement the Backtracking method to solve the Graph Coloring problem.
14. Design and implement sum of subsets problem using backtracking.

Course Outcomes:

After completion of the course, Students will be able to

CO1: Implement the operations on AVL Trees, B- Trees, and Graphs.

CO2: Solve and analyze the problems using Divide & Conquer strategy.

CO3: Execute the problems using Greedy Method.

CO4: Apply Backtracking Methods to solve various problems.

CO5: Apply Dynamic Programming Methods to solve various problems.

Reference Books:

1. Data Structures and program design in C,Robert Kruse,Pearson Education Asia

2. Fundamentals of Computer Algorithms, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Second Edition University Press, 2008.

3. An introduction to Data Structures with Applications,Trembley& Sorenson, McGraw Hill

Online Learning Resources:

1. http://cse01-iiith.vlabs.ac.in/
2. http://peterindia.net/Algorithms.html

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech II Year I Semester

23CAI202 DATABASE MANAGEMENT SYSTEMS LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

1. To understand the components of DBMS and to study the database design.
2. To study the retrieval of data using relational algebra and calculus and the concept of normal forms in the design of database.
3. To comprehend the structure of SQL Queries to query, update, and manage a database.
4. To understand all constraints to develop a business application using cursors, triggers and stored procedures.
5. To provide sufficient skill to utilize the DBMS concept in real time applications.

List of Experiments:

1. Design Conceptual database schema using ER Modelling Software Tools.
2. Development of Relational Database Schemas for Deposit/Customer/ borrow/ branch using DDL Constructs of SQL.
3. To perform various data manipulation commands such as select, insert, update etc. of SQL on Relational Database.
4. To perform various DCL and TCL construct of SQL on Relational Database.
5. Implement different types of referential and integrity constraints on Relation Database.
6. To apply the concept of Aggregating Data using Group functions.
7. To retrieve the queries using Group by, Having and Order by clauses of SQL.
8. Design and development of Banking database and perform various type of JOIN operations.
9. Insert the Data into table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL
10. Write a trigger that automatically deletes students when they graduate
11. Develop programs using features parameters in a CURSOR for UPDATE
12. a) Create a cursor to update the salary of employees in EMP table.
    b) Write a PL/SQL program to raise an Exception when the bonus exceeds salary.
13. **Design and implementation real time project with database connection.**

Course Outcomes:

CO1: Perform table creation, maintain, and manipulate a relational database using SQL.
CO2: Implement complex queries using SQL.
CO3: Apply Queries using Advanced Concepts of SQL.
CO4: Build PL/SQL programs including stored procedures, functions, cursors and triggers.
CO5: Develop a real-world application to access and render data.

Reference Books:

1. A. Silberschatz, H. F. Korth S. Sudershan, Database System Concepts, McGraw Hill, 7thEdition 2021.
2. R. Elmasri S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 2015.

3. Raghu Ramakrishnan, Database Management Systems,Mcgraw-Hill,4th edition,2015.

4. Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management,6th Edition,2012.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

II Year II Semester

B. Tech II Year II Semester

23MAT108 DISCRETE MATHEMATICAL STRUCTURES

L	T	P	C
3	0	0	3

Course Prerequisite: 23MAT101

Students should have a solid understanding of high school-level algebra, including Set notions, Relations, Functions, Permutations-Combinations, equations, and inequalities.

Course Description:

Discrete Mathematical Structures is a foundational course designed to introduce students to the essential concepts and structures of discrete mathematics. This course is crucial for students in computer science, information technology, computing, and related fields, providing the mathematical framework necessary for the analysis and design of algorithms, data structures, learning and intelligent systems.

Course Objectives:

This course enables students to

1. Develop a strong foundation in propositional and predicate logic, enabling the analysis and construction of logical arguments and proofs.
2. Master various counting techniques and understand the properties of algebraic structures such as groups and binary operations.
3. Gain a deep understanding of relations, equivalence classes, order relations, lattices, and Boolean algebras.
4. Learn to model and solve problems using sequences and recurrence relations, both homogeneous and nonhomogeneous.
5. Study the fundamental concepts of graph theory, including paths, cycles, trees, and the various types of graphs and their properties.

UNIT I LOGICAL STRUCTURES **9 hours**

Introduction- Propositions and Truth Values- Logical Connectives and Truth Tables-Tautologies and Contradictions -Logical Equivalence and Logical Implication -The Algebra of Propositions - Arguments - Formal Proof of the Validity of Arguments -Predicate Logic - Arguments in Predicate Logic (Theory of Inference).

UNIT II COUNTING TECHNIQUES AND ALGEBRAIC STRUCTURES **9 hours**

Counting Techniques- Pigeonhole principle- Inclusion-exclusion principle- Binary Operations and Their Properties- Algebraic Structures- Groups in Modular Arithmetic - Cyclic Groups- Groups of Permutations- Substructures-Morphisms.

UNIT III ORDERED STRUCTURES **9 hours**

Relations and Their Representations- Equivalence Classes and Partitions- Order Relations- - Hasse Diagrams-Lattices- Properties of Lattices- Boolean Algebras – Properties of Boolean Algebras- Boolean Functions- Minimization of Boolean Expressions.

UNIT IV RECURRENCE RELATIONS **9 hours**

Sequences - Recurrence Relations- Applications of Recurrence Relations- Modeling with Recurrence Relations- Solving Linear Recurrence Relations- Solving Linear Homogeneous Recurrence Relations with Constant Coefficients- Linear Nonhomogeneous Recurrence Relations with Constant Coefficients- Generating Functions- Useful facts about Power Series- Using Generating Functions to Solve Recurrence Relations

UNIT V GRAPH STRUCTURES **9 hours**

Graphs-Graph Terminology and Special Types of Graphs-Representing Graphs and Graph Isomorphism-Connectivity-Euler and Hamilton Paths-Shortest-Path Problems-Planar Graphs -Graph Coloring-Introduction to Trees-Spanning Trees-Minimum Spanning Trees.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Evaluate the elementary logical arguments and identify the fallacious reasoning for the syntax of programming languages.

CO2: Utilize counting principles in computing techniques and algorithm analysis, and learn the properties of various algebraic structures.

CO3: Analyze various types of relations, equivalence classes, partitions using Hasse diagrams, and the properties of lattices and Boolean algebra.

CO4: Apply recurrence relations to model and solve many computational problems by generating functions.

CO5: Identify the special types of graphs for analyzing the connectivity models, and also study the properties of trees.

Text Books:

1. Rowan Garnier and John Taylor, Discrete Mathematics (Proof, Structures and Applications), CRC Press, an informa business, 3rd Edition, 2009.

2. Kenneth H. Rosen, Discrete Mathematics and its applications, 6th Edition, Tata McGraw Hill, 2011.

Reference Books:

1. J.P. Trembley and R.Manohar, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill – 13th reprint, 2012.

2. U.S. Gupta, ''Discrete Mathematical Structures'', 1st Edition, Pearson Education India, 2014.

3. Kevin Ferland, ''Discrete Mathematical Structures'', 1st Edition, Cengage Learning, 2009.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year II Semester

23CAI103 DIGITAL LOGIC AND COMPUTER ORGANIZATION

L	T	P	C
3	0	0	3

Course Objectives:

The main objectives of the course is to

1. Provide a comprehensive understanding of digital logic design principles and computer organization fundamentals
2. Illustrate Computer Arithmetic Operations and Processor Organization
3. Explain the fundamentals of Memory and Input/output (I/O) systems

UNIT I **9 hours**

Data Representation: Signed and Unsigned Binary Arithmetic – Fixed and Floating Point Binary Number representations – Hamming Code - Error Detection and Correction

Digital Logic & Combinational Circuits: Boolean Algebra, Minimization of Logic expressions, Quine–McCluskey Method - K-Map Simplification - Combinational Circuits: - Adders, Multiplexers, De-Multiplexers, Encoders and Decoders – Code Converters

UNIT II **9 hours**

Digital Logic & Sequential Circuits: Sequential Circuits, Flip-Flops, Binary counters, Registers, Shift Registers

Introduction to Computer Architecture: Computer Types, Functional units, Bus structures, Software, Technology, Computer Generations, Von- Neumann Architecture, Eight Great Ideas

UNIT III **9 hours**

Computer Arithmetic: Fixed Point and Floating Point Arithmetic - Addition, Subtraction, Unsigned and Signed Multiplication, Division Algorithms - Floating Point Arithmetic Operations

Processor Organization: Fundamental Concepts, Execution of a Complete Instruction Cycle – CISC and RISC Processors – x86 and ARM Addressing Modes and Instruction set

UNIT IV **9 hours**

Memory Organization: Basic Concepts, Semiconductor RAM Memories, Read-Only Memories, Speed, Size and Cost, Cache Memory, Elements of Cache – Memory Mapping Techniques, Cache Performance - Redundant Array of Independent Disks.

UNIT V **9 hours**

Pipelining and Parallelism: Pipelining Strategy, Pipeline performance, Pipeline Hazards. Parallel Architecture - Flynn's classification – Multicore Architecture – Clusters – GPU Architecture

Input/output Organization: Data Transfer Schemes: - Programmed I/O, Interrupt Driven I/O, Direct Memory Access.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1:Demonstrate the fundamental principles of digital system design and design combinational logic circuits.

CO2: Design sequential logic circuits and explain the functional units of computer

CO3: Apply algorithms for Arithmetic Operations and understand Instruction Set Architectures

CO4: Explain memory hierarchy and Concepts of Cache

CO5: Understand the concepts of Pipelining, Parallelism and I/O

Text Books:

1. Computer Organization, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, 6th edition, McGraw Hill
2. William Stallings, "Computer Organization and Architecture Designing for Performance",11th Edition, Pearson Publications.
3. Digital Design, 6th Edition, M. Morris Mano, Pearson Education.

Reference Books:

1. Computer Systems Architecture, M.Moris Mano, 3rdEdition, Pearson
2. Computer Organization and Design, David A. Paterson, John L. Hennessy, Elsevier
3. Fundamentals of Logic Design, Roth, 5thEdition, Thomson

Online Learning Resources

1. https://nptel.ac.in/courses/106/103/106103068/

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year II Semester

23CAI105 MACHINE LEARNING

L	T	P	C
3	0	0	3

Course Objectives:

The objectives of the course are

- Define machine learning and its different types (supervised and unsupervised) and understand their applications.
- Apply supervised learning algorithms including decision trees and k-Nearest Neighbors (k-NN).
- Implement unsupervised learning techniques, such as K-means clustering.

UNIT I **9 hours**

Introduction to Machine Learning: Types of Data, Data Representation, Data Acquisition, Evolution of Machine Learning, Paradigms for ML, Learning by Rate, Learning by Induction, Stages in Machine Learning, Feature Engineering, Model Selection, Model Learning, Model Evaluation, Bias–Variance Trade-off

UNIT II **9 hours**

Regression Analysis: Hypothesis testing, Correlation, Univariate Linear Regression, Multivariate Linear Regression, Reduced model, Analysis of Variance.

Non-parametric Classifier: Similarity and distance measurements, K-Nearest Neighbor Classifier, Parzen window

UNIT III **9 hours**

Decision Trees Models: Decision Trees, Impurity Measures, Random Forests, XG Boost

The Bayes Classifier: Introduction to the Bayes Classifier, Bayes' Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification, Class Conditional Independence and Naive Bayes Classifier (NBC)

UNIT IV **9 hours**

Linear Classifier: Introduction to Linear Discriminants, Linear Discriminants Analysis, Perceptron Classifier and Learning Algorithm, Support Vector Machines, Linear SVM,

Non Linear Classifier: Kernel Trick in SVM, Logistic Regression, Multi-Layer Perceptrons (MLPs), Backpropagation for Training an MLP.

UNIT V **9 hours**

Clustering: Introduction to Clustering, Partitioning of Data, Hierarchical Clustering, Agglomerative Clustering, K-Means Clustering, K-medoids, X- Means Clustering

Soft Clustering: Gaussian Mixture, Fuzzy C-Means Clustering, Expectation Maximization-Based Clustering.

Document Clustering: Latent Semantic Analysis (LSA).

Introduction to Rough set, Rough K-Means Clustering Algorithm.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Identify machine learning techniques suitable for a given problem. (L3)

CO2: Solve real-world problems using various machine learning techniques. (L3)

CO3: Apply Dimensionality reduction techniques for data preprocessing. (L3)

CO4: Explain what is learning and why it is essential in the design of intelligent machines. (L2)

CO5: Evaluate Advanced learning models for language, vision, speech, decision making etc. (L5)

Text Books:

1. Machine Learning Theory and Practice", M N Murthy, V S Ananthanarayana, Universities Press (India), 2024

Reference Books:

1. "Machine Learning", Tom M. Mitchell, McGraw-Hill Publication, 2017
2. "Machine Learning in Action",Peter Harrington, DreamTech
3. "Introduction to Data Mining", Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year II Semester

23CAI106 OBJECT-ORIENTED PROGRAMMING THROUGH JAVA

L	T	P	C
3	0	0	3

Course Objectives:

The learning objectives of this course are to:

1. Identify Java language components and how they work together in applications.
2. Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
3. Learn how to extend Java classes with inheritance and interfaces in Java applications.
4. Understand how to use Java packages, Exceptions and I/O Streams for program development.
5. Understand how to design applications with threads in Java.

UNIT I — 9 hours

Object Oriented Programming: Basic concepts, Program Structure in Java: Introduction, Writing Simple Java Programs, Data types, Type casting, Tokens in Java Programs , Java Statements –Control statements, Looping Statements, Break Statement, Continue Statement. Command Line Arguments, User Input to Programs, Escape Sequences, Comments, Programming Style.

UNIT II — 9 hours

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, this and static keywords.

Methods: Introduction, Defining Methods, Overloaded Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods.

UNIT III — 9 hours

Arrays: one dimensional and multi-dimensional array.

Inheritance: Basics, Types of Inheritances, Usage of Super, Method Overriding, Abstract Classes, Final Keyword.

Interfaces: Creating, Implementing, Using, Extending, and Nesting of interfaces.

UNIT IV — 9 hours

Packages: Defining, Finding and Importing packages, Member Access.

Exception Handling: Fundamentals, Types, Multiple catch clauses, Nested try blocks, Thrown Class, Using Finally and Throws, Built-in exceptions, User-defined exceptions.

I/O Streams: Byte Stream Classes and Character Stream Classes.

UNIT V — 9 hours

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.

Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of New Threads, Thread States, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads.

Introduction to Spring Boot: Basic setup and configuration of a Spring Boot project, Creating and running a simple RESTful web service.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Analyze problems, design solutions using OOP principles, and implement them efficiently in Java.

CO2: Design and implement classes to model real-world entities, with a focus on attributes, behaviours, and relationships between objects.

CO3: Demonstrate an understanding of inheritance hierarchies and polymorphic behaviour, including method overriding and interface concept.

CO4: Apply Competence in handling exceptions and errors to write robust and fault-tolerant code.

CO5: Develop multithreaded applications with synchronization and Spring Boot.

Text Books:

1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, DebasisSamanta, MonalisaSarma, Cambridge, 2023.

Reference Books:

1. The complete Reference Java, 11thedition, Herbert Schildt,TMH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson
3. JAVA for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105191/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01288046454761881634 7_shared/overview

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year II Semester

23CAI203 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LABORATOTY

L	T	P	C
0	0	3	1.5

Course Objectives:

The objectives of the course are

1. The student should be made to study the concepts of Artificial Intelligence.
2. The student should be made to learn the methods of solving problems using Artificial Intelligence
3. The student should be made to introduce the concepts of Expert Systems and machine learning
4. To learn about computing central tendency measures and Data preprocessing techniques
5. To learn about classification and regression algorithms
6. To apply different clustering algorithms for a problem.

List of Experiments:

1. Write a Program to Implement Breadth First Search using Python.
2. Write a program to implement Best First Searching Algorithm
3. Write a Program to Implement Depth First Search using Python.
4. Write a program to implement the Heuristic Search
5. Write a python program to implement A* and AO* algorithm. (Ex: find the shortest path)
6. Write a python program to implement Tic-tac-toe
7. Pandas Library
   a. Write a python program to implement Pandas Series with labels
   b. Create a Pandas Series from a dictionary.
   c. Creating a Pandas Data Frame.
   d. Write a program which makes use of the following Pandas methods
      i) describe () ii) head () iii) tail () iv) info ()
8. Pandas Library: Visualization
   Write a program which use pandas inbuilt visualization to plot following graphs:
   i. Bar plots ii. Histograms iii. Line plots iv. Scatter plots
9. Apply the following Pre-processing techniques for a given dataset
   a. Attribute selection b. Handling Missing Values c. Discretization d. Elimination of Outliers
10. Apply KNN algorithm for classification and regression
11. Demonstrate decision tree algorithm for a classification problem and perform parameter tuning for better results
12. Apply Random Forest algorithm for classification and regression
13. Demonstrate Naïve Bayes Classification algorithm.
14. Apply Support Vector algorithm for classification
15. Implement the K-means algorithm and apply it to the data you selected. Evaluate performance by measuring the sum of the Euclidean distance of each example from its class center. Test the performance of the algorithm as a function of the parameters

Course Outcomes:

CO1: Understand the Mathematical and statistical prospectives of machine learning algorithms through python programming (L2)

CO2: Appreciate the importance of visualization in the data analytics solution. (L5)

CO3: Derive insights using Machine learning algorithms (L2)

CO4: Evaluate and demonstrate AI and ML algorithms. (L5)

CO5: Evaluate different algorithms. (L5)

Reference Books:

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach, Fourth Edition, Pearson, 2020
2. Martin C. Brown (Author), "Python: The Complete Reference" McGraw Hill Education, Fourth edition, 2018
3. R. NageswaraRao , "Core Python Programming" Dreamtech Press India Pvt Ltd 2018
4. "Machine Learning", Tom M. Mitchell, McGraw-Hill Publication, 2017
5. "Machine Learning in Action",Peter Harrington, DreamTech
6. "Introduction to Data Mining", Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech II Year II Semester

23CAI204 OBJECT-ORIENTED PROGRAMMING THROUGH JAVA LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

The aim of this course is to

1. Practice object-oriented programming in the Java programming language
2. Implement Classes, Objects, Methods, Inheritance and interfaces concepts.
3. Illustrate implement Packages and Exception handling mechanism.
4. Construct Threads and various states.

List of Experiments:

1. Write a JAVA program to display default value of all primitive data type of JAVA.
2. Write a Java program that checks whether a given string is a palindrome or not.
   Ex: MADAM is a Palindrome.
3. Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.
4. Write a JAVA program to implement constructor overloading.
5. Write a JAVA program implement method overloading.
6. Write a JAVA program to implement multi level Inheritance
7. Write a JAVA program give example for "super" keyword.
8. Write java program to create a super class called Figure that receives the dimensions of two dimensional objects. It also defines a method called area that computes the area of an object. The program derives two subclasses from Figure. The first is Rectangle and second is Triangle. Each of the sub class overridden area() so that it returns the area of a rectangle and a triangle respectively.
9. Write a JAVA program for abstract class to find areas of different shapes.
10. Write a JAVA program to implement Interface. What kind of Inheritance can be achieved?
11. Write a JAVA program that import and use the user defined packages
12. Write a JAVA program that describes exception handling mechanism
13. a) Write a JAVA program that creates threads by extending Thread class. First thread display "Good Morning "every 1 sec, the second thread displays "Hello "every 2 seconds and the third display "Welcome" every 3 seconds,(Repeat the same by implementing Runnable)
    b) Write a program illustrating is Alive and join ()
    c) Write a Program illustrating Daemon Threads.
    d) Write a JAVA program Producer Consumer Problem
14. Write a Java program to demonstrate socket communication where a server receives a message from a client and responds back.

Software requirements:

JDK 1.4 or higher versions

Course Outcomes:

After completion of the course, students will be able to

CO1: Demonstrate a solid understanding of Java syntax, including data types, control structures, methods, classes, objects, inheritance, polymorphism, and exception handling.

CO2: Apply fundamental OOP principles such as encapsulation, inheritance, polymorphism, and abstraction to solve programming problems effectively.

CO3: Familiar with commonly used Java Packages and exception handling in real time applications.

CO4: Develop problem-solving skills and algorithmic thinking, applying OOP concepts to design efficient solutions to various programming challenges.

CO5: Proficiently construct multi-threading applications.

Reference Books:

1. P. J. Deitel, H. M. Deitel, "Java for Programmers", Pearson Education, PHI, 4th Edition, 2007.

2. P. Radha Krishna, "Object Oriented Programming through Java", Universities Press, 2nd Edition, 2007.

3. Bruce Eckel, "Thinking in Java", Pearson Education, 4th Edition, 2006.

4. Sachin Malhotra, Saurabh Chaudhary, "Programming in Java", Oxford University Press, 5th Edition, 2010.

Online Resources:

1. https://java-iitd.vlabs.ac.in/

2. http://peterindia.net/JavaFiles.html

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech II Year II Semester
Audit Course

23CHE901 ENVIRONMENTAL SCIENCE

L	T	P	C
2	0	0	0

Course Objectives:
This course enables students to

1. To make the students to get awareness of the environment.
2. To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day-to-day activities of human life
3. To save the earth from the inventions by the engineers.

UNIT I MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES 6 hours

Definition, Scope, and Importance – Need for Public Awareness.
Natural Resources: Energy resources**-** Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

UNIT II ECOSYSTEMS 7 hours

Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

a) Forest ecosystem.
b) Grassland ecosystem
c) Desert ecosystem.
d) Aquatic ecosystems (freshwater - ponds, streams, lakes, rivers, marine ecosystem- oceans, estuaries)

Biodiversity and its Conservation : Introduction, Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Specific case studies.

UNIT III ORDERED STRUCTURES 6 hours

Definition, Cause, effects, and control measures of:
Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards
Pollution case studies - Role of an individual in the prevention of pollution

Solid Waste Management: Causes**,** effects and control measures of urban and industrial wastes
Disaster management: floods, earthquakes, cyclones and landslides.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 5 hours

Sustainable Development Goals, From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rainwater harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6 hours

Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of Information Technology in Environment and human health – Case studies.

Field Work: Visit a local area to document environmental assets River/forest grassland/hill/mountain – Polluted site - Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Exploring different types of renewable and non-renewable energy sources.

CO2: Students will learn about the structure and function of different ecosystems.
CO3: Students will learn about different types of pollution (air, water, soil) and their sources, effects, and control measures.
CO4: Exploring the science behind climate change, its evidence, and its impacts on ecosystems and human societies.
CO5: Understanding demographic factors and their environmental implications.

Text Books:

1. Textbook of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press, Third Edition, 2021.
2. Palaniswamy, “Environmental Studies”, Pearson Education, Second Edition, 2014.
3. S. Azeem Unnisa, “Environmental Studies” Academic Publishing Company
4. K. Raghavan Nambiar, “Textbook of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, Scitech Publications (India), Pvt. Ltd. Second Edition, 2008.
5. A. Koushik & C. P. Koushik, Perspectives in Environmental Studies, New Age International, Fourth Edition, 2006.

Reference Books:

1. Deeksha Dave and E. Sai Baba Reddy, “Textbook of Environmental Science”, Cengage Publications, Second Edition, 2012.
2. M. Anji Reddy, “Textbook of Environmental Sciences and Technology”, BS Publication, Second Edition, 2023.
3. J.P. Sharma, Comprehensive Environmental studies, Laxmi publications, Third Edition, 2009.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”, Prentice Hall of India Private Limited, Second Edition, 2004.
5. G.R. Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House, Fourth Edition, 2014.
6. Gilbert M. Masters and Wendell P. Ela, “Introduction to Environmental Engineering and Science, Prentice Hall of India Private Limited, Third Edition, 2007.

Online Resources:

1. Atika Qazi; Fayaz Hussain; Nasrudin ABD. Rahim; Glenn Hardaker; Daniyal Alghazzaw, "Towards sustainable energy: a systematic review of renewable energy sources, technologies, and public opinions," 10.1109/ACCESS.2019.2906402, IEEE Access, vol. 7, pp. 63837-63851, 2019.
2. Gina Garland, Samiran Banerjee, Anna Edlinger, Emily Miranda Oliveira, Chantal Herzog, Raphaël Wittwer, Laurent Philippot, Fernando T. Maestre, Marcel G. A. van der Heijden, "A closer look at the functions behind ecosystem multifunctionality: A review," https://doi.org/10.1111/1365-2745.13511, Journal of Ecology, vol. 109, no. 2, pp. 600-613, 2021.
3. Siddiqua, A, Hahladakis, J.N. and Al-Attiya, “An overview of the environmental pollution and health effects associated with waste landfilling and open dumping,” https://doi.org/10.1007/s11356-022-21578-z, Environmental Science and Pollution Research, 29(39), pp.58514-58536, 2022.
4. Seddon N, Chausson A, Berry P, Girardin C.A, Smith A. and Turner B, “Understanding the value and limits of nature-based solutions to climate change and other global challenges,” https://doi.org/10.1098/rstb.2019.0120, Philosophical Transactions of the Royal Society B, 375(1794), p.20190120, 2020.
5. Hannes Weber and Jennifer Dabbs Sciubba, "The effect of population growth on the environment: evidence from European regions," https://doi.org/10.1007/s10680-018-9486-0, European Journal of Population, vol. 35, pp. 379-402, 2019.

Mode of Evaluation: Assignments and Mid Term Tests

III Year I Semester

B. Tech III Year I Semester

23CAI107 BIG DATA ANALYTICS AND AI APPLICATIONS

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

The main objective of the course is to

1. To introduce the fundamentals of big data and its role in AI-driven applications.
2. To explore big data tools and technologies such as Hadoop, Spark, and NoSQL databases.
3. To enable students to build scalable AI pipelines for data analytics.
4. To apply AI/ML algorithms for real-time and batch processing environments.
5. To demonstrate use-cases of big data in domains like healthcare, finance, and IoT using AI.

UNIT I INTRODUCTION TO BIG DATA AND ANALYTICS ECOSYSTEM 9 hours

Definition and Characteristics of Big Data – Volume, Velocity, Variety, Veracity, Value, Types of Analytics: Descriptive, Diagnostic, Predictive, Prescriptive, Big Data Challenges and Opportunities, Hadoop Ecosystem Overview: HDFS, MapReduce, YARN, NoSQL Databases: Key-Value, Columnar, Document, Graph Models, Data Lake vs. Data Warehouse.

UNIT II BIG DATA TOOLS AND FRAMEWORKS 9 hours

Apache Spark Architecture and RDDs, Spark SQL, DataFrames, and Datasets, Spark Streaming for Real-Time Analytics, Kafka for Data Ingestion and Message Queues, Hive, Pig, and Impala for Big Data Querying, Comparative Analysis of Hadoop vs. Spark.

UNIT III MACHINE LEARNING ON BIG DATA 9 hours

Introduction to MLlib and Scikit-learn, Data Preprocessing for Big Data ML Pipelines, Supervised Learning: Classification and Regression on Large Datasets, Unsupervised Learning: Clustering and Dimensionality Reduction, Model Evaluation and Validation Techniques, Distributed Training and Optimization Techniques.

UNIT IV AI APPLICATIONS ON BIG DATA 9 hours

Predictive Maintenance using Big Data & AI, Fraud Detection in Banking with Machine Learning, AI in Healthcare: Diagnosis, Genomics, Patient Monitoring, Retail and E-commerce Analytics, AI for Smart Cities and IoT Sensor Data Analysis, Evaluation of Real-Time AI Applications on Streaming Data.

UNIT V ADVANCED TOPICS AND CASE STUDIES 9 hours

Deep Learning on Big Data using TensorFlow on Spark, Explainable AI (XAI) in Big Data Environments, Ethical Issues and Data Governance in Big Data AI, Edge Computing and AI for Low Latency Applications, Case Study 1: AI-Powered Big Data in Healthcare, Case Study 2: Big Data AI Solution in Smart Manufacturing.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the architecture and ecosystem of big data processing.
CO2: Analyze and manage large-scale datasets using Hadoop and Spark.
CO3: Apply AI/ML techniques to extract insights from big data.
CO4: Design and implement scalable data pipelines using distributed frameworks.
CO5: Solve real-world domain problems with AI-powered big data solutions.

Text Books:

1. Big Data: Principles and Paradigms by Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi – Wiley
2. Learning Spark: Lightning-Fast Big Data Analysis by Jules S. Damji et al. – O'Reilly
3. Data Science and Big Data Analytics by EMC Education Services – Wiley

Reference Books:

1. Designing Data-Intensive Applications by Martin Kleppmann – O'Reilly
2. Machine Learning with Spark by Rajdeep Dua, Tathagata Das – Packt Publishing
3. Streaming Systems by Tyler Akidau – O'Reilly Media

Online Learning Resources

1. https://www.coursera.org/specializations/big-data – Coursera Big Data Specialization

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech III Year I Semester

23CAI108 CLOUD COMPUTING FOR AI

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

The main objective of the course is to

1. To introduce the concepts, models, and services of cloud computing and its role in AI.
2. To explore the architecture and deployment of AI applications on cloud platforms.
3. To equip students with skills in using cloud-based tools and services for AI/ML workloads.
4. To understand data storage, processing, and security in cloud for AI tasks.
5. To apply cloud computing principles to real-world AI-based solutions.

