MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE

MADANAPALLE

(UGC-AUTONOMOUS)

www.mits.ac.in

DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

Course Structure

&

Detailed Syllabi

For the students admitted to

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

and

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

DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

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 bring forth globally competent engineers with societal consciousness, who thrive in academics and research in Computer Science and technology.
Mission	➢ To deliver technical education of the highest quality by improving the curriculum and using effective pedagogical techniques by qualified faculty. ➢ To foster interaction between Industry and academia, to improve students' abilities in research, innovation, and entrepreneurship. ➢ To prepare the students to become professionally competent and intellectually adept by imparting required Skills to mitigate the societal problems.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates will have successful career by contributing for innovation of new technologies and systems in the key domains of Computer Science and Technology.

PEO2: Graduates will be able to perform technical/ administrative roles in information technology industry / R&D sectors and pursue higher education in reputed institutions.

PEO3: Graduates will be ethically and socially responsible towards the societal development and opting a career as an entrepreneur with moral values in various domains of Computer Science & Technology.

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: Ability to design algorithms using mathematical models and implement problems through different programming tools to solve real world problems.

PSO2: Ability to apply Software Engineering Principles & Practices in the domain of Database Management Systems, Compilers, Computer Networks, Operating Systems and allied areas, Mobile and web based applications under realistic constraints.

PSO3: Ability to implement the principles and techniques of Artificial Intelligence and Machine Learning, IoT and Cloud Computing, Data Analytics & Security by applying them to develop intelligent systems and data-driven solutions.

MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE, MADANAPALLE

B. Tech Four Year Curriculum Structure

Branch: COMPUTER SCIENCE AND TECHNOLOGY

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	BSC	23MAT101	Linear Algebra and 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	23CSE101	Introduction to Programming	3	0	0	3	3
5	ESC	23ME101	Engineering Graphics	1	0	4	5	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	23CSE201	Computer Programming Laboratory	0	0	3	3	1.5
9	ESC	23CSE202	IT Workshop	0	0	2	2	1
10	HSMC	23HUM202	NSS / NCC / Scouts and Guides / Community Service	-	-	1	1	0.5
Total				**13**	**0**	**15**	**28**	**20.5**

I Year II 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	23MAT102	Differential Equations and Vector 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	PCC	23CSE102	Data Structures	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	23ME201	Engineering Workshop	0	0	3	3	1.5
9	PCC	23CSE203	Data Structures Laboratory	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**

(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	23MAT108	Discrete Mathematical Structures	3	0	0	3	3
4	ESC	23CST103	Digital Logic and Computer Organization	3	0	0	3	3
5	PCC	23CST101	Object-Oriented Programming Through JAVA	3	0	0	3	3
6	PCC	23CST102	Database Management Systems	3	0	0	3	3
7	PCC	23CST201	Object-Oriented Programming Through JAVA Laboratory	0	0	3	3	1.5
8	PCC	23CST202	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				**17**	**1**	**8**	**26**	**22**

II Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	BSC	23MAT107	Probability and Statistics for Computer Science	3	0	0	3	3
2	ESC		**Design Thinking and Innovation Related Courses** *(Refer ANNEXURE – II)*	1	0	2	3	2
3	PCC	23CST104	Design and Analysis of Algorithms	2	1	0	3	3
4	PCC	23CST105	Operating Systems	3	0	0	3	3
5	PCC	23CST106	Computer Networks	3	0	0	3	3
6	PCC	23CST203	Design and Analysis of Algorithms Laboratory	0	0	3	3	1.5
7	PCC	23CST204	Computer Networks Laboratory	0	0	3	3	1.5
8	SEC		**Skill Enhancement Course – II** *(Refer ANNEXURE – VI)*	1	0	2	3	2
9	AUC	23CHE901	Environmental Science	2	0	0	2	-
Total				**15**	**1**	**10**	**26**	**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	23CST107	Automata Theory and Compiler Design	3	0	0	3	3
2	PCC	23CST108	Artificial Intelligence	3	0	0	3	3
3	PCC	23CST109	Software Engineering	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	23CST205	Artificial Intelligence Laboratory	0	0	3	3	1.5
8	PCC	23CST206	Software Engineering 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	23CST701	Summer Internship I	0	0	4	4	2
Total				**21**	**0**	**12**	**33**	**25**

III Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PCC	23CST110	Cryptography and Network Security	3	0	0	3	3
2	PCC	23CST111	Cloud Computing	3	0	0	3	3
3	PCC	23CST112	Introduction to Machine Learning	3	0	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	23CST207	Cloud Computing Laboratory	0	0	3	3	1.5
8	PCC	23CST208	Machine Learning 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	23CST801	Workshop*	0	0	0	0	0
Total				**19**	**0**	**10**	**29**	**24**

(L = Lecture, T = Tutorial, P = Practical)

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

R23 - Curriculum Structure
IV Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week L	T	P	Total	Credits
1	PCC	23CST113	Deep Learning	3	0	0	3	3
2	MC		**Management Course-II** *(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	23CST702	Summer Internship II	0	0	4	4	2
Total				**20**	**0**	**6**	**26**	**21**

* 2 Months' internship during 3rd year summer vacation and to be evaluated in IV Year I Semester

IV Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week L	T	P	Total	Credits
1	PROJ	23CST703	Internship	0	0	8	8	4
		23CST704	Project Work	0	0	16	16	8
Total				**0**	**0**	**24**	**24**	**12**

(L = Lecture, T = Tutorial, P = Practical)

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	23MG3M04	Artificial Intelligence for Investments	Management
9	23CE3M01	Plastic Waste Management	Civil
10	23CE3M02	Safety in Construction	Civil
11	23ME3M01	Operations Management	Mechanical
12	23EEE3M01	Transducers For Instrumentation	EEE
13	23ECE3M01	Microprocessors and Interfacing	ECE
14	23ECE3M02	Microprocessors and Microcontrollers	ECE
15	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	23MG3M05	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	Building Technology	Civil
6	23CE305	Sustainability in Engineering Practices	Civil
7	23ME303	Total Quality Management	Mechanical
8	23ME304	Additive Manufacturing	Mechanical
9	23ME305	Refrigeration and Air Conditioning	Mechanical
10	23EEE303	Robotics	EEE
11	23EEE304	Smart Grid Technologies	EEE
12	23ECE303	Embedded Systems	ECE
13	23ECE304	Community Radio Technology	ECE
Any new Interdisciplinary Course can be appended in future.			

ANNEXURE - IV

List of Professional Elective

Professional Elective – I (To be offered under MOOC's Category from SWAYAM – NPTEL)		
Sl. No.	**Course Code**	**Course Title**
1.	23CST4M01	Privacy and Security in Online Social Media
2.	23CST4M02	Introduction to Internet of Things
3.	23CST4M03	Introduction to Soft Computing
4.	23CST4M04	Social Network Analysis
5.	23CST4M05	Software Project Management
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.	23CST401	Internet and Web Programming
2.	23CST402	Cyber Security
3.	23CST403	DevOps
4.	23CST404	Software Testing Methodologies
5.	23CST405	Graphics and Multimedia
Any advanced courses can be appended in future.		

Professional Elective – III		
Sl. No.	**Course Code**	**Course Title**
1.	23CST406	Perception and Computer Vision
2.	23CST407	Big Data Analytics
3.	23CST408	Digital Forensics
4.	23CST409	Modeling and Simulation
5.	23CST410	Network Programming
Any advanced courses can be appended in future.		

Professional Elective – IV		
Sl. No.	**Course Code**	**Course Title**
1.	23CST411	Software Architecture and Design Patterns
2.	23CST412	Blockchain Technology
3.	23CST413	Augmented Reality and Virtual Reality
4.	23CST414	Human Computer Interaction
Any advanced courses can be appended in future.		

Professional Elective – V		
Sl. No.	**Course Code**	**Course Title**
1	23CST415	Fundamentals of Fog and Edge Computing
2	23CST416	Agile methodologies
3	23CST417	Cyber Physical Systems
4	23CST418	Data Analytics and Visualization
Any advanced courses can be appended in future.		

ANNEXURE - V

MANAGEMENT COURSE		
Sl. No.	**Course Co4e**	**Course Title**
1	23HUM801	Business Ethics and Corporate Governance
2	23HUM802	Principles of Management
3	23HUM803	Human Resource Development
4	23HUM804	Management Science
5	23HUM805	National Cadet Corps

ANNEXURE - VI

List of Skill Enhancement Courses

Skill Enhancement Course– I		
Sl. No.	**Course Code**	**Course Title**
1.	23CST601	Python programming
Any advanced courses can be appended in future.		

Skill Enhancement Course– II		
Sl. No.	**Course Code**	**Course Title**
1.	23CST602	Data Science using R
2.	23CST603	Competitive Coding I
Any advanced courses can be appended in future.		

Skill Enhancement Course – III		
Sl. No.	**Course Code**	**Course Title**
1.	23CST604	Full Stack Development I
2.	23CST605	CISCO Certified Network Associate (CCNA)
3.	23CST606	Data Mining
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.	23CST607	Software Testing
2.	23CST608	Full Stack Development II
3.	23CST609	Competitive Coding II
Any Courses can be appended in future.		

ANNEXURE - VII

Minors in Computer Science and Technology
(Applicable to CE, EEE, ME and ECE)

Stream Name: Data Analytics (DA)

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	23MDCST101	Design and Analysis of Algorithms	3	0	0	3	3
2	Professional Core Course	23MDCST102	Database Management Systems	3	0	0	3	3
3	Professional Core Course	23MDCST201	Design and Analysis of Algorithms Laboratory	0	0	3	3	1.5
III Year II Semester								
4	Professional Core Course	23MDCST103	Big Data Analytics	3	0	0	3	3
5	Professional Core Course	23MDCST104	Data Mining and Data Warehousing	3	0	0	3	3
6	Professional Core Course	23MDCST202	Big Data Management and Data Analytics Laboratory	0	0	3	3	1.5
IV Year I Semester								
7	Professional Core Course	23MDCST105	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 Technology

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	23HDCST101	Multidisciplinary Research Methods for the Study of Evolution	3	0	0	3	3
2	Professional Core Course	23HDCST102	Introduction to Game Theory	3	0	0	3	3
3	Professional Core Course	23HDCST201	Game Design Laboratory	0	0	3	3	1.5
III Year II Semester								
4	Professional Core Course	23HDCST103	Evolutionary Computing	3	0	0	3	3
5	Professional Core Course	23HDCST104	Advanced Software Engineering	3	0	0	3	3
6	Professional Core Course	23HDCST202	Experiential Learning in Data Science Laboratory	0	0	3	3	1.5
IV Year I Semester								
7	Professional Core Course	23HDCST105	High Performance Computing	3	0	0	3	3
			Total	**15**	**0**	**6**	**21**	**18**

I Year I Semester

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.

Textbooks:

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

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.

Textbooks:

1. A Textbook 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 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.

Textbooks:

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

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.

Textbooks:

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

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.

Textbooks:

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 I 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.

Textbooks:

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 I 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 I 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, 4^{th} 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 I Semester

23CSE201 COMPUTER PROGRAMMING LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

- Provide hands-on experience in programming fundamentals, algorithm design, and basic problem-solving techniques.
- Enable students to implement control structures for program flow control in practical scenarios.
- Reinforce understanding of arrays, memory models, and string manipulation through practical exercises
- Provide hands-on practice with functions, function calls, and parameter manipulation using pointers.
- 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

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

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 I 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 Textbook 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.

I Year II Semester

B. Tech I Year II 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 is discussed

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

Textbooks:

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 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.

Textbooks:

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

23CHE102 CHEMISTRY

L	T	P	C
3	0	0	3

Course Objectives:

- To familiarize engineering chemistry and its applications
- To train the students on the principles and applications of electrochemistry and polymers
- 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.

Textbooks:

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 II Semester

23CME101 BASIC CIVIL AND MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

Course Objectives:

- Get familiarized with the scope and importance of Civil Engineering sub-divisions.
- Introduce the preliminary concepts of surveying.
- Acquire preliminary knowledge on Transportation and its importance in nation's economy.
- Get familiarized with the importance of quality, conveyance and storage of water.
- 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.

Textbooks:

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.

Textbooks:

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 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.

Textbooks:

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

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 II Semester

23CHE202 CHEMISTRY LABORATORY

L	T	P	C
0	0	2	1

Course Objectives:

- 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 II 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

List of Experiments

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 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.

Textbooks:

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

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.

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).

Textbooks:

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.

Textbooks:

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

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.

Textbooks:

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 I Semester

23CST103 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

Textbooks:

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

Reference Books:

1. Computer Systems Architecture, M.Moris Mano, 3^{rd}Edition, Pearson
2. Computer Organization and Design, David A. Paterson, John L. Hennessy, Elsevier
3. Fundamentals of Logic Design, Roth, 5^{th}Edition, 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 I Semester

23CST101 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 OBJECT ORIENTED PROGRAMMING CONCEPTS 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 CLASSES & OBJECTS AND METHODS 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 INHERITANCE & INFERFACES 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 PACKAGES, EXCEPTIONAL HANDLING AND I/O STREAMS 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 STRING HANDLING AND MULTITHREADED PROGRAMMING 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.

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.

Textbooks:

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_012880464547618816347_shared/overview

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

B. Tech II Year I Semester

23CST102 DATABASE MANAGEMENT SYSTEMS

L	T	P	C
3	0	0	3

Course Objectives:

The learning objectives of this course are to:

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 DISTRIBUTED AND NOSQL DATABASES 9 hours

Distributed Database Concepts – Data fragmentation and Replication – Allocation techniques; Introduction to NOSQL Systems – The CAP Theorem – Document-Based NOSQL Systems and MongoDB – Column-based NOSQL systems. 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: Explore the concepts of distributed databases and NoSQL systems.

Textbooks:

1. A. Silberschatz, H. F. Korth S. Sudershan, Database System Concepts, McGraw Hill, 7th Edition 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.

Online Resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_cs51

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

B. Tech II Year I Semester

23CST201 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 implement class mechanism. Create a class, methods and invoke them inside main method.
2. Write a JAVA program to implement constructor overloading.
3. Write a JAVA program to implement method overloading.
4. Write a JAVA program to implement the different types of inheritance.
5. Write a JAVA program to demonstrate the use of "SUPER" Keyword.
6. 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.
7. Write a Java program defining an abstract class Shape with an abstract method calculateArea(). Provide implementations for the calculateArea() method in concrete subclasses Circle, Rectangle, and Triangle.
8. Write a java program to create an interface named Shape with two methods: calculateArea() and calculatePerimeter(). Then, implement this interface in two classes: Circle and Rectangle.
9. Create a package named utilities. Inside this package, implement a class MathOperations with methods to perform basic mathematical operations like addition, subtraction, multiplication, and division. Develop a program to demonstrate the use of the import statement to access classes from a utilities package.Write a JAVA program that describes exception handling mechanism
10. 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

11. Create a Library Management System in Java that incorporates OOP concepts such as inheritance, polymorphism, method overriding, method overloading, file handling, exception handling, and threading. The system should support functionalities like adding books, registering members, issuing and returning books, viewing issued books, and searching books, while managing data persistence and handling concurrency.

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 I Semester

23CST202 DATABASE MANAGEMENT SYSTEMS LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

The aim of this course is to

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) Write a PL/SQL program to perform procedures and functions.
    b) Write a PL/SQL program to raise an Exception when the bonus exceeds salary.

Project Based Learning:

Design and implementation real time project with database connection.

Course Outcomes:

After completion of the course, students will be able to

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.

Textbooks:

1. A. Silberschatz, H. F. Korth S. Sudershan, Database System Concepts, McGraw Hill, 7th Edition 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.

Online Resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_cs51

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

II Year II Semester

B. Tech II Year II 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.

Textbooks:

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 II Semester

23CST104 DESIGN AND ANALYSIS OF ALGORITHMS

L	T	P	C
3	0	0	3

Course Prerequisite*:* 23CSE102

Course Objectives:

The learning objectives of this course are to:

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

UNIT I ALGORITHM ANALYSIS 9 hours

Introduction, Fundamentals of algorithm (Line count, operation count), Algorithm Design Techniques, Designing an algorithm and its Analysis (Best, Worst & Average case), Asymptotic Notations(O, Ω, Θ) based on Orders of Growth, Mathematical Analysis – Induction, Recurrence Relation - Substitution method, Recurrence Relation - Recursion method, Recurrence Relation - Master's Theorem

UNIT II DIVIDE AND CONQUER 9 hours

Divide and Conquer: The General Method, Binary search, Quick Sort and its analysis, Merge Sort and its analysis, Strassen's matrix multiplication, Finding Maximum and minimum, Algorithm for finding closest pair, Convex Hull Problem

UNIT III GREEDY AND DYNAMIC PROGRAMMING 9 hours

Introduction to graphs, Greedy Method: General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees

Dynamic Programming: General Method, General Weights (Bellman-Ford Algorithm), 0/1 Knapsack, Travelling Salesperson problem

UNIT IV BACKTRACKING 9 hours

Backtracking: General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring, Hamiltonian's Circuit, Travelling Salesman Problem, Generating Permutation

UNIT V BRANCH AND BOUND & RANDOMIZED ALGORITHM 9 hours

Branch and Bound: The General Method, 0/1 Knapsack Problem, Travelling Salesperson problem, Randomized algorithm- Hiring Problem, Randomized algorithm- Matrix Chain Multiplication, Randomized Quick Sort, Introduction to PN problems, Introduction to NP problems, NP Complete

Course Outcomes:

After completion of the course, students will be able to

CO1: Analyze the time complexity of algorithms to evaluate their efficiency.
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 and analyze the characteristics of NP-Hard and NP-Complete problems.

Textbooks:

1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta, Dinesh, 2nd Edition Universities Press
2. Computer Algorithms in C++, Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, 2nd Edition University Press
3. Thomas H Cormen, Charles E Leiserson, Ronald L Revest, Clifford Stein, “Introduction to Algorithms” 3rd Edition, The MIT Press Cambridge, Massachusetts London, England, 2014

Reference Books:

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

Online 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 II Semester

23CST105 OPERATING SYSTEMS

L	T	P	C
3	0	0	3

Course Objectives:

The learning objectives of this course are to:

1. To describe the operating system structures, services and system call.
2. To Demonstrate process management concepts and threads
3. To illustrate scheduling algorithms and process synchronization.
4. To understand the concept of deadlocks.
5. To analyze various memory management techniques.

UNIT I INTRODUCTION 9 hours

Introduction: Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS.

Korn Shell Programming: Basic Script Concepts, Expressions, Decisions: Making Selections, Repetition, Special Parameters and Variables, Changing Positional Parameters, Argument Validation

UNIT II PROCESS CONCEPTS 9 hours

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling.

UNIT III PROCESS SYNCHRONIZATION AND DEADLOCKS 9 hours

Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc. Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

UNIT IV MEMORY MANAGEMENT STRATEGIES 9 hours

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation, Fixed and variable partition, Internal and External fragmentation and Compaction; Paging: Principle of operation, Page allocation, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory, Hardware and control structures, Locality of reference, Page fault, Working Set, Dirty page/Dirty bit, Demand paging, Page Replacement algorithms.

UNIT V FILE SYSTEM 9 hours

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (Bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Disk Management: Disk structure, Disk scheduling.

Case study: Linux Vs Windows, Mobile OS: iOS Vs Android.

Course Outcomes:

After completion of the course, students will be able to

CO1: Understand the fundamental concepts of operating systems and demonstrate proficiency in Korn Shell programming.

CO2: Analyze process management and various process scheduling techniques.

CO3: Interpret the process synchronization, race conditions, and deadlocks using various algorithms and techniques.

CO4: Examine different memory management techniques and their impact on system performance.

CO5: Understand system structures, access methods, and disk scheduling strategies.

Textbooks:

1. "Modern Operating Systems", Andrew S Tanenbaum, Pearson, 5th Edition, 2022 New Delhi.
2. “Operating System Concepts”, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, 10th Edition, John Wiley and Sons Inc., 2018.

Reference Books:

1. “Operating Systems – A Spiral Approach”, Ramaz Elmasri, A. Gil Carrick, David Levine, Tata McGraw Hill Edition, 2010.
2 "Operating Systems: Internals and Design Principles", William Stallings, 7th Edition,Prentice Hall, 2018.
3. “Operating Systems”, Achyut S.Godbole, Atul Kahate, McGraw Hill Education, 2016.

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

B. Tech II Year II Semester

23CST106 COMPUTER NETWORKS

L	T	P	C
3	0	0	3

Course Objectives:

The learning objectives of this course are to:

1. The objective of the course is to equip the students with a general overview of the Networ concepts, Transmission Media and standard models for the layered approach.
2. Familiarize the students with Data link layered approach to communication between machines in network and the protocols of the various layers.
3. Understanding the functionalities of Network Layer
4. Explain the format of headers of IP, TCP and UDP in Transport Layer
5. Knowledge on Application Layer Protocols.

UNIT I INTRODUCTION TO COMPUTER NETWORKS 9 hours

Introduction: Networks, Network hardware & software, OSI, TCP/IP Reference models, Example Networks: ARPANET,Internet.

Physical Layer: Guided Transmission media: twisted pairs, coaxial cable, fiber optics, Wirelesstransmission.

UNIT II DATA LINK LAYER 9 hours

Introduction: Link-Layer addressing – Error Correction and Detection: Checksum, Hamming Code – DLC services – Data-Link layer Protocols – HDLC – Media Access Control – Wired LANs- Standard **Ethernet**: Characteristics, Address, Access Method, LLC, Services, IEEE 802.11 project– Connecting devices.

UNIT III NETWORK LAYER 9 hours

Introduction: Design issues, Routing algorithms, Network layer services, Switching, Performance, IPV4 Addresses - Forwarding of IP packets, Network Layer Protocols: IP, ICMP V4, Unicast routing algorithms, Protocols, Multi-casting, IPV6 addressing, IPV6 protocol, IP Addressing – Overview – Classful vs Classless Addressing – Subnetting & Super netting – CIDR.

UNIT IV TRANSPORT LAYER 9 hours

Introduction: Transport Services, Elements of Transport protocols, Connection management, TCP and UDP protocols, QoS (Quality of Service) – parameters(packet loss, bandwith, delay, jitter etc) – QoS requirements for different applications.

UNIT V APPLICATION LAYER 9 hours

Introduction: Traditional applications – Electronic mail (SMTP, POP3, IMAP, and MIME), HTTP, File transfer protocol (FTP), Secure shell (SSH), DNS, SNMP, WWW, Streaming audio and video. Introduction to Firewalls - Types of firewalls – Applications – Case Study - iptables.

Course Outcomes:

After completion of the course, students will be able to

CO1: Understand the functions of each layer in the OSI and TCP/IP reference models.

CO2: Apply data link layer protocols and routing mechanisms.

CO3: Identify essential protocols of the network layer and demonstrate their application in network design and implementation.

CO4: Analyze the functionalities and protocols used in the transport layer.

CO5: Explain the applications of the application layer with various protocols.

Textbooks:

1. Computer Networks -- Andrew S Tanenbaum, David. j. Wetherill, 5th Edition. Pearson Education/PHI
2. James F. Kurose, Keith W. Ross, “Computer Networking: A Top-Down Approach”, 6th edition, Pearson, 2019.

Reference Books:

1. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, ―Computer Networks: An Open Source Approach‖, Mc Graw Hill Publisher, 2011.
2. Behrouz A. Forouzan, ―Data communication and Networking‖, Fifth Edition, Tata McGraw –Hill, 2013

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

B. Tech II Year II Semester

23CST203 DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

The aim of this course is 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:

1. Write a program to implement Insertion and Bubble sort
2. Write a program to implement Binary Search using recurrence
3. Write a program to implement Quick sort using recurrence
4. Write a program to implement Merge sort using recurrence
5. Implement the Knapsack Problem using the Greedy method.
6. Construct Minimum Spanning Tree using
   (a) Prim's Method (b) Kruskal's Method
7. Write a program to solve 0/1 Knapsack problem Using Dynamic Programming.
8. Implement the Travelling Sales Person problem using Dynamic Programming.
9. Implement N-Queens Problem Using Backtracking Strategy.
10. Implement the Backtracking method to solve the Graph Coloring problem.
11. Implement the Travelling Sales Person problem using Dynamic Programming using branch & bo
12. Write a program to implement Randomized Quick sort

Course Outcomes:

After completion of the course, students will be able to

CO1: Implement various sorting algorithms using both iterative and recursive approaches.

CO2: Execute the problems using Greedy Method.

CO3: Solve optimization problems like the Knapsack Problem using both Greedy and Dynamic Programming techniques.

CO4: Implement algorithms to construct Minimum Spanning Trees using Prim's and Kruskal's methods.

CO5: Apply backtracking and branch-and-bound strategies to solve complex problems.

Textbooks:

1. Fundamentals of Data Structures in C++, Horowitz Ellis, Sahni Sartaj, Mehta, Dinesh, 2ndEdi Universities Press
2. Computer Algorithms/C++ Ellis Horowitz,Sartaj Sahni,Sanguthevar Rajasekaran, 2ndEdi University Press

Reference Books:

1. Fundamentals of Data Structures in C++, Horowitz Ellis, Sahni Sartaj, Mehta, Dinesh, 2ndEdi Universities Press
2. Computer Algorithms/C++ Ellis Horowitz,Sartaj Sahni,Sanguthevar Rajasekaran, 2ndEdi University Press
3. Data Structures and program design in C,Robert Kruse,Pearson Education Asia

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

Online 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 II Semester

23CST204 COMPUTER NETWORKS LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

The aim of this course is to

1. To learn and use network commands.
2. To learn socket programming.
3. To implement and analyze various network protocols.
4. To learn and use simulation tools.
5. To use simulation tools to analyze the performance of various network protocols.

List of Experiments:

1. Study different types of Network cables and prepare cables to connect two or more systems. Use crimping tool to connect jacks. Use LAN tester to connect the cables. Install and configure Network Devices: HUB, Switch and Routers. Install and Configure Wired and Wireless NIC and transfer files between systems in Wired LAN and Wireless LAN.
2. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and trace route. Capture ping andtrace route PDUs using a network protocol analyzer and examine.
3. Write applications using TCP sockets like:
   a. Echo client and echo server
   b. Chat
   c. File Transfer
4. Write a Java program to generate CRC code for checking error
5. Write a Program to implement flow control protocol in data link layer.
6. Find all the IP addresses on your network - Unicast, Multicast, and Broadcast.
7. Implement Distance Vector/Link State Routing algorithm n Java
8. Using Java implement DNS using UDP sockets.
9. Simulate TCP/UDP performance using Cisco Packet tracer.
10. Study of Network Simulator (NS2) and configure a wired topology using NS2.
11. Simulation of Congestion Control Algorithms using NS2 and analyze its performance.
12. Firewall Case Study – Configuration of iptables

Course Outcomes:

After completion of the course, students will be able to

CO1: Implements various Routing protocols at Network layer.

CO2: Develop socket programs using TCP and UDP, to implement various application protocols.

CO3: Develop socket programs to implement the functionalities of various layers in TCP / IP protocol suite.

CO4: Analyze the performance of various protocols using a network simulator tool.

CO5: Understand and configure the Firewall.

Textbooks:

1. Computer Networks -- Andrew S Tanenbaum, David. j. Wetherill, 5th Edition. PearsonEducation/PHI
2. James F. Kurose, Keith W. Ross, “Computer Networking: A Top-Down Approach”, 6th edition, Pear 2019.

Reference Books:

1. Shivendra S.Panwar, Shiwen Mao, Jeong-dong Ryoo, and Yihan Li, “TCP/IP Essentials A Lab-Based Approach”, Cambridge University Press, 2004.
2. Cisco Networking Academy, “CCNA1 and CCNA2 Companion Guide”,Cisco Networking Academy Program, 3rd edition, 2003.

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.

Textbooks:

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 Textbook 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, Mid Term Tests and End Semester Examination.

III Year I Semester

B. Tech III Year I Semester

23CST107 AUTOMATA THEORY AND COMPILER DESIGN

L	T	P	C
3	0	0	3

Pre-requisite NIL

Course Description:

This course provides a theoretical and practical foundation in formal language theory and compiler design. It begins with the study of automata and regular expressions to understand how languages are specified and recognized, then progresses to compiler phases, including lexical, syntax, semantic analysis, and code generation. It emphasizes constructing finite automata, designing context-free grammars, parsing strategies, and translating syntax into intermediate and machine code. The course enables students to build the fundamental components of a compiler and appreciate the role of optimization techniques in modern language processing systems.

Course Objectives:

1. To introduce the formal foundations of computer languages using finite automata and regular expressions.
2. To understand the design and implementation of lexical and syntax analysis for compilers.
3. To examine context-free grammars, top-down and bottom-up parsing techniques.
4. To explore syntax-directed translation, type checking, and intermediate code generation.
5. To study optimization techniques and principles of code generation for effective translation.

UNIT I AUTOMATA FUNDAMENTALS AND REGULAR EXPRESSIONS 9 hours

Fundamentals of Formal Languages: Strings - Alphabets and languages Finite Automata – Deterministic Finite Automata – Non-deterministic Finite Automata – Finite Automata with Epsilon Transitions – Regular Expressions - Conversion of Regular Expression into DFA using Subset construction method - Minimization of DFA.

UNIT II INTRODUCTION TO COMPILER AND LEXICAL ANALYSIS 9 hours

Chomsky hierarchy of languages and recognizers (Introduction to PDA,LBA,Turning machine).
Compiler – Interpreter – Assembler – Language Processor - Phases of a compiler – Lexical Analysis – Role of Lexical Analyzer – Specification of Tokens – Recognition of Tokens – Lex

UNIT III SYNTAX ANALYSIS 9 hours

CFG – Parse Trees – Ambiguity in Grammars and Languages, Elimination of Ambiguity.
Role of Parser - Top Down Parsing - General Strategies Recursive Descent Parser - Predictive Parser - LL(1)
Bottom Up Parsing – Shift Reduce Parser, Operator Precedence Parser, LR Parser – SLR,CLR,LALR - YAAC.

UNIT IV SEMANTIC ANALYSIS & SYNTAX DIRECTED TRANSLATION 9 hours

Semantic Analysis: Syntax-directed translation, S-attributed and L-attributed grammars ,type checking, intermediate code (syntax trees, three-address code)
Run time storage : Storage organization, storage allocation strategies scope access to now local names, parameters

UNIT V CODE OPTIMIZATION AND CODE GENERATION 9 hours

Code Optimization: Basic Blocks and Flow Graphs - Optimization of Basic Blocks - The principle sources of optimization - Introduction to data flow analysis, DAG

Code Generation: Issues in the Design of a Code Generator - The Target Language - A Simple Code Generator - Peephole optimization - Register allocation and assignment.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Explain the theory behind regular expressions, finite automata, and the Chomsky hierarchy of languages.

CO2: Design lexical analyzers and parsers using top-down and bottom-up techniques for given grammars.

CO3: Construct parse trees and abstract syntax trees and identify ambiguity in grammars.

CO4: Apply syntax-directed translation schemes and manage type checking and symbol tables.

CO5: Generate optimized intermediate and target machine code using data flow analysis and DAGs.

Textbook(s)

1. J.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory, Languages and Computations", Third Edition, Pearson Education, 2006.
2. Alfred V. Aho - Monica S.Lam - Ravi Sethi - Jeffrey D. Ullman,"Compilers-Principles - Techniques and Tools", 2nd edition, Pearson Education, 2018.

Reference Books

1. J.Martin, "Introduction to Languages and the Theory of Computation", Third Edition, TMH, 2003.
2. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.

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

B. Tech III Year I Semester

23CST108 ARTIFICIAL INTELLIGENCE

L	T	P	C
3	0	0	3

Pre-requisite NIL

Course Description:

This course covers the foundations, history, and state-of-the-art developments in AI, focusing on intelligent agents and rational behaviour. Key topics include problem-solving using search algorithms, reinforcement learning, natural language processing, and robotics. Students will explore AI applications in communication, perception, and ethical considerations, equipping them to develop and understand AI-driven systems.

Course Objectives:

1. To learn what Artificial Intelligence (AI) is and understand how intelligent agents work.
2. To understand different ways to solve problems using search techniques.
3. To explore how machines learn through reinforcement learning and process human language.
4. To study how AI understands and uses natural language and vision.
5. To learn about robots, how they work, and the ethical issues related to AI.

UNIT I INTRODUCTION 9 hours

Introduction: What is AI, Foundations of AI, History of AI, The State of Art. **Intelligent Agents:** Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, the structure of Agents.