UNIT I INTRODUCTION TO CLOUD COMPUTING AND AI INTEGRATION 9 hours

Basics of Cloud Computing: Definition, Characteristics, Benefits, Cloud Service Models: IaaS, PaaS, SaaS, Deployment Models: Public, Private, Hybrid, Community, Overview of Cloud Providers for AI: AWS, Azure, GCP, AI + Cloud: Benefits of integration, common use cases (NLP, Vision, Chatbots), Use Cases of AI in Cloud: NLP, Vision, Analytics, Chatbots

UNIT II STORAGE, COMPUTING, AND DATA PROCESSING IN THE CLOUD 9 hours

Cloud Storage Services: AWS S3, GCP Cloud Storage, Azure Blob, Elastic Compute Basics: EC2, Azure VMs, GCP Compute Engine, Data Processing Pipelines: Ingestion to Output, Introduction to Data Lakes, Warehouses, Intro to Cost Optimization: Compute billing, Storage pricing, Free tier use

UNIT III CLOUD-BASED MACHINE LEARNING AND DEEP LEARNING 9 hours

ML Model Lifecycle in the Cloud, AutoML Platforms: AWS SageMaker Studio Lab, GCP AutoML, Azure ML Studio, **Training & Deployment of Models** using GUI-based cloud tools, basic Use of GPUs/TPUs in cloud, Integration with Notebooks: Google Colab + GCP/AWS, Jupyter + Azure

UNIT IV ADVANCED CLOUD CONCEPTS FOR AI APPLICATIONS 9 hours

Docker basics, why use containers for ML, Serverless Computing: AWS Lambda, Azure Functions – concepts and demos, Introduction to Kubernetes: Concept, not deep orchestration, CI/CD for ML Projects: Concept of automating ML workflows, Auto-scaling and Load Balancing for AI Apps

UNIT V SECURITY, ETHICS, AND CASE STUDIES IN CLOUD AI 9 hours

IAM (roles, access policies), data protection, Cost Management in AI Projects: Budgeting, billing alerts, Ethical Considerations in AI: Bias, fairness, responsible AI, **Case Study 1:** AI in Healthcare using Cloud (e.g., disease prediction), **Case Study 2:** Real-time Analytics in Finance using Cloud (e.g., fraud detection)

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Explain cloud computing architecture, services, and deployment models.
CO2: Utilize cloud platforms (AWS, GCP, Azure) for training and deploying AI models.
CO3: Handle large-scale data storage and processing in the cloud environment.
CO4: Integrate AI workflows using serverless and container-based architectures.
CO5: Analyze challenges in security, cost, scalability, and performance of cloud-based AI systems.

Text Books:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, McGraw-Hill.
2. Judith Hurwitz et al., Cloud Computing for Dummies, Wiley.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly.

Online Resource:

1. https://ml.aws/
2. https://www.cloudskillsboost.google/
3. https://learn.microsoft.com/en-us/training/paths/get-started-ai-fundamentals/

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech III Year I Semester

23CAI109 DEEP LEARNING

L	T	P	C
3	0	0	3

Pre-requisite: Probability and Statistics, Introduction to Machine Learning

Course Objectives:

The main objective of the course is to

1. **Explain** the fundamental mathematical concepts used in deep learning.
2. **Describe** supervised machine learning models for regression and classification.
3. **Analyze** deep neural network architectures and optimization techniques
4. **Examine** convolutional architectures and regularization techniques such as dropout and batch normalization.
5. **Understand** the basic principles of memory-based architectures like recurrent neural networks and autoencoders.

UNIT I LINEAR ALGEBRA REVIEW AND OPTIMIZATION 9 hours

Brief review of concepts from Linear Algebra, Types of errors, bias-variance trade-off, overfitting under fitting, brief review of concepts from Vector Calculus and optimization, variants of gradient descent, momentum.

UNIT II LOGISTIC REGRESSION 9 hours

Basic concepts of regression and classification problems, linear models addressing regression and classification, maximum likelihood, logistic regression classifiers.

UNIT III NEURAL NETWORKS 9 hours

Basic concepts of artificial neurons, single and multi-layer perceptron, perceptron learning algorithm, its convergence proof, different activation functions, SoftMax cross entropy loss function.

UNIT IV CONVNETS 9 hours

Basic concepts of Convolutional Neural Networks starting from filtering. Convolution and pooling operation and arithmetic of these, Discussions on famous convent architectures - AlexNet, ZFNet, VGG, GoogLeNet, ResNet, MobileNet-v1

REGULARIZATION, BATCHNORM

Discussion on regularization, Dropout, Batchnorm, Discussion on detection as classification, region proposals, RCNN architectures.

UNIT V RECURRENT NEURAL NETWORKS 9 hours

Basic concepts of Recurrent Neural Networks (RNNs), backpropagation through time, Long-Short Term Memory (LSTM) architectures, the problem of exploding and vanishing gradients, and basics of word embedding.

AUTOENCODERS

Autoencoders, Denoising autoencoders, sparse autoencoders, contractive Autoencoders.

Course Outcomes:

CO1: Summarize the mathematical foundations of deep learning, including optimization and gradient-based methods.
CO2: Apply the supervised learning models in regression and classification.
CO3: Analyze perceptron, neural network architectures, activation functions, and loss functions.
CO4: Evaluate convolutional neural network models and apply regularization techniques for performance improvement.
CO5: Interpret autoencoder-based memory models and their applications in feature learning.

Text Books:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville. Deep Learning, the MIT press, 2016
2. Bengio, Yoshua. " Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1, Now Publishers, 2009.

Reference Books:

1. B. Vegnanarayana, Artificial Neural Networks, Prentice Hall of India, 2005.
2. Simon Haykin, Neural Networks a Comprehensive Foundations, PHI Edition, 2005.

Online Learning Resources

1. https://www.deeplearning.ai/program/deep-learning-specialization/

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B.Tech III Year I Semester

23PHY102 INTRODUCTION TO QUANTUM TECHNOLOGIES AND APPLICATIONS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Objectives:

The main objectives of the course is to

1. Introduce fundamental quantum concepts like superposition and entanglement.
2. Understand theoretical structure of qubits and quantum information.
3. Explore conceptual challenges in building quantum computers.
4. Explain principles of quantum communication and computing.
5. Examine real-world applications and the future of quantum technologies.

UNIT I INTRODUCTION TO QUANTUM THEORY AND TECHNOLOGIES 9 hours

The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison,Quantum states and measurement: nature of observation,Overview of quantum systems: electrons, photons, atoms,The concept of quantization: discrete energy levels,Why quantum? Strategic, scientific, and technological significance,A snapshot of quantum technologies: Computing, Communication, and Sensing,National and global quantum missions: India's Quantum Mission, EU, USA, China

UNIT II THEORETICAL STRUCTURE OF QUANTUM INFORMATION SYSTEMS 9 hours

What is a qubit? Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view),Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract,The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences,Philosophical implications: randomness, determinism, and observer role

UNIT III BUILDING A QUANTUM COMPUTER – THEORETICAL CHALLENGES AND REQUIREMENTS 9 hours

What is required to build a quantum computer (conceptual overview)?,Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers:

Why maintaining entanglement is difficult,Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual comparison),Superconducting circuits, Trapped ions, Photonics, Visionvs reality: what's working and what remains elusive,The role of quantum software in managing theoretical complexities

UNIT IV **QUANTUM COMMUNICATION AND COMPUTING – THEORETICAL PERSPECTIVE** **9 hours**

Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD),Role of Entanglement in Communication,The Idea of the Quantum Internet – Secure Global Networking,Introduction to Quantum Computing,Quantum Parallelism (Many States at Once),Classical vs Quantum Gates, Challenges: Decoherence and Error Correction,Real-World Importance and Future Potential

UNIT V **APPLICATIONS, USE CASES, AND THE QUANTUM FUTURE** **9 hours**

Real-world application domains: Healthcare (drug discovery),Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, PsiQuantum,Ethical, societal, and policy considerations, Challenges to adoption: cost, skills, standardization,Emerging careers in quantum: roles, skillsets, and preparation pathways,Educational and research landscape – India's opportunity in the global quantum race

Course Outcomes:

CO1: Explain core quantum principles in a non-mathematical manner.

CO2: Compare classical and quantum information systems.

CO3: Identify theoretical issues in building quantum computers.

CO4: Discuss quantum communication and computing concepts.

CO5: Recognize applications, industry trends, and career paths in quantum technology.

Text Books:

1. Michael A. Nielsen, Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
3. Chris Bernhardt, *Quantum Computing for Everyone*, MIT Press, 2019.

Reference Books:

1. David McMahon, *Quantum Computing Explained*, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, *An Introduction to Quantum Computing*, Oxford University Press, 2007.
3. Scott Aaronson, *Quantum Computing Since Democritus*, Cambridge University Press, 2013.
4. **Alastair I.M. Rae**, *Quantum Physics: A Beginner's Guide*, Oneworld Publications, Revised Edition, 2005.
5. **Eleanor G. Rieffel, Wolfgang H. Polak**, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
6. **Leonard Susskind, Art Friedman**, *Quantum Mechanics: The Theoretical Minimum*, Basic Books, 2014.
7. **Bruce Rosenblum, Fred Kuttner**, *Quantum Enigma: Physics Encounters Consciousness*, Oxford University Press, 2nd Edition, 2011.

8. **GiulianoBenenti, GiulioCasati, GiulianoStrini**, *Principles of Quantum Computation and Information, Volume I: Basic Concepts*, World Scientific Publishing, 2004.
9. **K.B. Whaley et al.**, *Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document*, Quantum Flagship, European Commission, 2020.
10. **Department of Science & Technology (DST), Government of India**, *National Mission on Quantum Technologies & Applications – Official Reports and Whitepapers*, MeitY/DST Publications, 2020 onward.

Online Learning Resources:

1. IBM Quantum Experience and Qiskit Tutorials
2. Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
3. edX – The Quantum Internet and Quantum Computers
4. YouTube – Quantum Computing for the Determined by Michael Nielsen
5. Qiskit Textbook – IBM Quantum

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech III Year I Semester

23CAI205 BIG DATA ANALYTICS LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: None

Course Objectives:

The objectives of the course are to

1. To provide hands-on experience in working with big data tools and cloud computing environments.
2. To equip students with practical skills in data ingestion, transformation, analysis, and visualization using Hadoop and Spark ecosystems.
3. To enable deployment and management of cloud services using AWS, Azure, or GCP.
4. To expose students to cloud-native storage, computing, and container orchestration techniques.
5. To integrate big data workflows with cloud infrastructure for scalable, distributed data processing.

List of Experiments:

1. Installation and Configuration of Hadoop Cluster (Single Node & Multi-node) Hadoop HDFS setup, NameNode & DataNode configuration.
2. Working with HDFS: File Operations Upload, read, delete, and replicate files in HDFS.
3. MapReduce Programming Basics Word count, sorting, and filtering examples in Java/Python.
4. Apache Hive & Pig for Querying Large Datasets Creation of tables, data loading, and running queries
5. Apache Spark Basics: RDDs and DataFrames Implement Spark transformations and actions
6. Data Preprocessing and Machine Learning using PySpark MLlib Classification or regression using MLlib pipelines
7. Introduction to Cloud Computing and AWS/Azure/GCP Console Creating virtual machines, basic compute and storage services
8. Cloud Storage and Database Services using S3 (AWS), Blob (Azure), or GCP buckets and Cloud SQL/NoSQL
9. Deploying Big Data Workloads on Cloud (EMR, HDInsight, Dataproc) Running Hadoop/Spark jobs in cloud-managed services
10. Cloud Function/Serverless Deployment

Course Outcomes:

After completion of the course, Students will be able to

CO1: Configure and manage Hadoop clusters and perform file operations using HDFS effectively.

CO2: Develop and execute MapReduce applications for sorting, filtering, and summarizing large datasets.

CO3: Use Apache Hive, Pig, and Spark for structured and unstructured data processing and analysis.

CO4: Preprocess data and build scalable machine learning pipelines using PySpark MLlib.

CO5: Deploy and run big data applications on cloud platforms using virtual machines, storage services, managed clusters, and serverless architectures.

Reference Books:

1. Tom White, Hadoop: The Definitive Guide, O'Reilly Media.
2. Rajkumar Buyya et al., Mastering Cloud Computing, McGraw-Hill Education.
3. Holden Karau et al., Learning Spark: Lightning-Fast Big Data Analysis, O'Reilly Media.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech III Year I Semester

23CAI206 DEEP LEARNING LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: Machine Learning Lab

Course Objectives:

The objectives of the course are to

1. Understand various image processing operations using OpenCV library
2. Learn different activation functions and optimization techniques used in neural networks.
3. Apply deep learning models for binary and multiclass classification.
4. Understand the architectures of CNN, VGG-16, RNN and LSTM.
5. Explore OpenCV to detect faces and objects.

List of Experiments:

1. Basic OpenCV operations: Reading Images, Displaying Images, Resizing the Image
2. Basic image processing operations: Histogram equalization, thresholding, edge detection, data augmentation, morphological operations
3. Artificial Neural Network:
    a) Implement coding our first neurons
    b) Implement Single Layered Neural Network
    c) Implement Multi Layered Neural Network
4. Implement all Activation Functions in Building Neural Network and analyse their usage
5. Implement Backpropagation Neural Network using Python
6. Build an ANN model using TensorFlow and Keras Libraries for classification of IRIS Flower dataset
7. Build an ANN model for classify the House Prize Prediction using TensorFlow and Keras Libraries
8. Create a CNN model and train it on MNIST handwritten image dataset for classification
9. Create a CNN model to analyse CIFAR10 dataset and classify the given image into one of the 10 classes of images
10. Build an image classification model using VGG-16 for Dog Vs Cat
11. Create a RNN model and do sentiment analysis of movie reviews on IMDB dataset
12. Create a LSTM model and analyse the Google Stock price data and find out increasing or decreasing the trend of stock prizes and predict the stock prize of next day
13. Design a Deep Learning Model to classify the movie reviews as Positive or Negative based on the text content of reviews using IMDB dataset.
14. Implement a program using OpenCV to detect faces in a given image or photo

15. Design a Deep Learning framework for Object Detection using YOLO algorithm on COCO dataset

Course Outcomes:

After completion of the course, Students will be able to

CO1: Illustrate image processing operations using OpenCV library.
CO2: Design single and multi-layer neural networks with Back propagation algorithm and evaluate the performance of various optimization techniques.
CO3: Build Deep Learning models for binary and multiclass classification problems.
CO4: Compare the various Deep learning architectures like CNN, VGG-16, RNN, LSTM
CO5: Use OpenCV library for object detection applications.

Reference Books:

1. Deep Learning with Python, Francois Chollet, Manning Publications Co.
2. Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms with contributions by Nikhil Buduma, O'Reilly publication.
3. Deep Learning, Ian Good fellow, Yoshua Bengio and Aaron Courville, MIT Press, London, England

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech III Year I Semester

23ENG901 TECHNICAL PAPER WRITING AND IPR

L	T	P	C
2	0	0	0

Pre-requisite: None

Course Objectives:

1. To enable the students to practice the basic skills of research paper writing
2. To make the students understand the importance of IP and to educate them on the basic concepts of Intellectual Property Rights.
3. To practice the basic skills of performing quality literature review
4. To help them in knowing the significance of real life practice and procedure of Patents.
5. To enable them learn the procedure of obtaining Patents, Copyrights, & Trade Marks

UNIT I **6 hours**

Principles of Technical Writing: styles in technical writing; clarity, precision, coherence and logical sequence in writing-avoiding ambiguity- repetition, and vague language - highlighting your findings-discussing your limitations -hedging and criticizing -plagiarism and paraphrasing.

UNIT II **6 hours**

Technical Research Paper Writing: Abstract- Objectives-Limitations-Review of Literature- Problems and Framing Research Questions- Synopsis

UNIT III **6 hours**

Process of research: publication mechanism: types of journals- indexing- seminars- conferences- proof reading –plagiarism style; seminar & conference paper writing; Methodology-discussion-results-citation rules.

UNIT IV **6 hours**

Introduction to Intellectual property: Introduction, types of intellectual property, International organizations, ncies and treaties, importance of intellectual property rights

de Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting evaluating trade mark, trade mark registration processes.

UNIT V **6 hours**

Law of copy rights: Fundamentals of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer. Patent law, intellectual property audits.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Identify key secondary literature related to their proposed technical paper writing.

CO2: Explain various principles and styles in technical writing

CO3: Use the acquired knowledge in writing a research/technical paper

CO4: Analyse rights and responsibilities of the holder of Patent, Copyright, Trademark, International Trademark etc.

CO5: Evaluate different forms of IPR available at National & international levels
CO6: Develop skill of making search of various forms of IPR by using dern tools and techniques.

Text Books:

1. Deborah. E. Bouchoux, Intellectual Property Rights, Cengage Learning India, 2013

2. Meenakshi Raman, Sangeeta Sharma. Technical Communication: Principles and Practives. Oxford.

Reference Books:

1. R.Myneni, Law of Intellectual Property, 9th Ed, Asia law House, 2019.

2. Prabuddha Ganguli, Intellectual Property Rights Tata Mcgraw Hill, 2001

3. P.Naryan, Intellectual Property Law, 3rd Ed ,Eastern Law House, 2007.

4. Adrian Wallwork. English for Writing Research Papers Second Edition. Springer Cham Heidelberg New York ,2016

5. Dan Jones, Sam Dragga, Technical Writing Style

Online Learning Resources

1. https://theconceptwriters.com.pk/principles-of-technical-writing/
2. https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriti ng.html
3. https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriti ng.html
4. https://www.manuscriptedit.com/scholar-hangout/process-publishing-research-paper- journal/
5. https://www.icsi.edu/media/website/IntellectualPropertyRightLaws&Practice.pdf
6. https://lawbhoomi.com/intellectual-property-rights-notes/
7. https://www.extension.purdue.edu/extmedia/ec/ec-723.pdf

Mode of Evaluation: Assignments and Mid Term Tests

III Year II Semester

B. Tech III Year II Semester

23CAI110 COMPUTER VISION AND IMAGE PROCESSING

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Objectives:

The main objective of the course is to

1. Understand the principles of image formation, enhancement, and processing techniques.
2. Apply feature extraction, segmentation, and recognition methods in image analysis.
3. Analyze 3D vision, motion tracking, and object recognition techniques.
4. Apply deep learning methods like CNNs for object detection and classification.
5. Explore real-world applications in face recognition, autonomous systems, and visual inspection.

UNIT I INTRODUCTION TO COMPUTER VISION AND IMAGE PROCESSING 9 hours

Overview of Computer Vision and Image Processing, image formation, sampling and quantization, color models, histogram processing, spatial filtering, image restoration, frequency domain processing, Discrete Fourier Transform (DFT), introduction to modern image acquisition and sensor technologies.

UNIT II IMAGE ANALYSIS TECHNIQUES 9 hours

Edge detection (Sobel, Prewitt, Canny), corner detection (Harris), feature extraction (SIFT, SURF, ORB), segmentation techniques (thresholding, region growing, K-means, watershed), morphological operations (dilation, erosion), texture analysis using Gabor filters and LBP.

UNIT III 3D VISION AND MOTION ANALYSIS 9 hours

Stereo vision, epipolar geometry, disparity and depth estimation, optical flow (Lucas-Kanade, Farneback), structure from motion (SfM), camera calibration (intrinsic/extrinsic parameters), 3D point cloud reconstruction, applications in scene understanding

UNIT IV OBJECT RECOGNITION AND MACHINE LEARNING IN VISION 9 hours

Feature matching, object detection using template matching and CNNs, YOLO, R-CNN, introduction to transfer learning, image classification using pretrained networks, comparison of traditional and deep learning models.

UNIT V APPLICATIONS AND ADVANCED TOPICS 9 hours

Face recognition, automated inspection, video analytics, content-based image retrieval (CBIR), medical imaging, augmented and virtual reality, ethics in computer vision including bias and privacy concerns.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the fundamentals of image formation, enhancement, and frequency-domain transformations.
CO2: Apply edge, corner, and texture-based methods for image analysis and segmentation.
CO3: Analyze depth estimation and motion tracking using stereo vision and optical flow techniques.
CO4: Implement object recognition using feature-based and deep learning-based approaches.
CO5: Examine real-world applications of computer vision and address associated ethical considerations.

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods (2018). Digital Image Processing, 4th Edition, Pearson.
2. Richard Szeliski (2022). Computer Vision: Algorithms and Applications, 2nd Edition, Springer.

Reference Books:

1. David A. Forsyth and Jean Ponce (2011). Computer Vision: A Modern Approach, 2nd Edition, Pearson.
2. E. R. Davies (2018). Computer Vision: Principles, Algorithms, Applications, Learning, 5th Edition, Academic Press (Elsevier).

Online Learning Resources

1. Stanford University: CS231n: Deep Learning for Computer Vision. Linkcs231n.stanford.edu

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech III Year II Semester

23CAI111 NATURAL LANGUAGE PROCESSING

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

The main objective of the course is to

1. Understand the basic components and challenges in natural language processing
2. Apply POS tagging and parsing techniques for syntactic analysis
3. Analyze text classification and information retrieval models
4. Apply semantic analysis and machine translation methods
5. Analyze speech processing and transformer-based NLP models

UNIT I INTRODUCTION TO NLP 9 hours

Introduction to NLP: Origins and Challenges, Language and Grammar in NLP, Regular Expressions and Finite-State Automata, Tokenization: Text Segmentation and Sentence Splitting, Morphological Parsing: Stemming and Lemmatization, Spelling Error Detection and Correction, Minimum Edit Distance and Applications, Statistical Language Models: Unigram, Bigram, and Trigram Models, Processing Indian Languages in NLP.

UNIT II WORD-LEVEL AND SYNTACTIC ANALYSIS 9 hours

Introduction, Part-of-Speech (POS) Tagging: Rule-Based, Stochastic and Transformation-Based Approaches, Hidden Markov Models (HMM) and Maximum Entropy Models for POS Tagging, Context-Free Grammar (CFG) and Constituency Parsing, Treebanks and Normal Forms for Grammar, Top-Down and Bottom-Up Parsing Strategies, CYK Parsing Algorithm, Probabilistic Context-Free Grammars (PCFGs), Feature Structures and Unification.

UNIT III TEXT CLASSIFICATION AND INFORMATION RETRIEVAL 9 hours

Naïve Bayes Classifier for Text Classification, Training and Optimization for Sentiment Analysis, Information Retrieval: Basic Concepts and Design Features, Information Retrieval Models: Classical, Non-Classical, and Alternative Models, Cluster Model, Fuzzy Model, and LSTM-Based Information, Retrieval, Word Sense Disambiguation (WSD) Methods: Supervised and Dictionary-Based Approaches.

UNIT IV MACHINE TRANSLATION AND SEMANTIC PROCESSING 9 hours

Introduction to Machine Translation (MT), Language Divergence and Typology in MT Encoder-Decoder Model for Machine Translation, Translating in Low-Resource Scenarios, MT Evaluation Metrics and Techniques, Bias and Ethical Issues in NLP and Machine Translation, Semantic Analysis and First-Order Logic in NLP, Thematic Roles and Selectional Restrictions in Semantics, Word Senses and Relations Between Senses

UNIT V SPEECH PROCESSING AND ADVANCED NLP MODELS 9 hours

Speech Fundamentals: Phonetics and Acoustic Phonetics, Digital Signal Processing in Speech Analysis, Feature Extraction in Speech: Short-Time Fourier Transform (STFT), Mel-Frequency Cepstral Coefficients (MFCC) and Perceptual Linear Prediction (PLP), Hidden Markov Models (HMMs) in Speech Recognition.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand text preprocessing, morphological analysis, and language modelling.

CO2: Apply syntactic analysis using statistical and grammar-based methods.

CO3: Analyze text classification and sentiment analysis techniques.

CO4: Apply neural models for translation and semantic role labelling.

CO5: Analyze speech features and implement transformer-based NLP applications

Text Books:

1. Daniel Jurafsky & James H. Martin – Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education, 2023.

2. Tanveer Siddiqui & U.S. Tiwary – Natural Language Processing and Information Retrieval, Oxford University Press.

Reference Books:

1. T.V. Geetha – Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives, Pearson, 2024.

2. Akshay Kulkarni & Adarsha Shivananda – Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python, Apress, 2019.

Online Learning Resources

1. https://archive.nptel.ac.in/courses/106/106/106106211/

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech III Year II Semester

23CAI112 EXPLORATORY DATA ANALYSIS WITH PYTHON

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

The main objective of the course is to

1. To introduce the principles and practices of Exploratory Data Analysis (EDA) using Python.
2. To teach techniques for data cleaning, preprocessing, transformation, and visualization.
3. To apply statistical techniques and visual methods to discover patterns and relationships.
4. To gain experience using popular Python libraries such as NumPy, Pandas, Matplotlib, and Seaborn.
5. To prepare datasets for further machine learning and predictive modeling.

UNIT I INTRODUCTION TO EDA AND PYTHON ENVIRONMENT **9 hours**

Introduction to Data Science and EDA, Importance of EDA in Data Science Life Cycle, Setting up Python Environment: Jupyter, Anaconda, VS Code, Introduction to NumPy and Pandas: Arrays, Series, DataFrames, Data loading, viewing, basic operations (info, describe, shape)

UNIT II DATA WRANGLING AND PREPROCESSING **9 hours**

Handling Missing Data (mean, median, drop, interpolation), Dealing with Duplicates, Outliers, and Anomalies, Encoding Categorical Variables (Label, One-hot), Data Transformation: Scaling, Normalization, Binning, Data Types Conversion and Data Type Casting.

UNIT III UNIVARIATE AND BIVARIATE ANALYSIS **9 hours**

Measures of Central Tendency and Dispersion, Distribution Plots: Histograms, Boxplots, KDE, Bar Charts, Count Plots, Pie Charts, Bivariate Analysis: Scatter Plots, Pair Plots, Heatmaps, Correlation and Covariance Analysis

UNIT IV DATA VISUALIZATION TECHNIQUES **9 hours**

Visualization with Matplotlib and Seaborn, Customizing Plots: Titles, Legends, Labels, Themes, Advanced Visuals: Violin Plots, Strip Plots, Swarm Plots, Multivariate Visualization and Subplots, Plotly and Interactive Visualizations (basic overview)

UNIT V EDA CASE STUDIES AND REAL-TIME DATASETS **9 hours**

Step-by-step EDA on Sample Datasets (Titanic, Iris, Sales, etc.), Outlier Detection Techniques, Feature Engineering Techniques in EDA, EDA Report Generation using Python Notebooks, Preparing Data for Machine Learning Models

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand and apply key concepts of EDA and data preprocessing. (Cognitive Level: Understand, Apply)

CO2: Perform exploratory analysis using Python libraries and interpret results. (Cognitive Level: Apply, Analyze)

CO3: Handle missing data, outliers, and categorical features effectively. (Cognitive Level: Apply)

CO4: Create meaningful visualizations to support data-driven insights. (Cognitive Level: Analyze, Evaluate)

CO5: Use EDA as a foundation for data science workflows. (Cognitive Level: Apply, Create)

Text Books:

1. Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly, 2016.
2. Wes McKinney, Python for Data Analysis, 2nd Edition, O'Reilly, 2018.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly.

Online Learning Resource:

1. NPTEL Course – Data Science for Engineers

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech III Year II Semester

23CAI207 COMPUTER VISION LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: None

Course Objectives:

The objectives of the course are to

1. Apply image enhancement, segmentation, and transformation techniques.
2. Implement feature detection, object tracking, and classification using OpenCV.
3. Analyze vision-based applications using classical and deep learning approaches.

List of Experiments:

1. Load and display an image using OpenCV and perform basic operations like resizing, cropping, and rotation.
2. Histogram equalization and image enhancement techniques.
3. Apply filtering: Gaussian, Median, Bilateral filters.
4. Edge detection using Sobel, Canny operators.
5. Feature extraction using SIFT, SURF, ORB and matching.
6. Image segmentation using K-means and watershed algorithms.
7. Object detection using Haar cascade and contour detection.
8. Face detection and tracking using pre-trained DNN models (YOLO or SSD).
9. Motion estimation using optical flow (Lucas-Kanade/Farneback).
10. Camera calibration and 3D reconstruction basics.
11. Object classification using pretrained CNN models (e.g., MobileNet, VGG).
12. Content-Based Image Retrieval (CBIR) using Feature Descriptors

Lab Software Requirements:

- Languages/Tools: Python, OpenCV, NLTK, spaCy, Tesseract OCR, scikit-learn, NumPy, Pandas, Matplotlib
- Platforms: Jupyter Notebook / Google Colab / PyCharm / VS Code

Course Outcomes:

After completion of the course, Students will be able to

CO1: Apply OpenCV tools for image preprocessing and enhancement.

CO2: Implement segmentation and feature extraction techniques.

CO3: Use pretrained deep learning models for object detection.

CO4: Perform motion tracking and optical flow analysis

CO5: Design and test computer vision applications for real-world problems

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods (2018). Digital Image Processing, 4th Edition, Pearson.
2. Richard Szeliski (2022). Computer Vision: Algorithms and Applications, 2nd Edition, Springer.

Reference Books:

1. David A. Forsyth and Jean Ponce (2011). Computer Vision: A Modern Approach, 2nd Edition, Pearson.
2. E. R. Davies (2018). Computer Vision: Principles, Algorithms, Applications, Learning, 5th Edition, Academic Press (Elsevier).

Online Learning Resources

1. Stanford University: CS231n: Deep Learning for Computer Vision. Linkcs231n.stanford.edu

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech III Year II Semester

23CAI208 NATURAL LANGUAGE PROCESSING LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: None

Course Objectives:

The objectives of the course are to

1. To implement core NLP techniques such as tokenization, tagging, parsing, and translation using Python libraries.
2. To experiment with statistical and deep learning models for NLP tasks.
3. To build small-scale NLP systems with real-world relevance and evaluate their performance.

List of Experiments:

1. Text Preprocessing: Tokenization, Stemming, Lemmatization.
2. Spelling Correction using Edit Distance Algorithms.
3. N-gram Language Model Implementation and Evaluation.
4. POS Tagging using Rule-Based and HMM Models
5. Named Entity Recognition using spaCy and Hugging Face Transformers
6. Sentiment Analysis using Logistic Regression and LSTM
7. Text Classification using BERT
8. Information Retrieval with TF-IDF and BM25
9. Machine Translation using Pre-trained Transformer Models
10. Semantic Role Labeling with Pre-trained Models
11. Building a Question Answering System using BERT

Lab Software Requirements:

- Languages/Tools: Python, OpenCV, NLTK, spaCy, Tesseract OCR, scikit-learn, NumPy, Pandas, Matplotlib
- Platforms: Jupyter Notebook / Google Colab / PyCharm / VS Code

Course Outcomes:

After completion of the course, Students will be able to

CO1: Apply preprocessing techniques to raw text data for analysis.
CO2: Implement POS tagging, named entity recognition, and classification using machine learning
CO3: Utilize pretrained Transformer models (e.g., BERT) for tasks like translation and question answering
CO4: Design and execute end-to-end NLP pipelines for specific applications
CO5: Compare performance of traditional vs. deep learning approaches in NLP experiments.

Text Books:

1. Daniel Jurafsky & James H. Martin – Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education, 2023.
2. Tanveer Siddiqui & U.S. Tiwary – Natural Language Processing and Information Retrieval, Oxford University Press.

Reference Books:

1. T.V. Geetha – Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives, Pearson, 2024.
2. Akshay Kulkarni & Adarsha Shivananda – Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python, Apress, 2019.

Online Learning Resources

1. https://archive.nptel.ac.in/courses/106/106/106106211/

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech III Year II Semester

23ECE501 TINKERING LABORATORY

L	T	P	C
0	0	2	1

Course Description:

The aim of tinkering lab for engineering students is to provide a hands-on learning environment where students can explore, experiment, and innovate by building and testing prototypes. These labs are designed to demonstrate practical skills that complement theoretical knowledge. These labs bridge the gap between academia and industry, providing students with the practical experience. Some students may also develop entrepreneurial skills, potentially leading to start-ups or innovation-driven careers. Tinkering labs aim to cultivate the next generation of engineers by giving them the tools, space, and mind-set to experiment, innovate, and solve real-world challenges.

Course Objectives:

1. Encourage Innovation and Creativity
2. Provide Hands-on Learning and Impart Skill Development
3. Foster Collaboration and Teamwork
4. Enable Interdisciplinary Learning, Prepare for Industry and Entrepreneurship
5. Impart Problem-Solving mind-set

List of Experiments:

1. Make your own parallel and series circuits using breadboard for any application of your choice.
2. Design and 3D print a Walking Robot
3. Design and 3D Print a Rocket.
4. Temperature & Humidity Monitoring System (DHT11 + LCD)
5. Water Level Detection and Alert System
6. Automatic Plant Watering System
7. Bluetooth-Based Door Lock System
8. Smart Dustbin Using Ultrasonic Sensor
9. Fire Detection and Alarm System
10. RFID-Based Attendance System
11. Voice-Controlled Devices via Google Assistant
12. Heart Rate Monitoring Using Pulse Sensor
13. Soil Moisture-Based Irrigation
14. Smart Helmet for Accident Detection
15. Milk Adulteration Detection System
16. Water Purification via Activated Carbon
17. Solar Dehydrator for Food Drying

18. Temperature-Controlled Chemical Reactor
19. Ethanol Mini-Plant Using Biomass
20. Smart Fluid Flow Control (Solenoid + pH Sensor)
21. Portable Water Quality Tester
22. AI Crop Disease Detection
23. AI-based Smart Irrigation
24. ECG Signal Acquisition and Plotting
25. AI-Powered Traffic Flow Prediction
26. Smart Grid Simulation with Load Monitoring
27. Smart Campus Indoor Navigator
28. Weather Station Prototype
29. Firefighting Robot with Sensor Guidance
30. Facial Recognition Dustbin
31. Barcode-Based Lab Inventory System
32. Growth Chamber for Plants
33. Biomedical Waste Alert System
34. Soil Classification with AI
35. Smart Railway Gate
36. Smart Bin Locator via GPS and Load Sensors
37. Algae-Based Water Purifier
38. Attendance via Face Recognition

Note: The students can also design and implement their own ideas, apart from the list of experiments mentioned above.

Note: A minimum of 8 to 10 experiments must be completed by the students.

Course Outcomes:

After completion of the course, Students will be able to

CO1: Apply the principles of design thinking to identify real-world problems and develop feasible solutions.

CO2: Demonstrate proficiency in using basic tools, components, and digital fabrication technologies (e.g., Arduino, sensors, 3D printing, etc.).

CO3: Develop functional prototypes through iterative design, fabrication, and testing.

CO4: Collaborate effectively in multidisciplinary teams to brainstorm, plan, and execute tinkering projects.

CO5: Document the development process, evaluate outcomes, and communicate project results clearly using oral, visual, and written formats.

Reference Books:

1. "Make: Getting Started with Arduino" by Massimo Banzi, Maker Media Publications.

Online Resources:

1. https://aim.gov.in/pdf/equipment-manual-pdf.pdf

2. https://atl.aim.gov.in/ATL-Equipment-Manual/

3. https://aim.gov.in/pdf/Level-1.pdf

4. https://aim.gov.in/pdf/Level-2.pdf

5. https://aim.gov.in/pdf/Level-3.pdf

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

OPEN ELECTIVE – I

Open Elective – I

23HUM301 INDIAN KNOWLEDGE SYSTEM

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Objectives:

The main objectives of the course is to

1. To introduce the scope, significance, and interdisciplinary nature of Indian Knowledge Systems and their relevance in the modern world.
2. To explore the philosophical and epistemological foundations of Indian Knowledge Systems, including key concepts like Pramāṇa, Dharma, and Rta.
3. To examine the scientific contributions of ancient India in fields such as mathematics, astronomy, medicine, and engineering.
4. To understand Indian perspectives on society, governance, literature, and aesthetics through classical texts and traditions.
5. To appreciate the cultural richness, ethical values, and traditional educational systems that shaped Indian civilization.

UNIT I INDIAN KNOWLEDGE SYSTEM: AN INTRODUCTION 9 hours

Indian Knowledge System: An Overview- Historical evolution and contemporary Relevance-Interdisciplinary approach and integration in education-The Vedic Corpus, The Four Vedas and their components, Oral transmission and cultural continuity--Philosophical Systems, Orthodox (Āstika) and Heterodox (Nāstika) schools, Logic, metaphysics, and epistemology in Indian philosophy -Wisdom through the Ages- Scientific and Mathematical Contributions, Ayurveda, Astronomy, Metallurgy, Mathematics, Key scholars: Charaka, Sushruta, Aryabhata, Bhaskaracharya

UNIT II FOUNDATIONAL CONCEPTS IN INDIAN KNOWLEDGE SYSTEMS 9 hours

Shaping India's intellectual traditions- Ancient Indian linguistics, highlighting phonetics, grammar, and language philosophy-traditional number systems, units of measurement, and their practical applications in science and trade -indigenous frameworks for organizing and classifying knowledge, offering insights into how Indian scholars approached learning, epistemology, and the systemic cultivation of wisdom across disciplines.

UNIT III SCIENCE AND TECHNOLOGY IN INDIAN KNOWLEDGE SYSTEMS 9 hours

India’s classical achievements in mathematics, astronomy, architecture, and science. Learners explore ancient texts and applications—highlighting concepts like zero, planetary motion, and structural design. integration of science with philosophy and sustainability. Through notable scholars and indigenous techniques, how Indian scientific thought continues to influence contemporary innovations-offering wisdom for solving modern challenges.

UNIT IV HUMANITIES AND SOCIAL SCIENCES IN INDIAN KNOWLEDGE SYSTEMS 9 hours

Indian insights on leadership, wellbeing, and governance through ancient texts like the Srimad Bhagavad Gita. Topics include holistic management principles, psychological well-being, ethical governance, and traditional administrative models—emphasizing their relevance to modern society, personal growth, and nation-building.

UNT V CULTURAL, EDUCATIONAL, AND ETHICAL DIMENSIONS OF INDIAN KNOWLEDGE SYSTEMS **9 hours**

Art, Architecture, and Aesthetics-Temple architecture and sculpture-Music, dance, and literary traditions-**Education Systems and Institutions,** Gurukula system and pedagogical practices, Ancient universities: Nalanda, Takshashila-**Ethics and Values in Indian Thought-**Dharma, Karma, Moksha — principles of righteous living, Sustainability, harmony, and spiritual ecology-**Contemporary Relevance and Global Influence,** Indian knowledge systems in modern science and culture, Resurgence through NEP 2020 and academic initiatives

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Learners will be able to **describe** the scope and interdisciplinary relevance of Indian Knowledge Systems in contemporary contexts.

CO2: Learners will be able to **analyze** foundational philosophical concepts such as *Pramāṇa*, *Dharma*, and *Rta* within Indian epistemology.

CO3: Learners will be able to **apply** ancient Indian scientific principles to understand traditional practices in mathematics, astronomy, and medicine.

CO4: Learners will be able to **evaluate** classical Indian texts to interpret perspectives on governance, society, and aesthetics.

CO5: Learners will be able to **design** culturally informed ethical frameworks and educational models inspired by traditional Indian systems.

Reference Books:

1. Introduction to Indian knowledge system: concepts and applications
   By B. Mahadevan , Nagendra Pavana , Vinayak Rajat Bhat, PHI publications
2. Bhagavad Gita: As It Is" by A.C. Bhaktivedanta Swami Prabhupada Published by The Bhaktivedanta Book Trust
3. "Indian Philosophy, Volume 1 and 2 by S. Radhakrishnan Published by Oxford university press.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23MAT301 ADVANCED NUMERICAL METHODS

L	T	P	C
3	0	0	3

Pre-requisite: 23MAT101, 23MAT102

Course Description:

This course reviews and continues the study of computational techniques for evaluating interpolations, derivatives and integrals; solving system of algebraic equations, transcendental equations, ordinary differential equations and partial differential equations. The course emphasizes on numerical and mathematical methods of solutions with appropriate error analysis.

Course Objectives:

The main objectives of the course is to

6. To introduce computation methods of solving algebraic and transcendental equations.
7. To avail the basics of numerical techniques for solving the system of linear equations.
8. To familiarize the knowledge of interpolation and numerical calculus.
9. To use numerical calculus for solving ordinary differential equations.
10. To introduce the computational techniques for solving partial differential equations.

UNIT I SOLUTIONS OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS 9 hours

Errors, sources of errors, floating point arithmetic, significant digits, relative error, propagation of errors, how to avoid loss of significant digits, evaluation of polynomial. Bisection method, False-position method, Secant method, Fixed-point iteration method, Newton's method – single and multiple roots, Order of convergence of the methods.

UNIT II SOLUTIONS OF SYSTEM OF ALGEBRAIC EQUATIONS 9 hours

LU decomposition, Thomas algorithm for the tridiagonal systems, Norms-Euclidean, mini-maxi, Frobenius and 1-,2- and ∞-norms, Condition numbers and errors in computed solutions. Jacobi's method, Gauss-Seidel method, Power method for obtaining eigenvalues and eigenvectors of matrices.

UNIT III INTERPOLATION & NUMERICAL CALCULUS 9 hours

Existence and Uniqueness of interpolating polynomial, Lagrange polynomials, Divided differences, Evenly spaced points, Error of interpolation, cubic spline, Inverse interpolation, Derivatives from difference table, Higher order derivatives, Trapezoidal rule, Simpsons rule, a composite formula, Gaussian Quadrature.

UNIT IV NUMERICAL SOLUTIONS TO ORDINARY DIFFERENTIAL EQUATIONS 9 hours

Taylor series method, Euler and Modified Euler's method, Runge-Kutta methods for initial value problems, Shooting method, Finite difference method for boundary value problems.

UNIT V NUMERICAL SOLUTIONS TO PARTIAL DIFFERENTIAL EQUATIONS 9 hours

Laplace and Poisson equations (five-point formula), Finite difference methods for one-dimensional Heat and Wave equations.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Solve the system of algebraic and transcendental equations.

CO2: Apply the numerical techniques to find the solution to system of equations.

CO3: Calculate and analyze the rate of variations and numerical sum of such changes using numerical calculus relevant to the field of Engineering.

CO4: Find the accurate numerical solutions to ordinary differential equations representing some Engineering problems.

CO5: Compute the solutions for engineering problems represented by partial differential equations.

Text Books:

1. Curtis F. Gerald, Patrich O. Wheatley, Applied Numerical Analysis, Pearson Education, 7th Edition, 2003.
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.

Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, 43rd edition (2014), Khanna publishers.
2. Burden and Faires, Numerical Analysis 7th ed., Thomson Learning, 2001.
3. E. Kreyszig, Advanced Engineering Mathematics, 10th ed., Wiley, 2010.
4. Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven C. Chapra, 3rd ed., Mc Graw Hill, 2012.
5. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering, New Age International Ltd., 5th Edition, 2010.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23MAT302 ENGINEERING OPTIMIZATION

L	T	P	C
3	0	0	3

Pre-requisite: 23MAT101, 23MAT102, 23MAT104

Course Description:

Unconstrained and constrained optimization, Linear programming problem, transportation and assignment problems, dynamic programming problem, project management and queuing models.

Course Objectives:

The main objectives of the course is to

1. Understand the optimization techniques for solving engineering problems.
2. Formulate and solve linear programming problem.
3. Obtain the optimal solution for transportation and assignment problems.
4. Avail knowledge to apply the game theory and project management techniques to find the solutions to the complex problems.
5. Understand the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.

UNIT I CLASSICAL OPTIMIZATION 9 hours

Introduction to optimization, unconstrained optimization with single variable and multi variable. Constrained multivariable optimization with equality constraints- Lagrange multipliers method, constrained multivariable optimization with inequality constraints - Kuhn-Tucker conditions.

UNIT II LINEAR PROGRAMMING PROBLEM 9 hours

Linear Programming Problem (LPP), Mathematical formulation, graphical solution, simplex method. Artificial variable technique - Big M-method and two phase simplex method. Duality, dual Simplex method.

UNIT III TRANSPORTATION PROBLEM AND ASSIGNMENT PROBLEM 9 hours

Transportation problem: definition and algorithm, transshipment problem. Assignment problem, travelling salesman problem.

UNIT IV GAME THEORY AND PROJECT MANAGEMENT 9 hours

Formulation of games, Two Person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance property. Network analysis: Network representation, Critical Path Method (CPM) and Project Evolutionary and Review Technique (PERT).

UNIT V QUEUING MODELS 9 hours

Introduction to queuing system, Birth and Death processes, Single and multiple server queueing models, Little's formula - Finite Calling Population Queuing Models – Multi-Phase Service Queuing Model.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understood the importance of unconstrained and constrained optimization to solve engineering problems.

CO2: Get an idea about the linear programming techniques.

CO3: Solve transportation and assignment problems in engineering situations.

CO4: Analyze the problems of network analysis for project management and game theory.

CO5: Apply the Queuing system models to solve problems in engineering & industry.

Text Books:

1. J K Sharma, Operations Research: Theory and Practice, Macmillan Publishers India Ltd, 5th edition,2013.

2. B.S. Grewal, Higher Engineering Mathematics, 43rd edition (2014), Khanna publishers.

Reference Books:

1. Hamdy A Taha, Operations Research: An Introduction, Pearson Education, 9/E, 2011.

2. FS Hillier and GJ Lieberman, Introduction to Operations Research, TMH, 8/E, 2006.

3. JC Pant, Introduction to Optimization: Operations Research, Jain Brothers, New, 6/E, 2004.

4. A Ravindran, DT Philips and JJ Solberg, Operations Research: Principles and Practice, John Wiley& Sons, Singapore, 2nd edition.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23PHY301 LASER PHYSICS AND ADVANCED LASER TECHNOLOGY

L	T	P	C
3	0	0	3

Pre-requisite: Basic knowledge of atomic structure at intermediate (10+2) level is sufficient

Course Description:

Laser usage is rampant in various technological applications. Several fields gaining attention in the usage of lasers. This course covers the introduction to the theory and mechanism of laser action, various types of lasers and their applications and future use.

Course Objectives:

The main objectives of the course is to

1. Make the student to understand the detailed principles of various lasers.
2. Profound understanding of different variety of lasers will provide them to think of superior selection and usage of lasers in practical technological applications.
3. Students are aware of latest developments in certain areas of Laser technology which have important applications for societal needs.
4. Explain how material processing is accomplished with lasers. Estimate laser operation parameters for material processing.
5. Exposure about Lasers applications in engineering, communications, spectroscopy and material process etc.

UNIT I INTRODUCTION TO LASER TECHNOLOGY 9 hours

Laser characteristics, The Einstein Coefficients, Absorption and Emission Cross Sections, Spontaneous and Stimulated emission of radiation, Population inversion, Methods of Population Inversion, Laser Rate Equations, stable two minor optical resonators, Mode selection, Gain in the regenerative laser cavity.

UNIT II GASES AND LIQUIDS LASING MEDIUM 9 hours

Energy levels & Radiative properties of Atoms and molecules**;** *Atomic lasers*: He-Ne laser, Argon Ion laser**;** *Molecular Lasers*: Carbon dioxide laser, Liquid energy levels and their radiative properties, Organic Dye laser.

UNIT III SOLID STATE LASERS 9 hours

Energy Levels in solids-dielectric medium, Solid-state lasing materials, Narrow line width laser materials, broad band line width laser materials, solid state lasers: Nd:YAG, Nd:YLF; Ti:Sapphire (introduction only)

Energy Levels in solids-semiconductor medium, direct and indirect band gap semiconductors, Semiconductor diode laser, Quantum dot lasers (Introduction only)

UNIT IV PULSED OPERATION OF LASERS **9 hours**

Nanosecond: Q-Switching, Techniques of Q-Switching: electro-optic, Acousto-Optic.Femtosecond: Relationship between pulse duration and Spectral Width, Passive mode-locking, Active mode locking, Kerr lens mode locking, Amplification of femtosecond pulses.

UNIT V LASER APPLICATIONS **9 hours**

Laser processing of materials: laser cutting, laser drilling, welding; Lasers in metrology- Accurate measurement of length, light wave communications; Laser spectroscopy: Laser fluorescence and Raman scattering.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the principle of phenomenon of laser and identify the operating principle involved in various type of lasers.

CO2: Estimate stability requirements in producing laser light by different types of sources

CO2: CO3: Differentiate or list the various types of lasers and their means of excitation.

CO4: Assess (Identify) which laser would best meet the need for a particular industrial or research task.

CO5: Student can knowledge of latest technological developments in laser technology. Femtosecond laser etc.

Text Books:

1. Laser Fundamentals: William T Silfvast. Cambridge Publication.
2. Laser Theory and Applications: A.K. Ghatak and K. Thyagarajan, Springer
3. Femtosecond Laser Pulses Principles and Experiments: Claude Rulli`ere, Springer
4. Principles of Laser: O. Svelto
5. Laser Physics: Peter W Miloni, Joseph H Eberly.

Reference Books:

1. Solid State Laser Engineering: Walter Koechner. Springer series in optical sciences.
2. Ultrafast Optics, Andrew M. Weiner
3. Laser spectroscopy: Demtroder
4. Laser Applications: Monte Ross

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23PHY302 THIN FILM TECHNOLOGY AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:

Nucleation, crystallization, surface energy, various thin film coating processes including both physical vapour deposition such as evaporation, sputtering, pulsed laser deposition and chemical vapour deposition, spray coating, and other methods such as spin-coating, plasma polymerization, Langmuir Blodgett, transport phenomena in thin films, various properties of thin films, techniques and method to characterize thin films, current application of thin film, introduction to fabrication of thin film devices

Course Objectives:

The main objectives of the course is to

1. To provide students with a comprehensive overview on the fundamentals of thin film preparation and characterization.
2. To enable the students to develop a thorough understanding of how core physics can be used to understand thin film deposition processes.
3. To establish the correlation between processing variables and materials characteristics and performance within the framework of key modern technologies.
4. To realize thin film applications to science and technology

UNIT I PHYSICS OF THIN FILMS **8 hours**

Introduction - Role of thin films in devices - Thin film definition - Crystalline and amorphous films - Crystal defects - Nucleation and growth - film formation.

UNIT II THIN FILM DEPOSITION TECHNIQUES **10 hours**

Physical methods of films deposition-evaporation, e-beam, sputter deposition, pulsed laser, molecular beam epitaxy. Chemical methods of film deposition -Deposition of Inorganic films from Solutions-Chemical vapour deposition - Electrolysis, Anodization, Spray pyrolysis, Other techniques: Langmuir Blodgett and Spin Coating.

UNIT III PROPERTIES OF THIN FILMS **8 hours**

Structural-Optical-Electrical-Magnetic-Mechanical and Thermal properties of thin films

UNIT IV CHARACTERIZATION OF THIN FILMS **10 hours**

Imaging Techniques (SEM, AFM, TEM) - Structural Techniques (XRD, Raman)-Optical Techniques (UV-Vis-NIR, PL)-Electrical Techniques (Hall Effect, IV, CV)-Magnetic Techniques (EPR, H-V curve)-Mechanical Techniques (Hardness testing)-Thickness measurement (profilometer, ellipsometry).

UNIT V APPLICATIONS OF THIN FILMS **9 hours**

Transparent conducting coating - Optical coating – Solar cells – Photocatalytic – Sensors - Superconductivity- Superhard coatings – Thin film transistors.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Discuss the differences and similarities between different vacuum based deposition techniques, evaluate and use models for nucleating and growth of thin films.

CO2: Asses the relation between deposition technique, film structure, and film properties.

CO3: Know the typical thin film applications.

CO4: Motivate selection of deposition techniques for various applications.

Text Books:

1. Thin Film Deposition: Principles and Practice, *Donald L. Smith*, McGraw Hill, Singapore, 2001.

2. Maissel, L.I and Glang. R, "Handbook of thin film technology", McGraw Hill, 1970.

Reference Books:

1. Thin film phenomena / *Kasturi L. Chopra,* New York: McGraw-Hill, c1969.

2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications" Imperial College Press, 2004.

3. An introduction to physics and technology of thin films / *Alfred Wagendristel*, *Yuming Wang*, Singapore: World Scientific, c1994.

4. Thin film processes, *John L Vossen, Werner Kehn* editors, Academic Press, New York, 1978.

5. Thin film physics / *O.S. Heavens*, London: Methuen, c1970.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23PHY303 WASTE TO SUSTAINABLE ENERGY AND ENERGY SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite: Basic knowledge of Physics and chemistry at the intermediate (10+2) level is sufficient

Course Description:

This course covers waste-to-energy conversion and energy storage technologies, including thermal, biological, and chemical methods. It introduces relevant policies, case studies, and trends to help students design sustainable energy solutions aligned with the circular economy and climate goals.

Course Objectives:

The main objectives of the course is to

1. Understand various methods of energy generation from waste.
2. To explore thermal, biological, and chemical conversion technologies.
3. To examine modern energy storage devices and their integration with waste-to-energy systems.
4. To analyse the techno-economic feasibility of these systems for sustainable development.
5. To develop interdisciplinary skills in waste-to-energy technologies, enhancing student employability in sustainable energy and environmental sectors.

UNIT I INTRODUCTION TO WASTE PROCESSING, TRANSPORT, AND MANAGEMENT **9 hours**

Types of Wastes, Agricultural Residues, and Wastes Including Animal Wastes, Industrial Wastes, Municipal Solid Wastes and Characterization. Waste Processing Types and Composition of Various Types of Wastes- Industrial Waste and Biomedical Waste- Waste Collection and Transportation- Waste Processing- Size Reduction, Separation- Waste Management Hierarchy- Waste Minimization and Recycling of Municipal Solid Waste.

UNIT II THERMAL WASTE CONVERSION TECHNOLOGIES **9 hours**

Combustion, incineration, pyrolysis, gasification, Process parameters, design considerations, Emission control, energy recovery, and Case studies of WTE (Waste to Energy) plants in India and abroad

UNIT III BIOLOGICAL AND CHEMICAL CONVERSION **9 hours**

Bio gasification: Biomethanation process, biogas digester types. Chemical Conversion: Hydrolysis & hydrogenation; solvent extraction of hydrocarbons; solvolysis of wood, bio crude, biodiesel production via chemical process; transesterification methods; Chemicals from biomass.

UNIT IV ENERGY STORAGE SYSTEMS **9 hours**

Introduction to Energy Storage Systems - Types of energy storage- electrical, mechanical, chemical, thermal; Batteries (Li-ion, lead-acid, flow batteries), Supercapacitors and hybrid storage, Hydrogen storage and fuel cells.

UNIT V WASTE MANAGEMENT AND ENERGY RECOVERY **9 hours**

Characteristics and Perspectives of Waste, Unit Operations & Transformation Technologies, Waste Disposal, Hazardous Waste Management & Waste Recycling

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: To understand various methods of energy recovery from waste.

CO2: To explore thermal conversion technologies.

CO3: To explore biological and chemical conversion technologies

CO4: To examine modern energy storage devices and their integration with waste-to-energy systems.

CO5: To analyse the techno-economic feasibility of these systems for sustainable development.

Text Books:

1. Waste-to-Energy. Technologies and Project Implementation by Marc J. Rogoff And Francois Screve (Auth.) Publisher: William Andrew, 2011/2019
2. Robert C. Brown Thermo-chemical Processing of Biomass: Conversion into Fuels, Chemicals and Power, John Wiley and Sons, 2019.
3. Sergio Capareda, Introduction to Biomass Energy Conversions, CRC Press, 2013.
4. Fundamentals of Energy Storage, J. Jensen, B. Squrensen, John Wiley, NY
5. Techobanoglous, Theisen, and Vigil, "Integrated Solid Waste Management", 2d Ed. McGraw-Hill, New York, 1993.

Reference Books:

1. Industrial and Urban Waste Management in India, TERI Press
2. B. Lal and M. Patwardhan, "Wealth from Waste: Trends and Technologies", TERI Press
3. Municipal Solid Waste to Energy Conversion Processes: Processes Technical, and Renewable comparisons, by Gary C. Young, ISBN:9780470539675, Publisher: John Wiley & Sons, Publication Date: June 2010.
4. Parker Colin, and Roberts, "Energy from Waste – An Evaluation of Conversion Technologies", Elsevier Applied Science, London, 1985.
5. La Grega, M., et al., "Hazardous Waste Management", McGraw-Hill, c. 1200 pp., 2nd ed.,2001

Journals & Reviews:

1. Updated Journals and Reviews of the last 5 Years
2. Home (https://swayam.gov.in) > Courses (https://swayam.gov.in/explorer) > Waste to Energy Conversion, By Prof. P. Mondal | IIT Roorkee

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23CHE301 CHEMISTRY OF POLYMERS AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Objectives:

The main objectives of the course is to

1. To understand the basic principles of polymers
2. To understand natural polymers and their applications.
3. To impart knowledge to the students about synthetic polymers, their preparation and importance.
4. To enumerate the applications of hydogel polymers
5. To enumerate applications of conducting and degradable polymers in engineering.

UNIT I POLYMERS-BASICS AND CHARACTERIZATION:- 9 hours

Basic concepts: monomers, repeating units, degree of polymerization, linear, branched and network polymers, classification of polymers, Polymerization: addition, condensation, copolymerization and coordination polymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution. Measurement of molecular weight: End group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

UNIT II NATURAL POLYMERS & MODIFIED CELLULOSICS 9 hours

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.

Modified cellulosics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEA.

UNIT III SYNTHETIC POLYMERS 9 hours

Addition and condensation polymerization processes– Bulk, Solution, Suspension and Emulsion polymerization. Preparation and significance, classification of polymers based on physical properties. Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications. Preparation of Polymers based on different types of monomers, Olefin polymers(PE,PVC), Butadiene polymers(BUNA-S,BUNA-N), nylons, Urea-formaldehyde, phenol – formaldehyde, Melamine Epoxy and Ion exchange resins.

UNIT IV HYDROGELS OF POLYMER NETWORKS 9 hours

Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, Applications of hydrogels in drug delivery.

UNIT V CONDUCTING AND DEGRADABLE POLYMERS: 9 hours

Conducting polymers: Introduction, Classification, Mechanism of conduction in Poly Acetylene, Poly Aniline, Poly Thiophene, Doping, Applications.

Degradable polymers: Introduction, Classifications, Examples, Mechanism of degradation, poly lactic acid, Nylon-6, Polyesters, applications.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Classify the polymers, explain polymerization mechanism, differentiate addition, condensation polymerizations, Describe measurement of molecular weight of polymer

CO2: Describe the physical and chemical properties of natural polymers and Modified cellulosics.

CO3: Differentiate Bulk, solution, Suspension and emulsion polymerization, describe fibers and elastomers, Identify the thermosetting and thermo polymers.

CO4: Identify types of polymer networks, describe methods involve in hydrogel preparation, Explain applications of hydrogels in drug delivery,

CO5: Explain classification and mechanism of conducting and degradable polymers.

Text Books:

1. A Text book of Polymer science, Billmayer
2. Polymer Chemistry – G.S.Mishra
3. Polymer Chemistry – Gowarikar

Reference Books:

1. Organic polymer Chemistry, K.J.Saunders, Chapman and Hall
2. Advanced Organic Chemistry, B.Miller, Prentice Hall
3. Polymer Science and Technology by Premamoy Ghosh, 3rd edition, McGraw-Hill, 2010.

Online Learning Resources

1. https://nptel.ac.in/courses/104105124

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23CHE302 GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE ENVIRONMENT

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Objectives:

The main objectives of the course is to

1. Learn an interdisciplinary approach to the scientific and societal issues arising from industrial chemical production, including the facets of chemistry and environmental health sciences that can be integrated to promote green chemistry
2. Sensitize the students in redesigning of chemicals, industrial processes and products by means of catalysis.
3. Understand the use of alternatives assessments in using environmentally benign solvents.
4. Emphasize current emerging greener technologies and the need of alternative energies.
5. Learn to adopt green chemistry principles in practicing Nanoscience

UNIT I PRINCIPLES AND CONCEPTS OF GREEN CHEMISTRY 9 hours

Introduction, Green chemistry Principles, sustainable development and green chemistry, atom economy, atom economic: Rearrangement and addition reactions and un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity. Waste - problems and Prevention: Design for degradation.