UNIT II SOLVING PROBLEMS BY SEARCHING 9 hours

Problem Solving Agents, Example problems, Searching for Solutions, Uninformed Search Strategies, Informed search strategies, Heuristic Functions, **Beyond Classical Search:** Local Search Algorithms and Optimization Problems, Local Search in Continues Spaces, Searching with Nondeterministic Actions, Searching with partial observations, online search agents and unknown environments.

UNIT III KNOWLEDGE, REASONING & PLANNING 9 hours

Logical Agents: Knowledge based Agents, The Wumpus world, Logic, Propositional Logic – A Very Simple Logic, Agent based on Propositional Logic. **Knowledge representation:** Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, The Internet Shopping world.

UNIT IV REINFORCEMENT LEARNING & NATURAL LANGUAGE PROCESSING 9 hours

Reinforcement Learning: Introduction, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning. **Natural Language Processing**: Stemming and Lemmatization, Term Frequency (TF), Inverse Document Frequency (IDF), Document classification, Language Models, Text Classification, Information Retrieval, Information Extraction.

UNIT V ROBOTICS 9 hours

Robotics: Introduction, Robot Hardware, Robotic Perception, planning uncertain movements, Robotic software architectures, application domains. **Philosophical foundations**: Weak AI, Strong AI, Ethics and Risks of AI, Agent Components, Agent Architectures, Are we going in the right direction, What if AI does succeed.

Course Outcomes:

CO1: Explain the basic concepts, history, and types of intelligent agents and their interaction with different environments.

CO2: Apply various uninformed and informed search strategies to solve AI-based problem scenarios.

CO3: Describe the working principles of reinforcement learning and basic techniques in natural language processing.

CO4: Apply syntax and semantic techniques in NLP and basic image processing concepts for perception in AI systems.

CO5: Discuss the fundamentals of robotics, AI architecture, and the ethical implications of AI in society.

Textbook(s)

1. Stuart J.Russell, Peter Norvig, ―Artificial Intelligence A Modern Approach‖, 3rd Edition, Pearson Education, 2019.

Reference Books

1. Nilsson, Nils J., and Nils Johan Nilsson. Artificial intelligence: a new synthesis. Morgan Kaufmann, 1998.
2. Johnson, Benny G., Fred Phillips, and Linda G. Chase. "An intelligent tutoring system for the accounting cycle: Enhancing textbook homework with artificial intelligence." Journal of Accounting Education 27.1 (2009): 3039.

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

B. Tech III Year I Semester

23CST109 SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

Pre-requisite NIL

Course Description:
The basic objective of Software Engineering is to develop methods and procedures for software development that can scale up for large systems to consistently produce high-quality software at low cost and with a small cycle time. Software Engineering is the systematic approach to the development, operation, maintenance, and retirement of software. This course provides a thorough introduction to the fundamental's principles of software engineering. The organization broadly be based on the classical analysis-design-implementation framework.

Course Objectives:
1. Software life cycle models, Software requirements and SRS document.
2. Project Planning, quality control and ensuring good quality software.
3. Software Testing strategies, use of CASE tools, Implementation issues, validation & verification procedures.

UNIT I INTRODUCTION 9 hours

Introduction: Evolution, Software development projects, Exploratory style of software developments, Emergence of software engineering, Notable changes in software development practices, Computer system engineering.
Software Life Cycle Models: Basic concepts, Waterfall model and its extensions, Rapid application development, Agile development model, Spiral model.

UNIT II PROJECT MANAGEMENT AND REQUIREMENTS ANALYSIS 9 hours

Software Project Management: Software project management complexities, Responsibilities of a software project manager, Metrics for project size estimation, Project estimation techniques, Empirical Estimation techniques, COCOMO, Halstead‘s software science, risk management.
Requirements Analysis And Specification: Requirements gathering and analysis, Software Requirements Specification (SRS), Formal system specification, Axiomatic specification, Algebraic specification, Executable specification and 4GL.

UNIT III SOFTWARE DESIGN 9 hours

Software Design: Overview of the design process, How to characterize a good software design? Layered arrangement of modules, Cohesion and Coupling. approaches to software design.
Agility: Agility and the Cost of Change, Agile Process, Extreme Programming (XP), Other Agile Process Models, Tool Set for the Agile Process (Textbook 2) Function-Oriented Software Design: Overview of SA/SD methodology, Structured analysis, Developing the DFD model of a system, Structured design, Detailed design, and Design Review.
User Interface Design: Characteristics of a good user interface, Basic concepts, Types of user interfaces, Fundamentals of component-based GUI development, and user interface design methodology.

UNIT IV SOFTWARE TESTING 9 hours

Coding And Testing: Coding, Code review, Software documentation, Testing, Black-box testing, White-Box testing, Debugging, Program analysis tools, Integration testing, Testing object-oriented programs, Smoke testing, and Some general issues associated with testing. Software Reliability And **Quality Management**: Software reliability. Statistical testing, Software quality, Software quality management system, ISO 9000. SEI Capability maturity model. Few other important quality standards, and Six Sigma.

UNIT V **SOFTWARE MAINTENANCE** 9 hours

Computer-Aided Software Engineering (Case): CASE and its scope, CASE environment, CASE support in the software life cycle, other characteristics of CASE tools, Towards second generation CASE Tool, and Architecture of a CASE Environment.

Software Maintenance: Characteristics of software maintenance, Software reverse engineering, Software maintenance process models and Estimation of maintenance cost. Software Reuse: reuse-definition, introduction, reason behind no reuse so far, Basic issues in any reuse program, A reuse approach, and Reuse at organization level.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance
2. Analyze various software engineering models and apply methods for design and development of software projects.
3. Develop system designs using appropriate techniques.
4. Understand various testing techniques for a software project.
5. Apply standards, CASE tools and techniques for engineering software projects

Textbook(s)

1. Fundamentals of Software Engineering, Rajib Mall, 5th Edition, PHI.

2. Software Engineering A practitioner‘s Approach, Roger S. Pressman, 9th Edition, McGraw-Hill International Edition

Reference Books

1. Software Engineering, Ian Sommerville,10th Edition, Pearson

2. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.

Mode of Evaluation: Assignments, Mid Term Tests, 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.

Textbooks:

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

23CST205 ARTIFICIAL INTELLIGENCE LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite -NIL-

Course Description:
This course provides hands-on experience with fundamental and advanced artificial intelligence techniques, including uninformed and informed search strategies, optimization algorithms, and intelligent agent simulations. Students will explore problem-solving methods such as DFS, BFS, A*, Hill Climbing, Simulated Annealing, and work on real-time applications like chatbots and virtual assistants. The lab emphasizes practical implementation using Python and cloud platforms like AWS and Wolfram Alpha to solve real-world AI problems.

Course Objectives:

The objectives of this course are

1. To learn and implement basic search algorithms like DFS, BFS, and A*.
2. To solve real-world problems using optimization methods like Simulated Annealing and Hill Climbing.
3. To understand how intelligent agents work using examples like the Wumpus World and 8 Puzzle.
4. To build simple AI applications like chatbots and virtual assistants.
5. To improve programming skills by doing hands-on experiments in AI.

List of Programs:

1. Write a program to implement DFS and BFS.
2. Write a program to implement 8 puzzle problems.
3. Write a program to implement Simulated Annealing algorithm.
4. Write a program to implement A* algorithm.
5. Write a program to find the solution for Travelling Salesman problem.
6. Write a program to find the solution for the Wumpus world problem.
7. Implement a Grid-World Environment for Passive Reinforcement Learning using Temporal Difference (TD) Learning.
8. Develop a Q-Learning Agent for Active Reinforcement Learning in a Custom Grid-World.
9. Apply Stemming and Lemmatization on Sample Text using NLTK and Compare Results.
10. Implement TF-IDF Vectorization and Visualize Most Significant Words in a Text Dataset.
11. Build a Bot that provides all the information related to your College.
12. Apply Robotics Across Domains: Simulate a Mobile Service Robot Navigating an Office Environment.

Course Outcomes:

Upon successful completion of the course, students will be able

CO1: To solve problems using basic search algorithms like DFS, BFS, A*, and Bidirectional Search.
CO2: To apply heuristic techniques like Hill Climbing and Simulated Annealing to find optimized solutions.
CO3: To develop solutions for classic AI problems like 8 Puzzle, Towers of Hanoi, Wumpus World, and TSP.
CO4: To build smart chatbots and virtual assistants using platforms like AWS Lex, Pandorabots, and Wolfram Alpha.
CO5: To use AI concepts to create real-world intelligent applications that solve practical problems.

Textbook(s)

1. Eckroth, J. (2017). *Python Artificial Intelligence Projects for Beginners*. Packt Publishing.

Reference Books

1. David Poole, Alan Mack worth, Randy Goebel,‖ Computational Intelligence: a logical approach‖, Oxford University Press, 2004.
2. G. Luger, ―Artificial Intelligence: Structures and Strategies for complex problem solving‖, Fourth Edition, Pearson Education, 2002.
3. J. Nilsson, ―Artificial Intelligence: A new Synthesis‖, Elsevier Publishers, 1998.
4. Artificial Neural Networks, B. Yagna Narayana, PHI

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination

B. Tech III Year I Semester

23CST206 SOFTWARE ENGINEERING LABORATORY

L	T	P	C
0	0	3	**1.5**

Pre-requisite -NIL-

Course Description:

This course presents software engineering techniques and explains the software development life cycle. The main goal of this course is to build their ability to do useful applications that could be released for real-world use.

Course Objectives:

The objectives of this course are to

1. To make students learn different Life Cycle models.
2. To make students learn different phases in Software Engineering.
3. To make students learn testing strategies.

List of Programs:

ATM Transaction, Online Ticket Reservation and Student Course Registration. For any given case/ problem statement do the following;

1. Document the Software Requirements Specification (SRS) for the identified system
2. Identify use cases and develop the Use Case model.
3. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.
4. Draw the activity diagram and sequence diagram for any two scenarios
5. Draw Collaboration Diagram, State Transition Diagram for the assigned project
6. Write Test Cases to Validate requirements of assigned project from SRS Document
7. Preparation of Software Configuration Management and Risk Management related documents.
8. Evaluate Size of the project using function point metric for the assigned project
9. Perform forward and reverse engineering in java.
10. Performing the Design by using any Design phase CASE tools.
11. Mini Project - Examination and Result Management System Software

Course Outcomes:

CO1: Identify software requirements specification for the project.
CO2: Sketch use case and class diagram by associating with different types of relationship.
CO3: Draw a sequence and collaboration diagram with their relationship.
CO4: Outline a state chart and component diagram with their relationship.
CO5: Implement forward and reverse engineering using Java.

Textbook(s)

1. Bernd Bruegge and Allen H. Dutoit, “Object-Oriented Software Engineering: Using UML, Patterns and Java”, Third Edition, Pearson Education, 2009
2. Roger S. Pressman, Object-Oriented Software Engineering: An Agile Unified Methodology, First Edition, Mc Graw-Hill International Edition, 2014.
3. Ian Sommerville, Software engineering, Pearson education Asia, 9th Edition, 2011.

Reference Books

1. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd edition, PHI Learning Pvt. Ltd., 2010.
2. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005
3. Len Bass, Ingo Weber and Liming Zhu, “DevOps: A Software Architect‘s Perspective”, Pearson Education, 2016

Mode of Evaluation: Continuous Internal Evaluation 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.

Textbooks:

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

23CST110 CRYPTOGRAPHY AND NETWORK SECURITY

L	T	P	C
3	0	0	3

Pre-requisite **NIL**

Course Description:

This course provides a comprehensive introduction to cryptography and network security, covering both classical and modern encryption techniques. It equips students with the skills to design and implement secure communication systems using protocols like Kerberos, IPsec, and TLS.

Course Objectives:

This course aims at training students to master the:

1. The concepts of classical encryption techniques and concepts of finite fields and number theory.
2. Working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes, and message digests, and public key algorithms.
3. Design issues and working principles of various authentication protocols, PKI standards.
4. Various secure communication standards including Kerberos, IPsec and email.
5. Concepts of web security, TLS and Firewall mechanisms to design policies.

UNIT I COMPUTER AND NETWORK SECURITY CONCEPTS 9 hours

Computer Security Concepts - The OSI Security Architecture - Security Attacks - Security Services and Mechanisms - A Model for Network Security - Classical Encryption Techniques: Substitution Techniques - Transposition Techniques - Steganography.

Symmetric Ciphers: Traditional Block Cipher Structure – DES - Block Cipher mode of operation - Advanced Encryption Standard: AES Structure - AES Transformation Functions.

UNIT II PUBLIC KEY CRYPTOGRAPHY 9 hours

Number Theory – Modular Arithmetic – Primes – Primality Testing - Euclid's Algorithm - Fermat‘s and Euler‘s Theorems - Chinese Remainder Theorem – Exponentiation logarithm - Discrete Logarithms.

Asymmetric Ciphers: Principles, Public Key Cryptography Algorithms, RSA Cryptosystem – Key Distribution – Key Management - Diffie Hellman Key Exchange - Elliptic Curve Cryptography.

UNIT III HASH FUNCTION AND DIGITAL SIGNATURE 9 hours

Authentication Requirement – Authentication Function – MAC – Hash Function – Security of Hash Function – HMAC, CMAC – Secure Hash Algorithm. **Digital Signatures**: NIST Digital Signature Algorithm, Distribution of Public Keys, X.509 Certificates, Public Key Infrastructure.

UNIT IV USER AUTHENTICATION AND IP SECURITY 9 hours

User Authentication: Remote User Authentication Principles, Kerberos. Electronic Mail Security: Pretty Good Privacy (PGP) And S/MIME.

IP Security: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange.

UNIT V TRANSPORT LEVEL SECURITY AND FIREWALLS 9 hours

Transport Level Security: Web Security Requirements, Transport Layer Security (TLS), HTTPS, Secure Shell (SSH).

Firewalls: Firewall Characteristics and Access Policy, Types of Firewalls, Firewall Location and Configurations.

Course Outcomes:

After completion of the course, students will be able to

CO1: Identify information security goals, classical encryption techniques and acquire fundamental knowledge on the concepts off in it fields and number theory.

CO2: Compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication.

CO3: Apply the knowledge of crypto graphic check sums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes.

CO4: Demonstrate the ability to apply user authentication principles including Kerberos for secure authentication.

CO5: Gain proficiency in securing web communications using TLS and HTTPS, manage secure remote access with SSH, and design firewall policies

Textbook(s)

1. Cryptography and Network Security: Principles and Practice (Global Edition) – William Stallings, Pearson Education, 9th Edition, 2024.
2. Network Security Essentials: Applications and Standards – William Stallings, Pearson Education, 6th edition 2020.

Reference Books

1. Cryptography and Network Security- BehrouzA Forouzan, Debdeep Mukhopadhyaya, Mc-Graw Hill, 4th Edition, 2019.
2. Introduction to Modern Cryptography - Jonathan Katz, Yehuda Lindell, CRC Press, 3rd edition, 2020.

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

B. Tech III Year II Semester

23CST111 CLOUD COMPUTING

L	T	P	C
3	0	0	3

Pre-requisite NIL

Course Description:
This course provides comprehensive knowledge of Cloud Computing concepts, architectures, virtualization techniques, application programming frameworks, leading industry platforms, and cloud security services. It emphasizes both theoretical understanding and practical implementation strategies required to design, deploy, and manage secure cloud environments.

Course Objectives:
1. Understand the foundations of parallel, distributed, and cloud computing environments
2. Learn virtualization technologies and cloud architectural models.
3. Develop applications using Aneka framework and data-intensive programming models.
4. Explore leading cloud platforms like AWS, GCP, Azure, and their real-world applications.
5. Analyze cloud security risks and implement secure software practices for the cloud.

UNIT I FOUNDATION FOR CLOUD COMPUTING 9 hours

Introduction: Cloud computing at a glance, Historical developments, Building cloud computing environments
Principles of Parallel and Distributed Computing: Parallel vs. distributed computing, Elements of parallel computing, Elements of distributed computing, Technologies for distributed computing

UNIT II Virtualization & Cloud Computing Architecture 9 hours
Virtualization: Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization,Technology examples
Cloud Computing Architecture : The cloud reference model, Types of clouds, Economics of the cloud, Open challenges

UNIT III CLOUD APPLICATION PROGRAMMING 9 hours
Aneka: Framework overview, Anatomy of the Aneka container, Building aneka clouds, Cloud programming and management
High-Throughput Computing: Task computing, Task-based application models, Aneka task-based programming
Data-Intensive Computing : What is data-intensive computing, Technologies for data-intensive computing, Aneka MapReduce programming

UNIT IV CLOUD PLATFORMS & APPLICATIONS 9 hours
Cloud Platforms in Industry : AWS,Google AppEngine, Microsoft Azure
Cloud Applications : Healthcare, CRM and ERP,Case Studies

UNIT V CLOUD SECURITY 9 hours

Risks in Cloud Computing: Cloud Computing Risks, Risk Management, Types of Risks in Cloud Computing

Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1 : Explain the basic principles of parallel, distributed, and cloud computing environments.

CO2 : Describe virtualization concepts and cloud architecture models.

CO3 : Develop simple cloud-based applications using Aneka and MapReduce.

CO4 : Utilize major cloud platforms (AWS, GCP, Azure) for deploying applications

CO5: Analyze cloud computing risks and recommend appropriate security mechanisms.

Textbook(s)

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, Morgan Kaufmann, 2013.
2. A.Srinivasan,J.Suresh,Cloud Computing-A Practical Approach for Learning and Impementation,Pearson Ed 2014.

Reference Books

1. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, McGraw-Hill, 2009.
2. Thomas Erl et al., Cloud Computing: Concepts, Technology & Architecture, Pearson, 2014.

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

B. Tech III Year II Semester

23CST112 INTRODUCTION TO MACHINE LEARNING

L	T	P	C
3	0	0	3

Pre-requisite **NIL**

Course Description:

This course offers a practical and conceptual introduction to machine learning, covering key algorithms, mathematical foundations, model evaluation, and real-world applications. It emphasizes both theory and hands-on skills essential for solving data-driven problems.

Course Objectives:

1. Understand the significance and application domains of machine learning.
2. Learn essential mathematical foundations underlying ML algorithms.
3. Study core machine learning paradigms: supervised, unsupervised, and semi-supervised learning.
4. Analyse support vector machines and kernel methods.
5. Understand Feature Selection and Sub-Selection.
6. Explore recent trends like Evolutionary algorithms and apply ML techniques to real-world problems.

UNIT I INTRODUCTION TO MACHINE LEARNING & PREREQUISITES **9 hours**

What is Machine Learning?, Types of Machine Learning: Supervised, Unsupervised, Semi-supervised, Reinforcement Learning, Motivation and Applications of ML, AI vs ML vs DL – Key Differences, Use cases in healthcare, finance, NLP, etc., Vectors and Matrices, Basic Matrix Operations (Addition, Multiplication), Inner Product, Norms (L1, L2), Orthogonality, Eigenvalues and Eigenvectors, Recommendation Systems, Derivatives and Gradients, Bayes' Rule, Conditional Probability, Expectation, Hypothesis Space, Training and Testing Data, Concept Learning as Search, Finding a Maximally Specific Hypothesis, Version Spaces, Candidate Elimination Algorithm

UNIT II REGRESSION, CLASSIFICATION & NEURAL FOUNDATIONS **9 hours**

Linear Regression, Least Squares Method, Cost Function and Optimization, Gradient Descent and Variants, Logistic Regression, Perceptron Algorithm, Activation Functions: Sigmoid, Tanh, ReLU, Multi-Layer Perceptron (MLP), Forward Propagation, Backpropagation Algorithm, Bias-Variance Trade off, Applications of MLP

UNIT III UNSUPERVISED LEARNING & DIMENSIONALITY REDUCTION **9 hours**

K-Means Clustering, Hierarchical Clustering (Agglomerative), DBSCAN (conceptual), Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), t-SNE (conceptual), Isomap, Locally Linear Embedding (LLE), Radial Basis Function (RBF) Networks, Training RBF Networks, RBF vs MLP

UNIT IV SUPPORT VECTOR MACHINES & KERNEL METHODS 9 hours

SVM for Binary Classification, Maximum Margin Classifier, Optimization Problem in SVM, Hard Margin SVM, Soft Margin SVM, Kernel Functions, Polynomial Kernel, RBF Kernel, Sigmoid Kernel, Kernel Trick, One-vs-All SVM, One-vs-One SVM, Support Vector Regression (SVR), ε-insensitive Loss

UNIT V FEATURE SELECTION, EVOLUTION ALGORITHMS, ENSEMBLE LEARNING & REAL-WORLD APPLICATIONS 9 hours

Feature Selection Techniques, Filter Methods (Correlation, Chi-Square, Mutual Information), Wrapper Methods (Forward Selection, Backward Elimination), Embedded Methods (Lasso, Ridge, Decision Tree Feature Importance), Dimensionality Reduction vs Feature Selection, Genetic Algorithms, Chromosome Encoding, Fitness Function, Selection, Crossover, Mutation, Genetic Programming, Introduction to Ensemble Learning, Bagging, Boosting, Random Forests (conceptual), ML in Healthcare, ML in Finance, ML in Natural Language Processing, Ethics in ML, Bias and Fairness.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Explain the need for machine learning and its role in solving real-world problems.

CO2: Apply essential mathematical foundations such as linear algebra, probability, and calculus to understand ML algorithms.

CO3: Implement and evaluate supervised, unsupervised, and semi-supervised learning algorithms.

CO4: Analyze support vector machines and kernel methods for classification and regression tasks.

CO5: Apply feature selection and modern ML techniques to build models for practical applications in domains like healthcare, finance, and NLP.

Textbook(s)

1. Kelleher, J. D., Mac Namee, B., & D'Arcy, A. (2020). Fundamentals of machine learning for predictive data analytics: Algorithms, worked examples, and case studies (2nd ed.). MIT Press.
2. Bishop, C. M. (2006). Pattern recognition and machine learning. Springer.
3. Kevin P. Murphy (2012). Machine Learning: A Probabilistic Perspective. MIT Press.

Reference Books

1. Ian H. Witten, Eibe Frank, Mark A. Hall, and Christopher J. Pal (2016). Data Mining: Practical Machine Learning Tools and Techniques (4th Ed.). Morgan Kaufmann.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman (2009). The Elements of Statistical Learning. Springer.

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

B. Tech III Year II Semester

23CST207 CLOUD COMPUTING LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite -NIL-

Course Description:

This course enables students to understand, deploy, and manage cloud computing services through hands-on labs involving open-source tools and public cloud platforms like AWS and Google Cloud. Students will learn about virtualization, containerization, serverless computing, and monitoring using real-world technologies.

Course Objectives:

1. To introduce basic concepts of virtualization and containerization.
2. To explore open-source cloud frameworks like Aneka.
3. To deploy applications using AWS and Google Cloud services.
4. To integrate and monitor cloud-based applications and services.
5. To provide practical experience with cloud development and DevOps tools

List of Programs:

1. Virtualization with VirtualBox
2. Containerization with Docker (Windows)
3. Aneka Setup and Application Deployment
4. Aneka Multi-threaded Job Submission
5. Google App Engine - Hello World App Deployment
6. Google App Engine - DataStore Integration
7. AWS CLI Setup and Basic Operations
8. AWS EC2 & EBS Integration
9. AWS Lambda Function Triggered by S3
10. Monitoring Simulated Metrics using Prometheus & Grafana

Course Outcomes:

CO1: Configure and manage virtual environments using VirtualBox.

CO2: Create and deploy containerized applications using Docker on Windows.

CO3: Deploy and manage cloud applications using Aneka.

CO4: Design and deploy scalable apps on Google App Engine with Datastore.

CO5: Execute cloud services like EC2, Lambda, and S3 using AWS CLI.

Textbook(s)

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, *Mastering Cloud Computing: Foundations and Applications Programming*, Morgan Kaufmann, 2013.
2. Amazon Web Services Official Documentation: https://docs.aws.amazon.com/

Reference Books

1. Docker Documentation: https://docs.docker.com/
2. XAMPP & phpMyAdmin Documentation: https://www.apachefriends.org/ and https://www.phpmyadmin.net/docs/

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination

B. Tech III Year II Semester

23CST208 MACHINE LEARNING LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: NIL

Course Objectives:

The objectives of this course are to

1. To understand the need and application of machine learning for solving real-world problems.
2. To apply fundamental mathematical concepts underlying various ML algorithms.
3. To implement and analyze supervised, semi-supervised, and unsupervised learning methods.
4. To explore support vector machines and kernel-based learning techniques.
5. To apply modern ML techniques in real-world domains including feature selection and model interpretability.

List of Experiments:

1. (i) Load a dataset such as Iris or Titanic, handle missing values, encode categorical features, normalize numeric values, and visualize the data using histograms and scatter plots

   (ii) Implement basic linear algebra operations using NumPy such as vector and matrix manipulations, inner products, norms, and eigenvalues/eigenvectors, and relate them to applications like recommendation systems.
2. Implement and demonstrate the FIND-S algorithm to identify the most specific hypothesis consistent with a given set of training data, reading the data from a .csv file and displaying the final hypothesis.
3. Implement the Candidate Elimination algorithm on training data provided in a .csv file and output the complete set of hypotheses consistent with the data, showing the general and specific boundaries.
4. Build a decision tree using the ID3 algorithm, train and test it on a suitable dataset like Play Tennis, and visualize the structure of the tree and the classification output.
5. Implement linear regression from scratch using gradient descent on a dataset such as student scores or housing prices, and plot the cost function reduction across iterations.
6. Implement logistic regression for binary classification using a dataset like diabetes, visualize the decision boundary, and evaluate model performance using accuracy, precision, and recall
7. Use scikit-learn to train a Perceptron and a Multi-Layer Perceptron (MLPClassifier) on a classification dataset such as Iris and analyze the convergence behavior and training performance.

8. Apply K-Means and Hierarchical clustering (Agglomerative) on a dataset like Mall Customers, and visualize the resulting clusters using PCA to reduce the dimensions to two.
9. Perform Principal Component Analysis (PCA) on a high-dimensional dataset such as Wine or Digits, analyze the explained variance ratio, and visualize the data in reduced dimensions using the top principal components.
10. Implement a Support Vector Machine (SVM) using scikit-learn with different kernels including linear and RBF on a binary classification problem, plot the decision boundaries, and analyze the support vectors.
11. Train a Support Vector Regressor (SVR) model on a regression dataset such as Boston Housing, generate predictions, visualize them against actual values, and compute error metrics like MAE or RMSE.
12. Apply feature selection techniques including Chi-Square, Recursive Feature Elimination (RFE), and Lasso on a classification dataset, build an end-to-end machine learning pipeline.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Explain the significance of machine learning and identify suitable use cases for different learning types.

CO2: Apply core mathematical concepts such as linear algebra and probability in understanding ML algorithms.

CO3: Implement and evaluate supervised, semi-supervised, and unsupervised machine learning models using Python.

CO4: Analyze and interpret the working of support vector machines and kernel-based methods.

CO5: Design ML pipelines incorporating feature selection, model evaluation, and interpretability for practical applications.

Reference Books:

1. Aurélien Géron (2022). Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow (3rd Ed.). O'Reilly.

2. Sebastian Raschka, Vahid Mirjalili (2020). Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2 (3rd Ed.). Packt.

3. Andreas C. Müller, Sarah Guido (2016). Introduction to Machine Learning with Python: A Guide for Data Scientists. O'Reilly.

4. Dipanjan Sarkar, Raghav Bali, Tushar Sharma (2017). Practical Machine Learning with Python. Apress.

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

IV Year I Semester

B. Tech IV Year I Semester

23CST113 DEEP LEARNING

L	T	P	C
3	0	0	3

Prerequisite: 23CST112

Course Objectives:

The main objectives of the course are to

1. Understand the mathematical foundations of deep learning.
2. Design, implement, and evaluate neural network models.
3. Build, train, and apply fully connected deep neural networks.
4. Demonstrate the major technology trends driving Deep Learning

UNIT I MATHEMATICAL AND MACHINE LEARNING FOUNDATION 9 hours

DL-Specific Mathematical Prerequisites: Matrix Operations, Probability and Statistics for Deep Learning, Gradient-Based Optimization, Perceptrons and Multilayer Perceptrons, Backpropagation and the Chain Rule, Activation Functions, Loss Functions, Model Evaluation and Generalization. Case Study: Linear Regression from Scratch

UNIT II DEEP LEARNING ESSENTIALS 9 hours

Regularization: L1 and L2 Norm Penalties, Dropout, Data Augmentation, Noise Robustness, Early Stopping, Parameter Sharing, Sparse Representations, Semi-Supervised and Multi-Task Learning, Ensemble Methods and Bagging, Adversarial Training, Optimization Algorithms: SGD, Momentum, RMSProp, Adam, Learning Rate Scheduling, Weight Initialization Strategies, Batch Normalization, Approximate Second-Order Methods, Hyperparameter Tuning.
Case Study: Improving Model Generalization on CIFAR

UNIT III CONVOLUTIONAL NEURAL NETWORKS 9 hours

The Convolution Operation, Pooling, Receptive Fields, Padding and Stride, Basic Convolution Functions, Structured Outputs, Efficient Convolution Algorithms, Modern CNN Architectures: AlexNet, VGG, Inception, ResNet, EfficientNet, MobileNet, Skip Connections and Depthwise Separable Convolutions, Transfer Learning and Fine-Tuning, Unsupervised and Random Feature Learning.
Case Study: Image Classification with Transfer Learning

UNIT IV RECURRENT NEURAL NETWORKS & SEQUENTIAL MODELS 9 hours

Sequence Modelling, Unfolding Computational Graphs, Recurrent Neural Networks, Backpropagation Through Time, Vanishing and Exploding Gradients, Bidirectional RNNs, LSTM, Gated Recurrent Units, Deep Recurrent Networks, Recursive Neural Networks, Encoder-Decoder and Sequence-to-Sequence Architectures, Optimization for Long-Term Dependencies, Attention Mechanisms, Transformer Architecture.
Case Study: Seq2Seq Machine Translation

UNIT V ADVANCED DEEP LEARNING MODELS AND MODERN APPLICATIONS 9 hours

Autoencoders, Variational Autoencoders, Generative Adversarial Networks, Representation Learning, Self-Supervised and Contrastive Learning, Large Language Models and Prompt Engineering, Vision Transformers, Explainable AI: SHAP and Grad-CAM, Ethical and Responsible AI.

Case Study: Fine-Tuning a Pretrained Transformer using Hugging Face

Course Outcomes:

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

CO1: Explain the fundamental concepts and mathematical foundations of deep learning.
CO2: Design and implement feedforward networks.
CO3: Apply and understand essential techniques in training deep learning models.
CO4: Build and evaluate Convolutional Neural Network models.
CO5: Apply recurrent neural network models to sequence-based data.

Textbooks:

1. Goodfellow, I., Bengio, Y., & Courville, A. *Deep Learning*. MIT Press, Cambridge, MA, 2016.

2. Chollet, F.Deep Learning with Python. 2nd Edition, Manning Publications, New York, 2021.

3. Zhang, A., Lipton, Z. C., Li, M., & Smola, A. J.
Dive into deep learning. Cambridge University Press, 2023.

Reference Books:

1. Nielsen, M. A.
Neural Networks and Deep Learning. Determination Press, 2015.

2. Josh Patterson and Adam Gibson, ―Deep learning: A practitioner's approach‖, O'Reilly Media, First Edition,2017.

3. Deep learning Cook Book, Practical recipes to get started Quickly, Douse Using, O'Reilly, Sheriff Publishers, 2019

Online Learning Resources

1. https://www.youtube.com/playlist?list=PLZbbT5o_s2xq7LwI2y8_QtvuXZedL6tQU

2. https://www.youtube.com/watch?v=V_xro1bcAuA

3. https://www.youtube.com/playlist?list=PLZHQObOWTQDNU6R1_67000Dx_ZCJB-3pi

Mode of Evaluation: Assignments, Midterm Tests, and End-Semester Examination.

Audit Course

23HUM901 GENDER SENSITIZATION

L	T	P	C
2	0	0	0

Pre-requisite: Nil

Course Description:

The Gender Sensitization course aims to develop students' critical understanding of gender as a social construct and its impact on various aspects of life, including family, workplace, education, media, and society. It explores gender roles, stereotypes, discrimination, division of labour, gender-based violence, and cultural representations of gender. The course encourages students (especially in engineering and technical fields) to reflect on gender issues in STEM education and workplaces, constitutional safeguards for gender equality, legal frameworks against gender violence, and the importance of building inclusive, gender-sensitive environments in professional and personal spheres.