UNIT II CATALYSIS AND GREEN CHEMISTRY 9 hours

Introduction to catalysis, Heterogeneous catalysts: Basics of Heterogeneous Catalysis, Zeolites: Catalytic cracking, ZSM-5 catalyst and high silica zeolites, TS1 Oxidation catalyst, Catalytic Converters, Homogeneous catalysis: Hydrogenation of alkenes using wilkinson's catalyst, Phase transfer catalysis: Hazard Reduction, C–C Bond Formation, Oxidation Using Hydrogen Peroxide.

UNIT III ORGANIC SOLVENTS: ENVIRONMENTALLY BENIGN SOLUTIONS 9 hours

Organic solvents and volatile organic compounds, solvent free systems, supercritical fluids: Super critical carbondioxide, super critical water and water as a reaction solvent: water based coatings, Ionic liquids as catalyst and solvent.

UNIT IV EMERGING GREENER TECHNOLOGIES AND ALTERNATIVE ENERGY SOURCES 9 hours

Biomass as renewable resource, Energy: Fossil Fuels, Energy from Biomass, Solar Power, Fuel Cells(Hydrogen—oxygen fuel cell), Photochemical Reactions: Advantages of and Challenges Faced by Photochemical Processes, Examples of Photochemical Reactions(caprolactum), Chemistry Using Microwaves: Microwave Heating, Microwave-assisted Reactions, Sonochemistry.

UNIT V GREEN PROCESSES FOR GREEN NANOSCIENCE 9 hours

Introduction and traditional methods in the nanomaterials synthesis, Translating green chemistry principles for practicing Green Nanoscience. Green Synthesis of Nanophase Inorganic Materials and Metal Oxide Nanoparticles: Hydrothermal Synthesis, Reflux Synthesis, Microwave-Assisted Synthesis, Other methods for Green synthesis of metal and metal oxide nanoparticles, Green chemistry applications of Inorganic nanomaterials

Course Outcomes:

Upon completion of this course the students should:

CO1: Recognize green chemistry concepts and apply these ideas to develop respect for the interconnectedness of our world and an ethic of environmental care and sustainability.
CO2: Understand and apply catalysis for developing eco-friendly processes.
CO3: Be in a position to use environmental benign solvents where ever possible.
CO4: Have knowledge of current trends in alternative energy sources.
CO5: Apply green chemistry principles in practicing green Nanoscience.

Text Books:

1. M. Lancaster, Green Chemistry an introductory text, Royal Society of Chemistry, 2002.
2. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, 4th Edition, Oxford University Press, USA

Reference Books:

1. Edited by Alvise Perosa and Maurizio Selva , Hand Book of Green chemistry Volume 8: Green Nanoscience, wiley-VCH
2. Advanced Organic Chemistry, B.Miller, Prentice Hall
3. Polymer Science and Technology by Premamoy Ghosh, 3rd edition, McGraw-Hill, 2010.

Online Learning Resources

1. https://nptel.ac.in/courses/104105124

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23CHE303 CHEMISTRY OF ENERGY SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite: NIL

Course Objectives:

1. To make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.
2. To understand the basic concepts of processing and limitations of Fuel cells & their applications.
3. To impart knowledge to the students about fundamental concepts of photo chemical cells, reactions and applications
4. Necessasity of harnessing alternate energy resources such as solar energy and its basic concepts.
5. To impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquification method.

UNIT I ELECTROCHEMICAL SYSTEMS 9 hours

Galvanic cell, Nernst equation, standard electrode potential, application of EMF, electrical double layer, polarization, Batteries- Introduction ,Lead-acid ,Nickel- cadmium, Lithium ion batteries and their applications**.**

UNIT II FUEL CELLS 9 hours

Fuel cell- Introduction, Basic design of fuel cell, working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency and applications.

UNIT III PHOTO AND PHOTO ELECTROCHEMICAL CONVERSIONS 9 hours

Photochemical cells Introduction and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions and their applications.

UNIT IV SOLAR ENERGY 9 hours

Introduction and prospects, photovoltaic (PV) technology, concentrated solar power (CSP), Solar cells and applications.

UNIT V HYDROGEN STORAGE 9 hours

Hydrogen storage and delivery: State-of-the art, Established technologies, Chemical and Physical methods of hydrogen storage, Compressed gas storage, Liquid hydrogen storage, Other storage methods, Hydrogen storage in metal hydrides, metal organic frameworks (MOF), Metal oxide porous structures, hydrogel , and Organic hydrogen carriers.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Solve the problems based on electrode potential, Describe the Galvanic Cell Differentiate between Lead acid and Lithium ion batteries, Illustrate the electrical double layer

CO2: Describe the working Principle of Fuel cell, Explain the efficiency of the fuel cell Discuss about the Basic design of fuel cells, Classify the fuel cell

CO3: Differentiate between Photo and Photo electrochemical Conversions, Illustrate the photochemical cells, Identify the applications of photochemical reactions, Interpret advantages of photoelectron catalytic conversion.

CO4: Apply the photo voltaic technology, Demonstrate about solar energy and prospects Illustrate the Solar cells, Discuss about concentrated solar power

CO5: Differentiate Chemical and Physical methods of hydrogen storage, Discuss the metal organic frame work, Illustrate the carbon and metal oxide porous structures Describe the liquification methods.

Text Books:

1. Physical chemistry by Ira N. Levine
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins

Reference Books:

1. Fuel Cell Hand Book 7th Edition, by US Department of Energy (EG&G technical services And corporation)
2. Hand book of solar energy and applications by ArvindTiwari and Shyam.
3. Solar energy fundamental, technology and systems by Klaus Jagar et.al.
4. Hydrogen storage by Levine Klebonoff

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23CE301 DISASTER MANAGEMENT

L	T	P	C
3	0	0	3

Pre-requisites: None

Course Description:

The goal of this course is to expose the undergraduate students to different types of disasters and the preparedness needed to mitigate their effects. The course matrix will cover various natural, biological, chemical, and emerging hazards and risks that may cause property loss, loss of lives, and livestock. Thus, the future engineers will understand the social responsibility for the preparedness and mitigation of the damages caused by the disasters.

Course Objectives:

1. To make the students aware of disasters and their impact on living beings.
2. To ensure the students understand vulnerability, disasters, disaster prevention, and risk reduction.
3. To gain a preliminary understanding of approaches for the Disaster Risk Reduction (DRR)
4. To enhance awareness of institutional processes available in the country for disaster risk mitigation.
5. To make the students aware of development activities and case studies.

UNIT I INTRODUCTION 8 hours

Introduction, Etymology of disaster, Concepts and definitions: disaster, hazard, vulnerability, risks, Resilience, prevention, and mitigation.

UNIT II TYPES OF DISASTERS 10 hours

Types of Disaster; natural disasters (earthquakes, volcanoes, forest fires and explosions, heat and cold waves, floods, draught, cyclones, tsunami, landslides, soil erosion); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.), hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

UNIT III DISASTER IMPACTS 9 hours

Disaster Impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT IV DISASTER RISK MITIGATION MEASURES 9 hours

Disaster Risk Reduction (DRR) - Disaster management- four phase approach; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications), DRR programmers in India and the activities of National Disaster Management Authority. Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction.

UNIT V IMPACT OF DEVELOPMENTAL ACTIVITIES 9 hours

Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization, etc.), sustainable and environmental friendly recovery; reconstruction and development methods. Different GIS software, basic data types and coordinate systems. Case studies.

Course Outcomes:

The students after completing the course will be able to:

CO1: Explain various disaster concepts

CO2: Differentiate between categories of disasters

CO3: Analyze the impact of various types of disasters

CO4: Select disaster risk mitigation measures

CO5: Identify the impact of development activities

Text Books:

1. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation

Reference Books:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster Management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003
6. Inter-Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23CE302 GREEN BUILDINGS

L	T	P	C
3	0	0	3

Pre-requisites: None

Course Description:

The course covers various aspects of bioclimatic architecture like climate-sensitive design, passive solar architecture, Water management, green building materials and construction techniques

Course Objectives:

1. To introduce concepts of sustainability and bioclimatic design in planning, Construction and life of buildings.
2. To equip students with technical knowledge of energy-efficient Green Buildings.
3. To guide students, through projects, to apply concepts and ideas for the design of a green building by introducing them to green initiatives and ratings.
4. To initiate students in basics of functional design and drawing of the various buildings using the above concepts.
5. To understand different evaluation criteria with various green building rating systems

UNIT I GREEN BUILDING CONCEPTS 9 hours

Introduction to bioclimatic architecture- Sustainability in building science and Functional planning- Orientation- Elements of building design and drawing- Building regulations and by-laws
Traditional and Vernacular Architecture- Climate zones- Design Charts- sun path diagram- Solar angles- Indices of thermal comfort- Vernacular buildings in different climate zones.

UNIT II CLIMATE RESPONSIVE SCIENTIFIC PROCESS OF DESIGN 9 hours

Introduction- various steps in Site planning- Plan for Building envelope- Land form-Topography-vegetation- water bodies; Orientation- S/V ratio- P/A ratio- Walls, Fenestration- Roof and floors- Active and passive solar strategies- Passive solar architecture.

UNIT III THERMAL FLOW IN BUILDINGS 9 hours

Calculation of thermal conductance- Heat flow through different building elements- Ventilation and day lighting- Design and placement of openings- Water management in buildings- Techniques to recycle, reuse and harvest water.

UNIT IV GREEN BUILDING MATERIALS AND CONSTRUCTION 9 hours

Material properties- Energy efficiency using various materials- emerging new materials, Construction techniques- Techniques for roof, wall and foundations.

UNIT V ECONOMY OF GREEN BUILDING 9 hours

Cost of building- operation and maintenance- Green building rating system- Evaluation criteria of LEED- TERI - GRIHA case studies- Case studies in different climate zones.

Course Outcomes:

After successful completion of this course, the student will be able to:

CO1: Use various regulations and by-laws for green building construction.
CO2: Do site planning, active and passive for Green Building.
CO3: Compute thermal flow through different building elements.
CO4: Identify energy efficient building materials and construction techniques for building components.
CO5: Compute cost of building/operation and maintenance, evaluation criteria for different case studies.

Text Books:

1. Krishnan, A., Baker, N., Yannas, S., & Szokolay, S. (Eds.). (2001). Climate responsive architecture, a design handbook for energy efficient buildings. New Delhi: Tata McGraw Hill Publishing Company.
2. TERI & ICAEN (InstitutCatalad'Energia). (2004). Sustainable building design manual (Vol II). New Delhi: The Energy and Resources Institute (TERI) Press

Reference Books:

1. Bureau of Indian Standards. (1995). SP:41, Handbook on functional requirements of Buildings (other than industrial buildings) (First reprint ed.). New Delhi: Bureau of Indian Standards.
2. Indian Green Building Council, LEED-India. (2011). LEED 2011 for India- Green building rating system, abridged reference guide for new construction and major renovations (LEED India NC). Hyderabad: Indian Green Building Council
3. Koenigsberger, O., ingersoll, T. G., Mayhew, A., & Skozolay, S. V. (2011). Manual of Tropical Housing and Building. Hyderabad: Universities Press
4. Prabhu, Balagopal T S, K Vincent Paul, and C Vijay an. Building Design and Drawing. Calicut: Spades Publishers, 2008
5. Szokolay, S. V. (2008). Introduction to Architectural Science- The Basis of sustainable Design (Second ed.). Architectural Press/Elsevier
6. The Energy and Resources Institute (TERI). (2011). Green Rating for Integrated Habitat Assessment (GRIHA) manual. New Delhi: TERI press
7. Journals: Energy and Buildings, Building and Environment, Other relevant publications.
8. National Building Code, Bureau of Indian Standards: New Delhi. 2005; Building Bye laws and building rules of selected Indian urban and rural areas
9. Swamy, N. K., & Rao, A. K. (2013). Building planning and Drawing, New Delhi, Charothar Publishing House

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23ME301 MATERIALS SCIENCE FOR ENGINEERS

L	T	P	C
3	0	0	3

Pre-requisite: 23PHY101 ENGINEERING PHYSICS

Course Objectives:

This course is designed to:

1. Understand the fundamental classification and properties of engineering materials.
2. Explore the structure, properties, and applications of metals and alloys.
3. Gain knowledge on composite materials and their relevance in engineering fields.
4. Learn about the structure and characteristics of ceramics and polymers.
5. Develop an appreciation of smart and advanced materials for modern technologies.

UNIT I CLASSIFICATION OF MATERIALS 9 hours

Introduction to materials science, Classification: Metals, Ceramics, Polymers, Composites, Semiconductors, Biomaterials, Properties: Mechanical, Electrical, Thermal, Optical, Magnetic, Atomic structure and bonding, Crystal structures and defects, Structure–property relationships, Materials selection charts for engineering design.

UNIT II METALS AND ALLOYS 9 hours

Types of metals: Ferrous and non-ferrous, Microstructure of metals, Phase diagrams (binary alloys), Heat treatment of steels, Corrosion and prevention methods, Mechanical behavior and testing: Stress-strain, hardness, fatigue, Common engineering alloys and their applications.

UNIT III COMPOSITES 9 hours

Definition and classification: Particle-reinforced, fiber-reinforced, structural composites, Matrix materials: Polymer, metal, and ceramic matrix, Manufacturing techniques: Hand lay-up, pultrusion, Powder Metallurgy, Slurry Infiltration and Sintering, Properties and performance, Applications in aerospace, automotive, construction, and electronics.

UNIT IV CERAMICS AND POLYMERS 9 hours

Structure and types of ceramics: Crystalline and amorphous, Properties: Thermal resistance, brittleness, conductivity, Processing of ceramics: Sintering, slip casting, hot pressing, Types of polymers: Thermoplastics, thermosets, elastomers, Polymerization processes: Addition and condensation, Mechanical and thermal properties, Applications in electronics, biomedical, and structural sectors.

UNIT V SMART AND ADVANCED MATERIALS 9 hours

Definition and need for smart materials, Shape memory alloys, piezoelectric materials, magnetostrictive materials, Electroactive polymers, self-healing materials, photonic crystals, Nanomaterials and carbon-based materials (graphene, CNTs), Biomaterials and biocompatibility, Materials for electronics, aerospace, and green energy systems, Emerging trends and future directions.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Identify and classify materials based on their properties and structure.
CO2: Understand the behaviour and applications of metals and alloys in engineering.
CO3: Compare the types and uses of composites in structural and functional applications.
CO4: Understand the processing and properties of ceramics and polymers.
CO5: Identify the emerging applications of smart and advanced materials in multidisciplinary domains.

Text Books:

1. Callister, W. D., & Rethwisch, D. G. (2020). Materials science and engineering: An introduction (10th ed.). Wiley.
2. Smith, W. F., Hashemi, J., & Prakash, R. (2021). Materials science and engineering (6th ed., SI units). McGraw Hill Education.
3. Upadhyaya, G. S., & Upadhyaya, A. (2022). Materials science and engineering (Revised ed.). Viva Books.

Reference Books:

1. Raghavan, V. (2018). Materials science and engineering (6th ed.). Prentice Hall of India.
2. C. Barry Carter and M. Grant Norton, Ceramic Materials: Science and Engineering, Springer, 3rd Edition, 2023.
3. Bhattacharya, D. (2023). Smart materials and structures (2nd ed.). Oxford University Press.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23ME302 SUSTAINABLE ENERGY TECHNOLOGIES

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Objectives:

This course is designed to:

1. Introduce the global and national energy scenario and emphasize the importance of sustainability in energy systems.
2. Explain the principles and technologies associated with solar and wind energy systems.
3. Familiarize students with hydropower, wave, and tidal energy generation systems and their real-world applications.
4. Describe bioenergy and geothermal systems, including design considerations and environmental implications.
5. Evaluate the economics of renewable energy projects and explore integration techniques including storage and smart grids.

UNIT I INTRODUCTION TO SUSTAINABLE ENERGY SYSTEMS 9 hours

Energy demand and supply scenario – global and Indian context, Environmental impacts of conventional energy sources, Concept of sustainability and carbon footprint, Overview of renewable energy sources, Policy frameworks and SDGs.

UNIT II SOLAR AND WIND ENERGY TECHNOLOGIES 9 hours

Solar radiation basics, types of solar collectors (thermal and photovoltaic), Photovoltaic cell operation, efficiency factors, MPPT basics, Solar thermal applications: water heating, drying, Wind resource assessment, turbine types and operation, Onshore vs offshore wind power.

UNIT III HYDROPOWER, WAVE, AND TIDAL ENERGY 9 hours

Types of hydropower plants, turbine types, site selection, Ocean energy: wave and tidal principles, design concepts, Challenges in marine energy utilization, Case studies from India and abroad.

UNIT IV BIOENERGY AND GEOTHERMAL TECHNOLOGIES 9 hours

Biomass types, anaerobic digestion, biodiesel, bioethanol, Biogas plant design and efficiency, Geothermal energy basics, types of geothermal systems, Environmental and economic impacts.

UNIT V ECONOMICS AND INTEGRATION OF RENEWABLE ENERGY 9 hours

Economic analysis: LCOE, payback, IRR, Energy storage technologies: batteries, pumped hydro, Grid integration issues and smart grids, Future trends: hybrid systems, microgrids, hydrogen. Concept of waste to wealth.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Explain the global and Indian energy scenario, sustainability concepts, and the role of renewable energy in achieving SDGs. (L2)

CO2: Analyze the working principles, components, and efficiency factors of solar and wind energy systems. (L3)

CO3: Illustrate the operation and site requirements of hydropower, wave, and tidal energy systems with relevant case studies. (L2)

CO4: Apply basic design and performance analysis for bioenergy and geothermal energy systems

considering environmental aspects. (L3)

CO5: Evaluate the techno-economic feasibility of renewable energy systems and their integration into smart grids with energy storage. (L3)

Text Books:

1. Boyle, G. (2021). Renewable energy: Power for a sustainable future (4th ed.). Oxford University Press.
2. Twidell, J., & Weir, T. (2021). Renewable energy resources (4th ed.). Routledge.
3. Kothari, D. P., Singal, K. C., & Ranjan, R. (2020). Renewable energy sources and emerging technologies (3rd ed.). PHI Learning.

Reference Books:

1. Sorensen, B. (2019). Renewable energy: Physics, engineering, environmental impacts, economics & planning (5th ed.). Academic Press.
2. Kalogirou, S. A. (2022). Solar energy engineering: Processes and systems (3rd ed.). Academic Press.
3. Lund, H. (2021). Renewable energy systems: A smart energy systems approach to the choice and modeling of 100% renewable solutions (4th ed.). Academic Press.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective - I

23EEE301 ELECTRICAL SAFETY PRACTICES AND STANDARDS

	L	T	P	C
Pre-requisite: 23EEE101	**3**	**0**	**0**	**3**

Course Objectives:

1. To introduce the fundamentals of electrical safety, hazards of electric shock, arc, blast, and failure causes.
2. To explain the function and importance of electrical safety components, voltage classification, and protection devices.
3. To impart knowledge on grounding systems, bonding, and arc hazard categorization to ensure workplace safety.
4. To develop awareness about safety practices across various environments including residential, industrial, and special installations.
5. To familiarize students with relevant electrical safety standards, statutory regulations, and compliance requirements.

UNIT I INTRODUCTION TO ELECTRICAL SAFETY: **9 hours**

Fundamentals of Electrical safety-Electric Shock- physiological effects of electric current - Safety requirements –Hazards of electricity- Arc - Blast- Causes for electrical failure.

UNIT II SAFETY COMPONENTS **9 hours**

Introduction to conductors and insulators- voltage classification -safety against over voltages- safety against static electricity-Electrical safety equipment‘s - Fire extinguishers for electrical safety.

UNIT III GROUNDING **9 hours**

General requirements for grounding and bonding- Definitions- System grounding-Equipment grounding - The Earth - Earthing practices- Determining safe approach distance-Determining arc hazard category.

UNIT IV SAFETY PRACTICES **9 hours**

General first aid- Safety in handling hand held electrical appliances tools- Electrical safety in train stations-swimming pools, external lighting installations, medical locations-Case studies.

UNIT V STANDARDS FOR ELECTRICAL SAFETY **9 hours**

Electricity Acts- Rules & regulations- Electrical standards-NFPA 70 E-OSHA standards-IEEE standards-National Electrical Code 2005 – National Electric Safety code NESC-Statutory requirements from electrical inspectorate.

Course Outcomes:

CO1: Understand the fundamental principles of electrical safety and the physiological effects of electric shock-L2

CO2: Apply knowledge of electrical safety components and protective devices to mitigate over-voltages and static hazards -L3

CO3: Analyze equipment grounding, system grounding, and arc flash hazard categories in practical installations -L4

CO4: Implement appropriate safety procedures in varied environments such as homes, public spaces, and medical areas- L4

CO5: Evaluate the applicability and compliance of electrical systems with respect to national and international safety standards-L5

Text Books:

1. Massimo A.G.Mitolo, ―Electrical Safety of Low-Voltage Systems‖, McGraw Hill, USA, 2009.

2. Mohamed El-Sharkawi, ―Electric Safety - Practice and Standards‖, CRC Press, USA, 2014.

Reference Books:

1. Kenneth G.Mastrullo, Ray A. Jones, ―The Electrical Safety Program Book‖, Jones and Bartlett Publishers, London, 2nd Edition, 2011.

2. Palmer Hickman, ―Electrical Safety-Related Work Practices‖, Jones & Bartlett Publishers, London, 2009.

3. Fordham Cooper, W., ―Electrical Safety Engineering‖, Butterworth and Company, London, 1986.

4. John Cadick, Mary Capelli-Schellpfeffer, Dennis K. Neitzel, ―Electrical Safety Hand book, McGraw-Hill, New York, USA, 4th edition, 2012.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective-I

23EEE302 INTRODUCTION TO MEMS

L	T	P	C
3	0	0	3

Pre-requisite 23EEE101

Course Objectives:

This course enables students to

1. To provide foundational knowledge on MEMS, its historical development, working principles, and scaling effects.
2. To understand the operation of micro sensors and actuators, and their integration into MEMS structures.
3. To explore MEMS materials and comprehend various microfabrication and micromachining techniques.
4. To develop competency in modeling MEMS devices using simulation methods such as FEM for sensor and actuator behavior.
5. To examine various applications of MEMS in different domains including RF, optical, microfluidic, and robotics systems.

UNIT I INTRODUCTION **9 hours**

Overview – History and industry perspectives – Working principles – Mechanics and dynamics Scaling law

UNIT II MICRO SENSORS & ACTUATORS **9 hours**

Micro sensors: Pressure sensors, accelerometers, gyroscopes-Micro actuators: comb drive actuators – Micro-electromechanical systems.

UNIT III MICRO MANUFACTURING **9 hours**

Materials for MEMS and Microsystems- Micro fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition- Physical Vapour Deposition, Micro manufacturing: Bulk micromachining, surface micromachining, LIGA Process- Packaging.

UNIT IV MODELING IN MEMS **9 hours**

Micro system design: Finite Element Methods-– Modeling of simulation – piezoelectric, Gyroscope

UNIT V MEMS APPLICATIONS **9 hours**

Micro fluids-sensors for turbulence measurement and control, micro-actuators for flow control, RFMEMS- filters, Oscillators and phase shifters, Optical MEMS, micro robotics – Case studies

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Explain the history, structure, operating principles, and scaling challenges of MEMS – L2

CO2: Describe the working of micro sensors and actuators and their roles in MEMS – L2

CO3: Analyze the materials and various microfabrication techniques used in MEMS manufacturing – L4

CO4: Apply modeling techniques like FEM to simulate MEMS device behavior such as gyroscopes and piezoelectric sensors – L3

CO5: Evaluate MEMS applications in RF, fluidics, optics, and robotics through real-world case studies – L5

Text Book(s)

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2006

2. G.K. Ananthsuresh et al ,'Micro and Smart Systems', Wiley, India, 2010

Reference Books

1. NadimMaluf, "An introduction to Micro electro mechanical system design", ArtechHouse, 2000

2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2000.

3. James J.Allen, micro electro mechanical system design, CRC Press published in 2005

4. Stephen D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Open Elective – I

23ECE301 BIO-MEDICAL ELECTRONICS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
This course provides the fundamental knowledge on applications of electronics in bio-medical signal measurements and processing, bio-medical instrumentation and imaging techniques.

Course Objectives:
This course enables students to

1. Acquire the basic knowledge on human physiology and biological transducers.
2. Learn about bio-electrodes and bio-amplifiers used in bio-signal acquisition.
3. Understand the working principle of bio-medical measuring instruments.
4. Study various types of imaging techniques used in medicine.
5. Learn the applications of medical instrumentation in designing artificial medical aids

UNIT I HUMAN PHYSIOLOGY AND BIOMEDICAL TRANSDUCERS 9 hours

Introduction to human physiology - Biomedical transducers for measuring displacement, velocity, force, acceleration, potential, dissolved ions and gases.

UNIT II BIO-ELECTRODES AND AMPLIFIERS 9 hours

Introduction to bio-potential, Bio-electrodes, Typical waveforms and characteristics of ECG, EMG and EEG, Bio-potential amplifiers for ECG, EMG and EEG – Lead systems and recording methods.

UNIT III BIOMEDICAL MEASURING INSTRUMENTS 9 hours

Measurement of blood pressure and temperature, Blood flow meter, Cardiac output measurement, Respiratory measurement, Blood cell counter, Impedance plethysmography.

UNIT IV MEDICAL IMAGING 9 hours

X-ray, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear imaging, Ultrasonic Imaging.

UNIT V PROSTHESES AND AIDS 9 hours

Pacemakers, Defibrillators, Heart-lung machine, Artificial kidney, Aids for the handicapped, Safety aspects

Course Outcomes:
Upon successful completion of the course, students will be able to

CO1: Understand the applications of biological transducers in medical field.

CO2: Analyze the design of bio-electrodes and bio-amplifiers.

CO3: Apply suitable measuring instruments to measure various medical parameters.

CO4: Understand and test various imaging techniques used in bio-medical diagnosis.

CO5: Analyze the applications of artificial medical aids.

Text Books:

1. W.F. Ganong, Review of Medical Physiology, 26th Edition, Tata McGraw-Hill, New Delhi, 2019.
2. J.G. Websster, ed., Medical Instrumentation, 3rd Edition, Wiley India Pvt. Ltd. 2009

Reference Books

1. A.M. Cook and J.G. Webster, eds., Medical Devices and Human Engineering, Taylor & Francis, 2014
2. R.S.Khandpur,"Handbook of Biomedical Instrumentation", 2nd edition, Tata McGraw - Hill, New Delhi, 2005
3. LeslieCromwell,"BiomedicalInstrumentationandMeasurement",Prentice-Hall, New Delhi, 2011.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

Open Elective – I

23ECE302 VLSI DESIGN

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
This course describes about various VLSI design methodologies, fundamentals of CMOS technology. It incorporates basics of MOSFET models, CMOS design rules, Design of VLSI Systems, combinational logic design, sequential logic design, logic families and VLSI Design flow.

Course Objectives:
This course enables students to

1. Study the fundamentals of CMOS circuits and its characteristics
2. Learn the design and realization of combinational digital circuits.
3. Learn the design and realization of sequential digital circuits.
4. Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
5. Learn the different FPGA architectures and testability of VLSI circuits.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9 hours

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9 hours

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls.
Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9 hours

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits.
Timing Issues: Timing Classification Of Digital System, Synchronous Design.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9 hours

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff.
Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9 hours

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Realize the concepts of digital building blocks using MOS transistor.

CO2: Design combinational MOS circuits and power strategies

CO3: Design and construct Sequential Circuits and Timing systems.

CO4: Design arithmetic building blocks and memory subsystems.

CO5: Apply and implement FPGA design flow and testing.

Text Books:

1. Neil H.E. Weste, David Money Harris "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson , 2017.

2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits:A Design perspective", Second Edition , Pearson , 2016.

Reference Books

1. Operating Systems - Internals and Design Principles. Stallings, 6th Edition2009. Pearson education.

2. William Stallings, "Operating Systems – Internals and Design Principles", 7th Edition, Prentice Hall, 2011.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

PROFESSIONAL ELECTIVES

Professional Elective – II

23CAI401 GRAPH NEURAL NETWORKS

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

The main objective of the course is to

1. To introduce the fundamentals of graph theory and graph-structured data.
2. To explore the concepts of neural networks extended to non-Euclidean domains.
3. To understand architectures and algorithms behind various types of GNNs.
4. To apply GNN models in real-world applications such as recommendation, social networks, and bioinformatics.
5. To enable students to build and evaluate GNN models using frameworks like PyTorch Geometric and DGL.

UNIT I FUNDAMENTALS OF GRAPH THEORY AND MACHINE LEARNING ON GRAPHS **9 hours**

Introduction to Graphs: Nodes, Edges, Adjacency Matrix, Types of Graphs: Directed, Undirected, Weighted, Bipartite, Graph Traversal Algorithms (BFS, DFS), Graph Representations for ML (Adjacency List, Matrix, Laplacian), Node, Edge, and Graph-level Prediction Problems, Motivation and Challenges for Learning on Graphs.

UNIT II SPECTRAL AND SPATIAL METHODS FOR GRAPH LEARNING **9 hours**

Spectral Graph Theory Basics, Graph Convolution via Spectral Methods, Chebyshev and First-order Approximations, Spatial Graph Convolutions, Comparison of Spectral vs Spatial GNNs, Graph Laplacian and Eigenvalue Properties.

UNIT III GRAPH NEURAL NETWORK ARCHITECTURES **9 hours**

Graph Convolutional Networks (GCNs), Graph Attention Networks (GATs), GraphSAGE: Sampling and Aggregation, Graph Isomorphism Networks (GIN), Message Passing Neural Networks (MPNNs), Inductive vs Transductive GNN Learning.

UNIT IV APPLICATIONS OF GNNS **9 hours**

Node Classification (e.g., Cora, Citeseer), Link Prediction (e.g., Recommender Systems), Graph Classification (e.g., Molecule Property Prediction), Traffic Forecasting and Social Network Modeling, GNNs in Healthcare and Bioinformatics, Explainability and Interpretability in GNNs.

UNIT V IMPLEMENTATION, OPTIMIZATION, AND RECENT ADVANCES **9 hours**

Overview of PyTorch Geometric and DGL, Data Loading and Preprocessing for Graph Datasets, Model Training, Loss Functions, and Evaluation Metrics, Hyperparameter Tuning in GNNs, Recent Research Trends and Architectures (e.g., Heterogeneous GNNs, Graph Transformers), Challenges and Future Directions in GNNs.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the basics of graph structures and their significance in machine learning.

CO2: Learn and implement different types of GNN architectures.

CO3: Apply GNNs to real-world structured data problems.

CO4: Use modern libraries and tools to train and evaluate GNNs.

CO5: Analyze the effectiveness and limitations of GNNs in different domains.

Text Books:

1. Zonghan Wu, Shirui Pan, Fengwen Chen, Guodong Long, Chengqi Zhang, Philip S. Yu, A Comprehensive Survey on Graph Neural Networks, IEEE Transactions on Neural Networks and Learning Systems, 2021.
2. Yao Ma, Jiliang Tang, Deep Learning on Graphs, Cambridge University Press, 2021.
3. William L. Hamilton, Graph Representation Learning, Morgan & Claypool Publishers, 2020.

Reference Books:

1. Barrett, Jure Leskovec, Mining of Massive Datasets, Cambridge University Press.
2. Thomas Kipf, GCN and related papers and tutorials (arXiv).
3. Michael Bronstein et al.,Geometric Deep Learning: Grids, Groups, Graphs, Geodesics, and Gauges (arXiv preprint).

Online Learning Resource:

1. https://www.coursera.org/learn/graph-neural-networks – Coursera GNN Course by Stanford

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Professional Elective – II

23CAI402 RECOMMENDER SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

The main objective of the course is to

1. To understand the theoretical foundations and practical techniques behind recommender systems.
2. To explore collaborative, content-based, and hybrid recommendation methods.
3. To apply matrix factorization and deep learning for building intelligent recommenders.
4. To analyze system performance using standard evaluation metrics.
5. To design and implement recommender systems for real-world applications..

UNIT I INTRODUCTION TO RECOMMENDER SYSTEMS **9 hours**

Introduction to Information Filtering Systems, Types of Recommender Systems: Content-based, Collaborative, Hybrid, Data Sources: Explicit vs Implicit Feedback, Applications and Challenges in Recommendation, User and Item Profiling, Popularity, Personalization, and Serendipity Trade-offs.

UNIT II COLLABORATIVE FILTERING TECHNIQUES **9 hours**

User-based Collaborative Filtering, Item-based Collaborative Filtering, Similarity Measures: Cosine, Pearson, Jaccard, Neighborhood Selection and k-NN, Cold-start and Data Sparsity Issues, Memory-based vs Model-based Collaborative Filtering.

UNIT III CONTENT-BASED AND HYBRID SYSTEMS **9 hours**

Item Feature Extraction and Vector Representation, TF-IDF and Cosine Similarity in Recommendations, User Profile Learning, Limitations of Content-based Filtering, Hybrid Recommender Architectures, Case Study: Netflix, Amazon Hybrid Systems.

UNIT IV MATRIX FACTORIZATION AND DEEP LEARNING APPROACHES **9 hours**

Latent Factor Models and SVD, ALS and SGD for Matrix Factorization, Non-negative Matrix Factorization (NMF), Neural Collaborative Filtering (NCF), Deep Learning Models: Autoencoders, CNNs, RNNs for Recommendations, Graph-based and Knowledge Graph Recommenders.

UNIT V EVALUATION, ETHICS, AND INDUSTRIAL APPLICATIONS **9 hours**

Evaluation Metrics: Precision, Recall, F1, NDCG, MAP, A/B Testing in Recommender Systems, Explainability in Recommendations, Fairness, Bias, and Privacy in Recommenders, Scalability and Real-time Recommendations, Deploying Recommender Systems at Scale (e.g., Spotify, YouTube).

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Explain the core concepts and types of recommender systems.
CO2: Implement basic collaborative and content-based filtering techniques.
CO3: Apply matrix factorization and deep learning models to recommendation problems.
CO4: Evaluate and optimize recommender systems using appropriate metrics.
CO5: Design scalable and context-aware recommender systems for diverse applications.

Text Books:

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

2. Francesco Ricci, Lior Rokach, and Bracha Shapira, Recommender Systems Handbook, Springer, 2nd Ed., 2015.

Reference Books:

1. Jannach, Dietmar et al., Recommender Systems: An Introduction, Cambridge University Press, 2010.

2. Michael Ekstrand, Joseph A. Konstan, Collaborative Filtering Recommender Systems, Now Publishers, 2011.

Online Learning Resource:

1. https://developers.google.com/machine-learning/recommendation – Google Developers

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Professional Elective – II

23CAI403 PREDICTIVE ANALYTICS

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

The main objective of the course is to

1. To introduce the fundamental concepts and techniques of predictive analytics.
2. To apply statistical models and machine learning algorithms for prediction.
3. To interpret model performance using evaluation metrics.
4. To explore feature engineering, model tuning, and cross-validation.
5. To implement predictive solutions for real-world business and research problems.

UNIT I INTRODUCTION TO PREDICTIVE ANALYTICS **9 hours**

Introduction to Predictive Analytics and Business Intelligence, Types of Predictive Models: Classification, Regression, Time Series, Supervised vs Unsupervised Learning, Predictive Modeling Workflow, Applications in Marketing, Finance, Healthcare, Challenges in Predictive Analytics.

UNIT II DATA PREPARATION AND FEATURE ENGINEERING **9 hours**

Data Cleaning: Handling Missing, Noisy, and Inconsistent Data, Feature Selection and Dimensionality Reduction (PCA, LDA), Feature Scaling: Normalization, Standardization, Encoding Categorical Variables, Feature Extraction and Construction, Dealing with Imbalanced Datasets.

UNIT III PREDICTIVE MODELING WITH REGRESSION AND CLASSIFICATION **9 hours**

Linear Regression and Polynomial Regression, Logistic Regression for Binary Classification, Decision Trees and Random Forest, k-Nearest Neighbors (k-NN) and Naïve Bayes, Support Vector Machines (SVM), Model Selection and Comparison.

UNIT IV MODEL EVALUATION AND VALIDATION **9 hours**

Training, Testing, and Validation Sets, Cross-Validation Techniques (k-Fold, Stratified, LOOCV), Evaluation Metrics: Accuracy, Precision, Recall, F1 Score, ROC-AUC, Confusion Matrix and Classification Report, Bias-Variance Trade-off and Overfitting, Hyperparameter Tuning: Grid Search, Random Search.

UNIT V ADVANCED TOPICS AND APPLICATIONS **9 hours**

Ensemble Learning: Bagging, Boosting (AdaBoost, XGBoost), Predictive Analytics with Time Series (ARIMA, Prophet), Deep Learning for Predictive Modeling (ANNs, LSTM), Use of Predictive Analytics in IoT, Retail, and Healthcare, Ethics and Privacy in Predictive Analytics, Building and Deploying End-to-End Predictive Systems.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the principles and importance of predictive analytics.

CO2: Apply regression and classification models for predictive tasks.

CO3: Perform data preprocessing, feature selection, and transformation.

CO4: Evaluate and validate models using standard metrics.

CO5: Design predictive solutions to solve domain-specific challenges.

Text Books:

1. Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Wiley, 2014.
2. John D. Kelleher, Brendan Tierney, Data Science: Predictive Analytics and Data Mining, MIT Press, 2018.

Reference Books:

1. Galit Shmueli et al., Data Mining for Business Analytics: Concepts, Techniques, and Applications in R, Wiley, 2017.
2. Eric Siegel, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Wiley, 2016.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer, 2009.

Online Learning Resource:

1. https://www.coursera.org/specializations/predictive-analytics – Coursera Specialization

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Professional Elective – II

23CAI404 BLOCKCHAIN FOR AI

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

The main objective of the course is to

1. To understand the foundational concepts of blockchain technology and its architecture.
2. To explore smart contracts, consensus algorithms, and distributed ledger technology.
3. To investigate the integration of AI with blockchain for secure, decentralized applications.
4. To develop blockchain-enabled AI solutions for real-world use cases.
5. To understand the ethical, security, and scalability challenges in Blockchain-AI ecosystems.

UNIT I BLOCKCHAIN FUNDAMENTALS AND ARCHITECTURE **9 hours**

Introduction to Blockchain Technology, Components: Blocks, Hashing, Merkle Trees, Types of Blockchains: Public, Private, Consortium, Distributed Ledger Technology (DLT) and P2P Networks, Blockchain Structure and Mining, Use Cases and Evolution of Blockchain.

UNIT II SMART CONTRACTS AND CONSENSUS MECHANISMS **9 hours**

Smart Contracts: Definition, Features, Use Cases, Ethereum and Solidity Basics, Consensus Algorithms: PoW, PoS, DPoS, PBFT, Gas, Transactions, and Events in Ethereum, Hyperledger Fabric: Architecture and Chaincode, Deployment and Testing of Smart Contracts.

UNIT III INTEGRATION OF BLOCKCHAIN AND AI **9 hours**

Motivation for Integrating Blockchain with AI, Decentralized AI Models and Federated Learning, Secure Model Sharing and Provenance, Blockchain for Data Integrity in AI Systems, AI for Blockchain (e.g., optimizing consensus), Case Study: Decentralized AI Marketplace.

UNIT IV APPLICATIONS OF BLOCKCHAIN IN AI SYSTEMS **9 hours**

Blockchain for Explainable and Trusted AI, Applications in Healthcare and Genomics, Blockchain for Autonomous Vehicles and IoT, Financial AI Systems with Smart Contracts, Supply Chain and Logistics Intelligence, NFT-based AI Applications (Digital Identity, IP).

UNIT V SECURITY, PRIVACY AND CHALLENGES IN BLOCKCHAIN-AI **9 hours**

Security Challenges: Sybil Attacks, 51% Attacks, Privacy Preservation and Zero Knowledge Proofs, Scalability and Energy Concerns in Blockchain-AI, Ethical and Legal Concerns in AI with Blockchain, Interoperability of Blockchain Platforms, Future Trends: Quantum-Resistant Blockchain AI.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Explain the fundamentals of blockchain and its components.

CO2: Analyze the role of consensus mechanisms in maintaining trust and decentralization.

CO3: Apply blockchain for secure data sharing in AI systems.

CO4: Develop and deploy smart contracts using Ethereum/Solidity.

CO5: Evaluate blockchain-based AI applications in healthcare, finance, and supply chains.

Text Books:

1. Imran Bashir, Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, Packt, 2020.
2. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly Media, 2015.
3. Joseph Holbrook, Architecting AI Solutions on Blockchain, Packt Publishing, 2020.

Reference Books:

1. Arshdeep Bahga, Vijay Madisetti, Blockchain Applications: A Hands-On Approach, VPT, 2017.
2. Karamjit Singh, Blockchain for AI: Use Cases and Implementation, Springer, 2023.
3. Roger Wattenhofer, The Science of the Blockchain, 2016.

Online Learning Resource:

1. Coursera: Blockchain Specialization – University at Buffalo

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Professional Elective – III

23CAI405 AI FOR FINANCE

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

The main objective of the course is to

1. To introduce the role of Artificial Intelligence (AI) in financial applications and decision making.
2. To understand financial data types, sources, and processing methods.
3. To apply machine learning and deep learning models in various finance sectors.
4. To analyze risk, fraud detection, credit scoring, and portfolio management using AI.
5. To evaluate ethical and regulatory challenges in AI-enabled finance.

UNIT I INTRODUCTION TO FINANCE AND AI APPLICATIONS 9 hours

Introduction to Financial Markets and Instruments, Overview of AI Techniques in Finance, Types of Financial Data: Market, Transactional, Customer, Financial Statements and Key Indicators, AI Use Cases in Banking, Insurance, and Investment, FinTech and the Rise of Robo-Advisors.

UNIT II MACHINE LEARNING IN FINANCE 9 hours

Supervised Learning for Credit Scoring, Unsupervised Learning for Customer Segmentation, Feature Engineering for Financial Data, Handling Imbalanced Datasets in Fraud Detection, Time Series Forecasting with Regression and ARIMA, Model Validation and Backtesting in Finance.

UNIT III DEEP LEARNING AND NLP IN FINANCE 9 hours

Introduction to Deep Learning for Finance, Stock Price Prediction using LSTM and RNNs, Sentiment Analysis from Financial News and Tweets, NLP for Document Classification: Earnings Reports, Chatbots and Virtual Assistants in Banking, Reinforcement Learning for Portfolio Optimization.

UNIT IV AI-DRIVEN FINANCIAL APPLICATIONS 9 hours

Fraud Detection Systems using ML and DL, Credit Risk and Loan Default Prediction, AI in Algorithmic and High-Frequency Trading, Robo-Advisors: Architecture and Optimization, Blockchain and AI Integration for Financial Security, Case Studies: AI in Wealth Management & Insurance.

UNIT V ETHICS, REGULATION, AND FUTURE OF AI IN FINANCE 9 hours

Regulatory Frameworks in AI-based Finance, Explainability and Interpretability of Financial Models, Ethical Issues: Bias, Fairness, Transparency, Data Privacy and GDPR in Financial AI, Responsible AI Practices in Finance, Emerging Trends: Quantum AI, Decentralized Finance (DeFi).

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Describe the fundamentals of AI techniques applicable to finance.
CO2: Analyze financial time series data using AI-based models.
CO3: Apply machine learning for fraud detection and credit risk analysis.
CO4: Build predictive models for stock prices, trading, and customer segmentation.
CO5: Evaluate the limitations and ethical implications of AI in financial systems.

Text Books:

1. Yves Hilpisch, Artificial Intelligence in Finance: A Python-Based Guide, O'Reilly, 2020.
2. Yves Hilpisch, Python for Finance: Mastering Data-Driven Finance, O'Reilly, 2018.
3. Markus Loecher, Machine Learning for Finance, Packt Publishing, 2021.

Reference Books:

1. A. W. Lo, The Evolution of Technical Analysis, Wiley Finance, 2010.
2. Tony Guida, Big Data and Machine Learning in Quantitative Investment, Wiley, 2019.
3. Tucker Balch, AI for Trading – Georgia Tech Specialization, Coursera.

Online Learning Resource:

1. Coursera: AI for Trading – by NYIF and Google Cloud

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Professional Elective – III

23CAI406 MALWARE ANALYSIS

L	T	P	C
3	0	0	3

Pre-requisite: **Operating System, Computer Networks and Cryptography and Network Security**

Course Objectives:

The main objective of the course is to

1. Introduce the fundamentals of malware, types and its effects.
2. Learn various malware types by static analysis.
3. Understand and analyse various malware types by dynamic analysis.
4. Explore different types of Malware Functionalities.
5. Practice the android malware analysis techniques for real world applications

UNIT I INTRODUCTION 9 hours

Introduction: Definition of Malware – Goals of. Malware Analysis– Malware Analysis Techniques - Types of Malware Analysis – General Rules for Malware Analysis. Analyzing malicious windows programs: Windows API – Windows Registry – Networking APIs – Following Running Malwares – Kernel vs User Mode- Native API.

UNIT II STATIC ANALYSIS 9 hours

X86 Architecture- Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, The Stack, Conditionals, Branching, Rep Instructions, C Main Method and Offsets. Antivirus Scanning, Fingerprint for Malware, Portable Executable File Format, The PE File Headers and Sections, The Structure of a Virtual Machine, Analyzing Windows programs, Anti-static analysis techniques, obfuscation, packing, metamorphism, polymorphism.

UNIT III DYNAMIC ANALYSIS 9 hours

Live malware analysis, dead malware analysis, analyzing traces of malware, system calls, API calls, registries, network activities. Anti-dynamic analysis techniques, VM detection techniques, Evasion techniques, Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching.

UNIT IV MALWARE FUNCTIONALITY 9 hours

Downloaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Handles, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection.

UNIT V ANDROID MALWARE 9 hours

Android Malware Analysis: Android architecture, App development cycle, APKTool, APKInspector, Dex2Jar, JD-GUI, Static and Dynamic Analysis. Case Study – Recent Trends.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the nature of malware, its capabilities, and how it is combated through detection and classification. Implement different malware analysis techniques.

CO2: Apply the tools and methodologies used to perform static analysis on unknown executables.

CO3: Identify the skills necessary to carry out independent analysis of modern malware samples using dynamic analysis techniques.

CO4: To be able to safely analyze, debug, and disassemble any malicious software by malware analysis.

CO5: Understand the concept of Android malware analysis their architecture, and App development.

Text Books:

1. "Practical Malware Analysis" by Michael Sikorski and Andrew Honig, 1st Edition, No Starch Press, 2012.

2. "The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System" by Bill Blunden, 2nd Edition, Jones & Bartlett Publishers, 2012.

3. "Android Malware and Analysis" by Dunham Ken, Auerbach Publications, 1st Edition, 2014

Reference Books:

1. "Rootkits: Subverting the Windows Kernel" by Jamie Butler and Greg Hoglund, Addison-Wesley Professional, 2005.

2. "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation" by Bruce Dang, Alexandre Gazet, Elias Bachaalany, SébastienJosse, Wiley, 1st Edition, 2014.

3. "Android Malware and Analysis" by Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales and Tim Strazzere, CRC Press, 2015.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Professional Elective – III

23CAI407 SOCIAL NETWORK ANALYSIS

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

The main objective of the course is to

1. To introduce the fundamentals and key concepts of social network theory and graph theory.
2. To analyze the structure and properties of large-scale social networks.
3. To apply centrality, influence, and community detection measures.
4. To model information diffusion and network dynamics.
5. To implement real-world social network analysis using tools and datasets.

UNIT I INTRODUCTION TO SOCIAL NETWORKS AND GRAPH THEORY 9 hours

Basic Concepts: Graphs, Nodes, Edges, Directed/Undirected Graphs, Real-world Examples: Facebook, Twitter, LinkedIn, Adjacency Matrix and Graph Representation, Types of Social Networks: Ego, Bipartite, Multilayer, Degree Distribution, Path Length, and Connectivity, Random Graph Models: Erdős–Rényi and Watts-Strogatz.

UNIT II STRUCTURAL PROPERTIES OF NETWORKS 9 hours

Network Centrality Measures: Degree, Closeness, Betweenness, Eigenvector Centrality and PageRank, Network Clustering and Community Detection Basics, Triadic Closure and Clustering Coefficient, Small-world Phenomenon and Milgram‘s Experiment, Homophily, Influence, and Structural Balance.

UNIT III COMMUNITY DETECTION AND SUBGROUP ANALYSIS 9 hours

Girvan–Newman Algorithm and Modularity, Label Propagation and Louvain Method, Clique Detection and k-Core Decomposition, Overlapping Communities and Fuzzy Clustering, Cohesive Subgroups and Structural Equivalence, Evaluation Metrics: NMI, Modularity Score.

UNIT IV INFORMATION DIFFUSION AND INFLUENCE IN NETWORKS 9 hours

Models of Diffusion: Linear Threshold and Independent Cascade, Influence Maximization and Viral Marketing, Contagion Models and Epidemic Spreading, Rumor Propagation and Cascade Models, Information Bottlenecks and Bridges, Measuring Influence and Reach.

UNIT V TOOLS, APPLICATIONS, AND ETHICS IN SNA 9 hours

SNA Tools: Gephi, Pajek, NetworkX, SNAP, Case Study: Twitter and Hashtag Analysis, LinkedIn Network Mining and Graph Features, Applications in Marketing, Security, and Epidemiology, Ethical Issues in Social Network Data Mining, Building and Visualizing Your Own Social Graph.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand basic network models and social network structures.

CO2: Analyze key properties like centrality, clustering, and small-world effect.

CO3: Apply community detection algorithms and influence maximization.

CO4: Interpret diffusion models for viral marketing and information spread.

CO5: Use tools such as Gephi, NetworkX, or SNAP for real-world SNA.

Text Books:

1. Wasserman, S., & Faust, K., Social Network Analysis: Methods and Applications, Cambridge University Press, 1994.
2. Easley, D., & Kleinberg, J., Networks, Crowds, and Markets: Reasoning About a Highly Connected World, Cambridge University Press, 2010.
3. Newman, M., Networks: An Introduction, Oxford University Press, 2010.

Reference Books:

1. Borgatti, S. P., Everett, M. G., & Johnson, J. C., Analyzing Social Networks, SAGE Publications, 2018.
2. Barabási, A.-L., Linked: How Everything Is Connected to Everything Else, Basic Books, 2014.
3. Hansen, D., Shneiderman, B., & Smith, M. A., Analyzing Social Media Networks with NodeXL, Elsevier, 2020.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Professional Elective – III

23CAI408 CYBERSECURITY AND AI-DRIVEN THREAT DETECTION

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Objectives:

The main objective of the course is to

1. To provide a foundational understanding of cybersecurity principles and threat landscapes.
2. To explore the application of AI and machine learning techniques in detecting cyber threats.
3. To analyze malware behavior, intrusion patterns, and anomaly detection using intelligent systems.
4. To evaluate and build automated systems for real-time security analytics.
5. To understand the ethical, legal, and societal implications of AI-driven security systems.

UNIT I FUNDAMENTALS OF CYBERSECURITY 9 hours

Introduction to Cybersecurity: CIA Triad, Threats & Vulnerabilities, Types of Attacks: Malware, Phishing, DDoS, Insider Threats, Security Policies and Access Controls, Risk Assessment and Vulnerability Management, Cryptography Basics: Symmetric, Asymmetric, Hash Functions, Cybersecurity Frameworks: NIST, ISO 27001, OWASP.

UNIT II MACHINE LEARNING FOR CYBER THREAT DETECTION 9 hours

Supervised and Unsupervised Learning in Security Contexts, Feature Engineering for Security Data, Classification Models for Intrusion Detection (SVM, RF, KNN), Clustering Techniques for Anomaly Detection, Evaluation Metrics: Accuracy, Precision, ROC, F1 Score, Case Study: AI for Email Phishing Detection.

UNIT III DEEP LEARNING IN THREAT INTELLIGENCE 9 hours

Deep Neural Networks for Cybersecurity, RNNs and LSTMs for Log and Sequence Data, Autoencoders for Anomaly Detection, CNNs for Malware Classification using Binary Analysis, Adversarial Attacks on AI-based Security Systems, Case Study: Threat Detection using Deep Learning.

UNIT IV REAL-TIME THREAT DETECTION AND SIEM SYSTEMS 9 hours

Security Information and Event Management (SIEM), Log Analysis and Real-Time Alerting, Threat Intelligence Platforms (TIPs), Integration of AI in SIEM Tools (Splunk, ELK Stack), Network Traffic and Packet Inspection using ML, SOC Operations and Automation using AI

UNIT V ETHICAL HACKING, PRIVACY, AND LEGAL ASPECTS 9 hours

Penetration Testing & Ethical Hacking with AI Tools, Red Team vs. Blue Team Simulation, Data Privacy Regulations: GDPR, HIPAA, Cyber Laws, AI Bias and Fairness in Security Decision Making, Case Study: Ethical Dilemmas in AI Security Systems, Future Trends: Zero Trust, AI SOC, Federated Threat Detection.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand cybersecurity frameworks, threat types, and vulnerabilities.
CO2: Apply AI/ML techniques for cyber threat identification and classification.
CO3: Analyze patterns in malware, network traffic, and security logs.
CO4: Design and evaluate intelligent intrusion detection and prevention systems.
CO5: Explore ethical hacking practices and policy aspects in AI-based security.

Text Books:

1. Stallings, W., Network Security Essentials: Applications and Standards, Pearson Education.
2. Shon Harris & Fernando Maymi, CISSP All-in-One Exam Guide, McGraw Hill.
3. Emmanuel Tsukerman, Machine Learning for Cybersecurity Cookbook, Packt Publishing.

Reference Books:

1. John Paul Mueller, Luca Massaron, Machine Learning for Dummies, Wiley.
2. Mark Stamp, Information Security: Principles and Practice, Wiley.
3. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning, Cambridge University Press.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Skill Enhancement Courses

Skill Enhancement Course – I

23CAI601 PYTHON PROGRAMMING

L	T	P	C
1	0	2	2

Pre-requisite

Course Description:

This course serves as an introduction to the Python programming language, designed for beginners with little or no prior programming experience. Python is renowned for its simplicity and readability, making it an ideal first language. The course will cover fundamental programming concepts such as variables, data types, control flow (loops and conditionals), functions, and basic file handling. Participants will gain hands-on experience through coding exercises and projects, reinforcing their understanding of Python syntax and best practices.

Course Objectives:

The main objectives of the course are to

1. Introduce core programming concepts of Python programming language.
2. Learn to solve problems using Python conditional and loops.
3. Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
4. Implement Functions, Modules and Regular Expressions in Python Programming and to create practical and contemporary applications.
5. Demonstrate to do input/output with files in Python.

UNIT I DATA TYPES, EXPRESSIONS AND CONTROL FLOW STATEMENTS — 6 hours

Introduction: Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: if statement, if-else statement, if...elif…else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a program to swap two numbers without using a temporary variable.
3. Demonstrate the following Operators in Python with suitable examples.
   i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators

UNIT II Lists & Dictionaries — 6 hours

Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

Dictionaries: Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

Sample Experiments:

4. Write a program to perform the given operations on a list:
    i. Addition ii. Insertion iii. slicing
5. Write a program to perform any 5 built-in functions by taking any list.
6. Write a program to sum all the items in a given dictionary.

UNIT III Tuples and Sets 6 hours

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Using zip() Function, Sets, Set Methods, Frozenset.

Sample Experiments:

7. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
8. Write a program to count the number of vowels in a string (No control flow allowed).
9. Write a program to check if a given key exists in a dictionary or not.

UNIT IV FUNCTIONS & STRINGS 6 hours

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Sample Experiments:

10. Write a program to define a function with multiple return values.
11. Write a program to define a function using default arguments.
12. Write a program to find the length of the string without using any library functions.

UNIT V Files handling in Python 6 hours

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

Sample Experiments:

13. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
14. Implement a Python program to print each line of a file in reverse order.
15. Write a Python program to compute the number of characters, words and lines in a file.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Understand to adept command of Python syntax, deftly utilizing variables, data types, and control structures.

CO2: Interpret Strings, functions, modules, exception handling to engineer robust and efficient code solutions.

CO3: Apply Python programming concepts like Lists and Dictionary to solve a variety of computational problems.

CO4: Build and manipulate fundamental data structures such as tuples and sets.

CO5: Demonstrate file handling concepts in python.

Text Book(s)

1. Gowri shankar S, Veena A., Introduction to Python Programming, CRC Press.

2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024.

Reference Books

1. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

2. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.

Online Material links:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://www.coursera.org/learn/python?specialization=python#syllabus

Mode of Evaluation: Continuous Internal Evaluation , Assignments, Mid Term Tests and End Semester Examination.

Skill Enhancement Course – II

23CAI602 FULL STACK DEVELOPMENT I

L	T	P	C
1	0	2	2

Course Objectives:

1. Make use of HTML elements and their attributes for designing static web pages
2. Build a web page by applying appropriate CSS styles to HTML elements
3. Experiment with JavaScript to develop dynamic web pages and validate forms
4. Build a web page using UI/UX design

UNIT I 6 hours

HTML Basics - Lists - Links – Images - HTML Tables - Forms – Frames

a. Design a webpage for a restaurant. The webpage should include the following elements:
   - An ordered list to describe the steps to make a reservation at the restaurant.
   - An unordered list to display the main categories of the menu (e.g., Appetizers, Main Courses, Desserts).
   - Nested lists to show sub-categories within each main category (e.g., under Main Courses, list "Vegetarian", "Non-Vegetarian", and "Vegan").
   - An ordered list within an unordered list to detail a special meal plan (e.g., daily special menu with steps for preparation).
   - Include links to the restaurant's social media pages (e.g., Facebook, Instagram) using the <a> tag with the href attribute.
   - Use the target attribute to open these links in a new tab.
   - Display an image of the restaurant's special dish with specified dimensions (height and width) and make the image a clickable link that navigates to a page with more details about the dish.

b. Write a HTML program, to explain the working of tables. (use tags: <table>, <tr>, <th>, <td> and attributes: border, rowspan, colspan)

c. Write a HTML program, to explain the working of tables by preparing a timetable. (Note: Use <caption> tag to set the caption to the table & also use cell spacing, cell padding, border, rowspan, colspan etc.).

d. Write a HTML program, to explain the working of forms by designing Registration form. (Note: Include text field, password field, number field, date of birth field, checkboxes, radio buttons, list boxes using <select>&<option> tags, <text area> and two buttons ie: submit and reset. Use tables to provide a better view).

e. Write a HTML program, to explain the working of frames, such that page is to be divided into 3 parts on either direction. (Note: first frame image, second frame paragraph, third frame hyperlink. And also make sure of using "no frame" attribute such that frames to be fixed).