Course Objectives:

This course enables students

1. Understand the basic concepts of gender, related terminology, and the processes of gender construction and socialization.
2. Familiarize students with the biological, sociological, psychological, and legal aspects of gender and gender roles.
3. Analyse how gender discrimination operates in society and explore ways to counter it.
4. Examine the gendered division of labour, its political and economic dimensions, and its implications in professional settings, including tech companies and start-ups.
5. Develop awareness of various forms of gender-based violence, their causes, consequences, and relevant legal protections in India.
6. Foster critical reflection on the influence of gender on culture, media, language, and relationships, and to promote gender-sensitive practices in engineering teams and workplaces.

UNIT I UNDERSTANDING GENDER **6 hours**

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men - Preparing for Womanhood. Growing up Male.

UNIT II GENDER ROLES AND RELATIONS **6 hours**

Two or Many? - Struggles with Discrimination - Gender Roles and Relations -Types of Gender Roles - gender stereotypes; Gender Roles and Relationships Matrix - Missing Women-Sex Selection and its Consequences-Declining Sex Ratio - Demographic Consequences - Gender Spectrum in STEM education and workplace (e.g., women in engineering)

UNIT III GENDER AND LABOUR **6 hours**

Division and Valuation of Labour - Housework: The Invisible Labour - "My Mother doesn't Work." "Share the Load."-Work: Its Politics and Economics -Fact and Fiction- Unrecognized and Unaccounted work - Gender Development Issues- Gender and Mainstreaming Gendered division of labour in tech companies/start-ups - case studies on work-life balance in IT

UNIT IV GENDER BASED VIOLENCE **6 hours**

The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment - Domestic Violence - Different forms of violence against women - Causes of violence, impact of violence against women - Consequences of gender-based violence - Cyber gender-based violence and online safety; gender-based laws in India (POSH, Domestic Violence Act, Immoral Traffic Prevention Act, Dowry Prohibition Act, Indecent representation of women prohibition Act, Maternity benefit Act, Equal remuneration Act, etc.

UNIT V GENDER AND CULTURE **6 hours**

Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature-Gender Development Issues-Gender Issues - Gender Sensitive Language- Just Relationships- Gender-sensitive language and inclusive practices in engineering teams/projects

Course Outcomes:

After completing this Unit, students will be able to

CO1: Understand the basic concepts of gender and its related terminology (L1, L2)

CO2: Identify the biological, sociological, psychological and legal aspects of gender. (L1, L2)

CO3: Use the knowledge in understanding how gender discrimination works in our society and how to counter it. (L3)

CO4: Analyze the gendered division of labour and its relation to politics and economics. (L4)

CO5: Analyze depiction of gender and culture in media projections (L4)

Textbook(s)

1. A.Suneetha, Uma Bhrugubanda, et al. *Towards a World of Equals: A Bilingual Textbook on Gender*", Telugu Akademi, Telangana, 2015.

Reference Books

1. Wtatt, Robin and Massood, Nazia, *Broken Mirrors: The dowry Problems in India,*London : Sage Publications, 2011
2. Datt, R. and Kornberg, J.(eds), *Women in Developing Countries, Assessing Strategies for Empowerment,* London: Lynne Rienner Publishers, 2002
3. Brush, Lisa D., *Gender and Governance*, New Delhi, Rawat Publication, 2007
4. Singh, Direeti, *Women and Politics World Wide*, New Delhi, Axis Publications, 2010
5. Raj Pal Singh, Anupama Sihag, *Gender Sensitization: Issues and Challenges* (English, Hardcover), Raj Publications, 2019
6. A.Revathy& Murali, Nandini, *A Life in Trans Activism* (Lakshmi Narayan Tripathi). The University of Chicago Press, 2016

Mode of Evaluation: Assignments and Mid Term Tests

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

5. To introduce computation methods of solving algebraic and transcendental equations.
6. To avail the basics of numerical techniques for solving the system of linear equations.
7. To familiarize the knowledge of interpolation and numerical calculus.
8. To use numerical calculus for solving ordinary differential equations.
9. 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.

Textbooks:

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.

Textbooks:

1. J K Sharma, Operations Research: Theory and Practice, Macmillan Publishers India Ltd, 5^{th} edition,2013.

2. B.S. Grewal, Higher Engineering Mathematics, 43^{rd} 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, 2^{nd}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.

Textbooks:

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.

Textbooks:

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.

Textbooks:

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.

Textbooks:

1. A Textbook 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.

Textbooks:

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.

Textbooks:

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

Textbooks:

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.

Textbooks:

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.

Textbooks:

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)

Textbooks:

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

Textbooks:

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

Textbook(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.

Textbooks:

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.

Textbooks:

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

OPEN ELECTIVE – IV

Open Elective - IV

23PHY304 SMART MATERIALS AND DEVICES

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:
This course introduces the fundamentals and evolution of smart materials and their responsive behavior to external stimuli. It covers key types such as shape memory, chromoactive, magnetorheological, photoactive materials, and polymer composites. The course explores important properties including electrical, optical, dielectric, piezoelectric, and magnetic characteristics. Students learn synthesis techniques like sol-gel, chemical vapor deposition, and thin-film fabrication methods. It also includes characterization techniques and applications in devices such as MEMS, sensors, actuators, and robotic systems.

Course Objectives:
1. To provide exposure to smart materials and their engineering applications.
2. To impart knowledge on the basics and phenomenon behind the working of smart materials
3. To explain the properties exhibited by smart materials
4. To educate various techniques used to synthesize and characterize smart materials
5. To identify the required smart material for distinct applications/devices

UNIT I INTRODUCTION TO SMART MATERIALS 9 hours
Historical account of the discovery and development of smart materials, Shape memory materials, chromoactive materials, magnetorheological materials, photoactive materials, Polymers and polymer composites (Basics).

UNIT II PROPERTIES OF SMART MATERIALS 9 hours
Optical, Electrical, Dielectric, Piezoelectric, Ferroelectric, Pyroelectric and Magnetic properties of smart materials.

UNIT III SYNTHESIS OF SMART MATERIALS 9 hours
Chemical route: Chemical vapour deposition, Sol-gel technique, Hydrothermal method, Mechanical alloying and Thin film deposition techniques: Chemical etching, Spray pyrolysis.

UNIT IV CHARACTERIZATION TECHNIQUES 9 hours
Powder X-ray diffraction, Raman spectroscopy (RS), UV-Visible spectroscopy, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM).

UNIT V SMART MATERIALS BASED DEVICES 9 hours
Devices based on smart materials: Shape memory alloys in robotic hands, piezoelectric based devices, MEMS and intelligent devices.

Course Outcomes:
Upon successful completion of this course, the student will be able to:

CO1: Identify key discoveries that led to modern applications of shape memory materials, describe the two phases in shape memory alloys.

CO2: Describe how different external stimuli (light, electricity, heat, stress, and magnetism) influence smart material properties.

CO3: Summarize various types of synthesis of smart materials

CO4: Analyze various characterization techniques used for smart materials
CO5: Interpret the importance of smart materials in various devices

Textbooks:

1. YaserDahman, Nanotechnology and Functional Materials for Engineers-, Elsevier, 2017
2. E. Zschech,C. Whelan, T. Mikolajick, Materials for Information Technology: Devices, Interconnects and Packaging Springer-Verlag London Limited 2005.

References Books:

1. Gauenzi,P.,Smart Structures, Wiley, 2009.
2. MahmoodAliofkhazraei, Handbook of functional nanomaterials, Vol (1&2), Nova Publishers, 2014
3. Handbook of Smart Materials, Technologies, and Devices: Applications of Industry,4.0, Chaudhery MustansarHussain, Paolo Di Sia, Springer,2022.
4. **Fundamentals of Smart Materials,**Mohsen Shahinpoor, Royal Society of Chemistry, 2020

Online Recourses

NPTEL course link: https://onlinecourses.nptel.ac.in/noc22_me17/preview

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

Open Elective - IV

23CHE304 INTRODUCTION TO NANO SCIENCE AND TECHNOLOGY

L	T	P	C
3	0	0	3

Pre-requisite Nil

Course Description:

This is primarily a lecture course which brings together relevant knowledge from the disciplines of physics and chemistry to give students a fundamental understanding of the integrated multidisciplinary nature of Nanotechnology.

Course Objectives:

This course enables students to

1. To understand the emergence of nanoscience and technology through history.
2. The various process techniques available for nanostructured materials.
3. The role of nanotechnology in electronics how basic nano-systems work
4. To use physical reasoning to develop simple nanoscale models to interpret the behaviour of such physical systems.

UNIT I MOLECULE TO MATERIALS: BASICS OF NANOTECHNOLOGY 8 hours

Atomic Structures: Rutherford and Bohr's model of atom. Bohr's model to Quantum: Wave function, Uncertainty principle, Orbital quantum numbers, Shape of the orbitals. Types of simple crystal structures, defects in nanocrystals. History & emergence (Feynman to present) of Nanoscience and Nanotechnology, Challenges in Nanotechnology.

UNIT II TYPES AND SYNTHESIS OF NANOSTRUCTURES 10 hours

Definition of a Nano system - Zero Dimensional (OD), One Dimensional (1D) - Two Dimensional (2D) - Three Dimensional (3D) nanostructured materials. Top-down and Bottom-up approaches, Nanoscale building blocks. Synthesis of Nanomaterials – Physical & Chemical methods: Chemical Vapour Deposition (CVD), Atomic Layer Deposition (ALD), Chemical Reduction, Electrochemical, Co-precipitation, Emulsion synthesis, Template based synthesis, Sol-Gel, Hydrothermal, Role of plants in Nanoparticle (NP) synthesis.

UNIT III PROPERTIES OF NANOMATERIAL 8 hours

Thermal, Mechanical, Optical, Electrical and Magnetic properties of nanomaterials (Metal oxides, Ceramics, Composites, Semiconductors) Carbon age materials: CNTs, and other Carbon-based materials). Relationship between surface effects on the properties of nanomaterials.

UNIT IV CHARACTERIZATION OF NANOMATERIALS 10 hours

Crystal Structure – XR; Composition: XPS; Optical & Electron microscopes: Scanning probe microscope, Scanning tunneling microscopes, Atomic force microscopes (AFM), Scanning electron microscope (SEM), Transmission electron microscope (TEM); Magnetic characterization (SQUID).

UNIT V APPLICATIONS OF NANOMATERIALS 9 hours

Molecular electronics and nano-electronics – Quantum electronic devices - CNT based transistor and Field Emission Display - Biological applications - Biochemical sensor - Membrane based water purification, Target based drug delivery system, LED applications.

Course Outcomes:

Upon completion of this course the students will be able to:

CO1: Understand the correlation between atomic, molecular structures and nanomaterials

CO2: Classify the types and synthesis the nanomaterials based on the needs of the society and environment.

CO3: Infer and interpret the properties of nanomaterials

CO4: Apply the knowledge of characterization tools towards making the sustainable engineering products.

CO5: Illustrate the application of various nanomaterials in daily life, industry towards the sustainable development.

Textbook(s)

1. Erich Gamma , Design Patterns ; Publisher, Pearson Education India, 1995; ISBN, 8131769461, 9788131769461. 1. M. Wilson, K. Kannangara, G. Smith, M. Simmons, and B. Raguse, *Nanotechnology: Basic science and Emerging technologies*, Overseas Press India Pvt Ltd, New Delhi, First Edition, 2005.
2. C. N. R. Rao, A. Muller, and A. K. Cheetham (Eds), The chemistry of nanomaterials: Synthesis, properties and applications, Wiley VCH Verlag Gmbh & Co, Weinheim, 2004.
3. Kenneth J. Klabunde (Eds), *Nanoscale Materials Science*, John Wiley & Sons, InC, 2001.
4. C. S. S. R. Kumar, J. Hormes, and C. Leuschner, Nanofabrication towards biomedical applications, Wiley - VCH Verlag GmbH & Co, Weinheim, 2004.
5. T. Pradeep, Nano: *The Essentials, Understanding Nanoscience and Nanotechnology*, Tata McGraw - Hill Publishing Company Limited, New Delhi, 2007.

Reference Books

1. W. Rainer, Nano Electronics and information Technology, Wiley, 2003.
2. K. E. Drexler, *Nano systems*, Wiley, 1992.
3. G. Cao, *Nanostructures and Nanomaterials: Synthesis, properties and applications*, Imperical College Press, 2004.

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

Open Elective - IV

23CHE305 WATER POLLUTION AND ITS MANAGEMENT

L	T	P	C
3	0	0	3

Pre-requisite Nil

Course Description:

This is primarily a lecture course which brings together relevant knowledge from the disciplines of physics and chemistry to give students a fundamental understanding of the integrated multidisciplinary nature of Nanotechnology.

Course Objectives:

This course enables students

1. To learn the fundamental concepts in the field of water pollution
2. To know the standards and importance of water pollution
3. To study the various industrial effects and mitigation management
4. To learn the importance of methods of control of water pollution
5. To study the various water control act and functions of regulatory boards

UNIT I SOURCES & CHARACTERISTICS OF WATER POLLUTION 9 hours

Water and wastewater pollution – Sources & Types of water and wastewater pollution – Physical, chemical and biological characteristics – Effects of water pollution. Drinking water - quality standards – WHO, ICMR, ICAR, Central and State quality control norms.

UNIT II WATER QUALITY & TESTING PROCEDURES 9 hours

Quality of surface water – Water quality in flowing water, Water quality in impounded water, Ground water quality – Testing procedures of important water quality parameters (pH, Electrical Conductivity, Total Dissolved Solids, Calcium, Magnesium, Chloride, Sulfate, Sodium, Potassium, Dissolved Oxygen, Iron, Total Kjeldahl nitrogen, FRC, FAC).

UNIT III INDUSTRIAL ACTIVITY & MITIGATION MEASURES 9 hours

Role of water in different industries – Effluent discharge characteristics – Discharge Standards for River and Streams – Role of stakeholders, public, NGOs, Government in Protection of Water bodies – Control measures – Industrial water contamination due to industries, ETP, Case Studies (Dye Industry, Pharmaceutical Industry, Cement Industry)

UNIT IV WATER POLLUTION REGULATION 9 hours

Administrative regulations under recent legislations in water pollution control. Water (Prevention & Control of Pollution) Act 1974 and its Amendment Act 1988, Rules 1975, Cess Act 1977 and its Amendment Act 1991.

UNIT V FUNCTIONS AND MANAGEMENT OF REGULATORY BOARDS 9 hours

Sustainable Development, Rain Water Harvesting – Methods – Water Pollution – Causes and Effects – Role of Regulatory bodies and Local bodies – CPCB – SPCB etc. – Case studies related to Effective Water Management.

Course Outcomes:

Upon completion of this course the students will be able to:

CO1: Understand the fundamental concepts with respect to water pollution (**L2)**

CO2: Recognize the standards and importance of water pollution **(L1)**

CO3: Understand the various industrial effects and mitigation management of pollution (**L2)**

CO4: Apply the different methods of control of water pollution (**L3)**

CO5: Awareness of the various water control acts and functions of regulatory boards **(L2)**

Textbook(s)

1. Metcalf & Eddy, Wastewater engineering, Treatment and Reuse, MacGrawhill publications, 2017.
2. Aruna Venkat, Environmental law and policy, PHI learning private limited, New Delhi, 2011

Reference Books

1. Fair, Geyer, and Okun', Water and Wastewater engineering, Vol I & II, John Wiley and Sons, Newyork, 2010.
2. P.K. Goel, Water Pollution: Causes, Effects and Control, New Age International, 2006.
3. S.K. Agarwal, Water Pollution, APH Publishing, 2005.
4. Anita Singh (Editor), Madhoolika Agrawal (Editor), Shashi Bhushan Agrawal (Editor), Water Pollution and Management Practices, Springer Verlag, Singapore, 1st Edition, 2021.

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

Open Elective - IV

23CE303 ENVIRONMENTAL IMPACT ASSESSMENT

	L	T	P	C
Pre-requisites:	3	0	0	3

Course Description:

The course will focus on Basic concept of Environmental Impact Assessment (EIA), EIA Methodologies, Impact of Developmental Activities and Land use in soil, water, and vegetation, Environmental Audit, Post Audit activities, and the Environmental pollution Acts.

Course Objectives:

1. To impart knowledge on Environmental management and Environmental Impact Assessment.
2. To identify key environmental elements like soil, water, air, and Biological Environment.
3. To understand the impact of development activities on vegetation and wildlife, including the causes and effects of deforestation.
4. To give the student the brief knowledge about various legislations and audit protocols.
5. To give student knowledge about the framing of environmental audit through case studies

UNIT I CONCEPTS AND METHODOLOGIES IN EIA 9 hours

Introduction to Environmental Impact Assessment, objectives and importance of EIA, factors affecting EIA, Preparation of environmental base map, classification of environmental parameters, criteria for selection of EIA methodologies including ad-hoc methods, matrix methods, network method, environmental media quality index method, overlay methods and cost–benefit analysis. Steps in EIA process including screening, scoping, impact prediction, mitigation measures, environmental management, monitoring and audit, with focus on statutory requirements and compliance procedures.

UNIT II IMPACT OF DEVELOPMENTAL ACTIVITIES AND CLEARANCE PROCEDURES 9 hours

Introduction and methodology for assessment of impacts on soil, groundwater, surface water, air, noise, biological and socioeconomic environment. Environmental clearance procedures for infrastructure projects including stages of environmental clearance, preparation and appraisal of EIA reports, statutory approvals and regulatory requirements. Project-specific clearance procedures for highways, airports, industrial corridors, water resources and urban infrastructure projects, highlighting practical implementation aspects.

UNIT III IMPACT ON VEGETATION, WILDLIFE AND PROJECT-SPECIFIC CONSIDERATIONS 9 hours

Assessment of impacts of developmental activities on vegetation and wildlife, environmental impact of deforestation, causes and effects of deforestation. Integration of environmental safeguards in large-scale infrastructure projects with emphasis on sector-specific environmental concerns such as transportation corridors, airport expansions, industrial development and water resource projects.

UNIT IV ENVIRONMENTAL MANAGEMENT, AUDIT AND COMPLIANCE FRAMEWORK 9 hours

Introduction and objectives of environmental management system. Environmental audit concepts, types of environmental audit, audit protocol, stages of environmental audit including onsite activities, evaluation of audit data and preparation of audit reports. Post-clearance monitoring requirements, compliance verification, environmental performance evaluation and reporting mechanisms.

UNIT V ENVIRONMENTAL LEGISLATIONS, CONSENTS AND REGULATORY FRAMEWORK 9 hours

Detailed study of environmental legislations including Water Act 1974, Air Act 1981, Wildlife Protection Act 1972, Forest Conservation Act 1980, Biological Diversity Act 2002, Environment Protection Act 1986 and Indian Forest Act 1927. Procedures for obtaining consent to establish (CTE) and consent to operate (CTO) from pollution control authorities, regulatory compliance requirements and legal provisions applicable to infrastructure projects.

Course Outcomes:

After successful completion of the course, student will be able to

CO1: Develop a base map and classify environmental parameters for impact evaluation and analysis using different EIA methods such as ad-hoc, matrix, network, overlay, and cost/benefit analysis.

CO2: Assess the significance of impact and identify and incorporate appropriate mitigation measures for developmental activities on different environmental media, including soil, groundwater, surface water, air, and biological environment.

CO3: Evaluate the impact of deforestation on vegetation and wildlife and analyse the causes and effects of deforestation.

CO4: Apply the principles and practices of environmental audit, including onsite activities, evaluation of audit data, preparation of audit reports, and post-audit activities, for compliance with environmental legislation.

CO5: Water Act-1974, Air Act-1981, Wild Life Act-1972, Indian Forest Conservation Act 1980, National Green Tribunal Act-2010, and Biological Diversity Act-2002, to control environmental pollution.

Textbooks:

1. Larry W Canter, Environmental Impact Assessment, McGraw-Hill, 1996

2. Anjaneyulu, Y., Environmental Impact Assessment Methodologies, B.S. Publication, Sultan

Reference Books:

1. Glynn, J. and Gary W. Hein Ke., Environmental Science and Engineering, Prentice Hall Publishers

2. Suresh K. Dhaneja Environmental Science and Engineering, S.K., Katania& Sons Publication,New Delhi.

3. Dr. Bhatia, H.S., Environmental Pollution and Control, Galgotia Publication (P) Ltd, Delhi. Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

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

Open Elective - IV

23CE304 BUILDING TECHNOLOGY

	L	T	P	C
Pre-requisites: 23CME101	**3**	**0**	**0**	**3**

Course Description:

This course provides a comprehensive understanding of modern construction practices, materials, and management techniques essential for civil engineering professionals. It covers planning principles, prefabrication, temporary structures, special materials, building services, and construction equipment.

Course Objectives:

1. To understand the principles of planning and building bye-laws.
2. To understand the purpose and types of temporary structures used in construction.
3. To study special concretes such as FRC, ferrocement, and polymeric concrete.
4. To understand basic building services including electrical wiring, water supply, and drainage.
5. To understand the selection criteria for construction equipment.

UNIT I PLANNING & PREFABRICATION 9 hours

Principles of Planning - regulations and byelaws, different codes of practice – Indian, American & British codes of practice – Preparation of layouts – Orientation and marking of Buildings- details and sequence of construction – co-ordination – site clearance - Earthwork excavations – timbering – Dewatering Principles of prefabrication – Types – materials for prefabrication.

UNIT II TEMPORARY STRUCTURE & SHELL STRUCTURES 9 hours

Temporary shed - centering and shuttering – sheet piles, scaffoldings, shuttering forms – special forms for shells – slip form, moving form- shoring, and under pinning.

UNIT III PRESERVATIVES & SPECIAL MATERIALS 9 hours

Plastering - types – Paints – varnishes – distempers – wall cladding. Polymers (PVC Sheets, Pipes GFRP) ceramics & Clay Products - Refractory – Special Concrete - FRC, ferrocement& polymeric concrete – geotextiles.

UNIT IV BUILDING SERVICES 9 hours

Electric Wiring – Water Supply – Drainage- Air Conditioning – Ventilation – ramps, Escalators, Lifts, Stairs. Water Proofing - Thermal Insulation - Termite proofing - Acoustic Treatment (Sound Conditioning) - Fire Protection - Intelligent Buildings

UNIT V CONSTRUCTION EQUIPMENTS 9 hours

Selection of equipment for earth work, concreting, paving, pile erection- Material handling, hauling and erection of structures – Dewatering and pumping equipments.

Course Outcomes:

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

CO1: Select appropriate finishing materials for different surfaces.

CO2: Select appropriate temporary sheds and support systems for construction sites.

CO3: Apply modern materials like polymers and geotextiles in construction.

CO4: Implement waterproofing, termite proofing, and acoustic treatments.

CO5: Optimize equipment selection for cost-effective and timely project completion.

Textbooks:

1. Arora S.P.and Bindra S.P. “Building Construction, Planning Techniques and Materials of Construction”. DhanapatRai and Sons.
2. Sheety, M.S, Concrete Technology, Theory and Practice, S. Chand and Company Ltd, New Delhi, 2005.

Reference Books:

1. Chudley R “Construction Technology”, (Vol.I,II,III,&IV) ELBS / Longman (2nd Edition).
2. Jha J and Sinha S.K. “Construction and Foundation Engineering” Khanna Publishers, 1993.
3. Peurifoy R.L.,”Formwork for concrete structures”, McGrew Hill Co., 199

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

Open Elective - IV

23CE305 SUSTAINABILITY IN ENGINEERING PRACTICES

	L	T	P	C
Pre-requisites:	3	0	0	3

Course Objectives:

Upon successful completion of the course, the student will be able to:

1. To understand the concepts of sustainable development and global frameworks like SDGs.
2. To identify major environmental issues and understand environmental legislations in India.
3. To apply sustainability assessment tools such as LCA and EIA.
4. To analyze sustainable practices in buildings, transportation, and urban systems.
5. To promote resource efficiency, renewable energy use, and sustainable decision-making in engineering practices.

UNIT I INTRODUCTION TO SUSTAINABLE ENGINEERING 9 hours

Sustainable Development – Definition, principles, and need – Overview of global frameworks: Agenda 21, Sustainable Development Goals (SDGs) – Role of engineering in sustainability – Basic sustainability models: Egg model, Atkisson pyramid – Major threats to sustainability

UNIT II ENVIRONMENTAL ETHICS AND LEGISLATIONS 9 hours

Environmental laws in India: Water Act, Air Act, Environment Protection Act (basic overview) – Local environmental issues: solid waste management, 3R concept – Global issues: climate change, global warming, air and water pollution – Carbon footprint

UNIT III TOOLS FOR SUSTAINABILITY 9 hours

Triple Bottom line - Environmental Management System (EMS) – ISO 14000 (concept) – Life Cycle Assessment (LCA): stages, techniques and applications - Circular economy - Carbon accounting

UNIT IV SUSTAINABLE HABITAT 9 hours

Green building concept and benefits – Green building rating systems: GRIHA and LEED – Energy-efficient buildings – Basics of sustainable cities and transport systems – Case studies

UNIT V SUSTAINABLE INDUSTRIALIZATION AND URBANIZATION 9 hours

Sustainable industrial practices: Air and water pollution prevention, industrial ecology (basic concept) – Renewable energy resources: solar, wind, biogas, small hydro – Introduction to green technologies: green energy, green construction, green computing

Course Outcomes:

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

CO1: Explain sustainable development and global sustainability frameworks
CO2: Describe environmental issues and relevant legislations
CO3: Apply tools like LCA and EIA for sustainability analysis
CO4: Analyze sustainable practices in buildings and urban systems
CO5: Explain renewable energy resources and green technologies

Textbooks:

1. R.L. Ragand Lekshmi Dinachandran Remesh. Introduction to Sustainable Engineering. 2nd Ed., PHI Learning Pvt. Ltd., 2016.

Reference Books:

1. D.T.Allenand, D.R.Shonnard, Sustainability Engineering: Concepts, Design and Case Studies, 1 stEd., Prentice Hall, 2011.
2. A.S.Bradley, A.O.Adebayo, P.Maria. Engineering applications in sustainable design and development, 1st Ed., Cengage learning, 2016.

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

Open Elective - IV

23ME303 TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:
Total quality management (TQM) is a philosophy, methodology and system of tools aimed to create and maintain mechanism of organization's continuous improvement. It involves all departments and employees for the improvement of processes and products. TQM encompasses various principles, techniques, and tools for identifying and solving problems, fostering a culture of quality, promoting teamwork, and striving for excellence in all areas of the organization. The goal of TQM is to achieve sustainable and long-term success by consistently delivering high-quality products and services that meet or exceed customer expectations while improving overall organizational performance.

Course Objectives:

1. Study comprehensive knowledge about the principles, practices, tools and techniques of total quality management.
2. Gain knowledge on leadership, customer satisfaction, addressing customer complaints, team work, employee involvement, related to customer and supplier partnership.
3. Gather information on various tools and techniques, concept on Six Sigma, bench marking and failure Mode Effective Analysis (FMEA).
4. Know the importance of Quality circle, Quality Function Deployment, Taguchi design and case studies related to TQM.
5. Facilitate the understanding of standards of quality.

UNIT I INTRODUCTION 9 hours

Introduction: Definition of Quality, Dimensions of Quality, Definition of Total quality management, Quality Planning, Quality costs – Analysis, Techniques for Quality costs, Basic concepts of Total Quality Management. Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM.

UNIT II TQM PRINCIPLES 9 hours

TQM principles - Strategic quality planning, Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention – Role of Leadership and Commitment in Quality Deployment, Team Building, Motivation and Rewards, Total Employee Empowerment, Performance appraisal - Continuous process improvement – Supplier partnership – Partnering, Supplier selection.

UNIT III TOOLS OF TQM 9 hours

TQM Tools: Benchmarking – Reasons to Benchmark, Benchmarking Process, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA, The seven tools of quality, Process capability, Concept of Six Sigma, New Seven management tools, Case studies.

UNIT IV TQM TECHNIQUES 9 hours

Quality circles – Quality Function Deployment (QFD) – House of Quality – Design of Experiments – Taguchi quality engineering – Orthogonal Arrays – Signal to Noise Ratio –
TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT V IMPELMENTATION OF TQM 9 hours

Introduction – Benefits of ISO Registration – ISO 9000 Series of Standards –Implementation – Environmental Management System: Introduction – ISO 14000 Series Standards – Concepts of ISO 14001 – Requirements of ISO 14001, Real Case studies on TQM principles followed by Indian Industries.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

CO1: Understand the various principles and practices of TQM to achieve quality.

CO2: Identify the various statistical approaches for Total Quality Control.

CO3: Demonstrate the TQM tools for continuous process improvement.

CO4: Adopt the importance of ISO and Quality systems.

CO5: Make use of the concepts of TQM to solve case studies.

Textbooks:

1. Dale H Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2015.
2. Subburaj Ramaswamy, Total Quality Management, Tata Mcgraw Hill Publishing Company Ltd., 2005.
3. Joel E.Ross , Total Quality Management, Third Eition, CRC Press, 2017.

References Books:

1. James R. Evans and William M. Lindsay, The Management and Control of Quality, (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition (2003).
3. Suganthi,L and Anand Samuel, Total Quality Management, Prentice Hall (India) Pvt. Ltd. (2006).

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

Open Elective - IV

23ME304 ADDITIVE MANUFACTURING

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:
This course provides an introduction to additive manufacturing technologies, focusing on their principles, processes, materials, and industrial applications. It covers various additive manufacturing techniques such as FDM, SLA, SLS, and metal-based processes, along with material selection and process parameters. The course also emphasizes CAD modeling for additive manufacturing, STL file preparation, slicing, and preprocessing techniques. Post-processing methods, quality control, and inspection of printed parts are discussed. The course enables students from various engineering disciplines to understand the potential of additive manufacturing in modern product development and production systems.

Course Objectives:

1. Understand the underlying principles of additive manufacturing.
2. Describe major additive manufacturing processes and their differences.
3. Identify suitable materials and process parameters for different applications.
4. Use CAD tools to prepare and export files for AM systems.
5. Apply post-processing techniques and quality control for AM parts

UNIT I INTRODUCTION TO ADDITIVE MANUFACTURING 9 hours

Definition and fundamentals of Additive Manufacturing (AM), Evolution of AM and comparison with conventional manufacturing, Process chain in AM (concept to finished part), Classification of AM processes, Advantages, limitations, and applications across industries (Automotive, Aerospace, Medical, Consumer products.

UNIT II ADDITIVE MANUFACTURING PROCESSES 9 hours

Stereolithography (SLA), Fused Deposition Modeling (FDM), Selective Laser Sintering (SLS), Selective Laser Melting (SLM), Laminated Object Manufacturing (LOM), Binder Jetting, Electron Beam Melting (EBM), Overview of wire-based and metal AM processes, Process parameters, advantages, and limitations of each technology.

UNIT III MATERIALS FOR ADDITIVE MANUFACTURING 9 hours

Materials used in AM: Polymers, Metals, Ceramics, Composites, Material forms: filaments, powders, resins, wires, Material properties and their influence on process selection, Introduction to material behavior during layer-by-layer deposition, Emerging materials in additive manufacturing

UNIT IV CAD, FILE HANDLING & PRE-PROCESSING 9 hours

CAD modelling for AM, STL and other AM file formats: generation and issues, Data translation and conversion, STL file repair and preparation, Slicing fundamentals and build file generation, Part orientation and support generation strategies, Software tools used in pre-processing for 3D printing.

UNIT V POST-PROCESSING & QUALITY 9 hours

Post-processing techniques: heat treatment, surface finishing, support removal Inspection, testing, and quality control of printed parts, Common defects and remedial practices

Course Outcomes:

Upon successful completion of this course, the student will be able to:
CO1: Explain fundamental AM processes and their principles.
CO2: Compare various AM technologies with respect to process characteristics.
CO3: Select appropriate materials and process parameters for specific AM applications.
CO4: Prepare and export CAD models for additive manufacturing.
CO5: Apply post-processing and inspection techniques to Additive Manufactured parts.

Textbooks:

1. Gibson, I., Rosen, D.W., & Stucker, B., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 3rd Edition (2021).
2. Chua, C.K., Leong, K.F., & Lim, C.S., Rapid Prototyping: Principles and Applications, 3rd ed., World Scientific Publishing (2010).

References:

1. Pham, D.T., & Dimov, S.S., Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer (2011).
2. Jacobs, P.F., Rapid Prototyping & Manufacturing: Fundamentals of Stereolithography, Society of Manufacturing Engineers (1992).