UNIT II 6 hours

HTML 5 - Cascading Style Sheets, Types of CSS - Selector forms -5. CSS with Color, Background, Font, Text and CSS Box Model

a. Write a HTML program, that makes use of <article>, <aside>, <figure>, <figcaption>, <footer>, <header>, <main>, <nav>, <section>, , tags.

b. Write a HTML program, to embed audio and video into HTML web page.

c. Write a program to apply different types (or levels of styles or style specification formats) - inline, internal, external styles to HTML elements. (identify selector, property and value).

d. Write a program to apply different types of selector forms
   - Simple selector (element, id, class, group, universal)
   - Combinator selector (descendant, child, adjacent sibling, general sibling)
   - Pseudo-class selector
   - Pseudo-element selector
   - Attribute selector

e. Write a program to demonstrate the various ways you can reference a color in CSS.
f. Write a CSS rule that places a background image halfway down the page, tilting it horizontally. The image should remain in place when the user scrolls up or down.
g. Write a program using the following terms related to CSS font and text:
   i. font-size ii. font-weight iii. font-style
   iv. text-decoration v. text-transformation vi. text-alignment
h. Write a program, to explain the importance of CSS Box model using
   i. Content ii. Border iii. Margin iv. padding

UNIT III **6 hours**

Introduction to Javascript - Applying JavaScript - internal and external, I/O, Type Conversion - JavaScript Pre-defined and User-defined Objects

a. Write a program to embed internal and external JavaScript in a web page.
b. Write a program to explain the different ways for displaying output.
c. Write a program to explain the different ways for taking input.
d. Create a webpage which uses prompt dialogue box to ask a voter for his name and age. Display the information in table format along with either the voter can vote or not
e. Write a program using the following object properties and methods.
   i. Document object
   ii. array object
   iii. math object
   iv. string object
   v. regex object
   vi. date object
f. Write a program to explain user-defined object by using properties, methods, accessors, constructors and display.

UNIT IV **6 hours**

JavaScript Conditional Statements and Loops - Javascript Functions and Events

a. Write a program which asks the user to enter three integers, obtains the numbers from the user and outputs HTML text that displays the larger number followed by the words "LARGER NUMBER" in an information message dialog. If the numbers are equal, output HTML text as "EQUAL NUMBERS".
b. Write a program to display week days using switch case.
c. Write a program to print 1 to 10 numbers using for, while and do-while loops.
d. Write aprogram to print data in object using for-in, for-each and for-of loops
e. Develop a program to determine whether a given number is an 'ARMSTRONG NUMBER' or not. [Eg: 153 is an Armstrong number, since sum of the cube of the digits is equal to the number i.e.,13 + 53+ 33 = 153]
f. Write a program to display the denomination of the amount deposited in the bank in terms of 100's, 50's, 20's, 10's, 5's, 2's & 1's. (Eg: If deposited amount is Rs.163, the output should be 1-100's, 1-50's, 1- 10's, 1-2's & 1-1's)
g. Design a HTML having a text box and four buttons named Factorial, Fibonacci, Prime, and Palindrome. When a button is pressed an appropriate function should be called to display

1. Factorial of that number
2. Fibonacci series up to that number
3. Prime numbers up to that number
4. Is it palindrome or not

h. Write a program to validate the following fields in a registration page
   i. Name (start with alphabet and followed by alphanumeric and the length should not be less than 6 characters)
   ii. Mobile (only numbers and length 10 digits)
   iii. E-mail (should contain format like xxxxxxx@xxxxxx.xxx)

UNIT V **6 hours**

UI/UX Design Principles and Techniques

a. Explain the basic principles of UI/UX design including user research, wireframing, prototyping, and usability testing.
b. Create a wireframe for a simple website layout using a tool like Balsamiq or Figma.
c. Develop a prototype of the website layout created in the wireframe using HTML and CSS.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Proficiency in designing static web pages using HTML and CSS, effectively utilizing different HTML elements, attributes, and CSS styles.
CO2: Understanding of advanced CSS concepts, enabling them to style web pages with complex layouts and responsive designs.
CO3: Build dynamic and interactive web pages using JavaScript, enhancing the functionality and interactivity of web pages.
CO4: Integrate JavaScript libraries like jQuery, including implementing form validation and handling user input/output efficiently.
CO5: Applying UI/UX design principles, creating wireframes, prototypes, and conducting usability testing to ensure user-centric web design.

Text Books:

1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.

2. Web Programming with HTML5, CSS and JavaScript, John Dean, Jones & Bartlett Learning, 2019 (Chapters 1-11).

Reference Books:

1. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.

Mode of Evaluation: Continuous Internal Evaluation , Assignments, Mid Term Tests and End Semester Examination.

Skill Enhancement Course - III

23CAI603 FULL STACK DEVELOPMENT II

L	T	P	C
1	0	2	2

Pre-requisite: NIL

Course Objectives:

1. To become knowledgeable about the most recent web development technologies.
2. Idea for creating two tier and three tier architectural web applications.
3. Design and Analyse real time web applications.
4. Constructing suitable client and server side applications.
5. To learn core concept of both front end and back end programming.

UNIT I WEB DEVELOPMENT BASICS 6 hours

Web development Basics - HTML & Web servers Shell - UNIX CLI Version control - Git & Github HTML, CSS.

a. Develop a personal portfolio webpage using basic HTML and CSS

b. Initialize a Git repository and push a static web project to GitHub

c. Practice basic Linux/Unix commands using terminal (navigation, file operations)

d. Create a multi-page static website with navigation and layout

e. Demonstrate version control operations: commit, branch, merge, clone

UNIT II FRONTEND DEVELOPMENT 6 hours

Javascript basics OOPS Aspects of JavaScript Memory usage and Functions in JS AJAX for data exchange with server jQuery Framework jQuery events, UI components etc. JSON data format.

a. Write JavaScript programs demonstrating variables, functions, and objects

b. Develop an AJAX-based form to submit and retrieve data from a mock server

c. Build a dynamic form with client-side validation using jQuery

d. Design interactive UI elements using jQuery (sliders, modals, tabs)

e. Work with JSON data for dynamic rendering of content

UNIT III REACT JS 6 hours

Introduction to React React Router and Single Page Applications React Forms, Flow Architecture and Introduction to Redux More Redux and Client-Server Communication.

a. Set up a basic React project using Create React App

b. Implement routing between pages using React Router

c. Create and manage form data using React state and hooks

d. Use Redux to manage state in a to-do or counter app

e. Fetch and render data from a public API using Axios

UNIT IV JAVA WEB DEVELOPMENT 6 hours

JAVA programming basics, Model View Controller (MVC) Pattern MVC Architecture using Spring RESTful API using Spring Framework Building an application using Maven.

a. Create a Java console app demonstrating classes, objects, and methods

b. Build a simple web application using Spring MVC pattern

c. Develop RESTful web services using Spring Boot (CRUD operations)

d. Connect frontend to Spring backend with JSON-based communication
e. Use Maven to build, package, and run the Spring Boot application

UNIT V DATABASES & DEPLOYMENT 6 hours

Relational schemas and normalization Structured Query Language (SQL) Data persistence using Spring JDBC Agile development principles and deploying application in Cloud.
a. Design and normalize a database schema up to 3NF
b. Perform SQL-based CRUD operations on MySQL/PostgreSQL
c. Integrate MySQL with a Spring Boot application using Spring JDBC
d. Plan and manage tasks using Agile tools (Trello, Jira)
e. Deploy a full stack application on a cloud platform (Heroku, AWS, or GitHub Pages)

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Demonstrate about the most recent web development technologies.

CO2: Develop two tier and three tier architectural web applications.

CO3: Implement real time web applications.

CO4: Apply suitable client and server-side applications.

CO5: Develop core concept of both front end and back-end programming.

Text Books:

1. Web Design with HTML, CSS, JavaScript and JQuery Set Book by Jon Duckett Professional JavaScript for Web Developers Book by Nicholas C. Zakas
2. "Professional JavaScript for Web Developers", Zakas N C, Wiley, 3rd Edition, 2011.
3. Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites by Robin Nixon

Reference Books:

1. Full-Stack JavaScript Development by Eric Bush
2. Mastering Full Stack React Web Development Paperback – April 28, 2017 by Tomasz Dyl, Kamil Przeorski, Maciej Czarnecki

Mode of Evaluation: Continuous Internal Evaluation , Assignments, Mid Term Tests and End Semester Examination.

Skill Enhancement Course - III

23CAI604 - SYSTEM SOFTWARE PROGRAMMING

L	T	P	C
1	0	2	2

Pre-requisite: NIL

Course Objectives:

1. To understand the architecture and design of system software including compilers, assemblers, linkers, loaders, and macro processors.
2. To gain in-depth knowledge of programming tools, shell environments, and low-level system utilities.
3. To apply principles of system programming in Unix/Linux environments.
4. To explore process creation, inter-process communication, signal handling, and multi threading using C/C++.
5. To enable development of foundational tools like simple compilers, parsers, and loaders.

UNIT I **6 hours**

Language processing system overview, Phases of compilation and data structures, Assemblers – features, single pass and two-pass assembler, Intermediate code generation, Literal and symbol tables, Relocation and linking concepts

1. Write simple programs in Prolog for facts, rules, and queries.
2. Develop a Prolog-based expert system for medical diagnosis or animal identification.
3. Implement Depth-First Search (DFS) and Breadth-First Search (BFS) in Python.

UNIT II **6 hours**

Macro instruction and features, Nested macros and macro expansion, Macro processing in two-pass assemblers, Design of macro processors, Loaders: absolute, relocating, and linking, Dynamic loading and linking, bootstrap loader

4. Implement A* Search Algorithm using heuristics in Python.
5. Implement the Minimax algorithm for a simple game (e.g., Tic Tac Toe).
6. Design and implement a two-pass assembler in C.

UNIT III **6 hours**

Language grammars and ambiguity, Lexical analysis – regular expressions, token generation, Syntax analysis – parsing techniques (top-down, bottom-up), Semantic analysis and intermediate code generation, Code optimization techniques – constant folding, dead code elimination

7. Implement a Macro Processor using C for assembly language programs.
8. Develop a simple Linux Shell (command interpreter) using C.
9. Write shell scripts for file operations, process creation, and monitoring.

UNIT-IV **6 hours**

Symbol resolution and relocation, Linking (static vs dynamic), relocation records, Debugging techniques and breakpoints, Unix/Linux shell environment, Shell commands, variables, redirection, pipes, control statements, Shell script functions and script-based automation

10. Demonstrate inter-process communication using pipes and signals in Linux.
11. Integrate AI logic (search/expert system) into a shell script or system utility for task automation.

UNIT V **6 hours**

Introduction to system-level programming in C, File I/O system calls (open, read, write, close), Process creation using fork(), exec(), wait(), Inter-process communication (pipes, FIFO), Signal handling and POSIX threads (pthread_create, pthread_join), Case studies: background processes, daemon creation, mini shell

12.Final Mini Project: Develop an AI-powered system utility (e.g., Intelligent File Manager, AI Bot for CLI commands).

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Explain the architecture and functions of system software like assemblers, loaders, linkers, and macro processors.

CO2: Apply scanning and parsing techniques for programming language processing.

CO3: Develop and analyze assembly-level programs and understand compilation techniques.

CO4: Implement Unix/Linux system programming tasks such as process creation, pipes, signals, and thread management.

CO5: Demonstrate hands-on experience in shell scripting, debugging, and low-level system tools.

Text Books:

1. Leland L. Beck, D. Manjula, System Software: An Introduction to Systems Programming, 3rd Edition, Pearson.

2. Silberschatz, Galvin, Gagne, Operating System Concepts, 10th Edition, Wiley (selectively for system calls & programming).

Reference Books:

1. D.M. Dhamdhere, System Programming and Operating Systems, McGraw Hill.

2. Neil Matthew, Richard Stones, Beginning Linux Programming, Wrox.

Mode of Evaluation: Continuous Internal Evaluation , Assignments, Mid Term Tests and End Semester Examination.

Skill Enhancement Course - IV

23ENG601 SOFT SKILLS

L	T	P	C
1	0	2	2

Course Objectives:

1. To encourage all round development of the students by focusing on soft skills
2. To make the students aware of critical thinking and problem-solving skills
3. To enhance healthy relationship and understanding within and outside an organization
4. To function effectively with heterogeneous teams
5. To prepare students for job interviews, group discussions, and workplace communication with confidence and clarity.

UNIT I SOFT SKILLS & COMMUNICATION SKILLS 9 hours

Soft Skills - Introduction, Need - Mastering Techniques of Soft Skills – Communication Skills - Significance, process, types - Barriers of communication - Improving techniques

Activities:

Intrapersonal Skills-Narration about self-strengths and weaknesses-clarity of thought–self-expression – articulating with felicity

(The facilitator can guide the participants before the activity citing example from the lives of the great, anecdotes and literary sources)

Interpersonal Skills-Group Discussion–Debate–Team Tasks-Book and film Reviews by groups - Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.

Verbal Communication-Oral Presentations-Extempore-brief addresses and speeches- convincing-negotiating- agreeing and disagreeing with professional grace.

Non-verbal communication–Public speaking–Mock interviews–presentations with an objective to identify non- verbal clues and remedy the lapses on observation

UNIT II CRITICAL THINKING 9 hours

Active Listening–Observation–Curiosity– Introspection–Analytical Thinking–Open- mindedness – Creative Thinking- Positive thinking - Reflection

Activities:

Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues–placing the problem–finding the root cause-seeking viable solution– judging with rationale – evaluating the views of others - Case Study, Story Analysis

UNIT III PROBLEM SOLVING & DECISION MAKING 9 hours

Meaning & features of Problem Solving – Managing Conflict – Conflict resolution – Team building - Effective decision making in teams – Methods & Styles

Activities:

Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision. Case Study & Group Discussion

UNIT IV EMOTIONAL INTELLIGENCE & STRESS MANAGEMENT 9 hours

Managing Emotions–Thinking before Reacting–Empathy for Others–Self-awareness– Self-Regulation – Stress factors – Controlling Stress – Tips.

Activities:

Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations. Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation, Organizing Debates

UNIT V CORPORATE ETIQUETTE 9 hours

Etiquette- Introduction, concept, significance - Corporate etiquette - meaning, modern etiquette, benefits - Global and local culture sensitivity - Gender Sensitivity - Etiquette in interaction-Cellphoneetiquette-Diningetiquette-Netiquette-Jobinterviewetiquette- Corporate grooming tips - Overcoming challenges

Activities

Providing situations to take part in the Role Plays where the students will learn about bad and good manners and etiquette-Group Activities to showcase gender sensitivity, dining etiquette etc. - Conducting mock job interviews - Case Study - Business Etiquette Games

NOTE-:

1. The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes, epics, scriptures, autobiographies and literary sources which bear true relevance to the prescribed skill.

Case studies may be given wherever feasible for example for Decision Making-The decision of King Lear.

Course Outcomes:

After completion of the course, students will be able to

CO1: List out various elements of soft skills
CO2: Describe methods for building professional image.
CO3: Apply critical thinking skills in problem solving
CO4: Analyse the needs of an individual and team for well-being
CO5: Assess the situation and take necessary decisions

Text Books:

1. Mitra Barun K, Personality Development and Soft Skills, Oxford University Press, Pap/Cdr edition 2012
2. Dr Shikha Kapoor, Personality Development and Soft Skills: Preparing for Tomorrow, 2018 ,esuo Hgnihsilbu PlanoitanretnIKI

Reference Books:

1. Sharma, Prashant, Soft Skills: Personality Development for Life Success, BPB Publications 2018.
2. Alex K, Soft Skills S.Chand & Co, 2012 (Revised edition)
3. Gajendra Singh Chauhan & Sangeetha Sharma, Soft Skills: An Integrated Approach to Maximise Personality Published by Wiley, 2013
4. Pillai, Sabina & Fernandez Agna, Soft Skills and Employability Skills, Cambridge University Press, 2018
5. Dr. Rajiv Kumar Jain, Dr. Usha Jain, Life Skills(Paperback English)Publisher: Vayu Education of India, 2014

Online Resources:

1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_ y-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ
3. https://youtu.be/-Y-R9hDl7lU
4. https://onlinecourses.nptel.ac.in/noc24_hs15/preview
5. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

Mode of Evaluation: : Continuous Internal Evaluation , Assignments, Mid Term Tests and End Semester Examination.

Minor
in
Computer Science and Engineering (Artificial Intelligence)

(Applicable to CE, EEE, ME and ECE)

Minor

23MDCAI101 FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

1. To provide a broad understanding of the basic techniques for building intelligent computer systems and an understanding of how AI is applied to problems.
2. To Gain knowledge in problem formulation and building intelligent agents.
3. To understand the search technique procedures applied to real world problems.
4. To learn the types of logic and knowledge representation schemes.
5. To understand the applications of Al: namely Game Playing, Theorem Proving and Expert systems.

UNIT I FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE **9 hours**

Introduction, A.I. Representation, Non-AI &AI Techniques, Representation of Knowledge, Knowledge Base Systems, State Space Search, Production Systems, Problem Characteristics, types of production systems, Intelligent Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

UNIT II UNINFORMED SEARCH STRATEGIES **9 hours**

Formulation of real-world problems, Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, Comparison of Uninformed search Strategies, Searching with partial information, Sensor-less problems, Contingency problems.

UNIT III INFORMED SEARCH STRATEGIES **9 hours**

Generate & test, Hill Climbing, Best First Search, A* and AO* Algorithm, Constraint satisfaction, Game playing: Minimax Search, Alpha-Beta Cutoffs, Waiting for Quiescence.

UNIT IV KNOWLEDGE REPRESENTATION **9 hours**

Propositional Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining. First order Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining.

UNIT V PLANNING AND UNCERTAINTY **9 hours**

Planning: Planning problem, Planning with State Space Search, Partial Order Planning, Hierarchical Planning, Conditional Planning. Non-Monotonic Reasoning, Logics for Non-Monotonic Reasoning, Justification based Truth Maintenance Systems, Semantic Nets, Statistical Reasoning, Fuzzy logic: fuzzy set definition and types, membership function, designing a fuzzy set for a given application. Probability and Bayes' theorem, Bayesian Networks.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Formulate a problem and build intelligent agents.
CO2: Apply appropriate searching techniques to solve a real world problem.
CO3: Evaluation of different uninformed search algorithms on well formulate problems along with stating valid conclusions that the evaluation supports.
CO4: Analyze the problem and infer new knowledge using suitable knowledge representation schemes.
CO5: Formulate and solve given problem using Propositional and first order logic.

Text Books:

1. Kevin Knight, Elaine Rich, B. Nair, Artificial Intelligence, McGraw Hill, 2008.

2. Stuart Russell and Peter Norvig. Artificial Intelligence – A Modern Approach, Pearson

Reference Books:

1. George F. Luger, "AI-Structures and Strategies for Complex Problem Solving", 4/e, 2002, Pearson Education.

2. Robert J. Schalkolf, Artificial Intelligence: An Engineering approach, McGraw Hill, 1990.

3. Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minor

23MDCAI102 DESIGN AND ANALYSIS OF ALGORITHMS

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

1. To introduce the concepts of Algorithm Analysis, Time Complexity, Space Complexity.
2. To discuss various Algorithm Design Strategies with proper illustrative examples.
3. To introduce Complexity Theory with NP and Approximation.

UNIT I INTRODUCTION & DIVIDE AND CONQUER **9 hours**

Introduction: What is an algorithm?, Algorithm specification, Space Complexity, Time Complexity, Orders of Growth, Worst-Case, Best-Case, and Average-Case Efficiencies, Asymptotic notations.
Divide and Conquer: Master's Method, Substitution Method, Recursion Tree Method, Binary Search, Finding the maximum and minimum, Merge sort, Quick Sort, Strassen's matrix multiplication.

UNIT II GREEDY METHOD & DYNAMIC PROGRAMMING **9 hours**

Greedy Method: General method, Fractional Knapsack problem, Huffman Code, Job Scheduling with Deadlines, Optimal merge pattern.
Dynamic Programming: General method, String Editing, Longest Common Subsequence, Matrix Chain Multiplication, 0/1 Knapsack problems, The traveling salesperson problem

UNIT III GRAPH ALGORITHMS **9 hours**

BFT, DFT, connected components, Biconnected Components, Spanning Trees, Minimum cost Spanning Trees, Kruskal's and Prim's algorithm, Topological sort, Shortest Path Algorithms: Dijkstra's Single Source Shortest Path Algorithm, Floyd-Warshall's All Pairs Shortest Path Algorithm.

UNIT IV BACK TRACKING & BRANCH AND BOUND **9 hours**

Backtracking: General method, N-Queens Problem, Sum of subset problem, Graph Coloring Problem.
Branch and Bound: General method: FIFO, LIFO and LC, Travelling salesperson problem, 0/1 Knapsack problem.

UNIT V NP PROBLEMS &APPROXIMATION ALGORITHMS **9 hours**

NP Problems: Complexity Class - P, NP, NP Complete, NP Hard. Reducibility, Cook's Theorem.
Approximation Algorithms: Introduction, Absolute Approximation, ϵ - Approximation, Polynomial time Approximation.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Analyze the performance of different algorithms.
CO2: Identify optimal solution for different problems using greedy method and dynamic programming.
CO3: Implement various graph-based algorithms.
CO4: Make use of backtracking and branch & Bound methods to solve real world problems.
CO5: Understand the complexity of NP problems and Approximation algorithms.

Text Books:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Second Edition, Universities Press, 2008
2. Jon Kleinberg and Eva Tardos "Algorithm Design", Pearson Education, 2007

Reference Books:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012
2. Micheal T. Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet examples", Second Edition, Wiley Publication, 2006
3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 2006

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minor

23MDCAI201 FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: 20CSE101

Course Objectives:

The objectives of the course are to

1. To train the students in solving computational problems
2. To elucidate solving mathematical problems using Python programming language
3. To understand the fundamentals of Python programming concepts and its applications.
4. Practical understanding of building different types of models and their evaluation

List of Experiments:

1. Construct an AVL tree for a given set of elements which are stored in a file. And implement 1. S
   of Numpy and Pandas basic programs.
2. Write a program to implement Breadth First Search using Python.
3. Write a program to implement Depth First Search using Python.
4. Write a program to implement Tic-Tac-Toe game using Python.
5. Write a program to implement 8-Puzzle problem using Python.
6. Write a program to implement Water-Jug problem using Python.
7. Write a program to implement Travelling Salesman Problem using Python.
8. Write a program to implement Tower of Hanoi using Python.
9. Write a program to implement Monkey Banana Problem using Python.
10. Write a program to implement Missionaries-Cannibals Problems using Python.
11. Write a program to implement 8-Queens Problem using Python.

Course Outcomes:

After completion of the course, Students will be able to

CO1: Formulate a problem and build intelligent agents.

CO2: Apply appropriate searching techniques to solve a real-world problem.

CO3: Evaluation of different uninformed search algorithms on well formulate problems along with stating valid conclusions that the evaluation supports.

Reference Books:

1. George F. Luger, "AI-Structures and Strategies for Complex Problem Solving", 4/e, 2002, Pearson Education.
2. Robert J. Schalkolf, Artificial Intelligence: An Engineering approach, McGraw Hill, 1990.
3. Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson.
4. Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

Minor

23MDCAI103 COMPUTER VISION

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

The main objective of the course is to

1. Understand the principles of image formation, enhancement, and processing techniques.
2. Apply feature extraction, segmentation, and recognition methods in image analysis.
3. Analyze 3D vision, motion tracking, and object recognition techniques.
4. Apply deep learning methods like CNNs for object detection and classification.
5. Explore real-world applications in face recognition, autonomous systems, and visual inspection.

UNIT I INTRODUCTION TO COMPUTER VISION AND IMAGE PROCESSING **9 hours**

Overview of Computer Vision and Image Processing, image formation, sampling and quantization, color models, histogram processing, spatial filtering, image restoration, frequency domain processing, Discrete Fourier Transform (DFT), introduction to modern image acquisition and sensor technologies.

UNIT II IMAGE ANALYSIS TECHNIQUES **9 hours**

Edge detection (Sobel, Prewitt, Canny), corner detection (Harris), feature extraction (SIFT, SURF, ORB), segmentation techniques (thresholding, region growing, K-means, watershed), morphological operations (dilation, erosion), texture analysis using Gabor filters and LBP.

UNIT III 3D VISION AND MOTION ANALYSIS **9 hours**

Stereo vision, epipolar geometry, disparity and depth estimation, optical flow (Lucas-Kanade, Farneback), structure from motion (SfM), camera calibration (intrinsic/extrinsic parameters), 3D point cloud reconstruction, applications in scene understanding

UNIT IV OBJECT RECOGNITION AND MACHINE LEARNING IN VISION **9 hours**

Feature matching, object detection using template matching and CNNs, YOLO, R-CNN, introduction to transfer learning, image classification using pretrained networks, comparison of traditional and deep learning models.

UNIT V APPLICATIONS AND ADVANCED TOPICS **9 hours**

Face recognition, automated inspection, video analytics, content-based image retrieval (CBIR), medical imaging, augmented and virtual reality, ethics in computer vision including bias and privacy concerns.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the fundamentals of image formation, enhancement, and frequency-domain transformations.
CO2: Apply edge, corner, and texture-based methods for image analysis and segmentation.
CO3: Analyze depth estimation and motion tracking using stereo vision and optical flow techniques.
CO4: Implement object recognition using feature-based and deep learning-based approaches.
CO5: Examine real-world applications of computer vision and address associated ethical considerations.

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods (2018). Digital Image Processing, 4th Edition, Pearson.
2. Richard Szeliski (2022). Computer Vision: Algorithms and Applications, 2nd Edition, Springer.

Reference Books:

1. David A. Forsyth and Jean Ponce (2011). Computer Vision: A Modern Approach, 2nd Edition, Pearson.
2. E. R. Davies (2018). Computer Vision: Principles, Algorithms, Applications, Learning, 5th Edition, Academic Press (Elsevier).

Online Learning Resources

1. Stanford University: CS231n: Deep Learning for Computer Vision. Linkcs231n.stanford.edu

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minor

23MDCAI104 DEEP LEARNING TECHNIQUES

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

1. To introduce the fundamentals of deep learning and the main research activities in this field.
2. To learn architecture and optimization methods for deep neural network training

UNIT I LINEAR ALGEBRA REVIEW AND OPTIMIZATION **9 hours**

Brief review of concepts from Linear Algebra, Types of errors, bias-variance trade-off, overfitting under fitting, brief review of concepts from Vector Calculus and optimization, variants of gradient descent, momentum.

UNIT II LOGISTIC REGRESSION **9 hours**

Basic concepts of regression and classification problems, linear models addressing regression and classification, maximum likelihood, logistic regression classifiers.

UNIT III NEURAL NETWORKS **9 hours**

Basic concepts of artificial neurons, single and multi-layer perceptron, perceptron learning algorithm, its convergence proof, different activation functions, SoftMax cross entropy loss function.

UNIT IV CONVNETS **9 hours**

Basic concepts of Convolutional Neural Networks starting from filtering. Convolution and pooling operation and arithmetic of these, Discussions on famous convent architectures - AlexNet, ZFNet, VGG, GoogLeNet, ResNet, MobileNet-v1

REGULARIZATION, BATCHNORM

Discussion on regularization, Dropout, Batchnorm, Discussion on detection as classification, region proposals, RCNN architectures

UNIT V RECURRENT NEURAL NETWORKS **9 hours**

Basic concepts of Recurrent Neural Networks (RNNs), backpropagation through time, Long-Short Term Memory (LSTM) architectures, the problem of exploding and vanishing gradients, and basics of word embedding.

AUTOENCODERS

Autoencoders, Denoising autoencoders, sparse autoencoders, contractive Autoencoders

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the fundamentals of deep learning

CO2: Compare various deep neural network architectures

CO3: Apply various deep learning algorithms based on real-world applications.

Text Books:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville. Deep Learning, the MIT press, 2016
2. Bengio, Yoshua. " Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1, Now Publishers, 2009.

Reference Books:

1. B. Vegnanarayana, Artificial Neural Networks, Prentice Hall of India, 2005.
2. Simon Haykin, Neural Networks a Comprehensive Foundations, PHI Edition, 2005.
3. Chao Pan, Deep Learning Fundamentals: An Introduction for Beginners, AI Sciences Publisher.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minor

23MDCAI202 COMPUTER VISION LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: None

Course Objectives:

The objectives of the course are to

1. Apply image enhancement, segmentation, and transformation techniques.
2. Implement feature detection, object tracking, and classification using OpenCV.
3. Analyze vision-based applications using classical and deep learning approaches.

List of Experiments:

1. Load and display an image using OpenCV and perform basic operations like resizing, cropping, and rotation.
2. Histogram equalization and image enhancement techniques.
3. Apply filtering: Gaussian, Median, Bilateral filters.
4. Edge detection using Sobel, Canny operators.
5. Feature extraction using SIFT, SURF, ORB and matching.
6. Image segmentation using K-means and watershed algorithms.
7. Object detection using Haar cascade and contour detection.
8. Face detection and tracking using pre-trained DNN models (YOLO or SSD).
9. Motion estimation using optical flow (Lucas-Kanade/Farneback).
10. Camera calibration and 3D reconstruction basics.
11. Object classification using pretrained CNN models (e.g., MobileNet, VGG).
12. Content-Based Image Retrieval (CBIR) using Feature Descriptors

Lab Software Requirements:

- Languages/Tools: Python, OpenCV, NLTK, spaCy, Tesseract OCR, scikit-learn, NumPy, Pandas, Matplotlib
- Platforms: Jupyter Notebook / Google Colab / PyCharm / VS Code

Course Outcomes:

After completion of the course, Students will be able to

CO1: Apply OpenCV tools for image preprocessing and enhancement.

CO2: Implement segmentation and feature extraction techniques.

CO3: Use pretrained deep learning models for object detection.

CO4: Perform motion tracking and optical flow analysis

CO5: Design and test computer vision applications for real-world problems

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

Minor in Quantum Computing

(Applicable to CE, EEE, ME, ECE, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

Minors

23MDINS101 INTRODUCTION TO QUANTUM COMPUTING

	L	T	P	C
Pre-requisite: None	**3**	**0**	**0**	**3**

Course Description:

This course introduces the basics of quantum mechanics as applied to computing. Students learn about qubits, quantum gates, circuits, and key algorithms like Grover's and Shor's. Concepts such as superposition, entanglement, and quantum communication are explored. Practical exposure is given through programming on platforms like IBM Qiskit.

Course Objectives:

1. Understand quantum mechanics principles in computing.
2. Explore qubits, quantum gates, and circuits.
3. Analyze the advantages of quantum algorithms.
4. Study entanglement, superposition, and interference.
5. Investigate real-world applications and platforms.

UNIT I QUBITS AND QUANTUM FOUNDATIONS 9 hours

Classical Bits vs Qubits, Postulates of Quantum Mechanics, Superposition and Probability Amplitudes, Dirac Notation (Bra-Ket), Bloch Sphere Representation, Measurement in Quantum Systems, Quantum State Collapse.

UNIT II QUANTUM GATES AND CIRCUITS 9 hours

Quantum Logic Gates: Pauli-X, Y, Z; Hadamard (H); Phase (S, T), Controlled Gates: CNOT, Toffoli, Unitary and Reversible Operations, Quantum Circuit Representation, Building Basic Quantum Circuits, Quantum Parallelism and Interference, No-Cloning Theorem and Quantum Gate Simulation.

UNIT III QUANTUM ALGORITHMS 9 hours

Need for Quantum Algorithms, Deutsch and Deutsch-Jozsa Algorithm, Grover's Search Algorithm (Quadratic Speed-up), Shor's Factoring Algorithm (Exponential Speed-up), Simon's Algorithm (Overview), Complexity Comparison: Classical vs Quantum.

UNIT IV ENTANGLEMENT AND QUANTUM COMMUNICATION 9 hours

Quantum Entanglement and Bell States, Quantum Teleportation Protocol, Superdense Coding, Quantum Key Distribution: BB84, E91 Protocols, Decoherence and Quantum Noise, Quantum Error Correction Codes (Bit Flip, Phase Flip, Shor Code).

UNIT V QUANTUM PLATFORMS AND APPLICATIONS 9 hours

Overview of Quantum Programming Platforms: IBM Qiskit, Microsoft Q#, Google Cirq, Quantum Circuit Simulation using Qiskit, Executing Code on Real Quantum Hardware (IBM Q). Quantum Applications in:Cryptography, Machine Learning, Optimization, Chemistry, Building and Testing a Sample Quantum Program.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Explain concepts of quantum mechanics
CO2: Illustrate quantum gates/circuits
CO3: Analyze algorithms (e.g., Shor, Grover)
CO4: Evaluate communication protocols
CO5: Develop quantum programs on IBM Q

Text Books:

1. **Michael A. Nielsen & Isaac L. Chuang** – *Quantum Computation and Quantum Information*, Cambridge University Press, 10th Anniversary Edition.
2. **David McMahon** – *Quantum Computing Explained*, Wiley.
3. **Bernhardt, Chris** – *Quantum Computing for Everyone*, MIT Press.

Reference Books:

1. **Mermin, N. David** – *Quantum Computer Science: An Introduction*, Cambridge University Press.
2. **William H. Press et al.** – *Numerical Recipes in C: The Art of Scientific Computing* (for simulation background)
3. **Rieffel&Polak** – *Quantum Computing: A Gentle Introduction*, MIT Press.
4. **Mermin, N. David** – *Quantum Computer Science: An Introduction*, Cambridge University Press.
5. **William H. Press et al.** – *Numerical Recipes in C: The Art of Scientific Computing* (for simulation background)
6. **Rieffel&Polak** – *Quantum Computing: A Gentle Introduction*, MIT Press.

Online Courses & Resources:
IBM Qiskit: IBM Qiskit Textbook:Hands-on, beginner-friendly curriculum for quantum programming
Coursera:*Quantum Mechanics for Scientists and Engineers* by Stanford (Leonard Susskind)

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minors

23MDINS102 MATHEMATICAL FOUNDATIONS FOR QUANTUM COMPUTING

	L	T	P	C
Pre-requisite: None	3	0	0	3

Course Description:

This course covers the mathematical tools required for quantum computing. It focuses on linear algebra, complex vector spaces, eigenvalues, and probability theory in quantum systems. Students gain skills to model quantum states and analyze measurements. These foundations prepare them for understanding quantum algorithms.

Course Objectives:

1. Cover linear algebra & complex vector spaces.
2. Model quantum states mathematically.
3. Apply probability theory to measurements.
4. Study eigenvalues and transformations.
5. Prepare for algorithm analysis with rigor.

UNIT I FOUNDATIONS OF COMPLEX VECTOR SPACES 9 hours

Complex Numbers: Polar form, Euler's formula, Vectors in $\mathbb{C}^n$, Inner Product Spaces, Dirac Notation (Bra-Ket), Hilbert Space: Definitions and Properties, Orthogonality and Completeness, Norms, Metrics, and Distance in Complex Spaces.

UNIT II MATRIX ALGEBRA AND OPERATORS 9 hours

Matrix Multiplication and Linear Transformations, Special Matrices: Identity, Diagonal, Unitary, Tensor Products of Matrices and Vectors, Kronecker Product Applications, Unitary and Invertible Operators, Quantum Gates as Linear Operators.

UNIT III EIGEN CONCEPTS AND QUANTUM OBSERVABLES 9 hours

Eigenvalues and Eigenvectors, Hermitian Operators and Spectral Theorem, Quantum Observables and Expectation Values, Commutators and Compatibility, Measurement Operators and Matrix Diagonalization, Applications in Quantum Gate Analysis.

UNIT IV QUANTUM MEASUREMENT & PROBABILITY 9 hours

Basics of Probability Theory in Quantum Systems, Born's Rule and Measurement Probabilities, Projection Postulate, Density Matrix Formalism, Mixed States and Pure States, Trace, Partial Trace, and Operator Sums.

UNIT V ADVANCED STRUCTURES IN QUANTUM MATH 9 hours

Group Theory Basics: Symmetry, Permutations, Pauli Group, Clifford Group, and their roles, Fourier Transform in Quantum Context, Gram-Schmidt Orthogonalization, Lie Groups and Lie Algebras, Use of Lie Algebra in Hamiltonian Formulation.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Explain concepts of quantum mechanics
CO2: Illustrate quantum gates/circuits
CO3: Analyze algorithms (e.g., Shor, Grover)
CO4: Evaluate communication protocols
CO5: Develop quantum programs on IBM Q

Text Books:

1. **Nielsen & Chuang** – *Quantum Computation and Quantum Information*, Cambridge University Press
2. **Brian C. Hall** – *Quantum Theory for Mathematicians*, Springer
3. **T.S. Blyth & E.F. Robertson** – *Basic Linear Algebra*, Springer

Reference Books:

1. **Roman S.** – *Advanced Linear Algebra*, Springer
2. **Axler, Sheldon** – *Linear Algebra Done Right*, Springer
3. **Shankar, R.** – *Principles of Quantum Mechanics*, Springer
4. **W. Greiner** – *Quantum Mechanics: An Introduction*, Springer

Online Courses & Resources:
MIT OpenCourseWare:*Linear Algebra (Gilbert Strang):*Link
edX:*Mathematics for Quantum Computing* by TUDelft:Link
Khan Academy:*Linear Algebra, Probability & Statistics:*Link
Quantum Country:*Spaced Repetition & Essays on Quantum Math:*Link

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minors

23MDINS201 QUANTUM PROGRAMMING AND SIMULATION LABORATORY

L	T	P	C
0	0	3	1.5

Prerequisties: None

Course Description:

This lab provides hands-on experience with quantum algorithms. Students implement and simulate algorithms such as Deutsch-Jozsa, Grover's search, Shor's algorithm, and teleportation. Both simulation and real hardware platforms are used. The focus is on practical understanding and experimentation.

Course Objectives:

1. To train students in programming quantum circuits using Qiskit, Q#, and related tools.
2. To explore advanced quantum simulations for teleportation, QFT, and hybrid models.
3. To develop practical skills in debugging and optimizing quantum programs.
4. To expose learners to both simulated environments and real quantum devices.
5. To motivate students through project-based learning in quantum applications.

List of Experiments:

1. State Vector Simulation (Qiskit)
2. Bell State Implementation
3. Deutsch-Jozsa Circuit
4. Grover's Search in Qiskit
5. QFT Circuit in Python
6. Shor Algorithm Simulation
7. Quantum Teleportation in Code
8. VQE (Hybrid Circuit)
9. QAOA Simulation
10. Quantum Random Number Generator
11. Comparison: Real vs Simulated Runs
12. Mini-Project: Quantum Password Cracker

Course Outcomes:

CO1: Ability to program and simulate quantum algorithms effectively.
CO2: Proficiency in using platforms like IBM Qiskit and Microsoft Q# for experimentation.
CO3: Understanding of differences between simulated and real hardware execution.
CO4: Skills to implement hybrid quantum-classical solutions such as VQE and QAOA.
CO5: Experience in developing a mini-project showcasing applied quantum computing.

Reference Books:

1. Michael Nielsen & Isaac Chuang – *Quantum Computation and Quantum Information*
2. Eric R. Johnston et al. – *Programming Quantum Computers*
3. David McMahon – *Quantum Computing Explained*
4. Gilbert Strang – *Introduction to Linear Algebra*
5. Sarah Kaiser & Chris Granade – *Learn Quantum Computing with Python and Q#*

Online Learning Resources/Virtual Labs:
IBM Qiskit Textbook: https://qiskit.org/learn
Microsoft Q# Documentation: https://learn.microsoft.com/en-us/azure/quantum/
Coursera: *Introduction to Quantum Computing*
edX: *Quantum Computing Fundamentals*, *Quantum Algorithms*
Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination.

Minors

23MDINS103 QUANTUM ALGORITHMS

	L	T	P	C
Pre-requisite: None	**3**	**0**	**0**	**3**

Course Description:

This course explores the design and analysis of algorithms in the quantum domain. Students study key algorithms like Deutsch, Grover's search, and Shor's factoring, along with Fourier-based methods. The course highlights the speed-up of quantum methods over classical ones. Implementation on real frameworks like Qiskit is emphasized.

Course Objectives:

1. Understand algorithm design principles in the quantum domain.
2. Use mathematical tools such as linear algebra and probability in algorithm analysis.
3. Implement quantum algorithms and compare them with classical equivalents.
4. Study key applications in cryptography, database search, and optimization.

UNIT I MATHEMATICAL TOOLS FOR QUANTUM ALGORITHMS 9 hours

Review of Complex Numbers & Linear Algebra for Quantum Computing, Inner Product Spaces, Hilbert Spaces, Dirac Notation and Interpretations, Quantum State Vectors and Superposition, Overview of Quantum Gates and Operators, Building Block Concepts for Algorithmic Design.

UNIT II SEARCH AND ORACLE-BASED ALGORITHMS 9 hours

Deutsch's Algorithm: Problem and Solution Strategy, **Simon's Algorithm**: Period-finding and Speed-up Over Classical, **Grover's Search Algorithm**: Amplitude Amplification, Oracle Construction in Grover's Algorithm, Circuit Analysis and Complexity Comparison, Limitations and Applications in Database Search.

UNIT III EIGEN CONCEPTS AND QUANTUM OBSERVABLES 9 hours

Eigenvalues and Eigenvectors, Hermitian Operators and Spectral Theorem, Quantum Observables and Expectation Values, Commutators and Compatibility, Measurement Operators and Matrix Diagonalization, Applications in Quantum Gate Analysis.

UNIT IV FOURIER-BASED & CRYPTOGRAPHIC ALGORITHMS 9 hours

Quantum Fourier Transform (QFT): Theory and Circuit, **Phase Estimation Algorithm**: Foundations and Usage, **Shor's Algorithm**: Integer Factorization and Discrete Logarithms, Modular Arithmetic and Period Finding, Cryptographic Implications of Quantum Algorithms, Efficiency Analysis vs Classical RSA Factorization.

UNIT V ADVANCED & HYBRID QUANTUM ALGORITHMS 9 hours

Variational Quantum Eigensolver (VQE), Quantum Approximate Optimization Algorithm (QAOA), Quantum Machine Learning (QML): Classification & Clustering, Hybrid Quantum-Classical Models, IBM Qiskit&Cirq for Implementation, Building Custom Quantum Algorithms for NISQ Devices.

Course Outcomes:

CO1: Understand quantum algorithm building blocks

CO2: Analyze well-known quantum algorithms

CO3: Apply quantum algorithms to application domains

CO4: Evaluate efficiency and complexity of algorithms

CO5: Create and simulate quantum algorithms

Text Books:

1. **Michael A. Nielsen & Isaac L. Chuang** – *Quantum Computation and Quantum Information*, Cambridge University Press
2. **Cristopher Moore & Stephan Mertens** – *The Nature of Computation*, Oxford University Press
3. **Eleanor G. Rieffel& Wolfgang Polak** – *Quantum Computing: A Gentle Introduction*, MIT Press

Reference Books:

1. **Gideon Amir** – *Quantum Algorithms via Linear Algebra*, MIT Press
2. **S. Jordan** – *Quantum Algorithm Zoo*, [Online repository]
3. **T. G. Wong** – *Quantum Algorithm Design Techniques*
4. **Roland, Cerf** – *Quantum Search Algorithms*, Springer

Online Courses & Resources:

edX (MIT)	*Quantum Algorithms for Cybersecurity*	Link
Coursera	*Quantum Computing* by University of London	Link
Qiskit Textbook	*Algorithms & Quantum Machine Learning Modules*	Link
Braket (AWS)	*Quantum Computing Developer Tools & Tutorials*	Link

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minors

23MDINS104 QUANTUM INFORMATION AND COMMUNICATION

	L	T	P	C
Pre-requisite:	**3**	**0**	**0**	**3**

Course Description:

This course introduces quantum information theory and its role in communication. Topics include entropy, fidelity, quantum teleportation, and quantum key distribution. Students analyze security protocols and the challenges of building quantum networks. Practical tools like Qiskit and NetSquid are used for simulation.

Course Objectives:

1. Understand the principles of quantum information theory.
2. Explore quantum entropy, fidelity, and mutual information.
3. Study quantum communication protocols and networks.
4. Analyze quantum key distribution and cryptographic security.
5. Implement protocols like teleportation and superdense coding.

UNIT I QUANTUM INFORMATION BASICS 9 hours

Classical vs Quantum Information, Density matrices and mixed states, Quantum entropy and Shannon entropy, Von Neumann entropy, Quantum data compression.

UNIT II QUANTUM COMMUNICATION PROTOCOLS 9 hours

Quantum teleportation, Superdense coding, Quantum repeaters and communication channels, No-cloning theorem, Quantum channel capacity.

UNIT III FIDELITY, DISTANCE & INFORMATION THEORY 9 hours

Fidelity and trace distance, Quantum mutual information, Holevo bound, Information trade-offs in communication, Channel noise and error modeling.

UNIT IV QUANTUM CRYPTOGRAPHY 9 hours

Principles of quantum cryptography, BB84 and B92 key distribution protocols, Eavesdropping and security analysis, Quantum bit commitment, Post-quantum cryptography relevance.

UNIT V APPLICATIONS & TOOLS 9 hours

Quantum internet: architecture and challenges, Networked quantum systems, Simulation using Qiskit, NetSquid, QuTiP, IBM Q Network and cloud-based setups, Practical implementation of QKD in simulation.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand quantum information concepts

CO2: Apply quantum communication protocols

CO3: Analyze fidelity, entropy, and data transfer limits

CO4: Evaluate quantum cryptographic techniques

CO5: Create and simulate quantum communication models

Text Books:

1. **Michael A. Nielsen & Isaac L. Chuang** – *Quantum Computation and Quantum Information*, Cambridge University Press
2. Mark M. Wilde – *Quantum Information Theory*, Cambridge University Press
3. John Watrous – *The Theory of Quantum Information*, Cambridge University Press

Reference Books:

1. Peter W. Shor – *Foundations of Quantum Computing* (Lecture notes)
2. Charles H. Bennett & Gilles Brassard – *Original Papers on QKD (BB84)*
3. Stephanie Wehner – *Quantum Communication Networks*, arXiv

Online Courses & Resources:

Coursera	*Quantum Cryptography* by University of Geneva	Coursera Link
edX	*Quantum Information Science I* (Harvard/MIT)	edX Course
Qiskit	*Quantum Information Applications in Qiskit Textbook*	Qiskit Info
QuTech	*Quantum Internet Tutorials & Tools*	QuTech

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minors

23MDINS202 QUANTUM ALGORITHMS LABORATORY

L	T	P	C
0	0	3	1.5

Prerequisties: None

Course Descriptions: This lab provides hands-on experience with quantum algorithms. Students implement and simulate algorithms such as Deutsch-Jozsa, Grover's search, Shor's algorithm, and teleportation. Both simulation and real hardware platforms are used. The focus is on practical understanding and experimentation.

Course Objectives:

1. To provide hands-on practice in implementing quantum algorithms.
2. To understand the working of algorithms like Grover's, Shor's, and Deutsch-Jozsa.
3. To strengthen the link between theoretical knowledge and practical applications.
4. To familiarize students with quantum simulators and real hardware platforms.
5. To encourage problem-solving through quantum circuit design.

List of Experiments

1. Deutsch Algorithm
2. Deutsch-Jozsa
3. Grover's Algorithm
4. QFT Visualization
5. Shor's Algorithm
6. QRNG Implementation
7. Bell State Entanglement
8. Bernstein-Vazirani Algorithm
9. Quantum Teleportation
10. Phase Estimation
11. Circuit Simulation
12. Mini-Project: RSA Key Breaking

Course Outcomes:

CO1: Ability to design and implement basic quantum algorithms.
CO2: Skill to simulate and test quantum circuits using software tools.
CO3: Competence in analyzing the performance of algorithms on quantum platforms.
CO4: Capability to compare classical vs quantum approaches for given problems.
CO5: Practical experience in applying algorithms to real-world inspired use cases.

Reference Books:

1. Michael A. Nielsen & Isaac L. Chuang – *Quantum Computation and Quantum Information*, Cambridge University Press.
2. Eleanor G. Rieffel & Wolfgang Polak – *Quantum Computing: A Gentle Introduction*, MIT Press.
3. David McMahon – *Quantum Computing Explained*, Wiley.

Online Learning Resources/Virtual Labs:

IBM Qiskit Textbook – https://qiskit.org/learn
Coursera – *Introduction to Quantum Computing* (University of Toronto / University of London).
edX – *Quantum Computing Fundamentals and Quantum Algorithms* (MIT / Delft).

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination.

Minors

23MDINS105 QUANTUM MACHINE LEARNING (QML)

	L	T	P	C
Pre-requisite: Nil	**3**	**0**	**0**	**3**

Course Description:

This course blends quantum computing with machine learning. Students learn quantum data encoding, supervised and unsupervised quantum algorithms, and hybrid models. Case studies such as quantum-enhanced fraud detection and NLP are included. Practical implementation is done using Qiskit and PennyLane.

Course Objectives:

1. Introduce the fundamentals of quantum-enhanced machine learning.
2. Understand quantum data encoding and kernel methods.
3. Explore quantum algorithms for supervised and unsupervised learning.
4. Analyze hybrid quantum-classical architectures.
5. Implement QML models using frameworks like Qiskit and PennyLane.

UNIT I INTRODUCTION TO QML **9 hours**

Need for QML: Why quantum for ML?,Classical vs quantum machine learning, Quantum states as information carriers, Data encoding: amplitude, angle, basis encoding, Introduction to quantum feature space.

UNIT II QML ALGORITHMS – SUPERVISED LEARNING **9 hours**

Quantum classifiers (quantum SVMs, qNN), Quantum perceptron, Variational quantum classifiers (VQC), Quantum kernels, Cost functions in quantum models.

UNIT III QML ALGORITHMS – UNSUPERVISED LEARNING **9 hours**

Quantum k-means and clustering, Quantum PCA, Quantum generative models (QGANs), Dimensionality reduction and similarity metrics, Performance analysis and limitations.

UNIT IV HYBRID MODELS & OPTIMIZATION **9 hours**

Variational Quantum Circuits (VQCs), Hybrid quantum-classical training loops, Barren plateaus and optimization issues, Quantum gradient descent and parameter shift rule, Comparative study of classical and QML models.

UNIT V QML TOOLS AND CASE STUDIES **9 hours**

Implementing QML with Qiskit Machine Learning, PennyLane and TensorFlow Quantum integration, Case studies: quantum-enhanced fraud detection, NLP, Quantum datasets and benchmark models, Project: design a small QML application.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand foundations of quantum machine learning

CO2: Apply QML algorithms to datasets

CO3: Analyze quantum kernels, data encoding, and models

CO4; Evaluate hybrid quantum-classical models

CO5: Create and simulate QML models using frameworks

Text Books:

1. Maria Schuld, Francesco Petruccione – *Machine Learning with Quantum Computers*, Springer
2. Peter Wittek – *Quantum Machine Learning: What Quantum Computing Means to Data Mining*, Academic Press

Reference Books:

1. Jacob Biamonte – *Quantum Machine Learning*, Nature, 2017
2. Seth Lloyd – *Quantum algorithms for supervised/unsupervised learning* (Research papers)
3. VojtěchHavlíček – *Supervised Learning with Quantum-Enhanced Feature Spaces*, Nature, 2019

Online Courses & Resources:

edX	*Quantum Machine Learning* by UTS	edX Course
Qiskit	*Qiskit Machine Learning Module*	Qiskit ML
Xanadu	*QML with PennyLane (Free online textbook)*	PennyLane QML Book
Coursera	*Quantum Machine Learning* by University of Toronto	Coursera

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minor in Quantum Technology

(Applicable to CE, EEE, ME, ECE, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

Minor

23MDINS106 FOUNDATIONS OF QUANTUM TECHNOLOGIES

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:

This course introduces the fundamental principles of quantum mechanics and their application in quantum information science. It covers the mathematical foundations, including linear algebra and complex vector spaces, to describe quantum states and operators. Key topics include superposition, measurement, entanglement, and quantum dynamics, along with the probabilistic nature of quantum systems. The course also explores practical aspects of quantum technologies, such as qubits, quantum logic gates, decoherence, and basic quantum circuit modeling using simulation tools. By the end, students will gain both theoretical understanding and foundational skills for working with quantum systems and emerging quantum technologies.

Course Objectives:

1. Introduce the fundamental quantum mechanics concepts essential for quantum technologies.
2. Build strong mathematical foundations for quantum state modeling.
3. Develop understanding of superposition, entanglement, and measurement.
4. Explain the physical principles behind quantum devices.
5. Prepare students for advanced studies in quantum computation, communication, sensing, and materials.

UNIT I: QUANTUM MECHANICS FOUNDATIONS **9 hours**

Classical vs Quantum systems, Wave-particle duality, Schrödinger equation (Time-dependent and Time-independent), Postulates of Quantum Mechanics, Quantum states and state vectors, Complex Hilbert spaces, Dirac notation (Bra-Ket notation), Probabilistic interpretation of quantum mechanics.

UNIT II: LINEAR ALGEBRA FOR QUANTUM SYSTEMS **9 hours**

Complex vector spaces and inner products, Orthonormal basis and orthogonality, Linear operators and transformations, Unitary operators and Hermitian operators, Tensor products for multi-qubit systems, Eigenvalues and Eigenvectors, Commutators and anti-commutators, Representing quantum states with matrices.

UNIT III: SUPERPOSITION, MEASUREMENT, AND ENTANGLEMENT 9 hours

Principle of superposition, Measurement postulate, Probability amplitudes and Born rule, State collapse upon measurement, Entanglement and Bell states, EPR paradox and non-locality, Density matrices and mixed states, Quantum decoherence.

UNIT IV: OPERATORS AND QUANTUM DYNAMICS 9 hours

Time evolution operators, Hamiltonian and energy eigenstates, Quantum harmonic oscillator (brief overview), Unitary evolution and Schrödinger equation solutions, Quantum tunnelling, Adiabatic theorem basics, Operator algebra in quantum systems, Expectation values and observables.

UNIT V: QUANTUM TECHNOLOGIES BUILDING BLOCKS 9 hours

Basic qubit systems (spin-1/2, photon polarization, superconducting qubits), Two-level quantum systems modelling, Bloch sphere representation, Quantum logic gates fundamentals, Multi-qubit systems: controlled operations, Introduction to decoherence and quantum error correction, Quantum technologies: hardware platforms overview, Basic quantum circuit modeling using simulators (Qiskit or Q# demo examples).

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Understand postulates of quantum mechanics for quantum technologies

CO2: Apply linear algebra and Dirac notation to quantum state analysis

CO3: Analyze superposition, entanglement, and measurement processes

CO4: Evaluate quantum systems through operators and probability amplitudes

CO5: Create mathematical models for simple quantum systems

Textbooks:

1□. Michael A. Nielsen & Isaac L. Chuang – Quantum Computation and Quantum Information

2□. N. David Mermin – Quantum Computer Science: An Introduction

3□. David McMahon – Quantum Computing Explained (Wiley)

Reference Books

1. Griffiths, D. – Introduction to Quantum Mechanics

2. Sakurai, J.J. – Modern Quantum Mechanics

3. ohnWatrous – The Theory of Quantum Information

4. V.K. Krishnan – Linear Algebra and its Applications to Quantum Computing

Online Courses & Resources

Platform	**Course Title**
MIT OpenCourseWare	Quantum Physics I, II (MIT OCW 8.04 & 8.05)
edX (Berkeley)	Quantum Mechanics and Quantum Computation

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

Minor

23MDINS107 SOLID STATE PHYSICS FOR QUANTUM TECHNOLOGIES

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:

This course provides a comprehensive understanding of the fundamental materials science and physics concepts essential for quantum technologies. It covers crystal structures, electronic properties, and semiconductor physics relevant to quantum devices, including quantum wells, dots, and superconductors. Students will explore quantum confinement in low-dimensional systems, lattice vibrations, phonon interactions, and their impact on qubit performance. The course also examines advanced materials for quantum technologies, such as topological insulators, NV centers, and photonic crystals, along with fabrication challenges and design strategies for achieving long coherence times.

Course Objectives:

1. Understand fundamental solid-state physics principles relevant to quantum technologies.
2. Study the electronic properties of materials used in quantum hardware.
3. Explore quantum confinement and nanostructures for qubit implementation.
4. Analyze crystal structures, band theory, and defects influencing quantum devices.
5. Build foundations for material selection and engineering for quantum systems.

UNIT I: CRYSTAL STRUCTURE AND ELECTRONIC PROPERTIES 9 hours

Crystal lattices and unit cells, Bravais lattices, Miller indices, Reciprocal lattice and Brillouin zones, Atomic bonding in solids (covalent, ionic, metallic, van der Waals), X-ray diffraction and crystal structure determination, Electronic structure of solids, Free electron theory, Energy bands: metals, semiconductors, and insulators.

UNIT II: SEMICONDUCTOR PHYSICS FOR QUANTUM DEVICES 9 hours

Intrinsic and extrinsic semiconductors, Charge carriers: electrons, holes, effective mass, Carrier concentration and Fermi level, p-n junctions and semiconductor heterostructures, Quantum wells and quantum dots as qubits, Superconductors and Josephson junctions, Semiconductor fabrication basics, Materials for quantum hardware: Si, GaAs, diamond NV centers, topological insulators.

UNIT III: QUANTUM CONFINEMENT AND LOW-DIMENSIONAL SYSTEMS 9 hours

Quantum size effects: nanowires, nanotubes, 2D materials, Quantum dots: discrete energy levels, Quantum Hall effect, Topological quantum materials, Spintronics and spin qubits, Quantum confinement in superconducting qubits, Heterostructure-based quantum devices, Valleytronics and emerging 2D materials (MoS_2 , graphene).

UNIT IV: LATTICE VIBRATIONS AND PHONON INTERACTIONS 9 hours

Lattice vibrations and phonons, Heat capacity and thermal conductivity of solids, Electron-phonon interaction, Decoherence in solid-state qubits due to phonons, Magnetic impurities and Kondo effect, Defects and dislocations in crystals, Dopants and quantum impurity systems, Nuclear spin environments and coherence times.

UNIT V: MATERIALS FOR QUANTUM TECHNOLOGIES 9 hours

Material engineering for superconducting qubits, NV centers in diamond for quantum sensing, Topological materials for robust qubits, Photonic crystal materials for optical qubits, Hybrid quantum systems: coupling different materials, Fabrication challenges and material purity, Advances in quantum materials research, Designing material systems for long coherence time.

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Understand crystal structures and band theory

CO2: Apply knowledge of semiconductors, insulators, and conductors in quantum materials

CO3: Analyze quantum confinement effects and low-dimensional systems

CO4: Evaluate defects, phonons, and interactions in solid-state systems

CO5: Create models for quantum device material systems

Textbooks:

1. Charles Kittel – Introduction to Solid State Physics

2. Michael A. Nielsen & Isaac Chuang – Quantum Computation and Quantum Information

3. Simon L. Altmann – Band Theory of Solids

Reference Books

1. Ashcroft &Mermin – Solid State Physics

2. Yu & Cardona – Fundamentals of Semiconductors: Physics and Materials Properties

3. David Awschalom – Semiconductor Spintronics and Quantum Computation

4. Dieter Vollhardt – Introduction to the Theory of Many-Body Systems

Online Courses & Resources

Platform	**Course Title**
MIT OpenCourseWare	Solid State Physics (MIT 8.231)
edX	Quantum Materials and Devices (U. Tokyo)
Coursera	Quantum Materials (ÉcolePolytechnique)

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

Minor

23MDINS203 QUANTUM DEVICES AND MATERIALS LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: Nil

Course Objectives:

1. Simulate quantum devices and materials behavior.
2. Explore quantum optics and solid-state quantum systems.
3. Model quantum dots, superconductors, and photonic devices.
4. Perform quantum simulation of condensed matter systems.
5. Build foundational skills for quantum hardware understanding.