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

Open Elective - IV

23ME305 REFRIGERATION AND AIR CONDITIONING

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Objectives:

This course is designed to:

1. Understand the fundamental concepts, performance metrics, and cycle analysis of vapour compression refrigeration systems.
2. Study the functional components of VCR systems and the selection criteria of refrigerants based on thermophysical and environmental properties.
3. Explore the working principles and applications of vapour absorption and alternative refrigeration systems.
4. Introduce psychrometric concepts, heat load analysis, and various air conditioning configurations.
5. Learn about air conditioning components and human thermal comfort requirements for effective HVAC design.

UNIT I INTRODUCTION TO REFRIGERATION AND VCR SYSTEM 9 hours

Introduction to Refrigeration, Necessity and Applications, Unit of Refrigeration, COP, EER, Methods of refrigeration.

Vapour compression refrigeration system: Working principle, effect of sub cooling and super heating, ideal and actual cycle, multi-stage, cascading VCR systems, numerical problems.

UNIT II COMPONENTS OF VCR SYSTEM AND REFRIGERANTS 9 hours

Vapour Compression Refrigeration System Components: General classification of compressors, condensers, evaporators and expansion devices and working principles.

Refrigerants: Desirable properties, Classification of refrigerants, Nomenclature, Environmental impact.

UNIT III VAR SYSTEM AND OTHER REFRIGERATION SYSTEMS 9 hours

Vapour Absorption Refrigeration system: Introduction to Vapour absorption refrigeration system, Lithium-Bromide absorption refrigeration system, three fluid absorption refrigeration system and comparison of compression and absorption refrigeration systems.

Other Refrigeration systems: Working principles of Steam jet refrigeration system, Thermoelectric refrigeration system, Solar refrigeration system, Vortex & Pulse tube refrigeration system.

UNIT IV INTRODUCTION TO AIR CONDITIONING SYSTEMS 9 hours

Psychrometric Properties & Processes, Characterization of Sensible and Latent Heat Loads, Need for Ventilation, Consideration of Infiltrated Air, Heat Load Concepts.

Air Conditioning Systems: Air Cooler (Evaporative Cooling), Window, Split, Summer, Winter, Year-Round, Central Air Conditioning Systems.

UNIT V AIR CONDITIONING EQUIPMENT 9 hours

Air Conditioning Equipment: Humidifiers, Dehumidifiers, Air Filters, Fans and Blowers. Inverter Technology in Air conditioners.

Human Comfort: Requirements of Temperature, Humidity and Concept of Effective Temperature, Comfort Chart. Heat Pump, Heat Sources, Different Heat Pump Circuits.

Course Outcomes:

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

CO1: Apply thermodynamic principles to evaluate the performance of vapor compression refrigeration systems including subcooling and superheating effects. (L3)

CO2: Explain the function and classification of VCR components and identify suitable refrigerants based on their properties and environmental impact. (L2)

CO3: Analyze and compare vapour absorption refrigeration systems with alternative refrigeration technologies for specific applications. (L4)

CO4: Apply psychrometric principles to assess heat loads and select appropriate air conditioning systems for various climate conditions. (L3)

CO5: Describe the role of air conditioning equipment and heat pump systems in achieving indoor human comfort conditions. (L2)

Textbooks:

1. Arora, C. P. (2020). Refrigeration and air conditioning (4th ed.). McGraw Hill Education.
2. Domkundwar, S. C., Arora, A., & Domkundwar, V. M. (2021). A course in refrigeration and air conditioning (Revised ed.). Dhanpat Rai & Co.
3. Ballaney, P. L. (2023). Refrigeration and air conditioning (Revised ed.). Khanna Publishers.

Reference Books:

1. Stoecker, W. F., & Jones, J. W. (2020). Refrigeration and air conditioning (2nd ed.). McGraw Hill Education.
2. Dossat, R. J., & Horan, T. J. (2019). Principles of refrigeration (5th ed.). Pearson Education.
3. Threlkeld, J. L. (2018). Thermal environmental engineering (3rd ed.). Pearson Education.

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

Open Elective - IV

23EEE303 ROBOTICS

	L	T	P	C
Pre-requisite: Nil	3	0	0	3

Course Objectives:

The objectives of the course are to make the students learn about:

Robotics is an interdisciplinary area ranging from mechanical & electrical component design to advanced sensor technology, incorporating computer systems and Artificial Intelligence (AI). With advances in AI-techniques & computational power in recent years, it has become one of the most interesting areas for multidisciplinary research, with lots of commercial applications already in market.

UNIT I INTRODUCTION, TRANSFORMATION AND MAPPING 9 hours

Evolution of Robots and Robotics, Laws of Robotics, Advancement in Robots, Robot Anatomy, Human Arm Characteristics, Design and Control Issues, Manipulation and Control, Sensors and Vision, Robotic Programming and Future Prospects. Coordinate Frames, Object Description in Space, Transformation of Vectors, Inverting a homogenous transform, Fundamental Rotation Matrices.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9 hours

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers. Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS AND MACHINE VISION 9 hours

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors, binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.

UNIT IV ROBOT KINEMATICS 9 hours

Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems.

UNIT V ROBOT PROGRAMMING, IMPLEMENTATION AND ECONOMICS **9 hours**

Commands, Sensor Commands, End Effector commands and simple Programs. RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

Course Outcomes:

After completing this Unit, students will be able to
CO1: Understand the fundamentals of Robotics.
CO2: Analyze the robot drive system.
CO3: Understand the various sensors and actuators.
CO4: Analyze the mechanical structure and notations kinematic model.
CO5: Implement the basic commands for robots.

Textbooks:

1. Mittal, R. K. and Nagrath, I.J., Robotic and Control, Tata McGraw Hill, New Delhi, 2003.
2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 2015. ISBN: 978-8173719547

Reference Books:

1. Fu, K.S., Gonzalez, R.C., and Lee, C.S.G., Robotics Control, Sensing, Vision and Intelligence, McGraw Hill, 1988.
2. Craig, J.J., Introduction to Robotics: Mechanism & Control. Addison Wesley, 1986.
3. Paul, R.P., Robot Manipulator: Mathematics Programming & Control. MIT Press, 1981.
4. Pugh, A., Robot Sensors, Vision Vol.-I. Springer Verlag, 1986.
5. Groover, M.P., Industrial Robotics Technology, programming & Application, McGraw Hill

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

Open Elective - IV

23EEE304 SMART GRID TECHNOLOGIES

L	T	P	C
3	0	0	3

Pre-requisite: 23EEE101

Course Objectives:

The objectives of the course are to make the students learn about:

1. To understand the evolution, need, architecture, and enabling technologies of smart grids.
2. To analyze synchro phasor technology and the operation of wide area monitoring systems using PMU and PDC.
3. To apply smart metering concepts including AMR, AMI, and demand side management techniques.
4. To evaluate communication technologies and protocols used in smart grid systems.
5. To design smart grid applications with renewable integration, energy storage, and cybersecurity measures.

UNIT I INTRODUCTION TO SMART GRID 9 hours

Evolution of Electric Grid – Need for Smart Grid – Difference between conventional & smart grid – Overview of enabling technologies – International experience in Smart Grid deployment efforts – Smart Grid road map for India – Smart Grid Architecture

UNIT II WIDE AREA MONITORING SYSTEM 9 hours

Fundamentals of Synchro phasor Technology – concept and benefits of Wide Area Monitoring System – Structure and functions of Phasor Measuring Unit (PMU) and Phasor Data Concentrator (PDC) – Road Map for Synchrophasor applications (NAPSI) – Operational experience and Blackout analysis using PMU - Case study on PMU.

UNIT III SMART METERS 9 hours

Features and functions of Smart Meters – Functional specification – category of Smart Meters – Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) drivers and benefits – AMI protocol – Demand Side Integration: Peak load, Outage and Power Quality management.

UNIT IV INFORMATION AND COMMUNICATION TECHNOLOGY 9 hours

Overview of Smart Grid Communication system – Modulation and Demodulation Techniques: Radio Communication – Mobile Communication – Power Line Communication – Optical Fibre Communication – Communication Protocol for Smart Grid

UNIT V SMART GRID APPLICATIONS AND CYBER SECURITY 9 hours

Applications : Overview and concept of Renewable Integration – Introduction to distributed generation - Role of Protective Relaying in Smart Grid – House Area Network – Advanced Energy Storage Technology: Flow battery – Fuel cell – SMES – Super capacitors – Plug – in Hybrid electric Vehicles - Cyber Security: Security issues in DG, Distribution Automation, AMI, Electric Vehicle Management Systems – Approach to assessment of smart grid cyber security risks – Methodologies. Cyber Security requirements – Smart Grid Information Model.

Course Outcomes:

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

CO1: Understanding the Concept and Evolution of Smart Grids. L2

CO2: Analyzing Wide Area Monitoring System and Synchrophasor Technology. L4

CO3: Applying Smart Metering and Advanced Metering Infrastructure (AMI) Concepts. L3

CO4: Evaluating Information and Communication Technology (ICT) Systems in Smart Grids. L5

CO5: Designing Smart Grid Applications and Cybersecurity Measures. L6

Textbooks:

1. James Momoh, "SMART GRID : Fundamentals of Design and Analysis", John Wiley and Sons, New York, 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & Sons, New Jersey, 2012

Reference Books:

1. Power Grid Corporation of India Limited, "Smart Grid Primer", 1st Edition, Power Grid Corporation of India Limited, Bangalore, India, 2013
2. Fereidoon.P.Sioshansi, "Smart Grid – Integrating Renewable, Distributed and Efficient Energy",1st Edition, Academic Press, USA, 2011.
   Reactive Power Control in Electric Systems, T J E Miller, John Wiley & Sons, New York, 1982.
3. Phadke A G, Thorp J S, "Synchronized Phasor Measurements and Their Applications", 1st Edition, Springer, Newyork, 2012.

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

Open Elective - IV

23ECE303 EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Objectives:

1. Introduce the building blocks in embedded hardware and firmware design
2. Explore Real-Time Operating Systems (RTOS) and their implementation.
3. Understand multitasking, scheduling, and real-time constraints.
4. Design embedded applications using ARM Cortex architecture.
5. Apply software/hardware co-design and UML modeling techniques.

UNIT I FUNDAMENTALS OF EMBEDDED SYSTEMS 9 hours

Embedded System Overview & Characteristics, Embedded vs General Purpose Systems, Embedded Processors: RISC, CISC, DSP, ARM Cortex-M, Memory Architecture: Flash, SRAM, EEPROM; Sensors, Actuators, ADC / DAC Interfaces, Case Studies of Consumer and Industrial Embedded Systems

UNIT II EMBEDDED SOFTWARE DEVELOPMENT & RTOS BASICS 9 hours

Embedded C: Startup Code, Interrupts, GPIOs, Timers; IDEs, Cross Compilers, Linkers, Debuggers, Operating System Concepts, Real-Time Operating System (RTOS) Introduction, RTOS Concepts: Task Scheduling, Context Switching, Preemptive vs Cooperative Scheduling, Task Creation, Priorities, Stack Management, Multitasking: Processes, Threads, Scheduling (Round Robin, Priority-based), RTOS Examples: FreeRTOS, Zephyr RTOS, Mbed OS (Concepts only).

UNIT III INTERFACING, COMMUNICATION AND RTOS SERVICES 9 hours

Interfacing with Peripherals: UART, SPI, I2C; Semaphores, Mutexes, Message Queues, Pipes; Shared Memory and Synchronization Issues; ISRs and Event flags, Device Drivers Basics (Polling, Interrupts), Choosing and Porting RTOS to Microcontrollers.

UNIT IV FIRMWARE DEVELOPMENT AND ARM ARCHITECTURE 9 hours

Firmware Boot Process, Startup Code, Linker Scripts, Memory Map, Startup Routine, ARM CortexM Architecture Overview, System Control Block (SCB), NVIC, Systick Timer, Memory Protection Unit (MPU), Exception Handling, Real-world Applications of ARM-based Embedded Systems.

UNIT V EMBEDDED SYSTEM DESIGN AND MODELING 9 hours

System Design Cycle: Requirement Analysis to Testing, Hardware/Software Partitioning, UML for Embedded Design: Use Case, Sequence, Activity Diagrams, Co-design Techniques, Co-simulation Tools, Single-Core vs Multi-Core Embedded Systems, Performance Metrics, Power Optimization in Embedded Systems.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Describe the structure and functionality of embedded systems.
CO2: Develop embedded programs using C and understand RTOS principles.
CO3: Design multitasking embedded applications using RTOS mechanisms.

CO4: Implement firmware with real-time constraints on ARM microcontrollers.
CO5: Apply UML and co-design techniques for embedded system modeling.

Textbooks:

1. Mazidi M.A., Mazidi J.G., "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2013.
2. Sloss, A.N., Symes, D., "ARM System Developer's Guide", Morgan Kaufmann, 2004.
3. Jonathan Valvano, "Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers", CreateSpace, 2017.

Reference Books:

1. Steve Furber, "ARM System-on-Chip Architecture", Pearson, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newnes, 2008.
3. Heath S., "Embedded Systems Design", Elsevier, 2009.
4. Joseph Yiu, "The Definitive Guide to ARM Cortex-M3/M4 Processors", Newnes.
5. Peter Marwedel, "Embedded System Design", Springer.

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

Open Elective - IV

23ECE304 COMMUNITY RADIO TECHNOLOGY

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Objectives:

The main objectives of the course are to

1. Associate the concept of fundamentals in Community Radio in Local Communication and development.
2. Gain knowledge of Studio technology and operations including Soundboards, Microphones, Recording, scheduling, content creation, and team coordination.
3. Develop skills in Audio Pre-production and post-production such as recording, editing, and mixing audio content.
4. Categorize the Radio Transmission Technology comprising signal requirements aligning with factors affecting Coverage and Shadow Areas.
5. Explore Radio Transmission technology essentials and understand the technical aspects of setting up and maintaining an FM transmitter.

UNIT I COMMUNITY RADIO CONCEPT AND CR STATION 9 hours

Introduction to Radio Broadcasting - Evolution of Community Radio (CR) - CR Policy Guidelines and Implications – CR Technology and Equipment; Components of a CR Station - Studios for Community Radio- Power Consumption and Conservation- Alternative Sources of Energy

UNIT II STUDIO TECHNOLOGY & OPERATIONS 9 hours

Basics of Sound - Components of Sound - Propagation of Sound Waves - Components of the Audio Chain - Audio Chain in a typical Broadcast Studio - Studio Acoustics; Techniques of Handling Various Tools - Types of Connectors & Audio Cables - Preventive and Corrective Maintenance - Content Distribution: Internet, Wireless Mesh Networking (WiMesh) & Mobile Telephony

UNIT III AUDIO PRE & POST PRODUCTION 9 hours

Audio Cables and Connectors– Recording Audio in the Field - Audio Cables and Connectors - Open Source Software for CR - Conventional Landline Systems- GSM/CDMA - Voice Over Internet Protocol (VoIP); Sound Recording and Editing - Mixing and Mastering - File Formats and Compression Transmission - Storing and Retrieval

UNIT IV RADIO TRANSMISSION TECHNOLOGY 9 hours

Transmission Chain Overview – Connectivity & Audio Processor/Limiter - Antenna (Types and Polarization) – Transmitter Maintenance and Fault Diagnosis - Antenna and Coaxial Cable - Antenna System - Propagation and Coverage – Field Strength Measurements and Drawing an Actual Coverage Map

UNIT V FM TRANSMITTER SETUP 9 hours

Mounting and Connecting the Transmitter- Interpretation of the Transmitter Meter Readings and Indications - Mounting and Connecting the Transmitter - Reporting on the Basis of Visual Observation - Checking Earth Conductivity - Transmitter Operation and Upkeep Issues

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Interpret the evolution with a framework of Community Radio with Technical Principles and essential Radio Spectrums. (L2)

CO2: Apply Studio Technology and Operational practices with the components of the Audio Chain including Acoustics and Equipment maintenance. (L3)

CO3: Conduct Comprehensive Audio Pre & Post-production to operate field Recordings with Hardware and Open-source software to manage sound recording, editing, mixing, mastering and file compression. (L4)

CO4: Infer the principles of FM transmission, Antenna systems, Radio wave propagation and factors affecting coverage. (L5)

CO5: Demonstrate knowledge of the connecting audio feeds for Transmitter setup by resolving operational Issues with corrective maintenance. (L6)

Textbook(s)

1. Pooja Murada R. Sreedher, *Community Radio in India*, Aakar Books, 2019.

2. Prof. Raj Misra, *Community Radio By the people, For the People*, Orange Books Publication, 2022

3. Fraser, Colin, and Sonia Restrepo Estrada, *Community radio handbook*. Paris: Unesco, 2001.

Reference Books

1. Juliet Fox, *Community Radio's Amplification of Communication for Social Change*, 7th Edition, Palgrave Macmillan (Springer International Publishing.), 2019.

2. Kanchan K. Malik, Vinod Pavarala, *Community Radio in South Asia: Reclaiming the Airwaves*, Routledge India, 2020.

Online Material links:

1. "Certificate in Community Radio Technology (CCRT)"
   https://www.cemca.org/resources/certificate-community-radio-technology-ccrt-0

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

PROFESSIONAL ELECTIVES

Professional Elective – II

23CST401 INTERNET AND WEB PROGRAMMING

L	T	P	C
3	0	0	3

Pre-requisite NIL

Course Description:

This course aims to comprehend and analyze the basic concepts of web programming and internet protocols. It also aims to describe how the client-server model of Internet programming works. This course aims to demonstrate the uses of scripting languages and their limitations.

Course Objectives:

After successfully completing the course, the student should be able to

1. Differentiate web protocols and web architecture.
2. Make use of JavaScript, HTML and CSS effectively to create interactive and dynamic websites.
3. Implement client-side scripting and server-side script using PHP, JSP and Servlets.
4. Develop XML based web applications.
5. Improve the network and firewall security.

UNIT I INTRODUCTION TO INTERNET & WEB ESSENTIALS 9 hours

Overview of Internet- Networks - Web Protocols — Web Organization and Addressing - Web Browsers and Web Servers -Web System Architecture – URL - Domain Name – HTTP request message-response message.

UNIT II WEB DESIGNING & XML 9 hours

HTML5 – Form elements, Input types and Media elements, CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layout, User Interface-Anatomy of xml document - XML Markup-working with elements and attributes - creating valid documents-xml objects-
XSL, XSLT, XML Schema-JSON, Case Study.

UNIT III CLIENT-SIDE & SERVER-SIDE SCRIPTING 9 hours

JavaScript- Introduction –Functions – Arrays – Operators – DOM, Built-in Objects, Regular Expression, Exceptions, Event handling, Validation- AJAX - JQuery.
Introduction to PHP – Operators – Conditionals – Looping – Functions – Arrays- Date and Time Functions – String functions - File Handling - File Uploading.

UNIT IV SESSION MANAGEMENT and DATABASE CONNECTIVITY 9 hours

Sessions-Cookies-MySQL Basics – Querying single and multiple MySQL Databases with PHP – PHP Data Objects.

UNIT V INTERNET SECURITY 9 hours

Introduction to Internet Security-Understanding Firewalls-Hackers-TCP/IP from a security view point –sockets and services-Encryption. Firewall Technology-packet filtering- Network Address Translation-application-level proxies-VPN- ideal firewall.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Understand the fundamentals of Internet web protocols.

CO2: Develop the design thinking capability.

CO3: Design a component or a product applying all the relevant standards and with realistic constraints.

CO4: Infer a good working knowledge of HTML5 & CSS.

CO5: To apply the security fundamental in Internet and Web programming.

Textbooks:

1. Paul Deitel, Harvey Deitel, Abbey Deitel, Internet & World Wide Web - How to Program, 5th edition, Pearson Education, 2012.
2. Thomas A.Powell, The Complete Reference Web design, Tata McGraw-Hill, 2000.

Reference Books:

1. Lindsay Bassett, Introduction to JavaScript Object Notation, 1st Edition, O'Reilly Media, 2015
2. Fritz Schneider, Thomas Powell , JavaScript – The Complete Reference, 3rd Edition, Mc-Graw Hill, 2017

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

Professional Elective – II

23CST402 CYBER SECURITY

L	T	P	C
3	0	0	3

Pre-requisite NIL

Course Description:

The course is designed to provide awareness on different cybercrimes, cyber offenses, tools and methods used in cybercrime.

Course Objectives:

1. Understand the fundamental concepts of cybercrime, types of cybercriminals, and legal frameworks with a focus on Indian and global perspectives.
2. Identify how cybercrimes are planned and executed using social engineering, botnets, and other modern attack strategies.
3. Analyze security challenges associated with mobile and wireless devices, and understand organizational countermeasures.
4. Explore the tools, techniques, and malware commonly used in cybercrime and assess their impact on digital security.
5. Evaluate the organizational implications of cybercrimes including cost, privacy, IPR concerns, and policy frameworks for cybersecurity.

UNIT I INTRODUCTION TO CYBERCRIME 9 hours

Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

UNIT II CYBER OFFENSES: HOW CRIMINALS PLAN THEM 9 hours

Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

UNIT III CYBERCRIME: MOBILE AND WIRELESS DEVICES 9 hours

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

UNIT IV TOOLS AND METHODS USED IN CYBERCRIME 9 hours

Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

UNIT V CYBER SECURITY: ORGANIZATIONAL IMPLICATIONS 9 hours

Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Course Outcomes:

After completion of the course, students will be able to

CO1: Classify the cybercrimes and understand the Indian ITA 2000

CO2: Analyse the vulnerabilities in any computing system and find the solutions

CO3: Predict the security threats of the future

CO4: Investigate the protection mechanisms

CO5:Design security solutions for organizations

Textbooks:

1. Cyber Security: Under standing Cyber Crimes, Computer Forensics and Legal Perspectives, NinaGodbole and Sunil Belapure, Wiley INDIA.

Reference Books:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security ,Chwan-Hwa(john) Wu,J.DavidIrwin.CRC Press T&F Group

Online Learning Resources:

http://nptel.ac.in/courses/106105031/40
http://nptel.ac.in/courses/106105031/39
http://nptel.ac.in/courses/106105031/38

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

Professional Elective – II

23CST403 DevOps

L	T	P	C
3	0	0	3

Pre-requisite **23CST109**

Course Description:
This course provides an in-depth understanding of DevOps principles to enhance collaboration, automation, and performance in software development and IT operations. Students will gain hands-on experience in CI/CD, infrastructure as code, and containerization tools, focusing on end-to-end automation using modern DevOps tools and best practices. It prepares learners to manage development pipelines, deployment strategies, and cloud-based infrastructure effectively.

Course Objectives:
1. Understand collaboration and productivity by automating infrastructure and workflows
2. Familiarize with continuous measuring applications performance

UNIT I FOUNDATIONS OF DEVOPS AND ITS EVOLUTION 9 hours

Dev Ops: An Overview, Dev Ops: Origins, Dev Ops: Roots, Dev Ops: Practices Dev Ops: Culture. **Adopting Dev Ops:** Developing the Playbook. Developing a Business Case for a Dev Ops: Developing the Business Case

UNIT II CUSTOMER SEGMENTS AND DEVOPS VALUE CHAIN 9 hours
Completing the Business Model Canvas, Customer Segments, Value Segments, Value Propositions, Channels, Customer Relationships, Revenue Streams, Key Resources, Key Activities, Key Partnerships, Cost Structures. Dev Ops Plays for Optimizing the delivery Pipeline: Dev Ops as an optimization Exercise, Core Themes, The Dev Ops Plays, Specializing Core Plays

UNIT III DEVOPS TOOLCHAIN AND LIFECYCLE PHASES 9 hours
Dev Ops Plays for Driving Innovation: Optimize to Innovate, The Uber Syndrome, Innovation and the Role of Technology, Core Themes, play: Build a Dev Ops Platform, play: Deliver Micro Services Architectures, play: DevOps an API Economy, play: Organizing for Innovation.

UNIT IV SCALING DEV OPS FOR THE ENTERPRISE 9 hours
Scaling Dev Ops for the Enterprise: Core Themes, play: Dev Ops Center of Competency, play: Developing Culture of Innovation at Scale, play: Developing a Culture of continuous Improvement, play: Team Models for Dev Ops, play: Standardization of Tools and Process, play: Security Considerations for Dev Ops, Play: Dev Ops and Outsourcing.

UNIT V LEADING DEV OPS ADOPTION IN THE ENTERPRISE 9 hours
Leading Dev Ops Adoption in the Enterprise: Play: Dev Ops as a transformation Exercise, play: Developing a Culture of Collaboration and Trust, play: Dev Ops Thinking for the Line of Business, play: starting with Pilot Projects, Play: Rearing Unicorns on an Aircrafts Carrier. Appendix Case Study: Example Dev Ops Adoption Roadmap Organization Background, Roadmap Structure, Adoption Roadmap.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Enumerate the principles of continuous development and deployment, automation of configuration management, inter-team collaboration, and IT serviceability

CO2: Describe Dev Ops &Dev Sec Ops methodologies and their key concepts

CO3: Illustrate the types of version control systems, continuous integration tools, continuous monitoring tools, and cloud models

CO4: Set up complete private infrastructure using version control systems and CI/CD tools

CO5: Analyze and apply strategies for enterprise-wide DevOps adoption, including scaling practices, cultural transformation, and innovation enablement.

Textbook(s)

1. Sanjeev Sharma, The Dev Ops Adoption Playbook, Published by John Wiley & Sons, Inc.2017

Reference Books

1. Sanjeev Sharma & Bernie Coyne, Dev Ops for Dummies, Published by John Wiley & Sons, Inc.
2. Michael Huttermann, Dev Ops for Developers, Apress publishers,2012.

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

Professional Elective – II

23CST404 SOFTWARE TESTING METHODOLOGIES

L	T	P	C
3	0	0	3

Pre-requisite **NIL**

Course Description:

The basic objective of Software testing methodologies course provides a comprehensive understanding of various techniques, strategies, and tools used to ensure software quality. It covers fundamental concepts, different testing levels (unit, integration, system, etc.), and various testing types (functional, non-functional, etc.). Students learn to design test cases, identify bugs, automate tests, and understand the software testing life cycle. The course also explores testing tools and their application in real-world scenarios.

Course Objectives:

1. To study the fundamental concepts of software testing which includes objectives, process, criteria, strategies, and methods.
2. To discuss various software testing types and levels of testing like black and white box testing along with levels unit test, integration, regression, and system testing.
3. It also helps to learn the types of bugs, testing levels with which the student can very well identify a bug and correct as when it happens.
4. It provides knowledge on transaction flow testing and data flow testing techniques so that the flow of the program is tested as well.
5. To learn the domain testing, path testing and logic based testing to explore the testing process easier.

UNIT I INTRODUCTION TO SOFTWARE TESTING AND PATH TESTING 9 hours

Introduction:-Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs, **Flow graphs and Path testing**:- Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT II SOFTWARE TESTING: FLOWS AND DATA 9 hours

Transaction Flow Testing: - Transaction flows, transaction flow testing techniques. **Dataflow Testing: -** Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing.

UNIT III SOFTWARE DOMAIN & INTERFACE TESTING 9 hours

Domain Testing:-domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability.

UNIT IV SOFTWARE TESTING: PATHS, LOGIC & REGULAR EXPRESSIONS 9 hours

Paths, Path products and Regular expressions: - path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection. Logic Based Testing:-over view, decision tables, path expressions, kv charts and specifications.

UNIT V SOFTWARE TESTING: STATES AND GRAPH ANALYSIS 9 hours

State, State Graphs and Transition testing: - state graphs, good & bad state graphs, state testing, Testability tips. Graph Matrices and Application:-Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools.

Course Outcomes:

CO1: Upon successful completion of the course, students will be able to
CO2: Know the basic concepts of software testing and its essentials.
CO3: Able to identify the various bugs and correcting them after knowing the consequences of the bug.
CO4: Use of program 's control flow as a structural model is the corner stone of testing.
CO5: Performing functional testing using control flow and transaction flow graphs.

Textbook(s)

1. Software Testing techniques – Boris Beizer, Dreamtech, second edition.
2. Software Testing Tools – Dr. K.V.K.K. Prasad, Dreamtech.

Reference Books

1. The craft of software testing – Brian Marick, Pearson Education.
2. Software Testing Techniques – SPD(Oreille).
3. Software Testing in the Real World – Edward Kit, Pearson.
4. Effective methods of Software Testing, Perry, John Wiley.
5. Art of Software Testing – Meyers, John Wiley.

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

Professional Elective – II

23CST405 GRAPHICS AND MULTIMEDIA

L	T	P	C
3	0	0	3

Pre-requisite **NIL**

Course Description:

This course will give the introduction to the field of graphics and multimedia computing to meet the diverse requirements of application areas such as entertainment, industrial design, virtual reality, intelligent media management, social media and remote sensing. It covers both the underpinning theories and the practices of computing and manipulating digital media including graphics / image, audio, animation, and video.

Course Objectives:

1. To study the graphics techniques and algorithms.
2. To study the multimedia concepts and various I/O technologies.
3. To enable the students to develop their creativity

UNIT I OUTPUT PRIMITIVES 9 hours

Introduction - Line - Curve and Ellipse Algorithms – Attributes – Two-Dimensional Geometric Transformations – Two-Dimensional Viewing.

UNIT II THREE-DIMENSIONAL CONCEPTS 9 hours

Three-Dimensional Object Representations – Three-Dimensional Geometric and Modeling Transformations – Three-Dimensional Viewing – Color models – Animation.

UNIT III MULTIMEDIA SYSTEMS DESIGN 9 hours

An Introduction – Multimedia applications – Multimedia System Architecture – Evolving technologies for Multimedia – Defining objects for Multimedia systems – Multimedia Data interface standards – Multimedia Databases.

UNIT IV MULTIMEDIA FILE HANDLING 9 hours

Compression & Decompression – Data & File Format standards – Multimedia I/O technologies - Digital voice and audio – video image and animation – Full motion video – Storage and retrieval Technologies.

UNIT V HYPERMEDIA 9 hours

Multimedia Authoring & User Interface – Hypermedia messaging - Mobile Messaging – Hypermedia message component – creating Hypermedia message – Integrated multimedia message standards – Integrated Document management – Distributed Multimedia Systems.

Course Outcomes:

Upon successful completion of the course, students will be able to
CO1: Design two-dimensional graphics.
CO2: Apply two-dimensional transformations.
CO3: Design three-dimensional graphics.
CO4: Apply three-dimensional transformations.
CO5: Apply Illumination and color models.

Textbooks:

1. Donald Hearn and M.Pauline Baker, "Computer Graphics C Version", Pearson Education, 2003.
2. Prabat K Andleigh and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003.

Reference Books:

1. Andleigh, P. K and Kiran Thakrar, ―Multimedia Systems and Design, PHI, 2003.
2. Hughes JF, Van Dam A, McGuire M, Foley JD, Sklar D, Feiner SK, Akeley K. Computer graphics: principles and practice. Pearson Education; 2014.

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

Professional Elective - III

23CST406 PERCEPTION AND COMPUTER VISION

L	T	P	C
3	0	0	3

Pre-requisite Nil

Course Description:

The objective of learning computer vision is to develop the skills and knowledge necessary to create algorithms and programs that can automatically analyze and interpret digital images and videos. This involves understanding the fundamental principles of image processing, pattern recognition, and machine learning, and applying these techniques to real-world problems such as object detection, face recognition, autonomous navigation, and medical image analysis.

Course Objectives:

1. To understand the fundamental concepts related to Image formation and processing.
2. To learn feature detection, matching and detection
3. To become familiar with feature-based alignment and motion estimation
4. To develop skills on 3D reconstruction
5. To understand image-based rendering and recognition

UNIT I INTRODUCTION TO IMAGE FORMATION AND PROCESSING 9 hours

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II FEATURE DETECTION, MATCHING AND SEGMENTATION 9 hours

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 9 hours

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT IV 3D RECONSTRUCTION 9 hours

Shape from X - Active range finding - Surface representations - Point-based representations Volumetric representations - Model-based reconstruction - Recovering texture maps and albedos.

UNIT V IMAGE-BASED RENDERING AND RECOGNITION 9 hours

View interpolation Layered depth images - Light fields and Lumi graph - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

Course Outcomes:

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

CO1: Understand basic knowledge, theories and methods in image processing and computer vision

CO2:Understand the feature detection, matching and segmentation process for perception and Computer Vision.

CO3: Apply 2D a feature-based based image alignment, segmentation, and motion estimations

CO4: Apply 3D image reconstruction techniques

CO5: Design and develop innovative image processing and computer vision applications

Textbook(s)

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

Reference Books

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006 3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012

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

Professional Elective – III

23CST407 BIG DATA ANALYTICS

L	T	P	C
3	0	0	3

Pre-requisite Nil

Course Description:

This course introduces fundamental concepts and tools required to understand Big Data analytics. The also discusses big data applications in Data Science and covers the applications and technologies needed to process the large-scale data.

Course Objectives:

1. To learn data mining and big data basics
2. To learn the big data in technology perspective
3. To learn Hadoop framework for data analytics
4. Applying HIV and PIG paradigms to solve problems.
5. To interpret the potential applications in big data scenario.

UNIT I INTRODUCTION TO DATA MINING AND BIG DATA 9 hours

Introduction to Data mining, KDD process, Data Mining Techniques: Mining Frequent patterns, Association rule, Cluster analysis, Classification and Regression. Introduction to Big Data - What is Big Data? Explosion in Quantity of Data, Big Data Characteristics, Types of Data, Common Big data Customer Scenarios, BIG DATA vs. HADOOP, A Holistic View of a Big Data System, Limitations of Existing Data Analytics Architecture.

UNIT II DATA ANALYTICS LIFE CYCLE 9 hours

Introduction to Big data Business Analytics - State of the practice in analytics role of data scientists- Key roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders.

UNIT III INTRODUCTION TO HADOOP 9 hours

Why DFS? What is Hadoop? Hadoop Distribution, Hadoop Key Characteristics, RDBMS vs. Hadoop, Hadoop 2.x Cluster Architecture, Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read., Name Node, Secondary Name Node, and Data Node, Hadoop 2.0 New Features – Name Node High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN Hadoop Distributed File System.

UNIT IV HIVE & PIG 9 hours

Exploring Hive: Introducing Hive, Getting Started with Hive, Hive Services, Data Types, Built- in Functions, Hive-DDL, Data Manipulation, Data Retrieval Queries, Using Joins. Analyzing Data with Pig: Introducing Pig, Running Pig, Getting started with Pig Latin, working `with operators in Pig, Debugging Pig, Working with Functions in pig, Error Handling in Pig.

UNIT V DATA SCIENCE AND APPLICATIONS 9 hours

Streams and Files - Streams – Text Input and Output – Reading and Writing Binary Data.
Data Loading Techniques & Data Analysis, Text Analytics for Large unstructured information, Analytic Stack, Big Data Applications - Fraud detection in Stock markets, Sentiment Analysis.

Course Outcomes:

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

CO1: Understanding of data mining and big data basics, including key concepts, techniques, and methodologies.

CO2: Analyze big data from a technological perspective, evaluating its impact on various industries and identifying the challenges and opportunities it presents.

CO3: Demonstrating proficiency in storing, processing, and analyzing large datasets.

CO4: Apply the HIV and PIG paradigms to solve real-world problems.

CO5: Evaluate the potential applications of big data in various scenarios, identifying suitable use cases and understanding the implications for decision-making and business strategy.

Textbook(s)

1. Jiawei Han, Jian Pei, Hanghang Tong, Data Mining: Concepts and Techniques, Fourth Edition, Morgan Kaufmann, 2022.
2. Tom White, “Hadoop: The Definitive Guide”, 3rd Edition, O’reilly, 2012.
3. Alberto Cordoba, “Understanding the Predictive Analytics Lifecycle”, Wiley, 2014.
4. Eric Siegel, Thomas H. Davenport, “Predictive Analytics: The Power to Predict Who WillClick, Buy, Lie, or Die”, Wiley, 2013.

Reference Books

1. Chuck Lam ,Hadoop in Action, Manning, Second Edition ,2016
2. Mark Gardener, Beginning R: The Statistical Programming Language, Wiley, 2013

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

Professional Elective – III

23CST408 DIGITAL FORENSICS

L	T	P	C
3	0	0	3

Pre-requisite **NIL**

Course Description:
This course on Computer Forensics aims to provide an in-depth understanding of the principles, techniques, and tools used in the investigation of computer-related crimes. The course will cover topics such as digital evidence acquisition, preservation, analysis, and presentation. Students will learn how to conduct forensic investigations of computers, networks, and digital devices, and how to present their findings in a court of law.

Course Objectives:
The purpose of learning this course is to:

1. Understand the fundamental principles and concepts of digital forensics.
2. Develop skills for collecting and analyzing various types of digital evidence.
3. Gain knowledge of the legal and ethical considerations in conducting digital forensic investigations.
4. Acquire proficiency in using digital forensic tools and techniques.
5. Apply critical thinking and problem-solving skills to real-world digital forensic scenarios.

UNIT I INTRODUCTION TO COMPUTER FORENSICS 9 hours

Introduction to Digital Forensics - Digital evidence types and characteristics, Applications of digital forensics, Digital forensics challenges and limitations.
Types of Digital Evidence - Computer and mobile device evidence, Network and cloud evidence, social media and web-based evidence, IoT device and vehicle forensics.
Forensic Investigations Process - Incident response and evidence collection, Evidence handling and analysis, Reporting and documentation.

UNIT II DIGITAL EVIDENCE ACQUISITION 9 hours
Digital Evidence Collection and Preservation - Evidence identification and collection, Data integrity and preservation, Chain of custody and documentation.
Types of Digital Evidence - Computer and mobile device evidence, Network and cloud evidence, Social media and web-based evidence, IoT device and vehicle forensics.
Digital Evidence Storage and Handling - Digital evidence storage methods, Secure handling and storage of digital evidence.

UNIT III DIGITAL EVIDENCE ANALYSIS 10 hours
File Systems and Data Recovery - Introduction to file systems and data structures, File system analysis, Disk structures and metadata, Recovering deleted and hidden files.
Network Forensics and Malware Analysis - Network analysis and reconstruction, Network traffic capture and analysis, Malware analysis and investigation.

UNIT IV DIGITAL FORENSIC TOOLS AND TECHNIQUES 10 hours

Digital Forensic Toolkits - Introduction to digital forensic toolkits, Choosing and configuring a toolkit, Available commercial toolkits.
Cloud Forensics - Introduction to cloud forensics, Cloud storage and security models, Cloud service provider analysis, Cloud data acquisition and analysis. Case Study: An open-source digital forensics platform – Autopsy.

UNIT V LEGAL AND ETHICAL ISSUES IN COMPUTER FORENSICS 7 hours

Digital Forensic Laws and Regulations - Overview of digital forensic laws and regulations, Legal principles and procedures, Legal issues related to digital evidence.
Ethics in Digital Forensics - Overview of ethics in digital forensics, Ethical considerations for digital forensic examiners, Ethical principles for handling digital evidence, Ethical conflicts and challenges in digital forensics.

Course Outcomes:

Upon successful completion of the course, students will be able to

- CO1: Identify and classify different types of digital evidence, including computer systems, networks, mobile devices, and cloud services.
- CO2: Demonstrate proficiency in digital evidence collection, preservation, and analysis techniques.
- CO3: Explain and adhere to legal and ethical standards in digital forensic investigations.
- CO4: Utilize digital forensic tools and techniques to investigate and solve forensic cases.
- CO5: Analyze and evaluate digital forensic findings, and effectively communicate the results through comprehensive reports.

Textbook(s)

1. "Computer Forensics: Principles and Practices" by Linda Volonino and Reynaldo Anzaldua, 1st edition, Publisher: Pearson (August 31, 2006).
2. "Computer Forensics and Cyber Crime: An Introduction" by Marjie T. Britz, 3rd edition, Publisher: Pearson (July 14th, 2021).
3. "Digital Forensics: Threatscape and Best Practices" by John Sammons and Michael R. Masino, 1st Edition, Publisher: CRC Press (2022)

Reference Books

1. "Practical Digital Forensics" by Richard Boddington, 2nd Edition, Publisher: Packt Publishing (2021)
2. "Digital Forensics and Incident Response: A Practical Guide to Deploying Digital Forensic Techniques" by Gerard Johansen and Mark Menzies, 1st Edition, Publisher: Wiley (2020)
3. "Guide to Computer Forensics and Investigations" by Bill Nelson, Amelia Phillips, and Christopher Steuart, 6th edition, Publisher: Cengage India Private Limited (1 October, 2020).

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

Professional Elective – III

23CST409 MODELING AND SIMULATION

L	T	P	C
3	0	0	3

Pre-requisite **NIL**

Course Description:

The course on Modelling and Simulation provides students with a comprehensive understanding of the principles, techniques, and tools involved in creating and analyzing models to simulate real-world systems. Students will gain hands-on experience in designing models, selecting appropriate simulation techniques, and analyzing the results to make informed decisions. The course aims to enhance students' problem-solving and analytical skills, enabling them to tackle complex system dynamics and optimize performance.

Course Objectives:

By the end of this course, students will be able to:

1. Understand the fundamental concepts and principles of modelling and simulation.
2. Develop mathematical and computational models for real-world systems.
3. Apply various simulation techniques to study system behavior and performance.
4. Analyze and interpret simulation results to make informed decisions.
5. Gain practical experience in using simulation software tools.

UNIT I INTRODUCTION TO MODELLING AND SIMULATION 9 hours

Introduction to Modelling and Simulation-Definition and Scope -Importance and Applications -Advantages and Limitations -Classification of Models-Deterministic -Stochastic -Static - Dynamic Models-Descriptive -Prescriptive Models-Physical- Mathematical –Continuous- Discrete Models-Systems and their Components-Understanding Systems and their Characteristics-Components of a System -System Boundaries and Interfaces-Input and Output Analysis

UNIT II MATHEMATICAL MODELS, SIMULATION PROCESS AND TECHNIQUES 9 hours

Mathematical Representation of Systems-Types of Mathematical Models -Linear vs. Nonlinear Models-Algebraic, Differential, and Difference Equation Models- Overview -Steps involved in Simulation-Model Formulation and Abstraction-Model Execution and Output Analysis-Verification and Validation of Simulation Models-Statistical Analysis of Simulation Results-Stability Analysis-Sensitivity Analysis and Optimization Techniques in Simulation

UNIT III DISCRETE EVENT SIMULATION 9 hours

Event Scheduling and Time Advance Mechanisms-Event-Based Simulation Paradigm-Discrete Event Simulation Concepts-Event List and Event Scheduling-Random Number Generation and Variate Generation-Importance and Techniques-Common Probability Distributions -Input Data Analysis and Verification-Importance of Input Data Analysis-Data Collection and Data Types-Data Preprocessing and Cleaning

UNIT IV CONTINUOUS SIMULATION 9 hours

Differential Equations and Integration Methods-Simulation of Dynamic Systems- Modeling Dynamic Systems using Differential Equations-Continuous System Simulation Techniques-Sensitivity Analysis and Parameter Estimation- Validation and Verification of Continuous Simulation Models

UNIT V SIMULATION SOFTWARE TOOLS 9 hours

Overview of Simulation Software Tools-Introduction -Role and Importance of Simulation Tools - Types of Simulation Software Tools-Introduction to a Widely Used Simulation Tool - Model Creation and Parameterization- Experiment Design and Simulation Runs- Output Analysis and Visualization- Advanced Topics in Modelling and Simulation (Real Time Examples and Case studies)

Course Outcomes:

Upon completion of this course, students will be able to:

CO1: Formulate and represent real-world systems as mathematical models.
CO2: Apply appropriate simulation techniques to study system behavior.
CO3: Design simulation experiments and analyze the obtained results.
CO4: Evaluate the performance of simulated systems and suggest improvements.
CO5: Develop real-time model using simulation software tools for modeling and analysis.

Textbook(s)

1. "Simulation Modeling and Analysis" by Averill M. Law and David Kelton

2. "System Simulation: The Art and Science" by Jerry Banks, John S. Carson II, and Barry L. Nelson

Reference Books

1. "Simulation Modeling and Analysis with Expertfit Software" by Averill M. Law and W. David Kelton
2. Simulation and the Monte Carlo Method" by Reuven Y. Rubinstein and Dirk P. Kroese
3 "Principles of Modeling and Simulation: A Multidisciplinary Approach" by John A. Sokolowski and Catherine M. Banks

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

Professional Elective – III

23CST410 NETWORK PROGRAMMING

L	T	P	C
3	0	0	3

Pre-requisite NIL

Course Description:
This course will cover the practical aspects of computer network programming, with emphasis on the Internet. The goal of this course is to introduce the students to the basics of computer networks and Internet programming. We will also look at industry trends and discuss some innovative ideas that have recently been developed.

Course Objectives:
1. Understand the basics of network programming
2. Describe the socket API based programs.
3. Implement network services that communicate through the Internet.
4. Understand the elementary function and address conversion using Protocol suite.
5. Apply the client-server model in networking applications.

UNIT I INTRODUCTION 9 hours

Introduction to Network Programming:
OSI model, Unix standards, TCP and UDP & TCP connection establishment and Format, Buffer sizes and limitation, standard internet services, Protocol usage by common internet application.

Sockets:
Address structures, value – result arguments, Byte ordering and manipulation function and related functions Elementary TCP sockets – Socket, connect, bind, listen, accept, fork and exec function, concurrent servers. Close function and related function.

UNIT II TCP CLIENT SERVER 9 hours

TCP client server:
Introduction, TCP Echo server functions, Normal startup, terminate and signal handling server process termination, Crashing and Rebooting of server host shutdown of server host.

Elementary UDP sockets and I/O Multiplexing
Introduction UDP Echo server function, lost datagram, summary of UDP example, Lack of flow control with UDP, determining outgoing interface with UDP, I/O Models, select function, Batch input, shutdown function, poll function, TCP Echo server.

UNIT III SOCKET OPTIONS 9 hours

Socket options:
getsockopt and setsockopt functions. Socket states, Generic socket option IPV6 socket option ICMPV6 socket option IPV6 socket option and TCP socket options, Raw sockets.

Advanced I/O Functions-
Introduction, Socket Timeouts, recv and send Functions,readv and writev Functions, recvmsg and sendmsg Functions, Ancillary Data, How Much Data Is Queued, Sockets and Standard I/O, T/TCP: TCP for Transactions.

UNIT IV ELEMENTARY NAME AND ADDRESS CONVERSIONS 9 hours

Elementary name and Address conversions:

DNS, gethost by Name function, Resolver option, Function and IPV6 support, uname function, other networking information.

Daemon Processes and inetd Superserver :

Introduction, syslogd Daemon, syslog Function, daemon_init Function, inetd Daemon, daemon_inetd Function

UNIT V BROADCASTING AND MULTICASTING 9 hours

Broadcasting-

Introduction, Broadcast Addresses, unicast versus Broadcast, dg_cli Function Using Broadcasting, Race Conditions

Multicasting-

Introduction, Multicast Addresses, Multicasting versus Broadcasting on A LAN, Multicasting on a WAN, Multicast Socket Options, mcast_join and Related Functions, dg_cli Function Using Multicasting, Receiving MBone Session Announcements, Sending and Receiving, SNTP: Simple Network Time Protocol, SNTP

Recent case studies- Internet protocol, Virtual Network and Debugging Techniques.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: To understand the basics network programming using TCP and UDP connections.

CO2: To describe socket API based programs.

CO3: To design and implement client-server applications using TCP and UDP sockets

CO4: To understand the elementary name functions and address conversion.

CO5: To analyze network programs.

Textbook(s)

1. W. Richard Stevens, “UNIX Network Programming Vol. I Sockets API”, 3nd Edition, Pearson, 2015
2. W.Richard Stevens, “UNIX Network Programming”, 2st Edition, PHI, 1998.

Reference Books

1. King abls, “UNIX for Programmers and Users”, 3rd Edition, Pearson, 2003
2. M.J.Rochkind, “Advanced UNIX Programming”, 2nd Edition, Pearson, 2000.

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

Professional Elective – IV

23CST411 SOFTWARE ARCHITECTURE AND DESIGN PATTERNS

L	T	P	C
3	0	0	3

Pre-requisite: 23CST109

Course Objectives:

The main objectives of the course are to make the student

1: Understand the basic concepts of software architecture and quality attributes.
2: Learn methods for analyzing and evaluating software architectures.
3: Study creational and structural design patterns.
4: Understand behavioral design patterns and their uses.
5: Learn how architectural principles are applied in real-world case studies.

UNIT I — ENVISIONING AND CREATION OF ARCHITECTURE — 9 hours

The Architecture Business Cycle, what is Software Architecture, Architectural patterns, reference models, reference architectures, architectural structures and views. Quality Attributes, achieving qualities, Architectural styles and patterns, designing the Architecture, Documenting software architectures, Reconstructing Software Architecture.

UNIT II — ANALYZING ARCHITECTURES — 9 hours

Architecture Evaluation, Architecture design decision making, ATAM, CBAM. Moving from one system to many: Software Product Lines, Building systems from off the shelf components, Software architecture in future.

UNIT III — DESIGN PATTERN CATALOG — 9 hours

Patterns: Pattern Description, organizing catalogs, role in solving design problems, Selection and usage.

Creational and Structural patterns: Abstract factory, builder, factory method, prototype, singleton, adapter, bridge, composite, façade, flyweight.

UNIT IV — BEHAVIOURAL PATTERNS — 9 hours

Chain of responsibility, command, Interpreter, iterator, mediator, memento, observer, state, strategy. template method, visitor.

UNIT V — CASE STUDIES — 9 hours

A-7E – A case study in utilizing architectural structures, The World Wide Web - a case study in interoperability, Air Traffic Control – a case study in designing for high availability, Celsius Tech – a case study in product line development.

Course Outcomes:

At the end of this course students will able to

CO1: Describe software architecture concepts and quality attributes.
CO2: Explain architecture evaluation methods and software product lines.
CO3: Apply creational and structural design patterns in software design.
CO4: Apply behavioral design patterns in applications.
CO5: Analyze real-world software architecture case studies.

Textbooks:

1. Software Architecture in Practice, fourth edition, Len Bass, Paul Clements & Rick Kazman, Pearson Education, 2003.
2. Design Patterns, Erich Gamma, Pearson Education.

Reference Books:

1. Beyond Software architecture, Luke Hohmann, Addison wesley, 2003.
2. Software architecture, David M. Dikel, David Kane and James R. Wilson, Prentice Hall PTR, 2001
3. Pattern Oriented Software Architecture, F.Buschmann &others, John Wiley & Sons.

Online Learning Resources

1. https://www.developertoarchitect.com/lessons/
   https://refactoring.guru/design-patterns

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

Professional Elective – IV

23CST412 BLOCK CHAIN TECHNOLOGY

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Objectives:

The main objective of the course is to

1. Understand how block chain systems (mainly Bit coin and Ethereum) work and to securely interact with them.
2. Design, build, and deploy smart contracts and distributed applications.
3. Integrate ideas from block chain technology into their own projects.

UNIT I INTRODUCTION 9 hours

Introduction, Scenarios, Challenges Articulated, Block chain, Block chain Characteristics, Opportunities Using Block chain, History of Block chain. Evolution of Block chain: Evolution of Computer Applications, Centralized Applications, Decentralized Applications, Stages in Block chain Evolution, Consortia, Forks, Public Block chain Environments, Type of Players in Block chain Ecosystem, Players in Market. Case Study: Walmart Food Traceability using Blockchain

UNIT II BLOCK CHAIN CONCEPTS 9 hours

Block chain Concepts: Introduction, Changing of Blocks, Hashing, Merkle-Tree, Consensus, Mining and Finalizing Blocks, Currency aka tokens, security on block chain, data storage on block chain, wallets, coding on block chain: smart contracts, peer-to-peer network, types of block chain nodes, risk associated with bloc chain solutions, life cycle of block chain transaction. Case Study: Bitcoin Transaction Lifecycle

UNIT III ARCHITECTING BLOCK CHAIN SOLUTIONS 9 hours

Architecting Block chain solutions: Introduction, Obstacles for Use of Block chain, Block chain Relevance Evaluation Framework, Block chain Solutions Reference Architecture, Types of Block chain Applications. Cryptographic Tokens, Typical Solution Architecture for Enterprise Use Cases, Types of Block chain Solutions, Architecture Considerations, Architecture with Block chain Platforms, Approach for Designing Block chain Applications. Case Study: Maersk & IBM TradeLens Platform

UNIT IV ETHEREUM BLOCK CHAIN IMPLEMENTATION 9 hours

Ethereum Block chain Implementation: Introduction, Tuna Fish Tracking Use Case, Ethereum Ecosystem, Ethereum Development, Ethereum Tool Stack, Ethereum Virtual Machine, Smart Contract Programming, Integrated Development Environment, Truffle Framework, Ganache, Unit Testing, Ethereum Accounts, My Ether Wallet, Ethereum Networks/Environments, Infura, Ether scan, Ethereum Clients, Decentralized Application, Metamask, Tuna Fish Use Case Implementation, Open Zeppel in Contracts . Case Study: Ethereum Smart Contracts in Crowdfunding

UNIT V HYPER LEDGER BLOCK CHAIN IMPLEMENTATION 9 hours

Hyper ledger Implementation: Introduction, Use Case – Car Ownership Tracking, Hyper ledger Fabric, Hyper ledger Fabric Transaction Flow, FabCar Use Case Implementation, Invoking Chain code Functions Using Client Application.

Advanced Concepts in Block chain: Introduction, Inter Planetary File System (IPFS), Zero Knowledge Proofs, Oracles, Self-Sovereign Identity, Block chain with IoT and AI/ML Quantum

Computing and Block chain, Initial Coin Offering, Block chain Cloud Offerings, Block chain and its Future Potential. Case Study: Hyperledger Fabric in Supply Chain (Car Ownership Tracking)

Course Outcomes:

After completion of the course, students will be able to

CO1: Explain the fundamental concepts of Blockchain technology, including architecture components, and transaction processes.

CO2: Apply Blockchain concepts such as hashing, consensus mechanisms, and smart contracts to develop basic decentralized applications.

CO3: Analyze the design considerations, risks, and challenges involved in developing Blockchain-based solutions.

CO4: Implement Blockchain applications using platforms like Ethereum and Hyperledger Fabric for real-world use cases.

CO5: Analyze advanced Blockchain concepts such as IPFS, Zero-Knowledge Proofs, and integration with IoT/AI to evaluate their impact on future applications.

Textbooks:

1. Ambadas, Arshad Sarfarz Ariff, Sham ―Block chain for Enterprise Application Developers‖, Wiley, 2020

2. Andreas M. Antonopoulos, ―Mastering Bitcoin: Programming the Open Blockchain‖, O'Reilly, 2017

Reference Books:

1. Joseph Bambara and Paul R. Allen, Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions, McGraw Hill, 2018.

2. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly Media, 2015.

Online Learning Resources

1. https://github.com/blockchainedindia/resources

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

Professional Elective – IV

23CST413 AUGMENTED REALITY AND VIRTUAL REALITY

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Objectives:

The main objectives of the course are:

1. To introduce the foundational principles and technologies of Virtual Reality (VR) and Augmented Reality (AR).
2. To explain the key devices, hardware, software, and human perception involved in immersive environments.
3. To provide knowledge of 3D modelling, interaction design, and audio rendering in VR and AR systems.
4. To give students hands-on experience in using VR and AR tools and technologies.
5. To enable students to understand the challenges and methodologies involved in building interactive virtual environments.

UNIT I INTRODUCTION TO VIRTUAL REALITY (VR) 9 hours

Defining Virtual Reality, Key elements of virtual reality experience, Virtual Reality, Telepresence, Augmented Reality and Cyberspace. **Bird's-Eye View:** Hardware, Software, Human Physiology and Perception.

UNIT II INPUT AND OUTPUT DEVICES 9 hours

Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces.

Output Devices: Graphics displays, sound displays & haptic feedback.

UNIT III MODELING 9 hours

Modeling: Geometric modeling, Kinematics modeling, Physical modeling, Behaviour modeling, Model management.

UNIT IV AUGMENTED REALITY (AR) 9 hours

Augmented Reality (AR): Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments, Evaluating AR systems

AR software development: AR software, Camera parameters and camera calibration, Marker-based augmented reality, AR Toolkit.

UNIT V INTERACTION & AUDIO 9 hours

Interaction - Motor Programs and Remapping, Locomotion, Manipulation, Social Interaction. Audio - The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering.

Course Outcomes:

At the end of the Course the student will be able to:

CO1: Understand the core concepts of Virtual Reality and Augmented Reality, and their differences.

CO2: Learn about the hardware and software components required for VR and AR systems, as well as the impact of human physiology and perception on the virtual experience.

CO3: Gain knowledge of input devices (trackers, navigation, and gesture interfaces) and output devices (graphics, sound displays, and haptic feedback).

CO4: Develop skills in modeling techniques, including geometric, kinematics, physical, and behavior modeling for VR and AR environments.

CO5: Explore the technologies and methodologies used to create Augmented Reality systems, including marker-based AR and AR software development.

Textbooks:

1. Grigore C. Burdea and Philippe Coiffet, *Virtual Reality Technology*, 2nd Edition, Wiley, 2017.

2. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016.

Reference Books:

1. RajeshK.Maurya, *Computer Graphics with Virtual Reality System*, 3rd Edition, Wiley Publication, 2018.

2. William R. Sherman and Alan B. Craig, *Understanding Virtual Reality Interface, Application, and Design*, 2nd Edition, Morgan Kaufmann Publishers, Elsevier, 2019.

3. K.S. Hale and K. M. Stanney, *Handbook on Virtual Environments*, 2nd Edition, CRC Press, 2015.

Online Learning Resources

1. https://nptel.ac.in/courses/106/106/106106138/

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

Professional Elective – IV

23CST414 HUMAN-COMPUTER INTERACTION

L	T	P	C
3	0	0	3

Pre-requisite: NIL

Course Objectives:

1. To understand the fundamentals of Human-Computer Interaction.
2. To design user-centric interfaces and systems with usability and accessibility in mind.
3. To explore cognitive models and interaction design processes.
4. To develop knowledge in evaluation techniques and prototyping.
5. To introduce the latest advancements in HCI including AR/VR, gesture, and voice-based interfaces.

UNIT I INTRODUCTION TO HCI & HUMAN FACTORS 9 hours

Introduction to HCI: History, Importance, and Applications, Human Factors: Perception, Cognition, and Memory, Models of Human Behavior : Norman's Model, Fitts Law , Ergonomics and Accessibility in Design , Visual, Auditory, and Haptic Modalities , Interaction Styles: Command-line, WIMP, Direct Manipulation , Principles of Good Design: Consistency, Feedback, Affordance , Case Study: Bad vs Good Interface Design

UNIT II DESIGN PROCESS AND USER-CENTERED DESIGN 9 hours

Design Thinking and User-Centered Design, Requirement Gathering: Task Analysis, Personas, Scenarios , Information Architecture: Navigation and Flow , Interface Design Guidelines (Shneiderman, Nielsen) , Storyboarding and Wireframing , Low-Fidelity vs High-Fidelity Prototyping, Interaction Design Patterns , Case Study: Designing an ATM Interface.

UNIT III EVALUATION TECHNIQUES AND USABILITY TESTING 9 hours

Types of Evaluation: Formative vs Summative, Usability Metrics: Learnability, Efficiency, Memorability, Cognitive Walkthrough and Heuristic Evaluation, A/B Testing and Controlled Experiments, Eye Tracking and Think-Aloud Protocols, User Feedback: Surveys and Interviews, Quantitative and Qualitative Data Analysis, Case Study: Usability Analysis of a Mobile App.

UNIT IV INTERFACE TECHNOLOGIES AND PROTOTYPING TOOLS 9 hours

Graphical User Interfaces (GUI) and Web Interfaces , Mobile and Touch Interfaces , Voice-Based Interfaces (VUI) and Chatbots , Gesture-Based Interaction and Wearables , Augmented and Virtual Reality Interfaces , Rapid Prototyping Tools: Figma, Adobe XD, Axure , HTML/CSS/JS for UI Prototyping , Case Study: Building a Prototype for a Fitness App .

UNIT V ADVANCED TOPICS IN HCI AND FUTURE TRENDS 9 hours

Brain-Computer Interfaces (BCI), Multimodal Interaction: Combining Voice , Gesture, Gaze , Intelligent Interfaces using AI, Emotion Recognition and Affective Computing , Ethics in HCI: Privacy, Bias, and Design for Inclusion , Accessibility Standards: WCAG, ADA , Gamification and Persuasive Design , Capstone Project: Designing an Inclusive Learning App .

Course Outcomes:

Upon the Successful Completion of the Course, the Students would be able to:
CO1: Understand the principles and concepts of Human-Computer Interaction.
CO2: Apply design techniques to create usable, intuitive interfaces.
CO3: Analyze and evaluate user interfaces through cognitive and empirical methods.
CO4: Implement effective prototypes and interaction models.
CO5: Explore emerging trends in multimodal and intelligent interfaces

Textbooks:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human-Computer Interaction”, Pearson Education, 4th Edition.
2. Ben Shneiderman et al., “Designing the User Interface: Strategies for Effective Human-Computer Interaction”, Pearson.
3. Donald A. Norman, “The Design of Everyday Things”, Basic Books.

Reference Books:

1. Jenny Preece, Yvonne Rogers, Helen Sharp, “Interaction Design: Beyond Human-Computer Interaction”, Wiley.
2. Jeff Johnson, “Designing with the Mind in Mind”, Morgan Kaufmann.
3. Steven Krug, “Don‘t Make Me Think”, New Riders.

Online Learning Resources

1. Coursera: Human-Centered Design by UC San Diego (https://www.coursera.org/learn/human-computer-interaction)

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

Professional Elective – V

23CST415 FUNDAMENTALS OF FOG AND EDGE COMPUTING

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Objectives:

1. Students will learn about relevant technologies and explore the hierarchy of fog and edge computing.
2. Students will learn about network slicing, its implementation in software-defined clouds, and the management of network slicing in edge and fog environments.
3. Students will gain knowledge of the formal modeling framework for fog computing and understand the metrics and quality attributes associated with optimization.
4. Students will understand the need for fog and edge computing middleware, identify the design goals, and explore state-of-the-art middleware infrastructures.
5. Students will learn about fog data management, the fog data life cycle, and its application in domains such as e-health and smart buildings.

UNIT I INTERNET OF THINGS (IOT) AND NEW COMPUTING PARADIGMS 9 hours

Introduction-Relevant Technologies, Fog and Edge Computing, Completing the Cloud-Hierarchy of Fog and Edge Computing, Business Models, Opportunities and Challenges, IoT Architecture Models, Cloud–Fog–Edge Computing Comparison, Edge Intelligence Basics, Real-Time and Latency, Aware Computing

UNIT II MANAGEMENT AND ORCHESTRATION OF NETWORK SLICES IN 5G, FOG, EDGE, AND CLOUDS 9 hours

Introduction-Background, Network Slicing, Network Slicing in Software, Defined Clouds, Network Slicing Management in Edge and Fog, Internet of Vehicles: Architecture, Protocol and Security Seven layered model architecture for Internet of Vehicles, IoV: Network Models, Challenges and future aspects

UNIT III OPTIMIZATION PROBLEMS IN FOG AND EDGE COMPUTING 9 hours

Preliminaries-The Case for Optimization in Fog Computing, Formal Modeling Framework for Fog Computing, Metrics, Further Quality Attributes, Optimization Opportunities along the Fog Architecture, Optimization Opportunities along the Service Life Cycle, Toward a Taxonomy of Optimization Problems in Fog Computing

UNIT IV MIDDLEWARE FOR FOG AND EDGE COMPUTING: DESIGN ISSUES 9 hours

Need for Fog and Edge Computing, Middleware, Design Goals, State-of-the-Art Middleware Infrastructures, System Model-Proposed Architecture, Microservices Architecture, Containerization and Virtualization, Service Orchestration, Case Study Example

UNIT V TECHNOLOGIES IN FOG COMPUTING 9 hours

Fog Data Management, Fog Data Life Cycle, e-Health Case Study. Predictive Analysis to Fog Application, Motivating Example: Smart Building-Predictive Analysis with Fog Torch. Machine Learning in Fog Computing-Data Analytics in the Fog-Data Analytics in the Fog Architecture Configurations

Course Outcomes:

At the end of the course, students will be able to:
CO1: Understand the principles and architectures of new computing paradigms.
CO2: Acquire the skills to manage and orchestrate network slices in 5G, fog, edge, and clouds.
CO3: Analyze optimization problems in fog and edge computing.
CO4: Analyze system models, propose architectures, and middleware for fog and edge computing.
CO5: Apply the security and privacy issues of fog Applications.

Textbooks:

1. Buyya, Rajkumar, and Satish Narayana Srirama, eds, Fog and edge computing: principles and paradigms, 1st edition, John Wiley & Sons, 2019.
2. Lea, Perry. IoT and edge computing for architects. Packt Publishing, 2020.

Reference Books:

1. Bahga, Arshdeep, and Vijay Madisetti. Cloud computing: A hands-on approach, 1st edition, CreateSpace Independent Publishing Platform, 2013.
2. Ovidiu Vermesan, Peter Friess, Internet of Things –From Research and Innovation to Market Deployment, 1st edition,River Publishers, 2014
3. Michael Missbach, Thorsten Staerk, Cameron Gardiner, Joshua McCloud, Robert Madl, Mark Tempes, George Anderson, SAP on Cloud, 1st edition, Springer, 2016

Online Learning Resources

1. https://onlinecourses.nptel.ac.in/noc25_cs28/preview

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

Professional Elective – V

23CST416 AGILE METHODOLOGIES

L	T	P	C
3	0	0	3

Pre-requisite: 23CST109

Course Objectives:

The main objectives of the course is to:

1. To understand the fundamental concepts, principles, and values of Agile Software Development.
2. To study various Agile methodologies such as Scrum, XP, FDD, Crystal, and Lean.
3. To analyze Agile knowledge management and decision-making processes.
4. To understand Agile requirements engineering and handling unstable requirements.
5. To evaluate Agile product development practices, metrics, quality assurance, and global development approaches.

UNIT I INTRODUCTION TO AGILE SOFTWARE DEVELOPMENT 9 hours

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values

UNIT II AGILE METHODOLOGIES AND EXTREME PROGRAMMING 9 hours

Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

UNIT III AGILE KNOWLEDGE MANAGEMENT 9 hours

Agile Information Systems – Agile Decision Making - Earl_S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment, Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

UNIT IV AGILE REQUIREMENTS ENGINEERING 9 hours

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

UNIT V AGILE PRODUCT DEVELOPMENT AND QUALITY ASSURANCE 9 hours

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.

Course Outcomes:

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

CO1: Explain Agile principles, values, and differences between traditional and Agile models.

CO2: Apply Scrum, XP, FDD, and Lean practices in iterative software development.

CO3: Analyze Agile knowledge management and decision-making techniques.

CO4: Implement Agile requirements elicitation, prioritization, and modeling techniques.

CO5: Evaluate Agile metrics, quality assurance practices, and scaling Agile to enterprise environments. Show how agile approaches can be scaled up to the enterprise level.

Textbooks:

1. The Art of Agile Development – James Shore and Shane Warden, O'Reilly Media, 2nd Edition, ISBN: 978-1492080695, 2021.

2. Agile Software Requirements: Lean Requirements Practices for Teams, Programs, and the Enterprise – Dean Leffingwell, Addison-Wesley Professional, 1st Edition, ISBN: 978-0321635846, 2011.

3. Agile Software Development: Principles, Patterns, and Practices – Robert C. Martin, Pearson Education (Prentice Hall), 1st Edition, ISBN: 978-0135974445, 2002.

Reference Books:

1. Extreme Programming Explained: Embrace Change – Kent Beck and Cynthia Andres, Addison-Wesley Professional, 2nd Edition, ISBN: 978-0321278654, 2004.

2. Test Driven Development: By Example – Kent Beck, Addison-Wesley Professional, 1st Edition, ISBN: 978-0321146533, 2002.

3. Agile Project Management with Scrum – Ken Schwaber, Microsoft Press, 1st Edition, ISBN: 978-0735619937, 2004.

Online Learning Resources

1. https://www.coursera.org/specializations/agile-development

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

Professional Elective – V

23CST417 CYBER PHYSICAL SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Objectives:

The main objectives of the course are to

1. To explain the fundamental principles and architectural concepts of Cyber-Physical Systems.
2. To apply symbolic modeling and synthesis techniques for the design and analysis of Cyber-Physical Systems.
3. To analyze security requirements, threat models, and countermeasures in Cyber-Physical Systems.
4. To evaluate synchronization and real-time scheduling mechanisms in distributed Cyber-Physical Systems.
5. To design and integrate heterogeneous Cyber-Physical System components to achieve correct and reliable system behavior.

UNIT I SYMBOLIC SYNTHESIS FOR CYBER-PHYSICAL SYSTEMS 9 hours

Introduction to Cyber-Physical Systems, CPS architecture, sensing–actuation–control loop, and motivation for correctness, safety, and reliability in CPS design, Basic Techniques - Preliminaries, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques: Construction of Symbolic Models, Continuous-Time Controllers, Software Tools

UNIT II SECURITY OF CYBER-PHYSICAL SYSTEMS 9 hours

Introduction and Motivation, Basic Techniques - Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques: System Theoretic Approaches, Practical CPS attack scenarios and AI-specific security threats

UNIT III SYNCHRONIZATION IN DISTRIBUTED CYBER-PHYSICAL SYSTEMS 9 hours

Challenges in Cyber-Physical Systems, A Complexity-Reducing Technique for Synchronization, Formal Software Engineering, Distributed Consensus Algorithms, Synchronous Lockstep Executions, Time-Triggered Architecture, Related Technology, Advanced Techniques

UNIT IV REAL-TIME SCHEDULING FOR CYBER-PHYSICAL SYSTEMS 9 hours

Introduction and Motivation, Basic Techniques - Scheduling with Fixed Timing Parameters, Memory Effects, Multiprocessor/Multicore Scheduling, Accommodating Variability and Uncertainty, Impact of scheduling and timing on CPS control and edge–cloud-based CPS

UNIT V MODEL INTEGRATION IN CYBER-PHYSICAL SYSTEMS 9 hours

Introduction and Motivation, Causality, Semantic Domains for Time, Interaction Models for Computational Processes, Semantics of CPS DSMLs, Advanced Techniques, ForSpec, The Syntax of CyPhyML, Formalization of Semantics, Formalization of Language Integration.

Course Outcomes:

Upon the Successful Completion of the Course, the Students would be able to:

CO1: Explain the architecture, components, and operational principles of Cyber-Physical Systems.

CO2: Apply symbolic modeling and synthesis techniques to represent and analyze Cyber-Physical Systems.

CO3: Analyze security threats, attack models, and defense mechanisms in Cyber-Physical Systems.

CO4: Evaluate synchronization and real-time scheduling strategies for distributed Cyber-Physical Systems.

CO5: Design and integrate CPS models using semantic frameworks and domain-specific languages to ensure correctness and reliability.

Textbooks:

1. Raj Rajkumar, Dionisio De Niz, and Mark Klein, Cyber-Physical Systems, Addison-Wesley Professional.
2. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, 2015

Reference Books:

1. Edward A. Lee & Sanjit A. Seshia, "Introduction to Embedded Systems – A Cyber-Physical Systems Approach", MIT Press
2. Hermann Kopetz, "Real-Time Systems: Design Principles for Distributed Embedded Applications".

Online Learning Resources

1. https://onlinecourses.nptel.ac.in/noc26_cs41/preview

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

Professional Elective – V

23CST418 DATA ANALYTICS AND VISUALIZATION

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:

This course introduces the fundamental concepts of data analytics and visualization techniques for analyzing structured and unstructured datasets. The course focuses on data preprocessing, exploratory analysis, data manipulation using analytical tools, and visualization methods for effective interpretation and decision-making.

Course Objectives:

The main objective of the course is to

1. To understand the concepts and lifecycle of data analytics.
2. To apply preprocessing and statistical techniques for data preparation.
3. To perform exploratory data analysis for extracting meaningful insights.
4. To implement data wrangling using Python analytical libraries.
5. To develop visualization models for effective data representation.

UNIT I FUNDAMENTALS OF DATA ANALYTICS 9 hours

Introduction to data analytics and data science, analytics lifecycle, types of analytics including descriptive, diagnostic, predictive and prescriptive analytics. Data types and sources, applications of analytics in various domains. Overview of data collection methods and statistical concepts including measures of central tendency, dispersion, probability and correlation.

Case Study: Analysis of retail sales transaction data to understand customer purchasing behaviour and seasonal demand trends.

UNIT II DATA PREPROCESSING AND STATISTICAL ANALYSIS 9 hours

Data collection strategies and preprocessing techniques including data cleaning, integration, transformation and reduction. Handling missing values and noisy datasets. Sampling techniques, data classification and tabulation. Statistical representation using frequency distributions, quartiles and percentile measures.

Case Study: Preprocessing banking customer data for identifying irregular transaction patterns and fraud detection.

UNIT III EXPLORATORY DATA ANALYSIS 9 hours

Concepts of exploratory data analysis for dataset understanding. Descriptive statistical measures including mean, standard deviation, skewness and kurtosis. Correlation analysis and covariance interpretation. Visualization-based exploration using box plots, pivot tables, heat maps and ANOVA analysis.

Case Study: Exploratory analysis of healthcare datasets to identify disease trends and patient risk patterns.

UNIT IV DATA WRANGLING USING NUMPY AND PANDAS 9 hours

Introduction to NumPy arrays and comparison with Python lists. Array creation, reshaping, indexing, slicing and broadcasting operations. Data manipulation using Pandas Series and DataFrames including loading datasets, filtering, aggregation, merging, concatenation and group-based analysis.

Case Study: Data wrangling of e-commerce customer datasets for product preference and segmentation analysis.

UNIT V DATA VISUALIZATION TECHNIQUES 9 hours

Principles of data visualization and graphical representation techniques. Visualization using line plots, scatter plots, bar charts, histograms and density plots. Multiple subplot generation, annotations, legends and customization for effective presentation of analytical results.

Case Study: Visualization of stock market data to analyze price trends and investment patterns.

Course Outcomes:

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

CO1: Explain fundamental concepts of data analytics and statistical measures.

CO2: Apply preprocessing techniques for preparing analytical datasets.

CO3: Perform exploratory data analysis using statistical methods.

CO4: Implement data manipulation using NumPy and Pandas libraries.

CO5: Develop visualization models for analytical interpretation.

Textbooks:

1. Wes McKinney, Python for Data Analysis, 3rd Edition, O’Reilly Media, 2022.
2. Peter Bruce, Andrew Bruce and Peter Gedeck, Practical Statistics for Data Scientists, 2nd Edition, O’Reilly Media, 2020.
3. Cole Nussbaumer Knaflic, Storytelling with Data, Wiley Publications, 2015.

Reference Books:

1. Jake VanderPlas, Python Data Science Handbook, O’Reilly Media, 2016.
2. Foster Provost and Tom Fawcett, Data Science for Business, O’Reilly Media, 2013.
3. Joel Grus, Data Science from Scratch, 2nd Edition, O’Reilly Media, 2019.

Online Learning Resources

1. Official Python Data Science Handbook (Free): https://jakevdp.github.io/PythonDataScienceHandbook/
2. Kaggle Learning Platform (Datasets + Tutorials): https://www.kaggle.com/learn
3. Microsoft Power BI Learning Resources: https://learn.microsoft.com/power-bi/

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

MANAGEMENT COURSE

Management Courses

23HUM801 BUSINESS ETHICS AND CORPORATE GOVERNANCE

L	T	P	C
2	0	0	2

Pre-requisite Nil

Course Description:

The course introduces students to the fundamental principles of business ethics and corporate governance. It equips engineering students with the knowledge and analytical skills required to navigate ethical dilemmas in professional life, understand ethical practices in various management functions, appreciate the role of corporate culture, and comprehend the legal and regulatory framework of corporate governance. Special emphasis is given to contemporary issues such as ethics in emerging technologies (AI, data privacy), fair trade practices, corporate social responsibility (CSR), and ESG (Environmental, Social, Governance) reporting, particularly relevant to Indian tech companies and start-ups.

Course Objectives:

This course enables students to:

1. Describe the concepts of Management theories, approaches and their application with organizations around us
2. Know the concepts of planning and management
3. Explain the basic concepts of organization, types and structure of organization
4. Make the students know leading, good communication, theories of motivation

UNIT I ETHICS 6 hours

Introduction – Meaning – Nature, Scope, significance, Loyalty, and ethical behavior.. Value systems - Business Ethics - Types, Characteristics, Factors, Contradictions and Ethical Practices in Management - Issues of Management

UNIT II ETHICS IN MANAGEMENT 6 hours

Introduction- Ethics in production, finance, Human resource management and Marketing Management - The Ethical Value System – Universalism, Utilitarianism, Distributive Justice, Social Contracts, Individual Freedom of Choice, Professional Codes; Culture and Ethics – Ethical Values in different Cultures; Ethical issues in AI, data privacy, and emerging technologies (e.g., bias in algorithms, ethical hacking dilemmas)

UNIT III CORPORATE CULTURE 6 hours

Introduction - Meaning, definition, Nature, and significance – Key elements of corporate culture, shared values, beliefs and norms, rituals, symbols and language - Types of corporate culture - hierarchical culture, market driven – Organization leadership and corporate culture, leadership styles and their impact on culture, transformational leadership and culture change

UNIT IV LEGAL FRAMEWORK 6 hours

Law and Ethics - Salient features of Companies Act 2013, Agencies enforcing Ethical Business Behavior – Legal Impact – Environmental Protection, Fair Trade Practices, legal Compliances – Corporate law, Securities and financial regulations, corporate governance code and principles: DPDP Act; Ethical considerations in Digital privacy

UNIT V CORPORATE GOVERNANCE 6 hours

Introduction - Meaning – Corporate governance code, transparency & disclosure - Role of auditors, board of directors and shareholders. Global issues, accounting and regulatory framework - Corporate scams - Committees in India and abroad, corporate social responsibility (CSR) BoDs composition, Cadbury Committee - Various committees - Reports - Benefits and Limitations; ESG (Environmental, Social, Governance) reporting and its relevance to Indian start-ups/tech companies

Course Outcomes:

After completing this Unit, students will be able to

CO1: Understand the Ethics and different types of ethics. (L2)

CO2: Understand business ethics and ethical practices in management (L2)

CO3: Understand the role of ethics in management (L2)

CO4: Apply the knowledge of professional ethics & technical ethics (L3)

CO5: Analyze corporate law, ethics, codes & principles (L4)

Textbook(s)

1. CSV Murthy: Business Ethics and Corporate Governance, Himalaya Publishing House, 2022

2. Linda K. Trevino & Katherine A. Nelson: Managing Business Ethics: Straight Talk about How to Do It Right, Wiley, 8E, 2025

Reference Books

1. Domènec Melé: Business Ethics in Action: Managing Human Excellence, Bloomsbury, 3e, Nov., 2025
2. Andrea Bonime-Blanc: Governing Pandora: Leading in the Age of Generative AI and Exponential Technology, Georgetown University Press, February, 2026

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

Management Courses

23HUM802 PRINCIPLES OF MANAGEMENT

L	T	P	C
2	0	0	2

Pre-requisite Nil

Course Description:

The course provides students with a practical and concrete explanation of management concepts and techniques they will need to manage today's and tomorrow's organizations. The course will follow the "planning, organizing, leading, controlling" format of managerial functions while putting together many small pictures presented by individual modules into one bigger meaningful picture in which managerial knowledge would apply. At the end of the course students are expected to understand role of components of bigger picture and interactions between and among components.

Course Objectives:

This course enables students to:

1. Describe the concepts of Management theories, approaches and their application with organizations around us
2. Know the concepts of planning and management
3. Explain the basic concepts of organization, types and structure of organization
4. Make the students know leading, good communication, theories of motivation

UNIT I INTRODUCTION TO MANAGEMENT 6 hours

Introduction to Management and Organizations- Management definition, skills, roles, goals and functions of a manager, organization, value of studying management - Managing in a Global Environment- Global Perspective, Understanding global environment

UNIT II PLANNING 6 hours

Decision-making process, Types of decisions and decision making conditions, styles, biases and errors, Planning: Meaning of planning, establishing goals and developing plans - Strategic Management-Importance of strategic management, strategic management process, types of organizational strategies; Basics of agile and digital project management in engineering organizations

UNIT III ORGANIZING 6 hours

Organization vs organizing **-** Organizational structures – Principles and types of organizational structure - Departmentation – decentralization – delegation of Authority

UNIT IV COMMUNICATION, MOTIVATION & LEADING 6 hours

Functions of communication, Inter-personal communication –Motivation: Theories of motivation and current issues in motivation. Leading: Leaders and Leadership, Leadership theories - Leadership in virtual/hybrid tech teams and Indian industry case studies (e.g., Infosys, Tata).in digital privacy

UNIT V CONTEMPORARY ISSUES IN MANAGEMENT 6 hours

Adapting to rapid technological advancements (AI integration), managing hybrid/remote work, and fostering employee well-being amid high burnout rates, value-chain management – Diversity-Equity- Inclusion – Communication gaps – environmental sustainability

Course Outcomes:

After completing this Unit, students will be able to

CO1: Understand the various concepts, approaches and theories of management in the real situation (L2)

CO2: Analyze the concept of planning and apply on the decisions in strategic management (L3, L4)

CO3: Compare organization structure designs and chart diligently with theoretical learning concepts (L4)

CO4: Apply communication and theories of motivation in an organization (L3)

CO5: Understand various tools for controlling organizational performance, management audit and apply to achieve the corporate objectives (L2, L3)

Textbook(s)

1. Stephen P. Robbins, Mary Coulter, and others, MANAGEMENT, Pearson, 16E, 2024
2. P.C. Tripathi and P.N. Reddy: PRINCIPLES OF MANAGEMENT, McGrawHill, 2021

Reference Books

1. Mohit Tiwari and Tripti Tiwari: PRINCIPLES OF MANAGEMENT FOR ENGINEERS, Leilani Katie Publications, November, 2025
2. J K Mitra, PRINCIPLES AND PRACTICE OF MANAGEMENT, Oxford University Press, 2023

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

Management Courses

23HUM803 HUMAN RESOURCE DEVELOPMENT

L	T	P	C
2	0	0	2

Pre-requisite Nil

Course Description:

The course content includes: Introduction to HRM, strategic human resource challenges, work flows, job analysis, managing diversity, concepts, goals, mechanism and system of HRD, recruitment and selection, downsizing and outplacement, appraising and managing employee performance, training, career development, managing compensation, rewarding performance, designing benefit plans, employee relation and employee discipline, and workplace safety and health.

Course Objectives:

This course enables students to:

1. Explain the nature and scope of HRM, its functions, policies and strategies
2. Describe the human resource planning, work analysis and importance in designing jobs
3. Know the recruitment, selection and the process of performance appraisal
4. Make the student to learn about training and development, compensation management
5. To appraise them of AI applications in HRD

UNIT I INTRODUCTION 6 hours

Understanding the nature and scope of Human Resource Management- Definition, Evolution of HRD, Functions - objectives, organization of department, Role and responsibility of HRM.

UNIT II HUMAN RESOURCE PLANNING 6 hours

Human Resource Planning- Factors affecting HRP, the planning process, managerial succession planning. Job Analysis, Methods of collecting job data, Competency based Job Analysis,
Job design Approach

UNIT III RECRUITMENT, SELECTION & PERFORMANCE APPRAISAL 6 hours

Recruiting and selecting employees-, Selection process. Performance Management, Process of Performance Appraisal, Bell curve, Methods of Performance Appraisal - AI in recruitment, ATS and performance tracking tools (relevant for tech/engineering roles).

UNIT IV TRAINING AND DEVELOPMENT 6 hours

Meaning – importance and benefits of Training and Development, Training v/s Development – Training Methods - challenges in training - Career development: Definition-objectives—importance of career development – HR analytics

UNIT V AI APPLICATIONS IN HRD 6 hours

AI Impact – adoption of AI for human resource development – integration of AI into HRD – goal setting and OKR, content management, on-boarding support, handling performance bias, employee engagement and retention; Managing remote/hybrid teams and employee engagement.

Course Outcomes:

After completing this Unit, students will be able to

CO1: Understand the concept of HRM, its nature, scope, functions, policies and strategies (L2)

CO2: Analyze human resource planning and apply in designing jobs (L3, L4)

CO3: Evaluate the recruitment, selection and the process of performance appraisal (L5)

CO4: Understand the importance of training and development activities, compensation management (L2)

CO5: Understand the AI applications in HRD and apply the applications in a real-time setting (L2, L3)

Textbook(s)

1. Stephen P. Robbins, Mary Coulter, and others, MANAGEMENT, Pearson, 16E, 2024
2. P.C. Tripathi and P.N. Reddy: PRINCIPLES OF MANAGEMENT, McGrawHill, 2021

Reference Books

1. Mohit Tiwari and Tripti Tiwari: PRINCIPLES OF MANAGEMENT FOR ENGINEERS, Leilani Katie Publications, November, 2025
2. Andrea Bonime-Blanc: Governing Pandora: Leading in the Age of Generative AI and Exponential Technology, Georgetown University Press, February, 2026

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

Management Courses

23HUM804 MANAGEMENT SCIENCE

L	T	P	C
2	0	0	2

Pre-requisite: Nil

Course Description:

This course provides a comprehensive understanding of the core concepts and techniques of management science with a focus on their application in engineering and industrial organizations. It covers the evolution of management thought, operations management, human resource management practices, project management tools (PERT/CPM), and marketing management. The course emphasizes practical tools such as work study, quality control, inventory management, strategic analysis (SWOT), and contemporary issues in modern management and technology, enabling students to apply management principles effectively in real-world technical environments.

Course Objectives:

This course enables students to:

1. Provide fundamental knowledge of management concepts, principles, schools of thought, and various organizational designs.
2. Familiarize students with operations management principles, including plant layout, production methods, work study, quality control, inventory management, TQM, Six Sigma, SCM, and ERP.
3. Impart knowledge of human resource management practices such as job analysis, recruitment, selection, training & development, performance appraisal, and wage administration.
4. Develop skills in project management using network analysis techniques like PERT and CPM, including project crashing and cost analysis.
5. Introduce the concepts of marketing management, marketing mix, customer relationship management (CRM), and contemporary issues in modern management and technology.

UNIT I INTRODUCTION TO MANAGEMENT SCIENCE 6 hours

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor's Scientific Theory-Henry Fayol's principles - Elton Mayo's Human relations - Organizational Designs - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization

UNIT II OPERATIONS MANAGEMENT 6 hours

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control**- Material Management -** Objectives - Inventory-Functions - Types, Inventory Techniques - EOQ-ABC Analysis - Total Quality Management (TQM) - Six Sigma Concept - Supply Chain Management (SCM) - Enterprise Resource Planning (ERP)

UNIT III HUMAN RESOURCE MANAGEMENT 6 hours

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Job Analysis - Human Resource Planning (HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process - Employee Training and Development - methods - Performance Appraisal Concept - Methods of Performance Appraisal – Bell Curve Performance - Wage and Salary Administration

UNIT IV PROJECT MANAGEMENT 6 hours

Project Management - Basic simulation and decision support systems - SWOT Analysis - Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems).

UNIT V MARKETING MANAGEMENT 6 hours

Marketing Management - Concept - Meaning - Nature-Functions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle. Customer Relations Management (CRM) - Performance Management – employee engagement and retention - Business Process Re-engineering and Bench Marking

Course Outcomes:

After completing this Unit, students will be able to

CO1: Remember the concepts & principles of management and designs of organization in a practical world (L1)

CO2: Understand the knowledge of Work-study principles & Quality Control techniques in industry (L2)

CO3: Apply the HRM processes in organization (L3)

CO4: Evaluate PERT/CPM Techniques for projects of an enterprise and estimate time & cost of project & to analyze the business through SWOT (L5)

CO5: Apply Marketing Management in organizations (L5)

Textbook(s)

1. Frederick S. Hillier and Mark S. Hillier: Introduction to Management Science: A Modeling and Case Studies Approach with Spreadsheets, McGrawHill, 7e, 2023
2. AR Aryasri: MANAGEMENT SCIENCE, Tata McGrawHill, 4e, 2011

Reference Books

1. Stoner, Freeman, Gilbert: MANAGEMENT, Pearson Education, New Delhi, 2019.
2. Koontz & Weihrich, *Essentials of Management*, 11e, TMH, 2020.

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

Management Courses

23HUM805 NATIONAL CADET CORPS

L	T	P	C
2	0	0	2

Pre-requisite: Nil

Course Description:
The course aims to instil knowledge about NCC, national integration, self-awareness, and social service, while promoting critical thinking and teamwork

Course Objectives:
This course enables students
1. To develop discipline, leadership, and character among students
2. To impart basic military training and physical fitness
3. To inculcate spirit of patriotism and social responsibility
4. To enhance personality, teamwork, and self-confidence

UNIT I NCC ORGANIZATION & LEADERSHIP 6 hours

Introduction to NCC: Aim, Motto, Objectives, Organizational structure of NCC, Role and responsibilities of cadets, Leadership traits and qualities, Types of leadership and leadership development, Personality development and communication skills

UNIT II DRILL & PARADE 6 hours

Importance and principles of drill, General drill instructions and words of command, Basic drill movements: *Savdhan, Vishram, Aaram Se*, *Dahine Mud, Bayen Mud, Piche Mud*, Formation of squad and line, Saluting and marching techniques, Practical drill sessions

UNIT III WEAPON TRAINING AND FIELD CRAFT 6 hours

Introduction to small arms (.22 rifle), Safety precautions and handling of weapons, Parts and mechanism of rifle, Aiming and firing techniques (theory), Field craft basics: camouflage and concealment, Introduction to map reading

UNIT IV PHYSICAL FITNESS AND ADVENTURE ACTIVITIES 6 hours

Importance of physical fitness in NCC, Basic exercises and endurance training, Obstacle training and its benefits, Yoga and mental fitness, Adventure activities: trekking, mountaineering, cycling, Disaster management basics and first aid

UNIT V SOCIAL AWARENESS AND NATIONAL INTEGRATION 6 hours

Social service and community development, Environmental awareness and sustainability, Swachh Bharat and health awareness programs, National integration and unity in diversity, Role of NCC in nation building, Participation in Camps and Community Service

Course Outcomes:
After completing this Unit, students will be able to

CO1: Understand and describe the aims and objectives of the National Cadet Corps (NCC) vis-à-vis concepts of leadership traits, personality development (discipline), and communication skills in the context of NCC) (L1)

CO2: Demonstrate basic drill movements, words of command, saluting, marching techniques and parade procedures. (L2)

CO3: Apply the fundamentals of weapon training, safety precautions, field craft, camouflage, concealment and map reading. (L3)

CO4: Demonstrate physical fitness through basic exercises, endurance training, obstacle courses, yoga and adventure activities (L3)

CO5: Develop social responsibility, national integration, environmental awareness, patriotism and contribute to community service and nation-building activities. (L3 / L4)

Textbook(s)

1. R. Gupta: Handbook for NCC Cadets for A, B, & C Certificates, Kindle Edition, Ramesh Publishing House, 2026
2. Major RC Mishra & Sanjay Sharma: A Hand Book of NCC, Kanti Prakashan Etawah, 2025

Reference Books

1. RPH Team, A Concise Handbook of NCC Cadets For A / B & C Certificate Examinations Including N=Model Papers & Solved Questions 2018 In English, RPH, 2018

2. R Gupta NCC (National Cadet Corps) - (A Concise Handbook Of Ncc Cadets For "A", "B" & "C" Certificate Examinations) Including Model Papers & Solved Questions , New 31th Edition (August, 2025)

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

SKILL ENHANCEMENT COURSES

Skill Enhancement Course – I

23CST601 PYTHON PROGRAMMING

L	T	P	C
1	0	2	2

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:

1. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
2. Write a program to count the number of vowels in a string (No control flow allowed).
3. 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:

1. Write a program to define a function with multiple return values.
2. Write a program to define a function using default arguments.
3. 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:

1. 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.
2. Implement a Python program to print each line of a file in reverse order.
3. Write a Python program to compute the number of characters, words and lines in a file

Course Outcomes:

After 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.

Textbooks:

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 Resources:

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, End Semester Examination.

Skill Enhancement Course - II

23CST602 DATA SCIENCE USING R

L	T	P	C
1	0	2	3

Pre-requisite **NIL**

Course Description:

This course describes how to use R for effective data analysis. The course covers practical issues in statistical computing which includes programming in R, reading data into R, accessing R packages, writing R functions, debugging, profiling R code, and organizing and commenting R code. In addition to this, drawing Graph and Chart through R has also been included.etc.

Course Objectives:

1. Understand the R Programming Language.
2. Exposure on Solving of data science problems.
3. Understand the classification, Regression Model and get an idea to plot various types of Charts and Graphs for data analyses.

UNIT I **INTRODUCTION** **6 hours**

Introduction to Data Science – What is Data Science? Current landscape of Perspectives, Skills Sets Needed, Role of Data Scientist, Data Pre-Processing. Introduction to R – What is R? Installation of R, Basic features of R, R Objects, Creating Vectors and Matrices.

a. Using with and without R objects on console
b. Using mathematical functions on console
c. Write an R script, to create R objects for calculator application and save in a specified location in disk

UNIT II **DESCRIPTIVE STATISTICS USING R** **6 hours**

Getting Data in and out of R, Managing Data Frames and Functions, Discrete and continuous random variables, Densities and distribution.

a. Write an R script to find basic descriptive statistics using summary
b. Write an R script to find subset of dataset by using subset ()

UNIT III **DATA SUMMARIZATION** **6 hours**

Data Summarization – Measures of Central Tendency, Measures of Dispersion (quartiles, five number summary, variance, standard deviation), Measures of shape (skewness, kurtosis), Measures of association (covariance, correlation), Outliers

a. Reading different types of data sets (.txt, .csv) from web and disk and writing in file in specific disk location.
b. Reading Excel data sheet in R.
c. Reading XML dataset in R.

UNIT IV PREDICTIVE ANALYSIS USING MACHINE LEARNING TECHNIQUES USING R 6 hours

Machine learning – what, how, where. Supervised, unsupervised and semi-supervised learning. Training, validation, testing, Validation, Generalization, over fitting.

a. Find the data distributions using box and scatter plot.
b. Find the outliers using plot.
c. Plot the histogram, bar chart and pie chart on sample data
d. Find the correlation matrix.
e. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data

UNIT V BUILDING A REGRESSION MODEL USING R 6 hours

Features and feature engineering, Using Decision trees, Linear Classifiers, Naïve Bayes, Nearest Neighbor methods in R packages.

Apply regression Model techniques to predict the data on any dataset and process the classification and clustering model

a) Classification Model
   i. Install relevant package for classification,
   ii. choose classifier for classification problem,
   iii. Evaluate the performance of classifier

b) Clustering Model
   i. Clustering algorithms for unsupervised classification.
   ii. Plot the cluster data using R visualizations.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Understand R programming statistical analysis.
2. Implement descriptive analytics using R programming.
3. Implement data summarization techniques to diverse datasets using R programming.
4. Apply predictive analysis through machine learning for data exploration using R programming.
5. Implement regression techniques using R.

Textbook(s)

1. "The Art of R Programming, A Tour of Statistical Soft Ware Design", Norman Matloff
2. "Hands-On Programming with R", Garrett Grolemund, O'Reilly Media, Inc.,

Reference Books

1. "Exploratory Data Analysis with R", Roger D Peng.
2. "Data Visualization: A practical introduction", by Kieran Healy.

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

Skill Enhancement Course - II

23CST603 COMPETITIVE CODING 1

L	T	P	C
1	0	2	2

Pre-requisite NIL

Course Description:
This course focuses on competitive coding using arrays, strings, and associated algorithms. It includes both theoretical concepts and practical implementations for solving computational problems efficiently. The course emphasizes problem-solving skills and prepares students for competitive programming challenges.

Course Objectives:
1. Understand the fundamentals and advanced operations of arrays and strings.
2. Implement and analyze searching, sorting, and manipulation algorithms.
3. Develop recursive and backtracking solutions for complex problems.
4. Solve real-world problems using advanced data manipulation techniques.
5. Apply efficient algorithms for subarrays, substrings, and subsets.

UNIT I Introduction to Arrays 6 hours

Arrays: Declaration, Initialization, Arrays indexing, memory model, Advantages of arrays, one dimensional array, two dimensional arrays, Passing array as an argument to function.

Operations of Arrays: Traversal, Insertion, and Deletion.

a) Print all elements of an array.
b) Insert an element at a specific position in an array.
c) Delete an element from a given position.
d) Count occurrences of an element in an array.
e) Find the second largest and second smallest elements.
f) Check if an array is sorted.
g) Find the unique element (XOR-based).
h) Find all leaders in an array.
i) Replace every element with the greatest element on the right.
j) Check if the array is a palindrome.

UNIT II Array Manipulations 6 hours

Reversal and Rotations, Frequency Count, Merging Arrays.

Recursion and Backtracking: Introduction to Recursion, Tail Recursion and Introduction to Backtracking, Two Pointer Approach.

Problems: Transpose of a Matrix, Matrix in Snake Pattern, Count Distinct Elements, Frequencies of Array Elements, etc.,

a) Reverse an array in place.
b) Rotate an array by k positions.
c) Find the majority element.
d) Move all zeros to the end of the array.
e) Rearrange the array alternately (max-min form).
f) Find the maximum and minimum difference between two elements.
g) Merge two sorted arrays without extra space.
h) Rearrange the array such that positive and negative elements alternate.
i) Rearrange the array in wave form (e.g., [1, 2, 3, 4] → [2, 1, 4, 3]).
j) Find all pairs with a given sum using the two-pointer technique

UNIT III Introduction to Strings 6 hours

String: Introduction to Strings, Initialization of strings, String Operations, Strings Library functions, Character Array vs String.

Basic String Manipulations: Character-level Operations using ASCII values, Palindromes and Substrings.

a) Find the count of all substrings of a string.
b) Check if two strings are equal.
c) Count vowels, consonants, digits, and spaces in a string.
d) Find the first non-repeating character in a string.
e) Find the longest palindromic substring.
f) Find the longest word and longest common prefix in a sentence.
g) Remove duplicates and adjacent duplicates from a string.
h) Reverse individual words in a string.
i) Replace all vowels in a string with their next consonant.
j) 10. Print all permutations of a string.

UNIT IV Searching and Sorting 6 hours

Searching: Overview of the Sorting Algorithm, Linear search and Binary search.

Sorting: Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, and Radix sort with Analysis of Time and space complexity.

a) Search for an element in an unsorted and Rotated Sorted array.
b) Find the first and last occurrence of an element using binary search.
c) Find the intersection of two sorted arrays.
d) Count the number of inversions in an array.
e) Find the peak element in the array.
f) Find the Square Root of an Integer.
g) Maximum and Minimum in Rotated Sorted Array.
h) Capacity to Ship Packages in D Days.
i) Allocate Minimum Number of Pages.
j) 10. Aggressive Cows.

UNIT V Subarrays, Substrings, and Subsets 6 hours

Introductions to Subarrays, Substrings and Subsets, Brute Force Approach, Sliding Window Technique, Kadane's Algorithm, Prefix Sum Technique, String anagram.

a) Find the maximum sum subarray of size k.
b) Longest substring without repeating characters.
c) Count subarrays with sum zero.
d) Find the largest subarray with equal 0s and 1s.
e) Check if two strings are anagrams.
f) Count distinct elements in every window of size k.
g) Count the number of subarrays with a given XOR value.
h) Generate all combinations of elements in an array.
i) Find the longest subarray with at most k distinct elements.
j) 10. Find the maximum sum of a circular subarray.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Apply advanced programming techniques to solve array and string-based problems.
2. Design and implement efficient algorithms for searching, sorting, and manipulation of data.
3. Solve problems using recursion and backtracking approaches effectively.
4. Develop optimal solutions for competitive programming problems involving subarrays and subsets.
5. Demonstrate analytical and logical skills in solving algorithmic challenges.

Textbook(s)

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms," 3rd Edition, MIT Press, 2009.
2. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy," 5th Edition, CareerMonk Publications, 2016.

Reference Books

1. Robert Sedgewick and Kevin Wayne, "Algorithms," 4th Edition, Addison-Wesley, 2011.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++," 4th Edition, Pearson, 2014.

Online Material links:

1. https://onlinecourses.nptel.ac.in/noc22_cs59/preview
2. https://takeuforward.org/
3. https://youtu.be/_ClZwBOAnuM?si=sIWFoSJymPSgZYsV

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

Skill Enhancement Course – III

23CST604 FULL STACK DEVELOPMENT I

L	T	P	C
1	0	2	2

Pre-requisite NIL

Course Description:

The primary objectives of this course are to equip students with the fundamental skills required for web development. Students will gain hands-on experience in designing static web pages using various HTML elements and their attributes. They will also learn to enhance the appearance and layout of web content by effectively applying CSS styles to HTML elements. Additionally, the course focuses on enabling students to create dynamic and interactive web pages using JavaScript. This includes implementing client-side functionalities and validating user input through form validation techniques, thus providing a comprehensive foundation in front-end web development.

Course Objectives:

The main objectives of the course are to

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. Integrate multimedia elements such as images, audio, and video into web pages to enhance user engagement and interactivity.
5. Implement responsive web design techniques to ensure web pages function well across various devices and screen sizes.

UNIT I LISTS, LINKS AND IMAGES 6 hours

Lists- an ordered (<ol>), unordered (<ul>), or definition (<dl>) format-Links-Images.

a. Write a HTML program, to explain the working of lists.
   Note: It should have an ordered list, unordered list, nested lists and ordered list in an unordered list and definition lists.
b. Write a HTML program, to explain the working of hyperlinks using <a> tag and href, target Attributes.
c. Create a HTML document that has your image and your friend's image with a specific height and width. Also when clicked on the images it should navigate to their respective profiles.
d. Write a HTML program, in such a way that, rather than placing large images on a page, the preferred technique is to use thumbnails by setting the height and width parameters to something like to 100*100 pixels. Each thumbnail image is also a link to a full sized version of the image. Create an image gallery using this technique

UNIT II HTML TABLES, FORMS AND FRAMES 6 hours

HTML Tables-Introduction to Tables-Table Tags and Structure-Table Attributes-Merging Cells: Rowspan and Colspan-Nested Tables-Table Styling with CSS-**HTML Forms-**Purpose and Structure of Forms-Input Types and Form Controls-Form Attributes-Fieldsets and Legends-HTML5 Form Validation-Accessibility Considerations-CSS Styling for Forms-Introduction to Frames and Frameset (Deprecated)-<iframe> Tag and Usage-Embedding External Content-Attributes and Security Best Practices

a) Write a HTML program, to explain the working of tables. (use tags: <table>, <tr>, <th>, <td> and attributes: border, rowspan, colspan)
b) 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.).
c) 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).
d) 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 III HTML 5 AND CASCADING STYLE SHEETS, SELECTOR FORMS 6 hours

Introduction to HTML5-New Semantic Elements- HTML5 Form Elements and Attributes-HTML5 Audio and Video-Introduction to CSS-Syntax and Selectors-CSS Properties and Values-Box Model and Layout- **Types of CSS-**Inline CSS-Internal CSS-External CSS. Introduction to selector forms-Types of selector forms-Simple selector-Combinator selector-Pseudo class-Pseudo element-Attribute selector.

a. Write a HTML program, that makes use of <article>, <aside>, <figure>, <figcaption>, <footer>, <header>, <main>, <nav>, <section>, <div>, <span> 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
    i. Simple selector (element, id, class, group, universal)
    ii. Combinator selector (descendant, child, adjacent sibling, general sibling)
    iii. Pseudo-class selector
    iv. Pseudo-element selector
    v. Attribute selector

UNIT IV CSS WITH COLOR, BACKGROUND, FONT, TEXT AND CSS BOX MODEL 6 hours

CSS with color - Color Names, HEX, RGB, RGBA, HSL, HSLA-Applying Colors to Text and Elements-Transparent Colors and Opacity-Background Color-Background Image-Background Repeat, Position, Size, Attachment-Font Family and Web-safe Font- Font Size, Style, and Weight-Using Google Fonts- CSS Text Properties and CSS box model.

a. Write a program to demonstrate the various ways you can reference a color in CSS.
b. 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.
c. 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
d. Write a program, to explain the importance of CSS Box model using
    i. Content ii. Border iii. Margin iv. padding

UNIT V APPLYING JAVA SCRIPT 6 hours

Applying Java Script-Internal and External, I/O, Type Conversion- JavaScript Pre-defined and User-defined Objects- JavaScript Conditional Statements and Loops- JavaScript Functions and Events.

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. Write a program using document, window, array, math, string, date object properties and methods.
e. Write a program to display week days using switch case.
f. Write a program to print 1 to 10 numbers using for, while and do-while loops.
g. Design a appropriate function should be called to display
   i. Factorial of that number
   ii. Fibonacci series up to that number
   iii. Prime numbers up to that number
   iv. 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)

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Apply HTML elements to design structured web pages using various lists, hyperlinks, and image embedding techniques.

CO2: Make Use of HTML tables, forms, and frames to create interactive and data-organized web page layouts.

CO3: Implement HTML5 elements and different types of CSS and selector forms to enhance the structure and presentation of web content.

CO4: Develop styling techniques using CSS properties to design visually appealing web interfaces.

CO5: Experiment with JavaScript to develop dynamic web pages and validate forms.

Textbook(s)

1. John Dean, Web Programming with HTML5, CSS and JavaScript, Jones & Bartlett Learning, 2019.
2. Paul Deitel, Harvey Deitel, Abbey Deitel, Internet & World Wide Web - How to Program, 5thedition, Pearson Education, 2012.

Reference Books

1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.

2. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.

Online Material links:

1. https://www.w3schools.com/html
2. https://www.w3schools.com/css
3. https://www.w3schools.com/js/
4. https://www.w3schools.com/nodejs
5. https://www.w3schools.com/typescript

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

Skill Enhancement Course – III

23CST605 CISCO CERTIFIED NETWORK ASSOCIATE (CCNA)

L	T	P	C
1	0	2	2

Pre-requisite NIL

Course Description:
This course introduces students to the foundational concepts of networking aligned with the CCNA 200-301 syllabus. It covers the role of networking devices, network topologies, IP addressing, Ethernet standards, switching concepts, VLANs, and wireless fundamentals. The students gain hands-on experience with Cisco Packet Tracer to simulate and configure basic LAN and wireless networks. This semester sets the groundwork for advanced topics in routing, security, and automation in the subsequent term.

Course Objectives:

1. Understand the roles and functions of networking components such as routers, switches, and access points.
2. Learn basic networking architectures and topologies including SOHO, two-tier, and three-tier designs.
3. Configure IPv4 and IPv6 addressing schemes and apply subletting techniques.
4. Explore VLANs, trucking, and basic switching concepts in multi-switch environments.
5. Examine wireless network design, RF behavior, SSIDs, and basic virtualization concepts.

UNIT I **Introduction to Networks** **6 hours**

Routers, switches, firewalls, WLCs, SOHO networks, two-tier, three-tier, spine-leaf.
Experiment 1:
a) Design a simple LAN with routers, switches, and PCs. Assign IPs and verify connectivity

UNIT II **Physical Interfaces and IP Addressing** **6 hours**

Cables, TCP/UDP, IPv4/IPv6 configuration, interface issues.
Experiment 2:
a) Perform IPv4 sub netting, assign IPs, and test with `ping` and `ipconfig`.
b) Configure link-local and global IPv6 addresses on routers and PCs.
c) Simulate TCP and UDP flows and capture packets for analysis.

UNIT III **VLANs and Switching Concepts** **6 hours**

VLANs, trunk ports, CDP/LLDP, MAC table, Ether Channel.
Experiment 3:

a) Create VLANs, assign ports, and verify segmentation in the LAN.
b) Configure router-on-a-stick or Layer 3 switch for VLAN routing.
c) Configure trunk ports using 802.1Q and native VLAN settings.
d) Use discovery protocols to identify neighboring Cisco devices.

UNIT IV **Wireless & Virtualization Basics** **6 hours**

APs, SSIDs, RF fundamentals, virtualization (VRF, containers)
Experiment 4:

a) Simulate and identify duplex mismatch and resolve connectivity issues.
b) Simulate WLAN setup with WPA2 security and connect wireless clients.
c) Troubleshoot incorrect IP configs, cables, and device roles.

UNIT V **IPv6 Deep Dive** **6 hours**

IPv6 address types, EUI-64, IP config on Linux/Windows, private addressing

Experiment 5:

a) Observe MAC address learning and frame forwarding behavior.

Course Outcomes:

Upon successful completion, students will be able to:

CO1: Describe fundamental networking architectures and identify the components used in a modern network.

CO2: Configure and troubleshoot IPv4/IPv6 addressing and subnetting for different network scenarios.

CO3: Create and manage VLANs and inter-switch connections using trunk ports and Ether Channel.

CO4: Set up basic wireless LANs with APs, security settings, and access methods.

CO5: Demonstrate switching behaviour including MAC learning, flooding, and frame forwarding using simulation tools.

Textbook(s)

1. Wendell Odom – *CCNA 200-301 Official Cert Guide, Volumes 1 and 2*, Cisco Press
2. Todd Lammle – *CCNA Certification Study Guide* (Latest Edition)

Reference Books

1. Allan Johnson – *31 Days Before Your CCNA Exam*
2. David Hucaby – *Cisco LAN Switching Fundamentals*

Online Material links:

1. https://learningnetwork.cisco.com/s/
2. https://www.netacad.com/networking
3. https://www.youtube.com/@NetworkChuck/playlists

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

Skill Enhancement Course – III

23CST606 DATA MINING

L	T	P	C
1	0	2	2

Pre-requisite NIL

Course Description:

Data Mining studies algorithms and computational paradigms that allow computers to find patterns and regularities in databases, perform prediction and forecasting, and generally improve their performance through interaction with data. Before starting a data-mining project, it is essential to determine the tasks to be performed and properly manage allocation of tasks among individuals involved in the data analysis. Hence, planning is important as it results in effective data analysis.

Course Objectives:

1. To familiarize student with the algorithms of data mining.
2. To be acquainted with the tools and techniques used for Knowledge Discovery in Databases.
3. To be exposed to web mining and text mining.
4. To acquire basic knowledge on Correlation Analysis of Data.
5. To gain knowledge on Classification techniques.

UNIT I DATA MINING AND DATA MODELS 6 hours

Introduction to basic concepts of data mining and different data models used to represent the data.

a) Explore various commands given in PL/SQL in Oracle8.0.

b) Execute multi-dimensional data model using SQL queries.

c) Perform SQL queries related data sets.

UNIT II DATA WARE HOUSING & ONLINE ANALYTICAL PROCESSING 6 hours

Introduction to Data warehousing concepts, data warehousing modelling and usage of data warehouse and information processing.

a) Implement various OLAP operations such as slice, dice, rollup, drill up, pivot etc.

b) Implementation of Text Mining on the data warehouse.

UNIT III CORRELATION ANALYSIS. 6 hours

Redundancy and Correlation Analysis, Correlation Test for Nominal Data, Correlation Coefficient for Numeric Data, Covariance of Numeric Data

a) Write a program to calculate Correlation for given Nominal data & Numeric data.

b) Explore the correlation-ship analysis between the dataset.

c) Evaluate attribute relevance analysis on a weather data warehouse.

UNIT IV BASIC CLASSIFICATION TECHNIQUES 6 hours

Introduction to basic concepts of classification, Attribute Selection Measures, Bayes Classification Methods.

a) Evaluate Information Gain of an attribute in the student database.
b) Implement Decision Tree Algorithm
c) Experiment to predict the class using the Bayesian classification.

UNIT V ADVANCED CLASSIFICATION METHODS AND MECHANISMS 6 hours

Introduction to advanced Concepts and Mechanisms, Training Bayesian Belief Networks, A Back Propagation Neural Network, and others classification methods and algorithms.

a) Find out a weight & bias updating using the Back Propagation Neural Network.
b) Implement SVM algorithm
c) To perform various data mining algorithms on the give database using WEKA.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Illustrate the algorithms of data mining.
CO2: Analyze the performance of tools and techniques used for Knowledge Discovery in Databases.
CO3: Analyze various web mining and text mining Algorithms.
CO4: Apply the Classification Algorithms for data mining applications.
CO5: Use Weka tools to demonstrate data mining concepts.

Textbook(s)

1. Data Mining and Data Warehouse by Udit Agarwal
2. Data Mining Introductory & advanced topic by Margaret H. Dunham, Pearson Education

Reference Books

1. Data Warehousing, Data Mining & OLAP by Alex Berson Stephen J.Smith.
2. Data Mining: Next Generation Challenges and Future Direction by Kargupta, et al, PHI.

Online Material links:

1. https://jntukucen.ac.in/ebook_files/116.pdf

Mode of Evaluation: Continuous Internal Evaluation, Assignments, Mid Term Tests, 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

Textbooks:

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, End Semester Examination.

Skill Enhancement Course - V

23CST607 SOFTWARE TESTING

L	T	P	C
1	0	2	2

Pre-requisite: **23CSE101**

Course Objectives:

The main objectives of the course is to

1. Understand different software testing tools and their features.
2. Learn how to manage a testing project from start to end.
3. Understand that testing is done to find errors in a program.
4. Learn the basic concepts of Selenium IDE.
5. Develop automation testing skills using Selenium WebDriver and TypeScript.

UNIT I INTRODUCTION TO SOFTWARE TESTING 6 hours

Introduction to Testing, Importance of testing, Roles and Responsibilities, Principles of software testing, What is Quality?, How much testing is enough?, Basics of C Language.

a) Write programs in C- Language to demonstrate the working of the following constructs. i) do-while ii) while….do iii) if…else iv) switch v) for
b) A program written in C- language for Matrix Multiplication fails´ Introspect the causes for its failure and write down the possible reasons for its failure.
c) Design and develop a program in C language to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all.

UNIT II TEST CASE DESIGN TECHNIQUES 6 hours

Introduction to Test Case Designing, Test Case Design Techniques: Static and Dynamic, Test Case Template, Type of Test Cases, Writing test cases, Reviewing Test Cases.

a) Take any system (e.g. E-Commerce Application) and study its system specifications and report the various bugs.
b) Write the test cases for any known application (e.g. Banking application).
c) Write the test cases for GMAIL.

UNIT III TEST PLANNING 6 hours

Objective of Test Plan, Scope of Testing, Testing Lifer Cycle, Assumptions, Roles and Responsibilities, Risks and Mitigations, Entry and Exit Criteria.

a) Create a test plan document for E-Commerce Application.
b) Create a test plan document for Bank Application.
c) Create a test plan document for GMAIL Application

UNIT IV INTRODUCTION TO WEB TESTING TOOL 6 hours

Introduction to Selenium-Advantages and disadvantages of Selenium, Selenium-IDE, Installing and opening the IDE, IDE Features, Script debugging.

a) Install and check the features of Selenium IDE.
b) Create a simple Selenium IDE Script and run it.
c) Create a simple Selenium IDE Script and use “Execute this command” option.

d) Create a simple Selenium IDE Script and use break point and starting point options.

UNIT V SELENIUM WEBDRIVER, LOCATORS & TYPESCRIPT AUTOMATION 6 hours

Introduction to Selenium web-driver, webdriver Architecture, Selenium RC Vs WebDriver, Scripting using WebDriver, Most Used Commands, LOCATORS, Locators Usage-ID, Name, Class Name, Tag Name, Link Text , Partial Link Text, Using TypeScript with Selenium WebDriver, Writing automation scripts in TypeScript.

a) Install Selenium webdriver and write java code to access google chrome browser.
b) Develop a java code with ID, Name and Class locators by using Selenium web-driver.
c) Develop a java code to locate web elements with LinkText, PartialLinkText and TagName locators by using Selenium web-driver.
d) Write a java code by using CssSelector and XPath locators.
e) Write automation scripts using TypeScript

Course Outcomes:

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

CO1: Understand the history, cost of using and building CASE tools.

CO2: Design test cases using black box testing technique which includes decision tables domain testing and transition testing.

CO3: Design test cases for a white box testing technique which includes path testing, data flow graphs and matrix representation for a given problem.

CO4: Students able to identify difference between Manual and Automation Testing, features of Selenium IDE.

CO5: Apply Selenium WebDriver concepts to design and execute automated test scripts using various locators for web application testing.

Textbooks:

1. Software testing techniques – Boris Beizer, Dreamtech, second edition.

2. Software Testing- Yogesh Singh, Camebridge. 3. Introduction to Software Testing, Paul Ammann and Jeff Offutt, Cambridge University Press, 2nd edition, 2016.

3. Boni Garcia, “ Hands-On Selenium WebDriver with Java ” O’RE ILLY publications 2022.

Reference Books:

1. The craft of software testing - Brian Marick, Pearson Education.

2. Software Testing, 3rd Edition,P.C. Jorgensen, Aurbach Publications (Dist.by SPD).

3. Unmesh Gundecha, Carl Cocchiaro, “ Learn Selenium ” by Packt Publishing 2019.

Online Learning Resources

1. https://www.youtube.com/watch?v=VuB6cc7FKm8&list=PLsjUcU8CQXGGJvTvqg5vmwEZcvok1luXd

2. https://www.guru99.com/selenium-tutorial.html

3. https://www.tutorialspoint.com/selenium/selenium_webdriver.htm

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

Skill Enhancement Course - V

23CST608 Full Stack Development – II

L	T	P	C
1	0	2	2

Pre-requisite: **23CST604 - Full Stack Development I**

Course Objectives:

The main objectives of the course are to

1. Apply modern-day JavaScript features based on ES6 standards to design dynamic, modular, and interactive web pages.
2. Develop responsive and reusable user interfaces using React.js by leveraging component-based architecture and state management.
3. Build robust backend APIs using Express.js to efficiently handle server-side operations and business logic.
4. Establish seamless integration between React-based frontend and Express-based backend for effective communication and data flow.
5. Implement full-stack web applications by connecting frontend and backend with MySQL databases for dynamic data interaction and persistent storage.

UNIT I INTRODUCTION TO MODERN JAVASCRIPT AND DOM 6 hours

Introduction to DOM (Document Object Model), Ecma Script (ES6) standards and features like Arrow functions, Spread operator, Rest operator, Type coercion, Type hoisting, String literals, Array and Object Destructuring.

a. Write a JavaScript program to link JavaScript file with the HTML page.
b. Write a JavaScript program to select the elements in HTML page using selectors.
c. Write a JavaScript program to implement the event listeners.
d. Write a JavaScript program to handle the click events for the HTML button elements.
e. Write a JavaScript program to with three types of functions
    - Function declaration
    - Function definition
    - Arrow functions

UNIT II BASICS OF REACT. JS 6 hours

Basics of React. js like React Components, JSX, Conditional rendering Differences between Real DOM and Virtual DOM.

a. Write a React program to implement a counter button using react class components.
b. Write a React program to implement a counter button using react functional components.
c. Write a React program to handle the button click events in functional component.
d. Write a React program to conditionally render a component in the browser.
e. Write a React program to display text using String literals.

UNIT III IMPORTANT CONCEPTS OF REACT. JS 6 hours

React.js concepts like React hooks, Props, React forms, Fetch API, Iterative rendering using JavaScript map() function.

a. Write a React program to implement a counter button using React use State hook.
b. Write a React program to fetch the data from an API using React use Effect hook.
c. Write a React program with two react components sharing data using Props.

d. Write a React program to implement the forms in react.
e. Write a React program to implement the iterative rendering using map() function.

UNIT IV INTRODUCTION TO NODE. JS AND EXPRESS. JS 6 hours

JavaScript runtime environment node. js and its uses, Express. js and Routing, Micro-Services architecture and MVC architecture, database connectivity using (My SQL).

a. Write a program to implement the _hello world‘ message in the route through the browser using Express.
b. Write a program to develop a small website with multiple routes using Express. js
c. Write a program to print the _hello world‘ in the browser console using Express. js
d. Write a program to implement the CRUD operations using Express. js
e. Write a program to establish the connection between API and Database using Express – My SQL driver

UNIT V INTRODUCTION TO REST API, MY SQL & NOSQL 6 hours

Understand API concepts and HTTP methods, Build a basic REST API, Introduction to My SQL, setting up MySQL and configuring, Databases, My SQL queries, subqueries, creating My SQL driver for database connectivity to Express. js server. Introduction to NoSQL, Characteristics of NoSQL, Types of NoSQL Databases.

a. Create a REST API using Node.js + Express.js with the following endpoints:
   GET /api/hello → returns a welcome message
   GET /api/time → returns current server time
b. Write a program to create a Database and table inside that database using My SQL Command line client.
c. Write a My SQL queries to create table, and insert the data, update the data in the table.
d. Write a My SQL queries to implement the subqueries in the My SQL command line client.
e. Create a NoSQL database and collection and insert documents using MongoDB.
f. Update a document and retrieve records based on a condition in MongoDB.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Build fast and interactive UIs.
CO2: Apply Declarative approach for developing web apps.
CO3: Make use of ES6 features to embrace modern JavaScript.
CO4: Experiment reliable APIs with Express. Js.
CO5: Implement full-stack web applications by connecting frontend and backend with MySQL and NoSQL databases.

Textbooks:

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. Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites by Robin Nixon.

Reference Books:

1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.
2. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.

Online Learning Resources

1. https://www.w3schools.com/html
2. https://www.w3schools.com/css
3. https://www.w3schools.com/js/
4 https://www.w3schools.com/nodejs
5 https://www.w3schools.com/typescript

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

Skill Enhancement Course - V

23CST609 COMPETITIVE CODING II

L	T	P	C
1	0	2	2

Pre-requisite: NIL

Course Objectives:

The main objectives of the course are to

1. Learn fundamental data structures used in coding interviews.
2. Apply dynamic programming techniques to solve optimization problems.
3. Understand graph algorithms and shortest path concepts.
4. Use greedy strategies and mathematical algorithms.

UNIT I ADVANCED ARRAY TECHNIQUES 6 hours

Advanced Array Techniques: Prefix Sum and Difference Array, Sliding Window Technique TwoPointer Technique, Basic Coordinate Compression Mathematical Algorithms: GCD and LCM, Modular Arithmetic Basics, Fast Exponentiation, Prime Numbers and Sieve of Eratosthenes.

Experiments:

1.Implement a java program to Count sub arrays with sum divisible by k
2. Write a java program find Maximum sum sub array
3. implement a java program find Product of array except self
4. Write a java program to Count pairs with given difference
5. implement a java program to find missing and repeating numbers
6. Write a java program to find all primes up to N using sieve
7. implement a java program to Power function using fast exponentiation
8. Write a java program to Minimum swaps to sort array
9. Write a java program to Count triplets with sum less than target
10. Write a java program to Largest rectangle in histogram (intro level)

UNIT II STACKS, QUEUES, HASHING, HEAP/PRIORITY QUEUE 6 hours

Stacks: Stack implementation, Applications ofstack
Queues: Queue implementation, Circular queue
Hashing: Hash Map basics, Frequency counting,
Heap / Priority Queue: Introduction to Min Heap and Max Heap
Sample Experiments:

1. Write a java program to find Next greater element
2. Write a java program to solve Valid parentheses problem
3. implement a java program to solve Sliding window maximum (basic approach)
4. implement a java program to find K largest elements in an array
5. Write a java program to find first non-repeating character in stream
6. implement a java program to Merge k sorted arrays (simple version)
7. Write a java program to Rearrange characters in string
8. implement a java program find top k frequent elements
9. Write a java program to Implement stack using queue
10. Write a java program to find Kth smallest element in array

UNIT III INTRODUCTION TO DYNAMIC PROGRAMMING, CLASSIC DP PROBLEMS 6 hours

Introduction to DP: Overlapping subproblems, Memoization, Tabulation
Classic DP Problems: Fibonacci using DP, Longest Increasing Subsequence, Longest Common Subsequence, Knapsack (basic idea)

Sample Experiments:

1. Write a java program to solve Coin Change Problem
2. Write a java program to solve House Robber Problem
3. implement a java program to solve Minimum Path Sum in Grid
4. Write a java program to solve Edit Distance (intro level)
5. Write a java program to solve Partition Equal Subset Sum
6. Write a java program to find Maximum Product Subarray
7. implement a java program to solve Decode Ways problems
8. Write a java program to solve Longest Palindromic Subsequence problem
9. implement a java program to solve Rod Cutting Problem
10. Write a java program to solve Word Break Problem

UNIT IV GRAPH BASICS, SHORTEST PATH CONCEPTS, GRAPH CONCEPTS 6 hours

Graph Basics: Graph representation (Adjacency List), BFS and DFS traversal, Connected Components
Shortest Path Concepts: Introduction to Dijkstra Algorithm, BFS in grid problems
Other Graph Concepts: Topological Sorting (basic), Cycle Detection, Minimum Spanning Tree (intro)

Sample Experiments:

1. Write a java program to solve Number of islands
2. Write a java program to solve Detect cycle in graph problem
3. implement a java program to solve Shortest path in grid problem
4. Write a java program to solve Course schedule problem
5. implement a java program to solve Minimum spanning tree (basic idea)
6. Write a java program to solve Network delay time problem
7. Write a java program to solve Clone graph (simple understanding) problem
8. implement a java program to solve Bipartite graph check problem
9. Write a java program to solve Flood fill problem
10. Write a java program to solve Word ladder problem

UNIT V GREEDY ALGORITHMS, SCHEDULING, BACKTRACKING 6 hours

Greedy Algorithms: Activity Selection, Interval
Scheduling, Backtracking: N-Queens (basic version),
Combination Sum Bit Manipulation: XOR tricks, Subset
generation
Introduction: Segment Tree (concept only), Fenwick Tree (basic idea)

Sample Experiments:

1. Write a java program to solve Job sequencing problem
2. implement a java program to solve N-Queens solution
3. Write a java program to find Generate all subsets using bit manipulation
4. Write a java program to Count set bits efficiently
5. implement a java program to solve Range sum queries (basic approach)
6. Write a java program to findMinimum number of platforms required
7. Implement a java program to solve Partition labels problem
8. Write a java program to solve Subset sum problem

Course Outcomes:

At the end of this course students will demonstrate the ability to
CO1: Solve intermediate-level competitive programming problems.
CO2: Use arrays, strings, and basic data structures efficiently.
CO3: Implement dynamic programming and graph-based solutions.
CO4: Apply greedy and backtracking techniques.
CO5: Perform better in coding interviews and programming contests.

Textbooks:

1 Narasimha Karumanchi – *Data Structures and Algorithms Made Easy*

2 Yashavant Kanetkar – *Let Us C / Data Structures Through C*

3 Steven Skiena – *The Algorithm Design Manual*

Reference Books:

1 Cormen et al. – *Introduction to Algorithms (CLRS)*

Online Learning Resources

1 https://leetcode.com/

2 https://cses.fi/problemset/

3 https://www.geeksforgeeks.org/

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

MINOR

Minor

23MDCST101 DESIGN AND ANALYSIS OF ALGORITHMS

L	T	P	C
3	0	0	3

Pre-requisite: NIL

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 sales person 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.

Textbooks:

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

Online Learning Resources

1. https://onlinecourses.nptel.ac.in/noc19_cs47/preview

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

Minor

23MDCST102 DATABASE MANAGEMENT SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite:

Course Description:

This course is designed to provide basic understanding on database systems and its design. The course material further used for developing any web-based applications in which database is back end. Course covers from all basic and advanced queries of SQL, PL/SQL programs, Relational algebra and calculus, normal forms, low level details such as representing data elements of database and indexed structures, transaction management and data recovery.

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.

Entity Relationship Model: Types of Attributes, Relationship, Structural Constraints - Relational Model, Relational model Constraints - Mapping ER model to a relational schema - Integrity Constraints.

UNIT II SQL 9 hours

The Database Language SQL – Simple Queries in SQL – Queries Involving More than One Relation, Sub Queries, aggregate operators, null values, complex integrity constraints, triggers and active databases Embedded SQL, Dynamic SQL, Cursors, Introduction to JDBC, Stored Procedures.

UNIT III SCHEMA REFINEMENT 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: To understand basic concept and role of DBMS in an organization.
CO2: Illustrate the design principles for database design, ER model and normalization for real time applications.
CO3: Demonstrate Concurrency control and recovery mechanisms for the desirable database problem.
CO4: Analysis the basic database storage structure and access techniques including B Tree, B+ Trees and hashing.
CO5: Design and implement the database system with the fundamental concepts of DBMS.

Textbooks:

1. A. Silberschatz, H. F. Korth S. Sudershan, Database System Concepts, McGraw Hill, 7th Edition 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. Micheal T. Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet examples", Second Edition, Wiley Publication, 2006

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

Online Learning Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs91/preview

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

Minor

23MDCST201 DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: NIL

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:

1. Write a program to implement Insertion and Bubble sort
2. Write a program to implement Binary Search using recurrence
3. Write a program to implement Quick sort using recurrence
4. Write a program to implement Merge sort using recurrence
5. Implement the Knapsack Problem using the Greedy method.
6. Construct Minimum Spanning Tree using
   (a) Prim’s Method (b) Kruskal’s Method
7. Write a program to solve 0/1 Knapsack problem Using Dynamic Programming.
8. Implement the Travelling Sales Person problem using Dynamic Programming.
9. Implement N-Queens Problem Using Backtracking Strategy.
10. Implement the Backtracking method to solve the Graph Coloring problem.
11. Implement the Travelling Sales Person problem using Dynamic Programming using branch & bound
12. Write a program to implement Randomized Quick sort

Course Outcomes:

After completion of the course, Students will be able to

CO1: Implement various sorting algorithms using both iterative and recursive approaches.
CO2: Execute the problems using Greedy Method.
CO3: Solve optimization problems like the Knapsack Problem using both Greedy and Dynamic Programming techniques.
CO4: Implement algorithms to construct Minimum Spanning Trees using Prim's and Kruskal's methods.
CO5: Apply backtracking and branch-and-bound strategies to solve complex problems.

Reference Books:

1. Fundamentals of Data Structures in C++, Horowitz Ellis, Sahni Sartaj, Mehta, Dinesh, 2ndEdition, Universities Press
2. Computer Algorithms/C++ Ellis Horowitz,Sartaj Sahni,Sanguthevar Rajasekaran, 2ndEdition, University Press
3. Data Structures and program design in C,Robert Kruse,Pearson Education Asia
4. An introduction to Data Structures with Applications,Trembley& Sorenson, McGraw Hill

Online 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

Minor

23MDCST103 BIG DATA ANALYTICS

L	T	P	C
3	0	0	3

Pre-requisite Nil

Course Description:
This course introduces fundamental concepts and tools required to understand Data analytics. The also discusses big data applications in Data Science and covers the applications and technologies needed to process the large-scale data.

Course Objectives:
1. To learn data mining and big data basics
2. To learn the big data in technology perspective
3. To learn Hadoop framework for data analytics
4. Applying MapReduce paradigm to solve problems
5. To interpret the potential applications in big data scenario.

UNIT I INTRODUCTION TO DATA MINING AND BIG DATA 9 hours

Introduction to Data mining, KDD process, Data Mining Techniques: Mining Frequent patterns, Association rule, Cluster analysis, Classification and Regression. Introduction to Big Data - What is Big Data? Explosion in Quantity of Data, Big Data Characteristics, Types of Data, Common Big data Customer Scenarios, BIG DATA vs. HADOOP, A Holistic View of a Big Data System, Limitations of Existing Data Analytics Architecture.

UNIT II DATA ANALYTICS LIFE CYCLE 9 hours
Introduction to Big data Business Analytics - State of the practice in analytics role of data scientists- Key roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders.

UNIT III INTRODUCTION TO HADOOP 9 hours
Why DFS? What is Hadoop? Hadoop Distribution, Hadoop Key Characteristics, RDBMS vs. Hadoop, Hadoop 2.x Cluster Architecture, Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read, Name Node, Secondary Name Node, and Data Node, Hadoop 2.0 New Features – Name Node High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN Hadoop Distributed File System.

UNIT IV PROGRAMMING FOR DATA ANALYTICS 9 hours
MapReduce program in Java – Map Reduce API – Programming Examples- Combiner Functions Streams and Files - Streams – Text Input and Output – Reading and Writing Binary Data.

UNIT V DATA SCIENCE AND APPLICATIONS 9 hours

Data Loading Techniques & Data Analysis, Text Analytics for Large unstructured information, Analytic Stack, Big Data Applications - Fraud detection in Stock markets, Sentiment Analysis.

Course Outcomes:

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

1. Apply data mining algorithms for classification and clustering.
2. Understand Big data framework.
3. To understand the map reduce way of solving analytic problems.
4. Illustrate the problem and its solution.
5. Analyze big data applications.

Textbook(s)

1. Jiawei Han Micheline Kamber Jian Pei, Data Mining: Concepts and Techniques, Third Edition, Elsevier, Morgan Kaufmann, 2011.
2. Tom White, "Hadoop: The Definitive Guide", 3rd Edition, O'reilly, 2012.
3. Alberto Cordoba, "Understanding the Predictive Analytics Lifecycle", Wiley, 2014.
4. Eric Siegel, Thomas H. Davenport, "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die", Wiley, 2013.

Reference Books

1. Chuck Lam, Hadoop in Action, Manning, Second Edition, 2016.
2. Mark Gardener, Beginning R: The Statistical Programming Language, Wiley, 2013.
3. Jiawei Han and Micheline Kamber, Data Mining, Second Edition, Elsevier, 2007. ISBN: 81-312-0535-5.

Online Resources:

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

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

Minor

23MDCST104 DATA MINING AND DATA WAREHOUSING

L	T	P	C
3	0	0	3

Pre-requisite Nil

Course Description:

In this course we explore how this interdisciplinary field brings together techniques from databases, statistics, machine learning, and information retrieval. We will discuss the main data mining methods currently used, including data warehousing and data cleaning, clustering, classification, association rules mining, and web mining.

Course Objectives:

1. To understand the fundamentals of Data mining and Pre-processing techniques
2. To understand the concept of Data warehouses.
3. To understand the algorithms of supervised techniques.
4. To understand the algorithms of unsupervised techniques.
5. To know the applications of data mining in the real world.

UNIT I INTRODUCTION TO DATA MINING 9 hours

Introduction: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Major issues in Data Mining. Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation, role of Data warehousing in Data mining.

UNIT II MINING FREQUENT PATTERNS 9 hours

Mining Frequent Patterns, Associations and Correlations: Basic Concepts, Efficient and Scalable Frequent Itemset Mining Methods, Mining various kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining

UNIT III CLASSIFICATION AND PREDICTION 9 hours

Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Backpropagation, Lazy Learners, Other Classification Methods, Prediction, Accuracy and Error measures, Evaluating the accuracy of a Classifier or a Predictor, Ensemble Methods.

UNIT IV CLUSTER ANALYSIS 9 hours

Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data, Constraint-Based Cluster Analysis, Outlier Analysis.

UNIT V APPLICATIONS IN DATA MINING 9 hours

Social networks Analysis, Web mining, Text mining, Multimedia.

Course Outcomes:

CO1: Student is able to preprocess any real world dataset by using preprocessing techniques.
CO2: Able to distinguish the OLTP and OLAP.
CO3: Able to implement data mining techniques such as Associations, classification.
CO4: Able to implement clustering techniques and its applications.
CO5: Students can identify the applications where data mining techniques can be applied.

Textbooks

1. Tan, Pang-Ning& others. "Introduction to Data Mining" Pearson Education, 2006.

Reference Books

1. Han J &Kamber M, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Second Edition, 2006
2. Dunhum M.H. & Sridhar S. "Data Mining-Introductory and Advanced Topics", Pearson Education, 2006.
3. Grigoris Antoniou and Frank van Harmelen "A Semantic Web Primer", The MIT Press Cambridge, Massachusetts London, England 2003.
4. S. Sumathi& S.N. Sivanandam "Introduction to Data mining and its applications", Springer-verlag.

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

Minor

23MDCST202 BIG DATA MANAGEMENT AND DATA ANALYTICS LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite -NIL-

Course Description:

Modern scientific, engineering, and business applications are increasingly dependent on data, existing traditional data storage technologies were not designed for the complexity of the modern world. Data Analytics has emerged as a new, exciting, and fast-paced discipline that explores novel statistical, algorithmic, and implementation challenges that emerge in processing, storing, and extracting knowledge from Big Data.

Course Objectives:

1. To optimize business decisions and create competitive advantage with Big Data Analytic.
2. Imparting the architectural concepts of Hadoop and introducing map reduce paradigm.
3. To introducing Java concepts required for developing map reduce programs
4. To derive business benefit from unstructured data
5. Introduce programming tools PIG & HIVE in Hadoop echo system.
6. Developing Big Data applications for streaming data using Apache Spark

List of Programs:

1. Perform setting up and Installing Hadoop in its two operating modes:
   - Pseudo distributed
   - Fully distributed.

2. Use web based tools to monitor your Hadoop setup.

3. a) Implement the following file management tasks in Hadoop:
   - Adding files and directories
   - Retrieving files
   - Deleting files

   b) Benchmark and stress test an Apache Hadoop cluster.
4. Stop word elimination problem:
   - Input:
     A large textual file containing one sentence per line
     A small file containing a set of stop words (One stop word per line)
   - Output:
     A textual file containing the same sentences of the large input file without the words appearing in the small file.
5. a) Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented.
   Data available at: https://github.com/tomwhite/hadoop-book/tree/master/input/ncdc/all.
   - Find average, max and min temperature for each year in NCDC data set?
   - Filter the readings of a set based on value of the measurement, Output the line of input files

associated with a temperature value greater than 30.0 and store it in a separate file.

6. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.

7. Write a Pig Latin scripts for finding TF-IDF value for book dataset (A corpus of eBooks available at: Project Gutenberg).

8. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, Functions and indexes.

9. Install, Deploy & configure Apache Spark Cluster. Run apache spark applications using Scala.

10. Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together. Write a single Spark application that:
    - Transposes the original Amazon food dataset, obtaining a PairRDD of the type:
    - <user_id> → <list of the product_ids reviewed by user_id>
    - Counts the frequencies of all the pairs of products reviewed together;
    - Writes on the output folder all the pairs of products that appear more than once and their frequencies. The pairs of products must be sorted by frequency.

Course Outcomes:

After completing this course the students should be able to

1. Preparing for data summarization, query, and analysis.
2. Applying data modelling techniques to large data sets.
3. Creating applications for Big Data analytics.
4. Building a complete business data analytic solution.

Textbooks:

1. Tom White, Hadoop: The Definitive Guide, Published by O'Reilly Media, 2015..

2. Bill Chambers and Matei Zaharia, Spark: The Definitive Guide – Big Data Processing Made Simple, Published by O'Reilly Media, 2018.

3. Alberto Cordoba, "Understanding the Predictive Analytics Lifecycle", Wiley, 2014.

4. Eric Siegel, Thomas H. Davenport, "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die", Wiley, 2013

Reference Books:

1. Chuck Lam, Hadoop in Action, Published by Manning Publications, 2010.

2. Jiawei Han Micheline Kamber Jian Pei, Data Mining: Concepts and Techniques, Third Edition, Elsevier, Morgan Kaufmann, 2011.

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

Minor

23MDCST105 NATURAL LANGUAGE PROCESSING

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Objectives:

The main objective of the course is to

1. Explain and apply fundamental algorithms and techniques in the area of natural language processing (NLP)
2. Discuss approaches to syn tax and semantics in NLP.
3. Examine current methods for statistical approach esto machine translation.
4. Teach machine learning techniques used in NLP.

UNIT I INTRODUCTION TO NATURAL LANGUAGE 9 hours

The Study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different Levels of Language Analysis, Representations and Understanding, Organization of Natural Language Understanding Systems, Linguistic Background: An Outline of English Syntax.

UNIT II GRAMMARS AND PARSING 9 hours

Grammars and Parsing – Top-Down and Bottom-Up Parsers, Transition Network Grammars, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks, Bayes' Rule, Shannon Game, Entropy, and Cross Entropy.

UNIT III GRAMMARS FOR NATURAL LANGUAGE 9 hours

Grammars for Natural Language, Movement **Phenomenon in** Language, Gap Threading, Human Preferences in Parsing, Shift-Reduce Parsers, Deterministic Parsers.

UNIT IV SEMANTIC INTERPRETATION 9 hours

Semantic Interpretation

Semantic and Logical form, Word senses and ambiguity, The basic logical form language, Encoding ambiguity in the logical form, Verbs and States in logical form, Thematic roles, Speech acts and embedded sentences, Defining semantic structure and model theory.

Language Modelling

Introduction, n-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modelling Problems, Multilingual and Crosslingual Language Modelling.

UNIT V MACHINE TRANSLATION 9 hours

Survey: Introduction, Problems of Machine Translation, Is Machine Translation Possible, Brief History, Possible Approaches, Current Status. Anusaraka or Language Accessor: Background, Cutting the Gordian Knot, The Problem, Structure of Anusaraka System, User Interface, Linguistic Area, Giving up Agreement in Anusaraka Output, Language Bridges.

Multilingual Information Retrieval

Introduction, Document Pre-processing, Monolingual Information Retrieval, CLIR, MLIR, Evaluation in Information Retrieval, Tools, Software, and Resources.

Multilingual Automatic Summarization

Introduction, Approaches to Summarization, Evaluation, How to Build a Summarizer, Competitions, and Datasets.

Course Outcomes:

After completion of the course, students will be able to

CO1: Understand the various NLP Applications and Organization of Natural language, able to learn and implement realistic applications using Python.

CO2: Apply the various Parsing techniques, Bayes Rule, Shannon game, Entropy and Cross Entropy.

CO3: Understand the fundamentals of CFG and parsers and mechanisms in ATN's.

CO4: Apply Semantic Interpretation and Language Modelling.

CO5: Apply the concept of Machine Translation and multilingual Information Retrieval systems and Automatic Summarization.

Textbooks:

1. James Allen, Natural Language Understanding, 2ndEdition, 2003, Pearson Education
2. Multilingual Natural Language Processing Applications: From Theory To Practice- Daniel M.Bikel and ImedZitouni, Pearson Publications
3. Natural Language Processing, A paninian perspective, Akshar Bharathi, Vineetchaitanya, Prentice –Hall of India.

Reference Books:

1. Charniack, Eugene, Statistical Language Learning, MITPress,1993.
2. Jurafsky, Dan and Martin, James, Speech and Language Processing, 2ndEdition, Prentice Hall,2008.
3. Manning, Christopher and Hen rich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press,1999.

Online Learning Resources

1. https://nptel.ac.in/courses/106/105/106105158/http://www.nptelvideos.in/2012/11/natural-language- processing.html

Mode of Evaluation: Assignments, Mid Term Tests 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

Textbooks:

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

Textbooks:

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

Pre-requisite: None

L	T	P	C
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

Textbooks:

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

Textbooks:

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)

Pre-requisite: Nil

L	T	P	C
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

Textbooks:

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

Honors

23HDCST101 MULTIDISCIPLINARY RESEARCH METHODS FOR THE STUDY OF EVOLUTION

L	T	P	C
3	0	0	3

Pre-requisite Nil

Course Description:

This course deals with basics of research and explores multifaceted possibilities in the discipline of research and provide participants the opportunity to practically, theoretically, critically and creatively think through methodological issues in their research and the research of others.

Course Objectives:

1. To explore multifaceted possibilities and pathways of translation and dialogue across knowledge, discipline, community and social borders
2. To further multifaceted possibilities and pathways of translation and dialogue across knowledge, discipline, community and social borders.
3. To provide participants the opportunity to practically, theoretically, critically and creatively think through methodological issues in their research and the research of others.
4. To engage in participatory interdisciplinary learning and exchange.

UNIT I INTRODUCTION TO RESEACH METHOLOGIES 9 hours

Survey of Research Methodologies- Rationalism, Idealism, Positivism, Post Positivism, Introduction to major binaries, Subjectivity vs Objectivity, Realism vs Anti –realism, True vs False, Scientific evolution vs Scientific Revolutions, Continuity vs Discontinuity, Deterministic vs Probabilistic, Linearity vs Non –Linearity, Beyond the binaries

UNIT II TYPES OF RESEARCH METHODS 9 hours

T Methods: Epistemology, Ontology, Deduction, Induction, Hypothetical Deductive method, Explanation and Prediction, General and Particular, Cause and Effect.

UNIT III QUANTITATIVE TECHNIQUES 9 hours

Techniques-Quantitative Techniques, Techniques of generating data, Techniques of classification, Techniques of measures, Central Tendency and Dispersion, Measures of Correspondence/Correlation, Measures of Causal relations/Regression, Techniques of Explanation ANOVA, Time Series Analysis-ARMA Adaptive Estimation Procedures (Kalman Filters) Techniques of inference.

UNIT IV STATISTICAL METHODS 9 hours

Advanced Techniques- Advanced Statistical Methods for data Analysis, Structural, quantitative, statistical approaches for the analysis of data.

UNIT V CLASSIFICATION AND APPLICATION 9 hours

Advances in classification, clustering and pattern recognition methods, Strategies for modelling complex data and mining large data sets, Chaos analysis and its measurement, Methods for the extraction of knowledge from whatever type of data, and Application of advanced methods in specific domains of practice.

Course Outcomes:

Upon successful completion of the course, students will be able to
CO1: Discuss the various research component and binaries.
CO2: Understand the guidelines for research methods.
CO3: Understand the various types of quantitative techniques and statistical methods.
CO4: Apply the various classification technique in advanced applications
CO5: Develop an interdisciplinary research framework by selecting suitable research methods and critically interpreting methodological issues across disciplines.

Textbook(s)

1. Abraham Kaplan, 1964, Conduct of Inquiry, Chander Publishing Company, California.
2. Ann Majchrzak, 1984, Methods for Policy Research, Sage London
3. Thomas S Khun, 1970, The Structure of Scientific Revolution, University of Chicago Press, Chicago

Reference Books

1. Carl G Hempel "The Covering Law Analysis of Scientific Explanation" in Leonard I Krimerman (ed)
2. Catheriner Marsh, 1988, Exploring Data, Polity Press, Cambridge
3. Cohen and Ernest Nagel (ed) 1978, An Introduction to Logic and Scientific Method, Allied, New Delhi.

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

Honors

23HDCST102 INTRODUCTION TO GAME THEORY

L	T	P	C
3	0	0	3

Pre-requisite Nil

Course Description:
This course covers the basics of text processing including basic pre-processing, spelling correction, language modeling, Part-of Speech tagging, Constituency and Dependency Parsing, Lexical Semantics, distributional Semantics and topic models.

Course Objectives:
1. Provide an in-depth introduction to technologies and techniques used in the game Theory.
2. To familiarize with the process of game design and development
3. To learn the processes, mechanics, issues in game design
4. To understand the architecture of game programming
5. To know about game engine development, modeling, techniques and frameworks

UNIT I INTRODUCTION 9 hours

Elements of Game Play – Artificial Intelligence – Getting Input from the Player – Sprite Programming – Sprite Animation - Multithreading – Importance of Game Design – Game Loop

UNIT II 3D GRAPHICS FOR GAME PROGRAMMING 9 hours
Coordinate Systems, Ray Tracing, Modeling in Game Production, Vertex Processing, Rasterization, Fragment Processing and Output Merging, Illumination and Shaders, Parametric Curves and Surfaces.

UNIT III GAME DESIGN PRINCIPLES 9 hours
Character Development, Story Telling, Narration, Game Balancing, Core mechanics, Principles of level design, Genres of Games, Collision Detection, Game Logic, Game AI, Path Finding, Case study: Tetris.

UNIT IV GAMING ENGINE DESIGN 9 hours
Renderers, Software Rendering, Hardware Rendering, and Controller Based Animation, Spatial Sorting, Level of Detail, Collision Detection, Standard Objects, and Physics, Case study : The Sims.

UNIT V GAME DEVELOPMENT 9 hours
Information Extraction - Question Answering and Summarization - Dialogue and Conversational Agents - Machine Translation

Course Outcomes:

Upon completion of the course, the students will be able to:
CO1: Understand the basic working of gaming.
CO2: Design an innovative 3D model for gaming.
CO3: Apply the basic principles of designing in game development.
CO4: Create interactive game via game engine.
CO5: Develop the 2D/3D interactive game using openGL.

Textbook(s)

1. David H. Eberly, ―3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics‖, Second Edition, Morgan Kaufmann, 2010.
2. Jung Hyun Han, ―3D Graphics for Game Programming‖, First Edition, Chapman and Hall/CRC, 2011.

Reference Books

1. Ernest Adams and Andrew Rollings, ―Fundamentals of Game Design‖, Third Edition, Pearson Education, 2014.
2. Jim Thompson, Barnaby Berbank-Green, and Nic Cusworth, ―Game Design: Principles, Practice, and Techniques - The Ultimate Guide for the Aspiring Game Designer‖, First Edition, Wiley, 2008.

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

Honors

23HDCST201 GAME DESIGN LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: NIL

Course Objectives:

The objectives of the course are

1. To introduce the foundational concepts and techniques in game theory and game design.
2. To understand the architecture and components involved in game development.
3. To explore 2D and 3D graphics techniques used in modern game programming.
4. To develop skills in implementing game logic, AI, and physics for interactive games.
5. To gain hands-on experience with game engines and tools for creating real-time games

List of Experiments:

1. To implement a fundamental game loop that handles player input, updates game state, and renders output
2. To animate a sprite character and control its movement using keyboard input
3. To integrate multithreading for concurrent execution of physics and rendering
4. To create a 3D object using vertex modeling and implement basic rotation
5. To simulate a basic ray tracing technique for lighting and visibility
6. To implement vertex and fragment shaders for illumination effects
7. To design a simple character and detect collisions with objects in the game world
8. To implement pathfinding using A* algorithm for enemy movement
9. To implement basic game states (menu, play, pause, win/lose) and transitions
10. To build a 2D game (e.g., Pong or Tetris clone) using a game engine like Unity or Godot.
11. To simulate object physics (gravity, bounce) and implement LOD in a 3D scene
12. To develop a complete interactive 3D game incorporating design principles, animation, AI, and graphics

Course Outcomes:

After completion of the course, Students will be able to

CO1: Understand the fundamental principles and architecture of game development.

CO2: Apply 2D and 3D graphics techniques for designing interactive game environments.

CO3: Develop game logic, character control, and AI behavior for real-time applications.

CO4: Use game engines and tools to design and build interactive games.

CO5: Create and evaluate functional 2D/3D games integrating game theory concepts and design principles.

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Reference Books:

1. David H. Eberly, ―3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics‖, Second Edition, Morgan Kaufmann, 2010.

2. Jung Hyun Han, ―3D Graphics for Game Programming‖, First Edition, Chapman and Hall/CRC, 2011.

3. Ernest Adams and Andrew Rollings, ―Fundamentals of Game Design‖, Third Edition, Pearson Education, 2014.

4. Jim Thompson, Barnaby Berbank-Green, and Nic Cusworth, ―Game Design: Principles, Practice, and Techniques - The Ultimate Guide for the Aspiring Game Designer‖, First Edition, Wiley, 2008.

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

Honors

23HDCST103 EVOLUTIONARY COMPUTING

L	T	P	C
3	0	0	3

Pre-requisite Nil

Course Description:
This course introduces the field of evolutionary computing (EC) and surveys the major types of evolutionary algorithms (EAs), a class of stochastic, population-based algorithms inspired by natural evolution theory, genetics, and population dynamics, capable of solving complex optimization and modeling problems. This is a rigorous and programming intensive course in which students will implement course concepts to gain hands-on experience in solving complex problems with EAs. Some popular types of EAs that will be reviewed are Genetic Algorithms, Evolution Strategies, Genetic Programming, Differential Evolution, Learning Classifier Systems, and Hyper-heuristics. This course will follow a unified approach focusing on the general characteristics of all EA types.

Course Objectives:
1. The ability to analyze and explain EA behavior,
2. The skills necessary to write formal technical reports in the field of EC

UNIT I INTRODUCTION **9 hours**

Complex adaptive systems (cas) as the motivation for genetic-algorithm (GA) research; classifier systems; overview of GA mechanisms and theory; quick run-through of EVOKE, the Evolutionary Computation Engine. Technical details of GA mechanisms; fitness landscapes; GA applications - prisoner's dilemma, sorting networks, task scheduling.

UNIT II GENETIC PROGRAMMING **9 hours**
Introduction to genetic programming (GP), Comparison of GA and GP. GA and GP applications to cellular automata, Advanced implementation details in EC. GP applications to control and classification problems.

UNIT III GENETIC ALGORITHM **9 hours**
Theoretical aspects of GAs: building blocks, schema theory, royal-roads functions. EC applications to neural nets. Introduction to Artificial Life. Modelling Learning and Evolution. Sampling of artificial life systems

UNIT IV PROBLEM REPRESENTATION **9 hours**
Derivative Methods in Genetic Programming, Learning Classifier Systems, Hybrid Methods. Introduction to Representations, Binary Strings, Real-Valued Vectors. Permutations, Finite-State Representations, Parse Trees

UNIT V GA OPERATORS **9 hours**
Introduction to Selection, Proportional Selection and Sampling Algorithms. Tournament Selection, Rank-based Selection, Boltzmann Selection. Generation Gap Methods, A comparison of Selection Mechanisms. Introduction to Search Operators, Mutation Operators, Recombination.

Course Outcomes:

CO1: To understanding of core EC concepts and EA mechanisms,

CO2: Understand of how to identify (real-world) problems for which EC is appropriate,

CO3: To implement and configure EAs to solve appropriate problems,

CO4: To perform statistical analysis on stochastic algorithms such as EAs, and

CO5: Skills necessary to write basic technical reports on solving problems with EC.

Textbook(s)

1. Genetic Programming, an Introduction, Wolfgang Banzhaf, Peter Nordin, Robert E. Keller, and Frank D. Francone, Morgan Kaufmann Publishers, 1998.

Reference Books

1. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 1996.
2. Genetic Programming, John Koza, MIT Press, 1992.
3. Evolutionary Computation, The Fossil Record, David Fogel, IEEE Press, 1998.

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

Honors

23HDCST104 ADVANCED SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

Pre-requisite Nil

Course Description:
The course aims to develop the broad understanding of the discipline of software engineering (gained in the earlier Software Engineering course) by considering the wider systems engineering context in which software plays a role. It aims to examine the concepts and techniques associated with a number of advanced and industrially relevant topics, relating to both the product and processes of software engineering. It seeks to complement this with an account of the associated practical and professional issues in software engineering.

Course Objectives:

1. To understand Software Engineering Lifecycle Models.
2. To do project management and cost estimation.
3. To gain knowledge of the System Analysis and Design concepts.
4. To understand software testing approaches.
5. To be familiar with DevOps practices.

UNIT I INTRODUCTION 9 hours

Software engineering concepts –Development activities –Software lifecycle models -Classical waterfall -Iterative waterfall –Prototyping –Evolutionary -Spiral –Software project management –Project planning –Estimation –Scheduling –Risk management –Software configuration management.

UNIT II SOFTWARE REQUIREMENT SPECIFICATION 9 hours

Requirement analysis and specification –Requirements gathering and analysis –Software Requirement Specification –Formal system specification –Finite State Machines –Petrinets –Object modelling using UML –Use case Model –Class diagrams –Interaction diagrams –Activity diagrams –State chart diagrams –Functional modelling –Data Flow Diagram.

UNIT III ARCHITECTURE AND DESIGN 9 hours

Software design –Design process –Design concepts –Coupling –Cohesion –Functional independence –Design patterns –Model-view-controller –Publish-subscribe –Adapter –Command –Strategy –Observer –Proxy –Facade –Architectural styles –Layered -Client-server -Tiered -Pipe and filter.-User interface design

UNIT IV TESTING 9 hours

Testing –Unit testing –Black box testing–White box testing –Integration and System testing–Regression testing –Debugging -Program analysis –Symbolic execution –Model Checking.

UNIT V DEVOPS 9 hours

DevOps: Motivation-Cloud as a platform-Operations-Deployment Pipeline: Overall Architecture-Building and Testing-Deployment-Case study: Migrating to Micro services.

Course Outcomes:

CO1: Understand the advantages of various Software Development Lifecycle Models

CO2: Gain knowledge on project management approaches as well as cost and schedule estimation strategies

CO3: Perform formal analysis on specifications

CO4: Use UML diagrams for analysis and design

CO5: Understand software testing advantages of DevOps practices

Textbook(s)

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2ndedition, Pearson Education, 2004.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd edition, PHI Learning Pvt. Ltd., 2010.

Reference Books

1. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.

2. Len Bass, Ingo Weberand Liming Zhu, ―DevOps: A Software Architect‘s Perspective‖, Pearson Education, 2016

3. Rajib Mall, Fundamentals of Software Engineering, 3rdedition, PHI Learning Pvt. Ltd., 2009.

4. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007.

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

Honors

23HDCST202 EXPERIENTIAL LEARNING IN DATA SCIENCE LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: NIL

Course Objectives:

The objectives of the course are to

1. To develop students' programming skills relevant to data science applications.
2. To introduce statistical techniques for analyzing and interpreting real-world data.
3. To enable students to build, train, and evaluate predictive data models.
4. To provide hands-on experience with professional data analysis and visualization tools.
5. To equip students with practical skills in data collection, cleaning, and management.

List of Experiments:

1. To understand the basic tools (Jupyter, Pandas, NumPy) and identify various types of data in data science projects
2. To practice collecting data from multiple sources including files and public APIs using Python
3. To clean missing, inconsistent, and duplicate data and perform basic preprocessing
4. To explore datasets using statistical summaries, groupings, and correlations
5. To compute mean, median, mode, standard deviation, skewness, and visualize distributions
6. To implement simple and multiple linear regression models and interpret the results
7. To apply and evaluate Naive Bayes and Support Vector Machine (SVM) classifiers on labeled dataset
8. To create bar charts, line plots, scatter plots, and heatmaps for effective data understanding
9. To develop interactive plots and dashboards using Bokeh for web-based visualization
10. To integrate and analyze data from multiple sources (e.g., APIs + CSV) for comprehensive insights
11. To solve a real-world problem involving data collection, analysis, modeling, and visualization
12. To present a complete end-to-end data science workflow applied to a specific domain (e.g., healthcare, finance, education)

Course Outcomes:

After completion of the course, Students will be able to

CO1: Apply core data science tools and techniques to real-world datasets.

CO2: Perform data collection, cleaning, integration, and management effectively.

CO3: Conduct statistical analysis and build predictive models using machine learning algorithms.

CO4: Visualize data insights using appropriate visualization libraries and tools.

CO5: Develop and present data-driven solutions to applied problems across various domains.

Reference Books:

1. Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from The Frontline. O'Reilly, 2013.

2. Jure Leskovek, Anand Rajaraman, Jeffrey Ullman, Mining of Massive Datasets. v2.1,CambridgeUniversity Press, 2014.

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

Honors

23HDCST105 HIGH PERFORMANCE COMPUTING

L	T	P	C
3	0	0	3

Pre-requisite: 23CST103 ,23CST104

Course Objectives:

The main objectives of the course are to

1. Provide systematic and comprehensive treatment of the hardware and the software high performance techniques involved in current day computing.
2. Introduce the fundamentals of high-performance computing with the graphics processing units and many integrated cores using their architectures and corresponding programming environments.
3. Introduce the learner to fundamental and advanced parallel algorithms through the GPU and MIC programming environments.
4. Provide systematic and comprehensive treatment of the components in the pipeline that extract instruction level parallelism.
5. Provide a strong foundation on memory hierarchy design and tradeoffs in both uniprocessor and multiprocessors.
6. Illustrate the cache coherence and consistency problems in multiprocessors, and their existing solutions.

UNIT I GRAPHICS PROCESSING UNITS 9 hours

Introduction to Heterogeneous Parallel Computing. GPU architecture. Thread hierarchy. GPU Memory Hierarchy.

UNIT II GPGPU PROGRAMMING 9 hours

Vector Addition, Matrix Multiplication algorithms. 1D, 2D, and 3D Stencil Operations. Image Processing algorithms – Image Blur, Grayscaling. Histogramming, Convolution, Scan, Reduction techniques.

UNIT III MANY INTEGRATED CORES 9 hours

Introduction to Many Integrated Cores. MIC, Xeon Phi architecture. Thread hierarchy. Memory Hierarchy. Memory Bandwidth and performance considerations

UNIT IV XEON PHI PROGRAMMING 9 hours

Xeon Phi programming environment. Native, offload and symmetric execution modes. OpenMP-based programming for MIC architecture. Vectorization and compiler directives. Memory allocation, data movement and memory management in Xeon Phi. Thread affinity, workload scheduling and load balancing. Performance tuning techniques. Scalability analysis and optimization of MIC-based applications.

UNIT V SHARED MEMORY PARALLEL PROGRAMMING & MESSAGE PASSING INTERFACE 9 hours

Symmetric and Distributed architectures. OpenMP Introduction. Thread creation, Parallel regions. Work sharing, Synchronization. MPI Introduction. Collective communication. Data grouping for communication.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Design, formulate, solve and implement high performance versions of standard single threaded algorithms

CO2: The learner will know and will be able to demonstrate the architectural features in the GPU and MIC hardware accelarators.

CO3: Design programs to extract maximum performance in a multicore, shared memory execution environment processor.

CO4: Design and deploy large scale parallel programs on tightly coupled parallel systems using the message passing paradigm.

CO5: Analyze memory hierarchy design, instruction-level parallelism, and cache coherence issues in multiprocessor systems to improve application performance.

Textbooks:

1. Wen-Mei W Hwu, David B Kirk, Programming Massively Parallel Processors A Hands-on Approach, Morgann Kaufmann, 3e.

Reference Books:

1. Rezaur Rahman, Intel Xeon Phi Coprocessor Architecture and Tools, Apress Open, 2013.

2. Barbara Chapman, Gabriele Jost, Ruud van der Pas, Using OpenMP, MIT Press, 2008.

3. Gropp, Lusk, Skjellum, Using MPI, Using MPI, 2014.

Online Learning Resources

1. https://onlinecourses.nptel.ac.in/noc25_ma27/preview

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