List of Experiments (12 Experiments)

1. Simulation of Single-Qubit Optical Devices
2. Modeling Quantum Dots and Energy Level Transitions
3. Simulation of Two-Level Atom and Rabi Oscillations
4. Quantum Harmonic Oscillator: Energy Levels Visualization
5. Spin-1/2 Systems and Magnetic Resonance Simulation
6. Superconducting Qubits Circuit Simulation
7. Josephson Junction Modeling for Quantum Circuits
8. Quantum Photonic Interferometer Simulation
9. Simulation of NV Centers in Diamond for Quantum Sensing
10. Solid-State Quantum Materials Simulation (Band Structures)
11. Modeling Quantum Light-Matter Interactions (Jaynes-Cummings Model)

Platforms & Tools:

1. QuTiP (Quantum Toolbox in Python)
2. Qiskit Nature / Qiskit Metal
3. MATLAB Simulink
4. COMSOL Multiphysics (for materials simulation)
5. Silvaco TCAD (for device-level modeling)

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination.

Minor

23MDINS108 INTRODUCTION TO QUANTUM COMMUNICATION

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:

This course provides a comprehensive introduction to quantum communication principles, technologies, and protocols. It covers the fundamental differences between classical and quantum communication, including quantum entanglement, qubits, and quantum information security. Key topics include Quantum Key Distribution (QKD) protocols, quantum teleportation, and entanglement distribution techniques for secure and long-distance communication. Students will explore quantum networks, quantum internet architecture, and advanced quantum communication applications such as quantum secure direct communication, quantum secret sharing, and post-quantum cryptography. The course also discusses practical implementation challenges, hybrid quantum-classical models, and emerging trends shaping the future of quantum communication.

Course Objectives:

1. Introduce fundamental principles of quantum communication.
2. Study quantum key distribution (QKD) protocols.
3. Analyze quantum teleportation, entanglement swapping, and quantum repeaters.
4. Evaluate quantum security principles and their advantages.
5. Prepare students for designing secure communication protocols for future quantum networks.

UNIT I: INTRODUCTION TO QUANTUM COMMUNICATION 9 hours

Classical communication vs quantum communication, No-cloning theorem and quantum information security, Qubits and qubit transmission channels, Quantum entanglement fundamentals, EPR paradox and Bell's inequalities, Quantum states and measurement, Role of superposition and measurement collapse, Overview of quantum internet and its architecture.

UNIT II: QUANTUM KEY DISTRIBUTION (QKD) PROTOCOLS 9 hours

Classical cryptography limitations, BB84 protocol, B92 protocol, E91 entanglement-based protocol, Decoy-state QKD, Device-independent QKD, Practical implementation challenges in QKD, Experimental QKD systems (fiber, free-space, satellites).

UNIT III: QUANTUM TELEPORTATION AND ENTANGLEMENT DISTRIBUTION

9 hours

Quantum teleportation protocol, Entanglement swapping, Quantum repeaters for long-distance communication, Error sources in quantum teleportation, Resource requirements for teleportation, Entanglement purification techniques, Bell state measurements, Applications of teleportation in distributed quantum computing.

UNIT IV: QUANTUM NETWORKS AND QUANTUM INTERNET **9 hours**

Architecture of quantum networks, Quantum routers and switching, Quantum memories and storage nodes, Distributed entanglement generation and management, Multiparty quantum communication Blind quantum computing, Performance metrics for quantum networks (fidelity, key rate), Challenges in large-scale quantum network deployment.

UNIT V: ADVANCED QUANTUM COMMUNICATION PROTOCOLS AND APPLICATIONS **9 hours**

Quantum secure direct communication, Quantum digital signatures, Position-based quantum cryptography, Quantum secret sharing, Post-quantum cryptography overview, Quantum cloud communication protocols, Building hybrid quantum-classical communication models, Future directions in quantum communication technology.

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Understand quantum communication concepts

CO2: Apply quantum entanglement to communication protocols

CO3: Analyze QKD protocols and teleportation mechanisms

CO4: Evaluate security of quantum communication

CO5: Design quantum communication networks and protocols

Textbooks:

1. M. Nielsen & I. Chuang – Quantum Computation and Quantum Information

2. Mark M. Wilde – Quantum Information Theory

3. Scarani – Quantum Cryptography: A Primer

Reference Books

1. VedranDunjko – Introduction to Quantum Communication and Cryptography

2. Norbert Lütkenhaus – Practical Security in Quantum Key Distribution

3. David McMahon – Quantum Computing Explained

4. Bouwmeester et al. – The Physics of Quantum Information

Online Courses & Resources

Platform	Course Title
edX	Quantum Cryptography (ETH Zurich)
Coursera	Quantum Communication (Delft University of Technology)
MIT	OpenCourseWare Quantum Information Science (MIT 6.443)
YouTube	Quantum Internet & Quantum Networking Tutorials
IBM Qiskit	Qiskit tutorials on quantum teleportation and QKD

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

Minor

23MDINS109 INTRODUCTION TO QUANTUM SENSING

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:

This course provides a comprehensive introduction to the principles and technologies of quantum sensing and metrology, highlighting how quantum phenomena such as superposition, entanglement, and squeezing enable precision measurements beyond classical limits. Students will explore fundamental concepts like the Standard Quantum Limit, Heisenberg limit, and quantum phase estimation, along with key measurement techniques including quantum interferometry, atomic clocks, magnetometry, and quantum imaging. The course also covers noise sources, decoherence, and error mitigation strategies, and examines cutting-edge applications in navigation, medical imaging, environmental monitoring, and space-based sensing. By the end, learners will gain both theoretical understanding and practical insight into the design and operation of advanced quantum sensor systems.

Course Objectives:

1. Introduce the principles of quantum sensing and metrology.
2. Explain how quantum superposition and entanglement enhance measurement sensitivity.
3. Study applications of quantum sensors across multiple domains.
4. Analyze noise, decoherence, and quantum limits on measurement.
5. Prepare students to design and analyze quantum-enhanced sensors.

UNIT I: INTRODUCTION TO QUANTUM SENSING AND METROLOGY 9 hours

Classical vs quantum sensing, Precision limits: Standard Quantum Limit (SQL), Quantum metrology fundamentals, Heisenberg limit, Quantum phase estimation for precision measurements, Quantum non-demolition measurements, Quantum error correction in sensing, Importance of coherence and entanglement in sensors.

UNIT II: QUANTUM MEASUREMENT PRINCIPLES **9 hours**

Superposition and interference in measurement, Quantum Fisher information, Squeezed states for noise reduction, Photon counting and single-photon detectors, Spin-based measurements (NV centers, trapped ions), Ramsey interferometry, Quantum state tomography, Applications of quantum-enhanced interferometry.

UNIT III: QUANTUM SENSOR TECHNOLOGIES **9 hours**

Atomic clocks (optical & microwave), Gravimeters and accelerometers, Magnetometers (SQUIDs, NV centers), Quantum gyroscopes, Quantum imaging & super-resolution microscopy, Quantum lidar and radar, Force and electric field sensing, Photonic quantum sensing systems.

UNIT IV: DECOHERENCE, NOISE, AND ERROR MITIGATION IN QUANTUM SENSING **9 hours**

Sources of decoherence in quantum sensors, Thermal noise and quantum noise sources, Quantum back-action, Squeezing and noise reduction techniques, Dynamical decoupling techniques, Noise spectroscopy for sensor calibration, Robust error mitigation protocols, Evaluating sensitivity vs noise tradeoffs.

UNIT V: ADVANCED APPLICATIONS AND FUTURE QUANTUM SENSING SYSTEMS **9 hours**

Quantum sensing for biological and medical imaging, Navigation and positioning without GPS, Quantum-enhanced gravitational wave detection (LIGO), Quantum-enhanced environmental monitoring, Sensors for national defense and security, Space-based quantum sensors, Integrated quantum photonic sensing platforms, Design of hybrid quantum-classical sensor systems.

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Understand the basic principles of quantum sensing

CO2: Apply quantum superposition and entanglement to sensing

CO3: Analyze quantum sensor architectures

CO4: Evaluate sensitivity and error limits in quantum measurements

CO5: Design quantum sensing systems for real-world applications

Textbooks:

1. Christian L. Degen, F. Reinhard, P. Cappellaro – Quantum Sensing
2. Giovannetti, Lloyd &Maccone – Advances in Quantum Metrology
3. David Budker& Derek F. Jackson Kimball – Optical Magnetometry

Reference Books

1. Kurt Jacobs – Quantum Measurement Theory and its Applications
2. Helmut Rauch – Neutron Interferometry
3. M. O. Scully & M. S. Zubairy – Quantum Optics (Chapters on Metrology)
4. VlatkoVedral – Introduction to Quantum Information Science

Online Courses & Resources

Platform	**Course Title**
edX	Quantum Sensing & Metrology (LMU Munich)
Coursera	Quantum Optics and Sensing (University of Colorado Boulder)
MIT OpenCourseWare	Quantum Measurement and Sensing (MIT)
YouTube	Quantum Sensing Lectures
IBM Qiskit	Tutorials on Quantum Phase Estimation

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

Minor

23MDINS204 QUANTUM COMMUNICATION AND SENSING LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: Nil

Course Objectives:

1. Simulate and analyze quantum communication protocols.
2. Implement quantum key distribution (QKD) and teleportation.
3. Perform quantum sensing simulations for precision measurements.
4. Evaluate sensor performance with noise and decoherence.
5. Gain hands-on experience with quantum simulation tools.

List of Experiments (12 Experiments)

1. Simulation of Qubits and Bloch Sphere Visualization
2. Implementation of BB84 Quantum Key Distribution Protocol
3. Simulation of B92 and E91 QKD Protocols
4. Quantum Entanglement Generation and Bell Inequality Testing
5. Quantum Teleportation Protocol using Qiskit/Cirq
6. Simulation of Quantum Repeaters and Entanglement Swapping
7. Noise and DecoherenceModeling in Quantum Communication Channels
8. Ramsey Interferometry Simulation for Quantum Sensing
9. Implementation of NV CenterMagnetometry Simulation
10. Quantum Gravimeter and Accelerometer Simulation
11. Quantum Phase Estimation for High-Precision Metrology

Platforms & Tools:

1. IBM Qiskit
2. Google Cirq
3. RigettiPyQuil
4. Quantum Inspire
5. MATLAB / Python with quantum libraries

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination.

Minor

23MDINS110 QUANTUM OPTICS PREREQUISITES FOR QUANTUM TECHNOLOGIES

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:

This course introduces the fundamental principles and applications of quantum optics and photonics. It covers the classical and quantum description of light, electromagnetic field quantization, and light–matter interactions. Topics include coherence theory, quantum noise, and advanced phenomena such as photon antibunching, squeezing, and cavity-QED. The course also explores emerging quantum photonics technologies, including single-photon sources, entangled photon generation, quantum key distribution, and quantum metrology, preparing students for research and experimentation in modern quantum optics.

Course Objectives:

1. Introduce fundamentals of light-matter interaction relevant for quantum technologies.
2. Explain the quantization of electromagnetic fields.
3. Study the role of photons as quantum information carriers.
4. Explore coherent states, squeezed states, and single-photon sources.
5. Prepare for quantum sensing, communication, and photonic quantum computing applications.

UNIT I: CLASSICAL AND QUANTUM DESCRIPTION OF LIGHT **9 hours**

Review of electromagnetic waves, Maxwell‘s equations for light propagation, Plane waves, polarization, Poynting vector, Classical interference, diffraction, coherence, Blackbody radiation & Planck's hypothesis, Photoelectric effect, Photons as quantized light energy, Introduction to quantum theory of radiation.

UNIT II: QUANTIZATION OF ELECTROMAGNETIC FIELD **9 hours**

Harmonic oscillator quantization, Field quantization in free space, Photon number (Fock) states, Coherent states and classical-quantum correspondence, Vacuum fluctuations and zero-point energy, Single-mode vs multi-mode quantization, Spontaneous and stimulated emission, Quantum field operators and commutation relations.

UNIT III: LIGHT-MATTER INTERACTION **9 hours**

Two-level atom model, Absorption, stimulated emission, spontaneous emission, Einstein coefficients, Rabi oscillations, Jaynes-Cummings model, Resonant and non-resonant interaction, Cavity Quantum Electrodynamics (Cavity-QED), Atom-photon entanglement.

UNIT IV: QUANTUM COHERENCE AND QUANTUM NOISE **9 hours**

Classical vs quantum coherence, First- and second-order coherence functions, Photon antibunching, Hanbury Brown and Twiss experiment, Quantum squeezing of light, Phase-sensitive amplification, Quantum noise, shot noise, and standard quantum limit, Quantum nondemolition measurements.

UNIT V: QUANTUM PHOTONICS APPLICATIONS **9 hours**

Single-photon sources (quantum dots, NV centers, SPDC), Entangled photon pair generation, Photonic qubits and linear optical quantum computing, Quantum key distribution with photons, Photonic integrated circuits, Quantum sensors based on squeezed light, Quantum metrology using entangled photons, Designing experiments for quantum optics labs.

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Understand quantum nature of light

CO2: Apply Maxwell‘s equations to optical fields

CO3: Analyze interaction of photons with matter

CO4: Evaluate coherence, squeezing, and quantum noise

CO5: Create models for photonic quantum systems

Textbooks:

1□ Mark Fox – Quantum Optics: An Introduction

2□. Rodney Loudon – The Quantum Theory of Light

3□. M. O. Scully & M. S. Zubairy – Quantum Optics

Reference Books

1□. Stephen Barnett – Quantum Information

2□. Peter Meystre – Elements of Quantum Optics

3□. Michel Le Bellac – Quantum Physics

4□. D. F. Walls & G. J. Milburn – Quantum Optics

Online Courses & Resources

Platform	**Course Title**
MIT OpenCourseWare	Quantum Optics (MIT 8.421)
edX	Principles of Photonics (EPFL)
Coursera	Quantum Optics 1 & 2 (U. Rochester)
YouTube	Quantum Optics Lectures (Various universities)

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

Honors
in
Computer Science and Engineering (Artificial Intelligence)

Honors

23HDCAI101 COGNITIVE SCIENCE AND ANALYTICS

L	T	P	C
3	0	0	3

Pre-requisite:
A course on AI should be studied by students, to study this course.

Course Description:
This course explores the area of cognitive computing and its implications for now a days world of big data analytics and evidence-based decision making. Cognitive computing design principles, natural language processing, knowledge representation, this is an opportunity to build cognitive applications, and explore how knowledge-based artificial intelligence and deep learning are impacting the field of data science.

Course Objectives:
To develop algorithms that use AI and machine learning along with human interaction and feedback to help humans make choices/decisions and to understand how Cognitive computing supports human reasoning by evaluating data in context and presenting relevant findings along with the evidence that justifies the answers.

UNIT I **9 Hours**
Introduction: Cognitive science and cognitive Computing with AI, Cognitive Computing - Cognitive Psychology - The Architecture of the Mind - The Nature of Cognitive Psychology – Cognitive architecture – Cognitive processes – The Cognitive Modeling Paradigms - Declarative / Logic based Computational cognitive modeling – connectionist models – Bayesian models.

UNIT II **9 Hours**
Introduction to Knowledge-Based AI – Human Cognition on AI – Cognitive Architectures. Cognitive Computing with Inference and Decision Support Systems: Intelligent Decision making, Fuzzy Cognitive Maps,

UNIT III **9 Hours**
Learning algorithms: Nonlinear Hebbian Learning – Data driven NHL - Hybrid learning, Fuzzy Grey cognitive maps, Dynamic Random fuzzy cognitive Maps. Cognitive Computing with Machine Learning: Machine learning Techniques for cognitive decision making.

UNIT IV **9 Hours**
Hypothesis Generation and Scoring - Natural Language Processing - Representing Knowledge - Taxonomies and Ontologies - Deep Learning

UNIT V **9 Hours**
Case Studies: Cognitive Systems in health care – Cognitive Assistant for visually impaired – AI for cancer detection, Predictive Analytics - Text Analytics - Image Analytics -Speech Analytics – IBM Watson

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Understand basics of Cognitive Computing and its differences from traditional Approaches of Computing

CO2: Plan and use the primary tools associated with cognitive computing.

CO3: Plan and execute a project that leverages Cognitive Computing.

Textbook(s)

1. Hurwitz, Kaufman, and Bowles, Cognitive Computing and Big Data Analytics, Wiley, Indianapolis, IN, 2005, ISBN: 978-1-118-89662-4.
2. Masood, Adnan, Hashmi, Adnan, Cognitive Computing Recipes-Artificial Intelligence Solutions Using Microsoft Cognitive Services and TensorFlow, 2015**.**

Reference Books

1. Peter Fingar, Cognitive Computing: A Brief Guide for Game Changers, PHI Publication, 2015
2. Gerardus Blokdyk, Cognitive Computing Complete Self-Assessment Guide, 2018
3. Rob High, Tanmay Bakshi, Cognitive Computing with IBM Watson: Build smart applications using Artificial Intelligence as a service, IBM Book Series, 2019

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Honors

23HDCAI102 BUSINESS INTELLIGENCE

L	T	P	C
3	0	0	3

Pre-requisite Database Management Systems, Basic probability and statistics

Course Description:

The course aims at examining Business Intelligence (BI) as a broad category of applications and technologies for gathering, storing, analyzing, sharing and providing access to data to help enterprise users make better managerial decisions. To learn the principles and best practices for how to use data in order to support fact-based decision making. Emphasis will be given to applications in marketing, where BI helps in, e.g., analyzing campaign returns, promotional yields, or tracking social media marketing; in sales, where BI helps performing for sales analysis; and in application domains such as Customer Relationship Management and e-Commerce. Practical experience will be gained by developing a BI project (case-study) with leading BI software.

Course Objectives:

1. Be exposed with the basic rudiments of business intelligence system
2. Understand the modeling aspects behind Business Intelligence
3. Understand of the business intelligence life cycle and the techniques used in it
4. Be exposed with different data analysis tools and techniques
5. Learn different reporting tools

UNIT I INTRODUCTION TO BUSINESS INTELLIGENCE 9 hours

What is business intelligence and analytics (BIA)? Evolution of BIA, Interplay among Business Intelligence, Business Analytics, Data Science, Data Mining, Data Analytics, Data Warehousing, Statistics and Machine Learning. Drawing insights from data: DIKW pyramid Business Analytics project methodology - detailed description of each phase, Data exploration and data preparation.

UNIT II DECISION MANAGEMENT SYSTEMS 9 hours

Study of Information Technology resources such as database systems, enterprise systems, and networks, role of supporting, decision makers, Decision Taxonomy Principles of Decision Management Systems, Building Decision Management Systems, Characteristics of Suitable Decisions, Prioritizing Decisions, Decision Analysis, Monitor Decisions, Fact-Based Decisions - The OODA Loop – Technology Enablers, Business Rules Management Systems

UNIT III DATA PREPROCESSING: 9 hours

Mechanisms of data collection and challenges involved therein. Notion of data quality. Typical preprocessing operations: combining values into one, handling incomplete or incorrect data, handling missing values, recoding values, sub setting, sorting, transforming scale, determining percentiles, data manipulation, removing noise, removing inconsistencies, transformations, standardizing, normalizing - min-max normalization, z-score standardization, rules of standardizing data Enterprise Reporting: Metrics, Measurement, Measures, KPIs, Dashboards, Reports,
Scorecards

UNIT IV ARCHITECTING THE DATA 9 hours

Introduction, Types of Data, Enterprise Data Model, Enterprise Subject Area Model, Enterprise Conceptual Model, Enterprise Conceptual Entity Model, Granularity of the Data, Data Reporting and Query Tools, Data Partitioning, Metadata, Total Data Quality Management (TDQM).

UNIT V DATA WAREHOUSING 9 hours

What is a data warehouse, need for a data warehouse, architecture, data marts, OLTP vs OLAP, Multidimensional Modeling: Star and snow flake schema, Data cubes, Enterprise Reporting OLAP operations, Data Cube Computation and Data Generalization, Data lake Descriptive statistics, Inferential statistics.
Data visualization: Role of visualization in analytics, different techniques for visualizing data based on the nature of data and what kind of insights need to be drawn

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Construct an end-to-end data warehousing solution for business intelligence involving various data sources, ETL, multi -dimensional modeling, OLAP, reporting and analytics
CO2: Evaluate various data processing algorithms in their applicability to different problems
CO3: Display the process of converting data into a user defined format required for particular analysis
CO4: Utilize statistical tools in deriving insights from data
CO5: Describe various techniques for descriptive, predictive and prescriptive analytics
CO6: Apply various techniques to solve real-world data analysis problems

Text Book:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, “Decision Support and Business Intelligence Systems”, 9th Edition, Pearson 2013.

Reference Books:

1. R. N. Prasad, SeemaAcharya , “Fundamentals of Business Analytics”,ISBN: 978-81-256-3203-2, Wiley-India – Types of Digital Data, OLTP-OLAP, Introduction to BI (ch 4 and 5), data integration (ch 6), MDDM (ch 7), Reporting (ch 8, 9)

2. Wolfgang Jank , Business Analytics for managers, exploring and discovering data (ch 2), Data Modeling (ch 3, 4, 5, 6)
3. Ralph Kimball, Margy Ross ,"The Data Warehouse Toolkit – Complete Guide to Dimensional Modeling", Wiley Computer Publishing

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Honors

23HDCAI201 COGNITIVE SCIENCE AND ANALYTICS LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: 23CSE203

Course Objectives:

The objectives of the course are to

1. To know the theoretical background of cognition.
2. To understand the link between cognition and computational intelligence.
3. To explore probabilistic programming language.
4. To study the computational inference models of cognition.
5. To study the computational learning models of cognition.

List of Experiments:

1. Demonstration of Mathematical functions using WebPPL.
2. Implementation of reasoning algorithms.
3. Developing an application system using generative model.
4. Developing an application using conditional inference learning model.
5. Application development using hierarchical model.
6. Application development using Mixture model.

Course Outcomes:

After completion of the course, Students will be able to

CO1: Understand the underlying theory behind cognition.

CO2: Connect to the cognition elements computationally.

CO3: Implement mathematical functions through WebPPL.

CO4: Develop applications using cognitive inference model.

CO5: Develop applications using cognitive learning model.

Reference Books:

1. Cognitive Science: An Introduction to the Science of the Mind Bermúdez, José Luis 2nd Edition Cambridge University Press
2. Cognition, Brain, and Consciousness Baars, Bernard J.; Gage, Nicole M. 2nd EditionAcademic Press
3. Computational Neuroscience and Cognitive Modelling Anderson, Britt 1st EditionSAGE Publications

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

Honors

23HDCAI103 DATA WAREHOUSING AND DATA MINING

L	T	P	C
3	0	0	3

Pre-requisite : Statistics for Data Analytics or equivalent working knowledge is required

Course Description:
This course covers the principles and practices of data mining and warehousing To extract knowledge from data repository for data analysis, frequent pattern, classification and prediction.

Course Objectives:

1. To understand the basic concepts of data mining and its applications and major issues.
2. To learn the various preprocessing technique in data mining.
3. To have knowledge about the data warehousing and OLAP.
4. To learn basic concepts and algorithms of classification.
5. To explore various data mining trends and research frontiers.

UNIT I INTRODUCTION TO DATA MINING 9 hours

Introduction :Why data mining, What is data mining, What kinds of data can be mined, What kinds of patterns can be mined, Which Technologies Are used, Which kinds of Applications are targeted, Major issues in data mining

UNIT II DATA PREPROCESSING 9 hours

Data Preprocessing: An overview, Data cleaning, Data integration, Data reduction, Data transformation and data discretization

UNIT III DATA WAREHOUSING AND ONLINE ANALYTICAL PROCESSING 9 hours

Data warehousing and online analytical processing: Data warehousing: Basic concepts, Data warehouse modeling: Data cube and OLAP, Data warehouse design and usage

UNIT IV CLASSIFICATION 9 hours

Classification: Basic Concepts: Basic Concepts, Decision tree induction, Bays Classification Methods, Rule-Based classification, Model evaluation and selection

UNIT V DATA MINING TRENDS AND RESEARCH FRONTIERS 9 hours

Data mining trends and research frontiers: Mining complex data types, other methodologies of data mining, Data mining applications, Data Mining and society.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Understand various basic topics of data mining

CO2: Analyze the different preprocessing technique in data mining

CO3: Analyze about data warehousing and OLAP topics

CO4: Evaluate the concepts of classification and its algorithms

CO5: Explore the data mining trends and its applications in various fields

Text Book(s)

1. Data Mining Concepts andTechniques: Jiawei Han, MichelineKamber , Jian Pei, ELSEVIER,3rd editing 2012

Reference Books

1. Alex berson and Stephen J.Smith"Data Warehousing,Data Mining & OLAP",Tata McGraw-Hill Edition,Tenth Reprint 2007.

2. K.P.Soman,Shyam Diwakar and V. Ajay "Insight into Data Mining Theory and Practice",Easter Economy Edition, Prentice Hall of India,2006.

3. G.K. Gupta "Introduction to Data Mining with Case studies"Easter Economy Edition,Prentice Hall of India,2006.

4. Pang-Ning Tan,Michael Steinbach and Vipin kumar"Introduction to data Mining",Pearson Education,2007.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Honors

23HDCAI104 EXPERT SYSTEM

L	T	P	C
3	0	0	3

Pre-requisite : Nil

Course Objectives:

1. To provide an overview of the Expert System.
2. To introduce students about insights of the several topics of Expert System such as
3. building an expert system and knowledge engineering
4. To provide comprehensive details about various Evaluation methods of the expert system.
5. To provide implementation insight about the topics covered in the course.

UNIT I INTRODUCTION TO EXPERT SYSTEM 9 hours

The nature of Expert Systems. Types of applications of Expert Systems; the relationship of Expert Systems to Artificial Intelligence and Knowledge-Based Systems. The nature of expertise. Distinguishing features of Expert Systems. Benefits of using an Expert System, choosing an application.

UNIT II THEORETICAL FOUNDATIONS OF EXPERT SYSTEM 9 hours

What an expert system is; how it works and how it is built—basic forms of inference: abduction; deduction; induction.

UNIT III THE REPRESENTATION AND MANIPULATION OF KNOWLEDGE IN A COMPUTER 9 hours

Rule-based representations (with backward and forward reasoning); logic-based representations (with resolution refutation); taxonomies; meronomies; frames (with inheritance and exceptions); semantic and partitioned nets (query handling).

UNIT IV BASIC COMPONENTS OF AN EXPERT SYSTEM 9 hours

Component of expert system, Generation of explanations. Handling of uncertainties. Truth Maintenance Systems. Expert System Architectures. An analysis of some classic expert systems. Limitations of first-generation expert systems. Deep expert systems. Co-operating expert systems and the blackboard model.

UNIT V BUILDING EXPERT SYSTEMS 9 hours

Methodologies for building expert systems: knowledge acquisition and elicitation; formalization; representation and evaluation. Knowledge Engineering tools, Case Study.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Students will be able to explain and describe the concepts central to the creation of Knowledge bases and expert systems.

CO2: Students will be knowledgeable about the tools and the processes used for the creation of an expert system.

CO3: Students will know the methods used to evaluate the performance of an expert system.

CO4: Students will be able to conduct an in-depth examination of an existing expert system with an emphasis on basic methods of creating a knowledge base.

CO5: Students will be able to examine the properties of existing systems in a case-study manner, comparing differing approaches.

Textbook (s):

1. P Jackson, Introduction to Expert Systems, Addison Wesley, 1990 (2nd Edition)

Reference Books:

1. Elaine Rich, Kevin Knight, Artificial Intelligence, McGraw-Hill, Inc, 1991 (2nd Edition)

2. Jackson. Jean-Louis Lauriere, Problem Solving and Artificial Intelligence, Prentice Hall, 1990

3. P. Jackson, "Introduction to Expert Systems", Third Edition, Pearson Education. Author(s)

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Honors

23HDCAI202 DATA WAREHOUSING AND MINING LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: None

Course Objectives:

The objectives of the course are to

1. Learn how to build a data warehouse and query it (using open source tools like Pentaho Data Integration Tool, Pentaho Business Analytics).
2. Learn to perform data mining tasks using a data mining toolkit (such as open source WEKA).
3. Understand the data sets and data preprocessing.
4. Demonstrate the working of algorithms for data mining tasks such association rule mining, classification, clustering and regression.

List of Experiments:

1. Build Data Warehouse and Explore WEKA
2. Perform data preprocessing tasks and demonstrate performing association rule mining on data sets
3. Demonstrate performing classification on data sets.
4. Demonstrate performing clustering on data sets.
5. Demonstrate performing Regression on data sets
6. Credit Risk Assessment. Sample Programs using German Credit Data.
7. Sample Programs using Hospital Management System

Course Outcomes:

After completion of the course, Students will be able to

CO1: Ability to understand various kinds of tools.

CO2: Demonstrate the classification, clustering etc. in large data sets.

CO3: Ability to add mining algorithms as a component to the exiting tools.

CO4: Ability to apply mining techniques for realistic data.

Reference Books:

1. Alex berson and Stephen J.Smith"Data Warehousing,Data Mining & OLAP",Tata McGraw Hill Edition,Tenth Reprint 2007.
2. K.P.Soman,Shyam Diwakar and V. Ajay "Insight into Data Mining Theory and Practice",Easter Economy Edition, Prentice Hall of India,2006.
3. Data Mining Concepts and Techniques: Jiawei Han, MichelineKamber , Jian Pei, ELSEVIER,3rd editing 2012

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination