

MOHAN BABU UNIVERSITY

Sree Sainath Nagar, Tirupati – 517 102



SCHOOL OF ENGINEERING

B.Tech. Electronics and Computer Engineering

CURRICULUM AND SYLLABUS

(From 2022-23 Admitted Batches)

**FULLY FLEXIBLE CHOICE BASED CREDIT SYSTEM
(FFCBCS)**



MBU
MOHAN BABU
UNIVERSITY

MOHAN BABU UNIVERSITY

Vision

To be a globally respected institution with an innovative and entrepreneurial culture that offers transformative education to advance sustainability and societal good.

Mission

- ❖ Develop industry-focused professionals with a global perspective.
- ❖ Offer academic programs that provide transformative learning experience founded on the spirit of curiosity, innovation, and integrity.
- ❖ Create confluence of research, innovation, and ideation to bring about sustainable and socially relevant enterprises.
- ❖ Uphold high standards of professional ethics leading to harmonious relationship with environment and society.

SCHOOL OF ENGINEERING

Vision

To be the sought-after destination for engineering education recognised for excellence, innovation and the societal relevance and impact of its pursuits.

Mission

- ❖ Instil within our students fundamental engineering knowledge, a broad set of skills, and an inquisitive attitude to create innovative solutions to serve industry and community.
- ❖ Provide an experience par excellence with our state-of-the-art research, innovation, and incubation ecosystem to realise our learners' fullest potential.
- ❖ Impart continued education and research support to working professionals in engineering fields to enhance their domain expertise in the cutting-edge technologies.
- ❖ Inculcate among the engineers of tomorrow with a spirit to solve societal challenges.

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Vision

To be a center of excellence in the fields of Electronics and Computers through teaching and research producing high quality engineering professionals and Entrepreneurs with values and ethics to meet local and global demands.

Mission

- ❖ Imparting knowledge through contemporary curriculum and striving for development of students with diverse background.
- ❖ Developing skills for enhancing employability of students through comprehensive training process.
- ❖ Inspiring students and faculty members for innovative research through constant interaction with research organizations and industry to meet societal needs.
- ❖ Inculcating ethics and values in students for effective engineering practice.

B.Tech Electronics and Computer Engineering

PROGRAM EDUCATIONAL OBJECTIVES

After few years of graduation, the graduates of B.Tech. ECM will:

- PEO1.** Pursue higher education in the core or allied areas of Electronics and Computer Engineering.
- PEO2.** Develop into a productive and valued professional in industry /research by addressing the challenges in the core or allied areas of Electronics and Computer Engineering.
- PEO3.** Choose entrepreneurial career in the core or other fields of interest.
- PEO4.** Adapt to evolving technologies by upgrading knowledge and skills through lifelong learning.

PROGRAM OUTCOMES

On successful completion of the Program, the graduates of B.Tech. ECM Program will be able to:

- PO1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2. Problem analysis:** Identify, formulate, review 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 the public health and safety, and the cultural, societal, and environmental considerations.
- PO4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 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 norms of the engineering practice.

- PO9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with 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

On successful completion of the Program, the graduates of B.Tech. ECM program will be able to:

- PSO1.** Design and develop intelligent electronic systems by integrating principles of embedded systems, digital electronics, and software technologies to solve real-world problems in industry and automation.
- PSO2.** Apply algorithms and techniques from computer science and data analytics to process signals, images, and large-scale data for applications in communication, healthcare, and smart systems.
- PSO3.** Analyze, design, and deploy secure communication and network systems by leveraging modern tools, protocols, and interdisciplinary knowledge from electronics and computer engineering.

B.Tech. Electronics and Computer Engineering
(Regular - 4 Years Program)

Basket Wise - Credit Distribution

S. No.	Basket	Credits (Min. - Max.)
1	SCHOOL CORE	50-56
2	PROGRAM CORE	45-61
3	PROGRAM ELECTIVE	24-36
4	SPECIALIZATION ELECTIVE	12-18
5	UNIVERSITY ELECTIVE	9-15
TOTAL CREDITS		Min. 160

B.Tech. Electronics and Computer Engineering
(Lateral Entry - 3 Years Program)

Basket Wise - Credit Distribution

S. No.	Basket	Credits (Min. - Max.)
1	SCHOOL CORE	20-36
2	PROGRAM CORE	45-61
3	PROGRAM ELECTIVE	24-36
4	SPECIALIZATION ELECTIVE	12-18
5	UNIVERSITY ELECTIVE	9-15
TOTAL CREDITS		Min. 120

School Core (50-56 Credits) (Regular – 4 Years Program)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22BS102401	Engineering Chemistry	3	-	2	-	4	-
22EE102402	Fundamentals of Electrical Engineering	2	-	2	-	3	-
22CS102001	Programming for Problem Solving	3	-	2	-	4	Logic Building Using C (Anti-requisite)
22CS102031	Logic Building Using C	3	-	2	-	4	Programming for Problem Solving (Anti-requisite)
22AI102401	Data Structures and Algorithms	3	-	2	-	4	Programming for Problem Solving
22ME105401	Engineering Drawing	-	1	2	-	2	-
22AI105001	Design Thinking	-	1	2	-	2	-
22EC111002	Technology Extension for Societal Problems	-	-	-	4	1	-
22EC111001	Internship	-	-	-	-	2	-
22EC108001	Capstone Project	-	-	-	-	10	-
Language Basket (Min. 3 Credits to be earned)							
22LG102401	English for Professionals	2	-	2	-	3	-
22LG111001	English Language Proficiency	-	-	-	0	2	-
22LG102402	Empowering Your English	2	-	2	-	3	-
22LG105402	Soft Skills	-	-	2	-	1	-
22LG101403	German Language	2	-	-	-	2	-
22LG101404	French Language	2	-	-	-	2	-
Mathematics Basket (Min. 9 Credits to be earned)							
22MM101402	Multivariable Calculus and Differential Equations	3	-	-	-	3	-
22MM101404	Transformation Techniques and Linear Algebra	3	-	-	-	3	-
22MM102404	Transformation Techniques and Linear Algebra	3	-	2	-	4	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22MM101406	Special Functions and Complex Analysis	3	-	-	-	3	-
22MM101405	Numerical Methods, Probability and Statistics	3	-	-	-	3	-
Physics Basket (Min. 4 Credits to be earned)							
22MM102452	Engineering Physics	3	-	2	-	4	-
22MM102451	Applied Physics	3	-	2	-	4	-
Management Basket (Min. 3 Credits to be earned)							
22CM101402	Principles of Business Economics and Accountancy	3	-	-	-	3	-
22MG101401	Essentials of Leadership	2	-	-	-	2	-
22MG101402	Organizational Behaviour	2	-	-	-	2	-
22MG101403	Project Management	2	-	-	-	2	-
Mandatory Courses (Min. 8 Credits to be earned- Earned Credits will not be considered for CGPA)							
22LG107601	Professional Ethics and Human Values	2	-	-	-	2	-
22CE107601	Environmental Science*	2	-	-	-	2	-
22CE107602	Disaster Mitigation and Management	2	-	-	-	2	-
22CE107603	Rural Technology	2	-	-	-	2	-
22LG107603	Spoken English	-	1	2	-	2	-
22LG107651	STEP	-	-	-	-	2	-
22LG107602	Essential Life Skills for Holistic Development	2	-	-	-	2	-
22AB107601	NSS Activities	-	-	-	-	2	-
22AB107602	Yoga	-	-	-	-	2	-
22AB107603	NCC Activities	-	-	-	-	2	-
22MG107601	Innovation, Incubation and Entrepreneurship	2	-	-	-	2	-
22EE107601	Intellectual Property Rights	2	-	-	-	2	-
22EE107602	Fundamentals of Research Methodology	2	-	-	-	2	-

* Compulsory Course

School Core (20-36 Credits) (Lateral Entry – 3 Years Program)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22BS102401	Engineering Chemistry	3	-	2	-	4	-
22EE102402	Fundamentals of Electrical Engineering	2	-	2	-	3	-
22CS102001	Programming for Problem Solving	3	-	2	-	4	-
22AI102401	Data Structures and Algorithms	3	-	2	-	4	-
22ME105401	Engineering Drawing	-	1	2	-	2	-
22AI105001	Design Thinking	-	1	2	-	2	-
22EC111002	Technology Extension for Societal Problems	-	-	-	4	1	-
22EC111001	Internship	-	-	-	-	2	-
22EC108001	Capstone Project	-	-	-	-	10	-
22LG102401	English for Professionals	2	-	2	-	3	-
22LG105402	Soft Skills	-	-	2	-	1	-
22LG101403	German Language	2	-	-	-	2	-
22LG101404	French Language	2	-	-	-	2	-
22MM101402	Multivariable Calculus and Differential Equations	3	-	-	-	3	-
22MM101404	Transformation Techniques and Linear Algebra	3	-	-	-	3	-
22MM101406	Special Functions and Complex Analysis	3	-	-	-	3	-
22MM101405	Numerical Methods, Probability and Statistics	3	-	-	-	3	-
22MM102452	Engineering Physics	3	-	2	-	4	-
22MM102451	Applied Physics	3	-	2	-	4	-
22CM101402	Principles of Business Economics and Accountancy	3	-	-	-	3	-
22MG101401	Essentials of Leadership	2	-	-	-	2	-
22MG101402	Organizational Behaviour	2	-	-	-	2	-
22MG101403	Project Management	2	-	-	-	2	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
Mandatory Courses (Min. 6 Credits to be earned- Earned Credits will not be considered for CGPA)							
22LG107601	Professional Ethics and Human Values	2	-	-	-	2	-
22CE107601	Environmental Science*	2	-	-	-	2	-
22CE107602	Disaster Mitigation and Management	2	-	-	-	2	-
22CE107603	Rural Technology	2	-	-	-	2	-
22LG107603	Spoken English	-	1	2	-	2	-
22LG107651	STEP	-	-	-	-	2	-
22LG107602	Essential Life Skills for Holistic Development	2	-	-	-	2	-
22AB107601	NSS Activities	-	-	-	-	2	-
22AB107602	Yoga	-	-	-	-	2	-
22AB107603	NCC Activities	-	-	-	-	2	-
22MG107601	Innovation, Incubation and Entrepreneurship	2	-	-	-	2	-
22EE107601	Intellectual Property Rights	2	-	-	-	2	-
22EE107602	Fundamentals of Research Methodology	2	-	-	-	2	-

* Compulsory Course

Program Core (45-61 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22CS102002	Python Programming	3	-	2	-	4	-
22EE102403	Network Analysis	3	-	2	-	4	Fundamentals of Electrical Engineering
22EC102001	Semiconductor Devices and Circuits	3	-	2	-	4	-
22CS102032	PROBLEM SOLVING THROUGH JAVA	3	-	2	-	4	Object Oriented Programming Through Java
22EC102003	Linear IC Applications	3	-	2	-	4	Semiconductor Devices and Circuits
22EC102010	Digital Design	3	-	2	-	4	-
22EC104002	Electronic Circuit Analysis and Design	3	-	2	4	5	Semiconductor Devices and Circuits
22AI101001	Discrete Mathematical Structures	3	-	-	-	3	-
22EC101005	Signals and Systems	3	-	-	-	3	Transformation Techniques and LinearAlgebra
22CB102002	Computer Networks	3	-	2	-	4	-
22CS102003	Data Structures	3	-	2	-	4	-
22AI102001	Operating Systems	3	-	2	-	4	-
22EC104009	Digital Signal Processing	2	-	2	4	4	Signals and Systems
22EC103011	VLSI System Design	3	-	-	4	4	Digital Design
22EC101012	Computer Organization	3	-	-	-	3	-
22EC104013	Microcontroller and Interfacing	3	-	2	4	5	-
22CS102005	Database Management Systems	3	-	2	-	4	-

Program Elective (24 - 36 Credits)

Course Code	Knowledge Area	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
			L	T	P	S	C	
22CS102008	Programming Languages	Mobile Application Development	3	-	2	4	5	Object Oriented Programming through Java
22AI104002		Object Oriented Programming Through Java	3	-	2	4	5	Programming for Problem Solving
22CS102007		Linux Programming	3	-	2	-	4	Programming for Problem Solving
22IT104001		Web Technologies	3	-	2	4	5	Object Oriented Programming through Java
22IT101001	Software Development	Software Engineering	3	-	-	-	3	-
22CS103001		Object Oriented Modelling and Design	3	-	-	4	4	Software Engineering
22CS101008		Software Architectures	3	-	-	-	3	Software Engineering
22EC101135	Electronics	Sensors and measuring instruments	3	-	-	-	3	-
22EC102015		Nanostructures and Nanotechnology	3	-	2	-	4	Engineering Physics, Engineering Chemistry
22EC101016		Microelectromechanical Systems	3	-	-	-	3	-
22EC101137		Automotive Electronics	3	-	-	-	3	-
22EC104017	Embedded Systems	Embedded Systems	3	-	2	4	5	Microcontroller and Interfacing
22EC104018		Advanced Microcontrollers	3	-	2	4	5	Microcontroller and Interfacing
22EC101019		FPGA Architectures and Applications	3	-	-	-	3	VLSI System Design
22EE101406	Signal Processing	Linear Control Systems	3	-	-	-	3	Signals and Systems
22EC104026		Image Processing	3	-	2	4	5	-
22EC102028	IoT	Internet of Things and Applications	3	-	2	-	4	-
22AI101402		Introduction to Soft Computing	3	-	-	-	3	-
22DS102003	Data Science	Data Visualization	3	-	2	-	4	Python Programming

Course Code	Knowledge Area	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
			L	T	P	S	C	
22AI101017		Data Mining	3	-	-	-	3	Database Management Systems
22IT102003		Cloud Computing	3	-	2	-	4	-
22CS101005		Distributed Systems	3	-	-	-	3	-
22CB102001	Computing & Security	Cryptography and Network Security	3	-	2	-	4	Computer Networks
22CB101001		Cyber Security Essentials	3	-	-	-	3	-
22AI102002	Intelligent Computing	Artificial Intelligence	3	-	2	-	4	-
22AI102003		Machine Learning	3	-	2	-	4	-
22AI101020		Pattern Recognition Techniques	3	-	-	-	3	Numerical Methods, Probability and Statistics
22CS102002		Python programming	3	-	2	-	4	Problem Solving Through Python (Anti-Requisite)
22CS102034		Problem Solving Through Python	3	-	2	-	4	Python programming (Anti-Requisite)
22CS102036		Data Structures and Algorithms with Python	3	-	2	-	4	Data Structures and Algorithms

Specialization Elective (12 - 18 Credits)

Course Code	Knowledge Area	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
			L	T	P	S	C	
22AI101010	Artificial Intelligence and Machine Learning	Nature Inspired Algorithms	3	-	-	-	3	Differential Equations and Multivariable Calculus
22AI102006		Deep Learning	3	-	2	-	4	Machine Learning
22AI101021		Generative AI	3	-	-	-	3	Machine Learning
22AI101015		AI for Robotics	3	-	-	-	3	Artificial Intelligence
22DS104001	Data Science	Data Analytics	3	-	2	4	5	Data Mining
22DS101004		Predictive Analytics	3	-	-	-	3	-
22DS102008		Business Intelligence Tools	3	-	2	-	4	-
22DS102002		Big Data Technologies	3	-	2	-	4	Database Management Systems
22CB102005	Computer Networks & Security	Ethical Hacking	3	-	2	-	4	Computer Networks
22CB101011		Cloud Security	3	-	-	-	3	Cloud Computing
22CB104001		Cyber Forensics and Investigation	3	-	2	4	5	Computer Networks
22EC102033	Embedded Systems	Embedded Programming	3	-	2	-	4	Microcontroller and Interfacing
22EC101034		Hardware-Software Co-design	3	-	-	-	3	Embedded Systems
22EC101035		Real Time Systems	3	-	-	-	3	-
22EC103040	Signal Processing	Machine Learning for Signal Processing	3	-	-	4	4	Digital Signal Processing
22EC101041		Adaptive Signal Processing	3	-	-	-	3	Digital Signal Processing
22EC102118		Biomedical Signal Processing	3	-	2	-	4	Digital Signal Processing
22EC101042	IoT	IoT System Architecture and Protocols	3	-	-	-	3	-
22EC101043		Smart IoT Applications	3	-	-	-	3	IoT System Architecture and Protocols

University Elective (9-15 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22EC101701	AI in Healthcare	3	-	-	-	3	-
22CM101701	Banking and Insurance	3	-	-	-	3	-
22DS101701	Bioinformatics	3	-	-	-	3	-
22BS101701	Biology for Engineers	3	-	-	-	3	-
22LG101701	Business Communication and Career Skills	3	-	-	-	3	-
22LG101702	Quantitative Aptitude and Verbal Ability	3	-	-	-	3	-
22LG101703	Logical Reasoning and Recruitment Essentials	3	-	-	-	3	-
22CE101701	Civil Engineering and The Society	3	-	-	-	3	-
22SS101701	Constitution of India	3	-	-	-	3	-
22CM101702	Cost Accounting and Financial Management	3	-	-	-	3	-
22CB101701	Cyber Laws and Security	3	-	-	-	3	-
22EE101701	Electrical Safety and Safety Management	3	-	-	-	3	-
22MG101701	Entrepreneurship for Micro, Small and Medium Enterprises	3	-	-	-	3	-
22CE101702	Environmental Pollution and Control	3	-	-	-	3	-
22EC101702	Essentials of VLSI	3	-	-	-	3	-
22CB101702	Introduction to Ethical Hacking	3	-	-	-	3	-
22CB101703	Forensic Science	3	-	-	-	3	-
22SS101702	Gender and Environment	3	-	-	-	3	-
22ME101701	Global Strategy and Technology	3	-	-	-	3	-
22EE101704	Green Technologies	3	-	-	-	3	-
22ME101702	Human Resource Management	3	-	-	-	3	-
22SS101703	Indian Economy	3	-	-	-	3	-
22SS101704	Indian History	3	-	-	-	3	-
22SS101705	Indian Tradition and Culture	3	-	-	-	3	-
22EC101703	Instrumentation in Industries	3	-	-	-	3	-
22EC101704	Introduction to Nanotechnology	3	-	-	-	3	-
22AI101702	Introduction to Artificial Intelligence	3	-	-	-	3	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22DS101702	Introduction to Data Science	3	-	-	-	3	-
22AI101704	Introduction to Machine Learning	3	-	-	-	3	-
22CS101701	Introduction to Python Programming	3	-	-	-	3	-
22CB101704	Introduction to Internet of Things	3	-	-	-	3	-
22ME101703	Management Science	3	-	-	-	3	-
22ME101704	Managing Innovation and Entrepreneurship	3	-	-	-	3	-
22ME101705	Material Science	3	-	-	-	3	-
22LG201701	Personality Development	3	-	-	-	3	-
22CE101703	Planning for Sustainable Development	3	-	-	-	3	-
22EC101705	Principles of Communication Engineering	3	-	-	-	3	-
22EE101702	Reliability and Safety Engineering	3	-	-	-	3	-
22CE101704	Remote Sensing, GIS and GPS	3	-	-	-	3	-
22CE101705	Smart Cities	3	-	-	-	3	-
22EC101706	Smart Sensors for Engineering Applications	3	-	-	-	3	-
22EE101703	Sustainable Energy Systems	3	-	-	-	3	-
22CS101702	Web Design Fundamentals	3	-	-	-	3	-
22SS101706	Women Empowerment	3	-	-	-	3	-

Note:

1. If any student has chosen a course or equivalent course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s under University Elective.
2. The student can choose courses from other disciplines offered across the schools of MBU satisfying the pre-requisite other than the above list.

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22BS102401	ENGINEERING CHEMISTRY	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on water technology, multi-functional materials, applications of electrochemistry, and instrumental methods of analysis, fuel chemistry and lubricants. This course also provides analytical skills for the quantitative estimation of materials through volumetric and instrumental methods of analysis and addresses the societal, health issues related to quality of water.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Solve problems associated with water, and address the societal, health and safety issues related to quality of water.
- CO2.** Acquire basic knowledge on industrial polymers, composites, and Nano materials used in engineering applications.
- CO3.** Apply and demonstrate competency in the basic concepts of electrochemical cells and sensors.
- CO4.** Acquire basic knowledge of instrumental methods and their applications in the analysis of materials.
- CO5.** Identify the quality of fuels and lubricants for their engineering applications.
- CO6.** Develops independent working ability, through problem solving and effective communication.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	1	-	2	1	-	-	-	-
CO2	3	-	-	-	-	-	2	-	-	-	-	-
CO3	3	-	-	-	1	-	1	-	-	-	-	2
CO4	3	-	-	-	2	-	-	-	-	-	-	1
CO5	3	2	-	-	-	-	1	-	-	-	-	-
CO6	3	3	-	-	1	1	2	-	3	3	-	1
Course Correlation Mapping	3	3	-	-	2	1	2	1	3	3	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: WATER TECHNOLOGY

(09 Periods)

Introduction, types of water, Impurities in water and their consequences. Hardness of water, units of hardness, disadvantages of hardness, determination of hardness by EDTA method, numerical problems, boiler troubles, softening of water – Internal treatment, External treatment (Ion exchange process, zeolite process), desalination of brackish water by reverse osmosis, specifications of potable water as per WHO and BIS standards. Fluoride in ground water: Effects on human health, defluoridation method – Nalgonda method; merits and demerits of various defluoridation methods.

Module 2: CHEMISTRY OF MULTI FUNCTIONAL MATERIALS

(09 Periods)

Engineering plastics: Definition, synthesis, properties and applications of PC, PTFE, and PMMA.

Conducting polymers: Definition, types and applications.

Biodegradable polymers: Definition, classification, mechanism of degradation and applications.

Nano Materials: Introduction, size dependent properties (Colour, magnetic and electrical), method of synthesis – CVD, applications of Nano materials.

Module 3: ELECTROCHEMICAL CELLS, STORAGE DEVICES AND SENSORS

(09 Periods)

Electrode potential, Electrochemical cell, EMF of an electrochemical cell.

Batteries: Introduction, types of Batteries-Primary battery-dry cell, secondary battery- Lead-acid batteries, Lithium-ion batteries, Lithium- Polymer batteries, Applications of batteries.

Fuel Cells: Definition, H₂-O₂ fuel cell, solid oxide fuel cell, applications of fuel cells.

Sensors: Introduction, Types of Sensors, electrochemical sensors, applications.

Module 4: INSTRUMENTAL METHODS AND APPLICATIONS

(08 Periods)

Introduction to spectroscopy-types of energy present in molecules, types of spectra, UV-Vis spectroscopy – principle, types of electronic transitions, Instrumentation and applications; Infrared spectroscopy – principle, types of vibrational modes, Instrumentation and applications; working principle and applications of SEM, TEM, and XRD.

Module 5: FUELS AND LUBRICANTS

(10 Periods)

Fuels: Classification of fuels, calorific value, numerical problems; Liquid fuels, cracking of oils (Thermal and Fixed-bed catalytic cracking), Synthetic petrol: Fischer-Tropsch method and Bergius process. Eco friendly fuels-Types, significances.

Lubricants: Definition, functions of lubricants, mechanism of lubrication, classification of lubricants, properties of lubricants – viscosity and viscosity index, flash and fire point, cloud and pour point, Aniline point, neutralization number and mechanical strength.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 10 exercises shall be conducted)

1. Determination of hardness of ground water sample.
2. Determination of alkalinity of Water sample.
3. Estimation of residual chlorine in drinking water.
4. Estimation of Dissolved Oxygen in water by Winkler's method.
5. Estimation of Fe (II) by Dichrometry.
6. Conductometric titration of strong acid Vs strong base.
7. Estimation of Ferrous ion amount by Potentiometry.
8. Synthesis of nano ZnO using sol-gel process.
9. Determination of Viscosity by Ostwald's viscometer.
10. Determination of strength of acid by using pH metric method.
11. Determination of Strength of an acid in Pb-Acid battery.
12. Determination of percentage of Iron in Cement sample by colorimetry.

RESOURCES

TEXT BOOKS:

1. P. C. Jain & Monika Jain, Engineering Chemistry, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 16th edition, 2013.
2. K.N. Jayaveera, G.V. Subba Reddy and C. Ramachandriah, Engineering Chemistry, Mc.Graw Hill Publishers, New Delhi.
3. Engineering Chemistry lab Manual

REFERENCE BOOKS:

1. Peter Atkins, Julio de Paula and James Keelar, Atkins' Physical Chemistry, Oxford University Press, 10th edition, 2010.
2. Skoog and West, Principles of Instrumental Analysis, Thomson, 6th edition, 2007.
3. K. Mukkanti, Practical Engineering Chemistry, BS Publications, 2013.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=ly_FS3LZXEY
2. https://www.youtube.com/watch?v=0_ZcQqpS2o
3. <https://www.youtube.com/watch?v=Tye3dcBOqtY>
4. <https://www.youtube.com/watch?v=tsvIvQJiTL4>

Web Resources:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4851520/>
2. [https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_\(Analytical_Chemistry\)/Analytical_Sciences_Digital_Library/Active_Learning/Shorter_Activities/Electrochemical_Sensor_Project/01_Introduction_To_Electrochemical_Sensors](https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Analytical_Sciences_Digital_Library/Active_Learning/Shorter_Activities/Electrochemical_Sensor_Project/01_Introduction_To_Electrochemical_Sensors)
3. <https://www.arsdcollege.ac.in/wp-content/uploads/2020/04/Document-2.pdf>
4. https://www.salon.com/2015/10/14/4_outlandish_things_our_ancestors_used_as_lubepartner/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22EE102402	FUNDAMENTALS OF ELECTRICAL ENGINEERING	2	-	2	-	3
Pre-Requisite	-					
Anti-Requisite	Basic Electrical and Electronics Engineering					
Co-Requisite	-					

COURSE DESCRIPTION: This course is designed to provide an overview on the fundamentals of electrical technology for non-electrical graduates. The course provides a deep insight about the various concepts such as network reduction techniques, analysis of DC and AC circuits; Constructional details, operation and applications of various Electrical Machines used in industry and for domestic applications.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Analyze the DC electrical circuits by applying the principles of network reduction techniques, mesh and nodal analysis.
- CO2.** Analyze the single phase AC electrical circuits to investigate the response and determine various electrical quantities.
- CO3.** Analyze the operational aspects of Single Phase Induction Motors and realize their applications.
- CO4.** Understand the operational aspects of Special Machines used in industry and for domestic applications.
- CO5.** Analyse the equivalent circuit of a single phase transformer, to determine the performance and assess its sustainability for various load conditions.
- CO6.** Work independently or in teams to solve problems with effective communication.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	1	2	-	-	-	-	-	-	-
CO2	3	3	-	1	-	-	-	-	-	-	-	-
CO3	3	3	-	2	-	1	-	-	-	-	-	-
CO4	3	3	-	1	-	1	1	-	-	-	-	-
CO5	3	-	-	-	-	1	1	2	-	-	-	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-
Course Correlation Mapping	3	3	-	1	2	1	1	2	3	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DC CIRCUITS

(08 Periods)

Classification of network elements; Voltage-Current relations for passive elements; Network reduction techniques-series, parallel, series-parallel circuits, current and voltage division rules; wye-to-delta and delta-to-wye transformations; nodal analysis and mesh analysis with dependent and independent DC sources.

Module 2: SINGLE PHASE AC CIRCUITS

(08 Periods)

Analysis of single phase AC circuits: impedance and admittance, impedance triangle; Power triangle; Response of R, L and C elements with different combinations; Resonance, bandwidth and quality factor for series and parallel networks.

Module 3: SINGLE PHASE INDUCTION MOTOR

(05 Periods)

Construction of single phase induction motor, capacitor start & run split phase induction motors operation and applications.

Module 4: SPECIAL MACHINES

(04 Periods)

Constructional details, operation and applications of PMBLDC motor and stepper motor (VR and PM type only).

Module 5: SINGLE PHASE TRANSFORMERS

(05 Periods)

Construction and working principle, EMF equation, losses, equivalent circuit, OC and SC tests on single phase transformer, predetermination of efficiency and regulation.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Verification of Kirchhoff's laws.
2. Verification of Mesh and Nodal Analysis.
3. Measurement of power and power factor in a single phase AC circuits.
4. Development of Locus diagram for RL and RC circuits.
5. Design a resonant circuits to select or reject the specified range of frequencies.
6. Brake test on single phase induction motor.
7. No-load and blocked rotor test on single phase induction motor.
8. OC and SC tests on a single phase transformer.
9. Separation of no-load losses of a single phase transformer.
10. Load test on single phase transformer.

RESOURCES

TEXT BOOKS:

1. A. Sudhakar, Shyammohan S Palli, *Circuits and Networks Analysis and Synthesis*, McGraw Hill Education (India) Private Limited, New Delhi, 5th Edition, 2015.
2. JB Gupta, *Theory and performance of Electrical Machines* (DC machines, Poly phase Circuits & AC machines) in SI Units, S.K. Kataria & Sons, New Delhi, 15th Edition, 2015.

REFERENCE BOOKS:

1. Charles K. Alexander, Mathew N O Sadiku, *Fundamentals of Electric Circuits*, McGraw Hill Education (India) Private Limited, New Delhi, 5th Edition, 2013.
2. B.L. Theraja and A.K. Theraja, *A Text Book of Electrical Technology (in S. I. Units)*, Vol.2, S. Chand & Company Ltd, New Delhi, Multicolour illustrative edition, 2014.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/108108076>
2. <https://nptel.ac.in/courses/108105112>

Web Resources:

1. <https://www.electronicshub.org/dc-circuits-basics/>
2. <https://www.engineeringenotes.com/electrical-engineering/circuits/single-phase-ac-circuit-with-diagram-electrical-engineering/27590>
3. <https://siiet.ac.in/wp-content/uploads/2019/05/BEE.pdf>
4. <https://www.youtube.com/watch?v=fbwZkhaF0dk>
5. https://people.ucalgary.ca/~aknigh/electrical_machines/fundamentals/f_main.html
6. <https://www.electronics-tutorials.ws/transformer/transformer-basics.html>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CS102001	PROGRAMMING FOR PROBLEM SOLVING	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on C Programming concepts, Operators and Expressions, Input and Output Functions, Control Structures, Problem Solving Aspects, Arrays and Strings, Functions, Pointers, Structures and Unions and File Handling.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge on C programming constructs to develop programs.
- CO2.** Design algorithms using problem-solving techniques for given problems.
- CO3.** Apply functions and Arrays to enhance reusability and data manipulation.
- CO4.** Use pointers to manage the memory effectively.
- CO5.** Apply Structures, Unions and File handling concepts to develop societal applications.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	3	-	-	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-
CO4	2	2	2	2	3	-	-	-	-	-	-	-
CO5	3	2	2	3	2	3	-	-	-	-	-	-
Course Correlation Mapping	3	2	3	3	3	3	-	-	-	-	-	-

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO C PROGRAMMING

(09 Periods)

Basics of C Programming: Introduction, Structure of a C program, Concept of a variable, Data types in C, Program statement, Declaration, Storing the data in memory, Tokens, Operators and expressions, Lvalues and Rvalues, Type conversion in C.

Input and Output: Basic screen and keyboard I/O in C, Non-formatted input and output, formatted input and output functions.

Module 2: CONTROL STATEMENTS AND INTRODUCTION TO PROBLEM SOLVING

(08 Periods)

Control Statements: Specifying test condition for selection and iteration, Writing test expression, Conditional execution and selection, Iteration and repetitive execution, goto statement, Special control statements, Nested loops.

Introduction to Problem Solving: Algorithms, Flowcharts, Problem solving aspect, Top-down design, Implementation of algorithms, program verification and efficiency of algorithms.

Module 3: ARRAYS & STRINGS AND FUNCTIONS

(10 Periods)

Arrays and Strings: One-dimensional array – Declaration, Initialization, Accessing elements, operations; Multi-dimensional arrays – Declaration, Initialization, Working with 2D arrays; Strings – Declaration, Initialization, Printing strings, String input, Character manipulation, String manipulation; Arrays of strings – Initialization, manipulating string arrays.

Functions: Concept of function, Using functions, Call by value mechanism, working with functions, passing arrays to functions, Scope and extent, Storage classes, Recursion.

Module 4: POINTERS

(08 Periods)

Introduction to Pointers: Understanding memory addresses, Address operator (&), Pointer – declaration, Initialization, Indirection operator and dereferencing, Void and Null pointers, Use of pointers, Arrays and pointers, Pointers and strings, Pointer arithmetic, Pointers to pointers, Array of pointers, Pointers to an array, Two-dimensional arrays and pointers, Pointers to functions, Dynamic memory allocation.

Module 5: USER-DEFINED DATA TYPES AND FILES

(10 Periods)

User-Defined Data Types: Structures - Declaration, Accessing the members, Initialization, typedef and its use, Arrays of structures, Arrays within structure, Structures and pointers, Structures and functions; Unions, Enumeration types, Bitfields.

Files: Using files in C, Working with text and binary files, Direct File Input and Output, Files of records, Random access to files of records.

Total Periods: 45

EXPERIENTIAL LEARNING

1.
 - a) Write a C program to perform the arithmetic operations on two integer numbers.
 - b) Write a program to evaluate the following expressions by reading the necessary values from the keyboard.
 - i. $(ax + b)/(ax - b)$
 - ii. $2.5 \log x + \cos 320^\circ + |x^2 + y^2|$
 - iii. $ax^5 + bx^3 + c$
 - iv. $aekt$
2.
 - a) Write a C program to find the roots of a quadratic equation.
 - b) In a town, the percentage of men is 52. The percentage of total literacy is 48 and the total percentage of literate men is 35 of the total population. Write a C program to find the total number of illiterate men and women if the population of the town is 7000.
 - c) The total distance travelled by a vehicle in t seconds is given by the distance $ut + at^2/2$ where u and a are the initial velocity (m/sec.) and acceleration (m/sec²). Write C program to find the distance travelled at regular intervals of time given the values of u and a . The program should provide the flexibility to the user to select his own time intervals and repeat the calculations for different values of u and a .

3. a) Write a C Program to compute an electricity bill based on the following slab rates.

Consumption units	Rate (in Rupees/unit)
0-100	4.0
101-150	4.6
151-200	5.2
201-300	6.3
Above 300	8.0

(Hint: Take current and old meter readings from the user to get consumption units)

- b) An insurance company computes the premium amount based on the following;
 - i) If a person's health is excellent and the person is between 25 and 35 years of age and lives in a city, and is a male then the premium is Rs.4 per thousand and the policy amount cannot exceed Rs.2 lakhs.
 - ii) If a person satisfies all the above conditions and is female then the premium is Rs.3 per thousand and the policy amount cannot exceed Rs.1 lakh.
 - iii) If a person's health is poor and the person is between 25 and 35 years of age and lives in a village and is a male then premium is Rs.6 per thousand and the policy cannot exceed Rs. 10000.
 - iv) In all other cases the person is not insured.

Write a C program to determine whether the person should be insured or not, his/her premium rate and maximum amount for which he/she can be insured.
- c) Write a C Program to find the grade for a student using a Switch case. The user needs to enter a subject score (varies from 0 to 100) and then display the grade as described below.

Score	Grade	Score	Grade
≥ 90	O	≥ 50 to < 60	D
≥ 80 to < 90	A	≥ 40 to < 50	E
≥ 70 to < 80	B	< 40	Fail
≥ 60 to < 70	C		

4. a) A Fibonacci sequence is defined as follows:
The first and second terms in the sequence are 0 and 1. Sub-sequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
- b) Write a C program to find the sum of individual digits of a positive integer.
- c) Write a C program to read two numbers x and n, and then compute the sum of the geometric progression: $1+x+x^2+x^3+\dots+x^n$. Show appropriate error message for $n<0$. (Example: if n is 3 and x is 5, then the sum is: $1+5+25+125$)
- d) Write a C program to print the following pattern.

```

          1
        1 2 1
      1 2 3 2 1
    1 2 3 4 3 2 1
  1 2 3 4 5 4 3 2 1

```

5. a) Write a C program to generate all the prime numbers between 1 and n, where n is a value entered by the user. Define a separate function to generate prime numbers.
- b) Write C program that uses recursive function to find the following.
- i) Factorial of a given integer ii) GCD of two given integers
6. a) Write a C program to find both the largest and smallest numbers in a list of integers.
- b) Write a C program that uses function to perform the following:
- i) Addition of Two Matrices ii) Multiplication of Two Matrices
7. a) Write a C program to insert a sub-string in to a main string at a given position.
- b) Write a C program to count the lines, words and characters in a given text.
8. a) Write a C program to print the elements of an array in reverse order using pointers.
- b) Write a C program to count the number of vowels and consonants in a string using pointers.
9. a) Write a C program that performs the following operations:
- i. Reading a complex number ii. Writing a complex number
- iii. Addition of two complex numbers iv. Multiplication of two complex numbers
- (Note: Represent complex number using a structure.)
- b) Define a structure to store employee details include Employee-Number, Employee- Name, Basic-pay, Date-of-Joining. Write a C program for the following.
- i) A function to store 10 employee details.
- ii) A function to implement the following rules while revising the basic pay.
- If Basic-pay $\leq$ Rs.5000 then increase it by 15%.
- If Basic-pay $>$ Rs.5000 and $\leq$ Rs.25000 then it increase by 10%.
- If Basic-pay $>$ Rs.25000 then there is no change in Basic-pay.
- iii) A function to print the details of employees who have completed 20 years of service from the Date-of-Joining.
10. a) Write a C program to reverse the first n characters of a given text file.
- b) Write a C program to merge two files into a new file.

RESOURCES

TEXT BOOKS:

1. Pradip Dey and Manas Ghosh, *Programming in C*, Oxford University Press, New Delhi, 2nd Edition, 2013.
2. R. G. Dromey, *How to Solve it by Computer*, Pearson Education, 1st Edition, 2013.

REFERENCE BOOKS:

1. Byron S Gottfried and Jitender Kumar Chhabra, *Programming with C*, McGraw Hill Education, 4th Edition, 2019.
2. Yashavant Kanetkar, *Let Us C*, BPB Publications, 15th Edition, 2017.
3. E. Balagurusamy, *Programming in C*, McGraw Hill Education Pvt, Ltd, New Delhi, 7th Edition, 2017.
4. Behrouz A. Forouzan and Richard F. Gilberg, *Computer Science: A Structured Programming Approach Using C*, Cengage Learning, 3rd Edition, 2008.

SOFTWARE/TOOLS:

1. Software: Turbo C++/Dev C++

VIDEO LECTURES:

1. <https://www.digimat.in/nptel/courses/video/106105171/L03.html>
2. <https://nptel.ac.in/courses/106104128>

Web Resources:

1. Learn C Programming - <https://www.programiz.com/c-programming>
2. Learn C Programming - <https://www.tutorialspoint.com/cprogramming/index.htm>
3. C Programming Exercises, Practice, Solution - <https://www.w3resource.com/c-programming-exercises/>
4. Basic programming exercises and solutions in C - <https://codeforwin.org/2015/05/basic-programming-practice-problems.html>
5. C Programming Exercises, Practice, Solution - <https://www.w3resource.com/c-programming-exercises/>
6. Basic programming exercises and solutions in C - <https://codeforwin.org/2015/05/basic-programming-practice-problems.html>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CS102031	LOGIC BUILDING USING C	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	Programming for Problem Solving					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a comprehensive introduction to programming using the C language. It covers fundamental concepts including data types, control structures, arrays, strings, functions, and recursion. The curriculum explores pointers, dynamic memory allocation, structures, unions, and file handling techniques. Emphasis is placed on problem-solving and building efficient, modular C programs.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge of C language fundamentals including data types, control structures, operators, and input/output operations.
- CO2.** Apply decision-making and looping constructs to solve mathematical series problems and generate patterns using nested loops.
- CO3.** Develop solutions using arrays, strings, functions, and recursion to address basic searching, sorting, and algorithmic problems.
- CO4.** Utilize pointers and dynamic memory allocation techniques to manage memory and optimize program performance.
- CO5.** Design structured programs using user-defined data types and implement file handling operations for persistent data storage.
- CO6.** Work independently to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	2	2	3	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	3	3	-	-	3	3	-	-	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO C & BASIC CONCEPTS (7 Periods)

History of C language, Structure of a C program, Header files, main() function, Compilation process, Data types: int, char, float, double; Type modifiers, Constants, Variables, Scope rules, Input/output operations: printf, scanf, getchar, putchar; Format specifiers. Operators: Arithmetic, relational, logical, bitwise, assignment, ternary; Operator precedence and associativity, Introduction of Debugging tools such as GDB and online IDEs

Module 2: DECISION MAKING, LOOPING, SERIES & PATTERNS (10 Periods)

Decision making: if, if-else, nested if, switch-case; Looping constructs: for, while, do-while; Loop control statements: break, continue, goto; Mathematical series: Fibonacci, factorial, sum of digits, prime checking; Pattern printing: star patterns, number pyramids, hollow shapes, alphabet patterns; Nested loops, Flow control applications.

Module 3: ARRAYS, STRINGS AND FUNCTIONS (10 Periods)

One-dimensional arrays: declaration, initialization, traversal; Two-dimensional arrays: matrix input/output, addition, multiplication; Searching algorithms: linear, binary search; Sorting algorithms: bubble sort, selection sort; Strings: character arrays, pointers to characters, manual manipulation, common library functions; Functions: declaration, definition, calling, parameter passing by value and reference, return values; Recursion fundamentals: concept, base case, recursive calls; Recursive examples: factorial, Fibonacci, Tower of Hanoi

Module 4: POINTERS & DYNAMIC MEMORY ALLOCATION (10 Periods)

Pointers: declaration, initialization, dereferencing, pointer arithmetic; Pointers and arrays, Understanding memory addresses, Address operator (&), Pointer – declaration, Initialization, Indirection operator and dereferencing, Void and Null pointers, Use of pointers, Arrays and pointers, Pointers and strings, Pointer arithmetic, Pointers to pointers, Array of pointers, Pointers to an array, Two-dimensional arrays and pointers, Pointers to functions,

Dynamic memory allocation: malloc, calloc, realloc, free; Memory management pitfalls; Scope and storage classes: auto, static, extern, register;

Module 5: STRUCTURES, UNIONS & FILE HANDLING (8 Periods)

Structures: declaration, initialization, accessing members, nested structures, arrays and pointers to structures; Unions and enums, File handling basics: fopen, fclose, fprintf, fscanf, fgetc, fputc; Text and binary file modes, File pointers and navigation: fseek, ftell; Command-line arguments.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

(All source code should be maintained and version-controlled on GitHub)

1) INTRODUCTION TO C & BASIC CONCEPTS

Leetcode: #231. Power of Two

Given an integer n , return *true* if it is a power of two. Otherwise, return *false*.
An integer n is a power of two, if there exists an integer x such that $n == 2^x$.

Example 1:

Input: $n = 1$

Output: true

Explanation: $2^0 = 1$

Example 2:

Input: $n = 16$

Output: true

Explanation: $2^4 = 16$

Example 3:**Input:** n = 3**Output:** false**Constraints:**

- $-2^{31} \leq n \leq 2^{31} - 1$

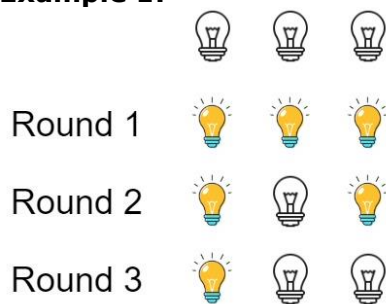
✓ This problem helps students understand how binary systems work and how to efficiently determine powers of numbers using both mathematical and bitwise approaches

2) **INTRODUCTION TO C & BASIC CONCEPTS****Leetcode:** [#319. Bulb Switcher](#)

There are n bulbs that are initially off. You first turn on all the bulbs, then you turn off every second bulb.

On the third round, you toggle every third bulb (turning on if it's off or turning off if it's on). For the i^{th} round, you toggle every i bulb. For the n^{th} round, you only toggle the last bulb.

Return *the number of bulbs that are on after n rounds*.

Example 1:**Input:** n = 3**Output:** 1**Explanation:** At first, the three bulbs are [off, off, off].

After the first round, the three bulbs are [on, on, on].

After the second round, the three bulbs are [on, off, on].

After the third round, the three bulbs are [on, off, off].

So you should return 1 because there is only one bulb is on.

Example 2:**Input:** n = 0**Output:** 0**Example 3:****Input:** n = 1**Output:** 1**Constraints:**

- $0 \leq n \leq 10^9$

✓ This problem helps students recognize mathematical patterns and optimize iterative logic through observation.

3) **DECISION MAKING, LOOPING, SERIES & PATTERNS****Leetcode:** [#9. Palindrome Number](#)

Given an integer x, return true *if x is a **palindrome***, and false *otherwise*.

Example 1:**Input:** x = 121**Output:** true**Explanation:** 121 reads as 121 from left to right and from right to left.**Example 2:****Input:** x = -121**Output:** false

Explanation: From left to right, it reads -121. From right to left, it becomes 121-. Therefore it is not a palindrome.

Example 3:**Input:** x = 10

Output: false

Explanation: Reads 01 from right to left. Therefore it is not a palindrome.

Constraints:

- $-2^{31} \leq x \leq 2^{31} - 1$

✓ This problem introduces students to basic numerical manipulation and edge case handling. It reinforces logic building by comparing number reversal techniques without converting to strings.

4) **DECISION MAKING, LOOPING, SERIES & PATTERNS**

Leetcode: [#172. Factorial Trailing Zeroes](#)

Given an integer n , return *the number of trailing zeroes in $n!$* .

Note that $n! = n * (n - 1) * (n - 2) * \dots * 3 * 2 * 1$.

Example 1:

Input: $n = 3$

Output: 0

Explanation: $3! = 6$, no trailing zero.

Example 2:

Input: $n = 5$

Output: 1

Explanation: $5! = 120$, one trailing zero.

Example 3:

Input: $n = 0$

Output: 0

Constraints:

- $0 \leq n \leq 10^4$

✓ This problem helps students understand how trailing zeroes relate to factors of 10 in a factorial. It teaches efficient counting using division by powers of 5 instead of computing the full factorial. It strengthens mathematical intuition and optimization skills for combinatorics and number theory problems.

5) **ARRAYS, STRINGS AND FUNCTIONS**

Leetcode: [#1. Two Sum](#)

Given an array of integers `nums` and an integer `target`, return *indices of the two numbers such that they add up to target*.

You may assume that each input would have **exactly one solution**, and you may not use the *same* element twice.

You can return the answer in any order.

Example 1:

Input: `nums = [2,7,11,15]`, `target = 9`

Output: `[0,1]`

Explanation: Because `nums[0] + nums[1] == 9`, we return `[0, 1]`.

Example 2:

Input: `nums = [3,2,4]`, `target = 6`

Output: `[1,2]`

Example 3:

Input: `nums = [3,3]`, `target = 6`

Output: `[0,1]`

Constraints:

- $2 \leq \text{nums.length} \leq 10^4$
- $-10^9 \leq \text{nums}[i] \leq 10^9$
- $-10^9 \leq \text{target} \leq 10^9$
- **Only one valid answer exists.**

✓ This problem builds foundational skills in array traversal and hash-based lookup optimization. It is a classic example for understanding time complexity trade-offs and real-time problem solving.

6) **ARRAYS, STRINGS AND FUNCTIONS**

Leetcode: [#58. Length of Last Word](#)

Given a string *s* consisting of words and spaces, return *the length of the **last** word in the string.*

A **word** is a maximal substring consisting of non-space characters only.

Example 1:

Input: *s* = "Hello World"

Output: 5

Explanation: The last word is "World" with length 5.

Example 2:

Input: *s* = " fly me to the moon "

Output: 4

Explanation: The last word is "moon" with length 4.

Example 3:

Input: *s* = "luffy is still joyboy"

Output: 6

Explanation: The last word is "joyboy" with length 6.

Constraints:

- $1 \leq s.length \leq 10^4$
- *s* consists of only English letters and spaces ' '.
- There will be at least one word in *s*.

✓ This problem improves string manipulation skills by focusing on trimming whitespace and identifying word boundaries. It helps learners understand edge cases involving trailing spaces and multiple separators. It lays the groundwork for efficient parsing techniques used in text processing and input sanitization.

7) **POINTERS & DYNAMIC MEMORY ALLOCATION**

Leetcode: [#832. Flipping an Image](#)

Given an *n* x *n* binary matrix *image*, flip the image **horizontally**, then invert it, and return *the resulting image*.

To flip an image horizontally means that each row of the image is reversed.

- For example, flipping [1,1,0] horizontally results in [0,1,1].

To invert an image means that each 0 is replaced by 1, and each 1 is replaced by 0.

- For example, inverting [0,1,1] results in [1,0,0].

Example 1:

Input: *image* = [[1,1,0],[1,0,1],[0,0,0]]

Output: [[1,0,0],[0,1,0],[1,1,1]]

Explanation: First reverse each row: [[0,1,1],[1,0,1],[0,0,0]].

Then, invert the image: [[1,0,0],[0,1,0],[1,1,1]]

Example 2:

Input: *image* = [[1,1,0,0],[1,0,0,1],[0,1,1,1],[1,0,1,0]]

Output: [[1,1,0,0],[0,1,1,0],[0,0,0,1],[1,0,1,0]]

Explanation: First reverse each row: [[0,0,1,1],[1,0,0,1],[1,1,1,0],[0,1,0,1]].

Then invert the image: [[1,1,0,0],[0,1,1,0],[0,0,0,1],[1,0,1,0]]

Constraints:

- $n == image.length$
- $n == image[i].length$
- $1 \leq n \leq 20$
- $images[i][j]$ is either 0 or 1.

✓ This problem enhances understanding of 2D matrix manipulation through row-wise reversal and bitwise inversion. It develops skills in nested iteration, in-place transformation, and binary operations. It lays the foundation for advanced image processing algorithms and real-world visual data handling.

8) **POINTERS & DYNAMIC MEMORY ALLOCATION**

Leetcode: [#345. Reverse Vowels of a String](#)

Given a string *s*, reverse only all the vowels in the string and return it.

The vowels are 'a', 'e', 'i', 'o', and 'u', and they can appear in both lower and upper cases, more than once.

Example 1:

Input: s = "IceCreAm"

Output: "AceCreIm"

Explanation:

The vowels in s are ['I', 'e', 'e', 'A']. On reversing the vowels, s becomes "AceCreIm".

Example 2:

Input: s = "leetcode"

Output: "leotcede"

Constraints:

- $1 \leq s.length \leq 3 * 10^5$
- s consist of **printable ASCII** characters.

✓ This problem strengthens the understanding of two-pointer techniques in string manipulation. It reinforces the concept of character classification and conditional swapping based on criteria (vowels in this case).

9) **STRUCTURES, UNIONS & FILE HANDLING**

Student Record Management System (Text File Based)

A simple system to manage student records using a .txt file. The user can:

- Add a student
- View all students
- Search by roll number
- Delete a record
-

Concepts Used:

- File creation and appending
- Reading and searching in files
- Overwriting file content

Sample Menu:

1. Add Student
2. View All Students
3. Search Student by Roll Number
4. Delete Student by Roll Number
5. Exit

File Format:

Each line in the file (e.g., students.txt) stores a record like:

101, John Doe, Computer Science

102, Jane Smith, Electronics

✓ Gain hands-on experience with file handling operations like read, write, append, and delete using C

10) **STRUCTURES, UNIONS & FILE HANDLING**

Simple Expense Tracker

Description:

An expense tracker that allows users to log their daily expenses and retrieve summaries.

Concepts Used:

- Writing data to files with timestamps
- Reading and parsing files
- Date-based filtering

Features:

- Add an expense (amount, description, category)
- View all expenses

- View total spent
- Filter by category or date

File Format (expenses.txt):

2025-06-25, 150, Food, Lunch
 2025-06-25, 300, Travel, Auto to Office
 2025-06-26, 100, Food, Tea and Snacks

Sample Menu:

1. Add Expense
2. View All Expenses
3. Total Amount Spent
4. View Expenses by Category
5. Exit

✓ Learners will gain hands-on experience in reading, writing, and managing structured data using Python file handling. They will also learn to organize and analyze daily expense records using functions, control flow, and date-based filtering.

RESOURCES

TEXT BOOKS:

1. Pradip Dey and Manas Ghosh, Programming in C, Second Edition, Oxford University Press, New Delhi, 2013.
2. R. G. Dromey, How to Solve it by Computer, First Edition, Pearson Education, 2013.

REFERENCE BOOKS:

1. Byron S Gottfried and Jitender Kumar Chhabra, Programming with C, Fourth Edition, McGraw Hill Education, 2019..
2. Yashavant Kanetkar, Let Us C, Fifteenth Edition, BPB Publications, 2017.

SOFTWARE/TOOLS:

1. Dev C++
2. Online IDE

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=rQoqCP7LX60&list=PLxgZQoSe9cg1drBnejUaDD9GEJBGQ5hMt>
2. https://www.youtube.com/watch?v=EjavYOFoJJ0&list=PLdo5W4Nhv31a8UcMN9-35ghv8qyFWD9_S
3. <https://www.youtube.com/watch?v=rQoqCP7LX60&list=PLxgZQoSe9cg1drBnejUaDD9GEJBGQ5hMt>
4. <https://www.youtube.com/watch?v=irqbmMNs2Bo>
5. <https://www.youtube.com/watch?v=wKoGImLA2KA&list=PLsyebzWxl7oBxHp43xQTFrw9f1CDPR6C>

WEB RESOURCES:

1. <https://www.w3schools.com/c/>
2. <https://www.tutorialspoint.com/cprogramming/index.htm>
3. <https://www.programiz.com/c-programming>
4. <https://www.cprogramming.com/tutorial/c-tutorial.html>
5. <https://www.geeksforgeeks.org/c/printf-in-c/>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22AI102401	DATA STRUCTURES AND ALGORITHMS	3	-	2	-	4
Pre-Requisite	Programming for Problem Solving					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides theoretical and practical knowledge on sorting and searching, Linked list, stacks and queues. It also emphasizes on concepts and techniques of trees, search trees and heaps, multi way trees, graphs and hashing.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the fundamental concepts of data structures, asymptotic notations and Algorithm analysis techniques to measure the performance of an algorithm.
- CO2.** Analyze performance of sorting and searching algorithms by making use of time and space complexity.
- CO3.** Design algorithms to solve societal problems by applying contextual knowledge on linked lists
- CO4.** Identify suitable data structure to Solve computational problems
- CO5.** Construct hash tables by using Hash functions and relevant collision resolution technique
- CO6.** Work independently or in team to solve problems with effective communication

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	1	-	-	-	-	-	-	-
CO3	2	2	3	-	1	1	-	-	-	-	-	-
CO4	3	2	3	-	1	-	-	-	-	-	-	-
CO5	2	2	3	-	1	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-
Course Correlation Mapping	2.4	1.8	3	-	1	1	-	-	3	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION, SORTING AND SEARCHING

(11 Periods)

Introduction: Introduction to data structures, Introduction to Algorithm, Performance Analysis- Space Complexity, Time Complexity, Asymptotic Notation- Big Oh, Omega, Theta notations, Guidelines for Asymptotic Analysis, Algorithms Analysis: Problems & Solutions.

Sorting: Bubble Sort, Insertion sort, Selection Sort, Shell Sort, Radix sort and their performance analysis.

Searching: Linear Search, Binary Search and their performance analysis.

Module 2: LINKED LIST

(08 Periods)

Single Linked List, Circular Linked List, Double Linked List, Circular Double Linked List, Applications of Linked List- Sparse Matrix Representation and its performance analysis, Addition of Polynomials and its performance analysis.

Module 3: STACKS AND QUEUES

(08Periods)

Stacks: Introduction, Definition, Implementation of stacks using arrays, Implementation of stacks using linked list, Applications of Stacks.

Queues: Introduction, Definition, Implementation of queues using arrays, Implementation of queues using linked list, Circular Queue, Dequeue, Priority Queue, Applications of Queues.

Module 4: TREES, SEARCH TREES AND HEAPS

(09 Periods)

Trees: Basic Terminologies, binary trees, Properties of binary tree, Representation of Binary Tree, Binary tree traversals.

Search Trees: Binary Search Trees, Operations on Binary Search Trees, AVL Trees and Operations on AVL trees

Heap: Heap Trees, Implementation of Heap Trees, Applications of Heap – Heap Sort and Its performance Analysis.

Module 5: MULTI WAY TREES, GRAPHS AND HASHING

(09 Periods)

Multiway Trees: M-way search trees, B-trees, Operations on B-trees, B+-trees.

Graphs: Introduction, Basic Terminologies, Representation of Graphs, Breadth First Search and its Complexity Analysis, Depth First Search and its Complexity Analysis.

Hashing: Introduction, Hash Table Structure, Hash Functions, Linear Open Addressing, Chaining and their performance analysis.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Implement following sorting algorithms
 - a) Bubble Sort
 - b) Insertion sort
 - c) Selection sort
2. Store roll numbers of students who attended placement training program in random order in an array.
 - a) Write a program to search whether a particular student attended training or not using linear search
 - b) Write a program to search whether a particular student attended training or not using binary search
3.
 - a) Department of CSE has a readers club named 'Prerana'. Students of all years can be granted membership on request and they can get books. Similarly one may cancel the membership of club. First node is reserved for head of readers club and last node is reserved for in-charge of readers club. The student's information in each node consisting of name of the student and roll no of the student. Develop program to perform following operations on readers club member's information using singly linked list.
 - i. Add and delete the members as well as head or even in-charge.
 - ii. Compute total number of members in readers club
 - iii. Display members in readers club
 - iv. Display list in reverse order using recursion
 - v. Sort the list using name and display it.
 - b) A Company has N employees and it maintains each employee data with the following attributes like: emp_id, emp-dept, emp_sal, emp_mobilen. Use a menu driven Program to perform following operations on employee's data using Doubly Linked List (DLL).
 - i. Create a DLL of N Employees Data by using end insertion.
 - ii. Display the status of DLL and count the number of nodes in it
 - iii. Perform Insertion and Deletion at End of DLL
 - iv. Perform Insertion and Deletion at Front of DLL
 - v. Perform Insertion and Deletion at any user specified position of DLL
 - vi. Exit
4.
 - a) Implement a menu driven Program for the following operations on stack using arrays.
 - i. Push an Element on to Stack
 - ii. Pop an Element from Stack
 - iii. Demonstrate how Stack can be used to check Palindrome
 - iv. Display the elements of a Stack
 - v. Exit
 - b) Develop a menu driven program to implement queue operations using arrays.
5.
 - a) Write a program to implement stack using linked list
 - b) Write a program to implement queue using linked list
6.
 - a) Develop a program to convert an infix expression to postfix expression using stack
 - b) Write a program to evaluate given postfix expression using stack

7. Develop a menu driven program to perform the following operations on a binary search tree
 - a) Create a binary search tree
 - b) Insert an element into a binary search tree
 - c) Delete an element from binary search tree
 - d) Traverse the binary search tree in In order, Preorder and post order
8. Write a program to perform the following operations on AVL tree
 - a) Insert an element into AVL tree
 - b) Delete an element from AVL tree
 - c) Display the elements of AVL tree in ascending order
9.
 - a) Develop a program to implement Breadth first search traversal.
 - b) Develop a program to implement Depth first search traversal.
10. Write a program to implement hashing with
 - a) Separate Chaining Method
 - b) Open Addressing Method

RESOURCES

TEXT BOOKS:

1. Debasis Samanta, *Classic Data Structures*, PHI Learning private limited, 2nd Edition, 2017.
2. Narasimha Karumanchi, *Data Structures and Algorithms made easy*, Career Monk, 5th Edition, 2017.

REFERENCE BOOKS:

1. G A V Pai, *Data Structures and Algorithms: Concepts, Techniques and Applications*, Mcgraw Hill Edition.
2. Satraj Sahani, *Data Structures, Algorithms and Applications in Java*, Universities Press, 2nd Edition, 2008.
3. Michael T. Goodrich, Roberto Tamassia, *Data Structures and Algorithms in java*, Wiley India, 2nd Edition, 2007.

SOFTWARE/TOOLS:

1. **Software:** JDK 1.8
2. **Operating System:** Windows/ Linux

VIDEO LECTURES:

1. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-006-introduction-to-algorithms-fall-2011/lecture-videos>
2. <http://nptel.ac.in/courses/106106127/>
3. <http://www.nptel.ac.in/courses/106102064>

Web Resources:

1. <https://www.codechef.com/certification/data-structures-and-algorithms/prepare>
2. <https://hackr.io/tutorials/learn-data-structures-algorithms>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22ME105401	ENGINEERING DRAWING	-	1	2	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on engineering drawing conventions, Importance of engineering drawing, fundamental concepts of sketching, computer aided drafting and different types of projections of geometric entities (both 2D and 3D) through computer aided drafting packages.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Apply the principles of engineering drawing, Methods and CAD tools to draw the Geometries and Curves to communicate in engineering field.
- CO2.** Understand and draw projections of points (0D) located in four quadrants
- CO3.** Visualize, plan and draw projections of lines (1D) and planes (2D) (inclined to both planes of projection)
- CO4.** Visualize and draw projections of regular solids (3D) (inclined to both planes of projection) and sections of regular solids (front view, top view and true shape)
- CO5.** Develop lateral surfaces of solids and draw Isometric views of given objects for engineering communication using principles of engineering drawing and CAD tools.
- CO6.** Work independently or in teams to solve problems with effective communication.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-
Course Correlation Mapping	3	2	1	-	-	-	-	-	3	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ENGINEERING GRAPHICS AND DESIGN (06 Periods)

Principles, significance -Conventions in drawing-lettering - BIS conventions-Dimensioning principles and conventional representations.

Exercises:

1. Practice exercise on Basic Lettering and Dimensioning
2. Practice exercise on Conventional representations

Introduction to AutoCAD: Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions.

Exercises:

1. Practice exercise using basic drawing commands
2. Practice exercise using editing commands

Module 2: CONICS, PROJECTION OF POINTS (06 Periods)

Conics & Special Curves: Conic sections - eccentricity method only

Exercises:

1. Practice exercises on Ellipse, Parabola, Hyperbola
2. Practice exercises on Projection of points

Module 3: PROJECTION OF LINES AND PLANES (8 Periods)

Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line, Projections of regular plane surfaces.

Exercises:

1. Practice exercises on projection of lines inclined to one plane
2. Practice exercises on projection of lines inclined to both planes
3. Practice exercises on Projections of regular plane surfaces

Module 4: PROJECTION OF SOLIDS AND SECTION OF SOLIDS (6 Periods)

Projection of solids: Projection of regular solids inclined to one plane.

Sections of solids: Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone, True shapes of the sections.

Exercises:

1. Practice exercises on Projections of regular solids
2. Practice exercises on Sections of solids

Module 5: DEVELOPMENT OF SURFACES, ORTHOGRAPHIC AND ISOMETRIC PROJECTIONS (10 Periods)

Development of surfaces: Development of surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts.

Exercises:

1. Practice exercises on Development of surfaces of right regular solids

ORTHOGRAPHIC AND ISOMETRIC PROJECTIONS

Orthographic Projections: Systems of projections, conventions and application to orthographic projections.

Isometric Projections: Principles of isometric projection- Isometric scale; Isometric views: lines, planes, simple solids.

Exercises:

1. Practice exercises on Orthographic Projections
2. Practice exercises on Isometric Projections
3. Practice exercise on Isometric Projection of the 2-storage building.

Total Periods: 36

RESOURCES

TEXT BOOKS:

1. D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, *Engineering Graphics with Auto CAD*, PHI Learning Private Limited, New Delhi, Revised edition, 2010.
2. N. D. Bhatt and V. M. Panchal, *Engineering Drawing*, Charotar Publishing House, Gujarat, 51st edition, 2013.

REFERENCE BOOKS/LABORATORY MANUALS:

1. Sham Tickoo, *AutoCAD 2013 for Engineers and Designers*, Dreamtech Press, 2013.
2. M. H. Annaiah & Rajashekar Patil, *Computer Aided Engineering Drawing*, New Age International Publishers, 4th Edition, 2012.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/112105294>

SCHOOL CORE

Course Code

22AI105001

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

Course Title

DESIGN THINKING

L T P S C

- 1 2 - 2

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on design thinking process, evaluation of requirement specification and reflections on design experience. This course also focuses on demonstration of five phases of design thinking such as empathize, define, ideate, prototyping, testing and validation with design thinking tools and frameworks.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Investigate the requirements of a problem by conducting surveys.
- CO2.** Create meaningful and actionable problem statements for creative problem solving.
- CO3.** Construct blueprints to visualize user attitudes and behavior for gaining insights of customers.
- CO4.** Design prototypes of innovative products or services for a customer base.
- CO5.** Develop relevant products or services by choosing good design and applying empathy tools for experiencing user requirements.
- CO6.** Work independently and communicate effectively in oral and written forms.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	2	-	-	-	-	-	-	-	-	1	1	-
CO2	1	-	1	3	-	-	-	-	-	-	-	-	1	1	-
CO3	-	2	-	3	-	-	-	-	-	-	-	1	1	1	-
CO4	-	2	3	2	-	-	-	-	-	-	-	-	1	1	-
CO5	-	3	-	1	1	-	1	2	-	-	-	-	1	1	-
CO6	-	-	-	-	-	-	-	-	3	3	2	-	-	-	-
Course Correlation Mapping	1	3	2	3	1	-	1	2	3	3	2	1	1	1	-

Correlation Levels: 3: High; 2: Medium; 1: Low

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

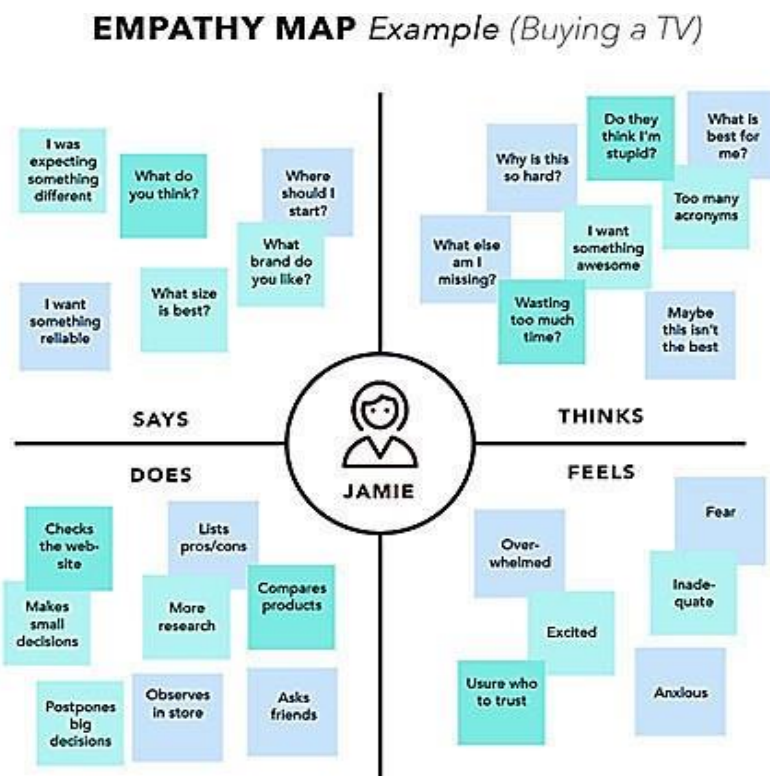
Introduction to Design Thinking – Design thinking Process, Definition, Importance, Phases of Design Thinking, Canva Tool.

1. Conduct survey and identify the problem by either individual or group and frame a problem statement using AEIOU (Activities, Environment, Interactions, Objects, Users) framework.
2. Identify demographic or focus group for problem statement and create persona and explicitly define the characteristics of persona using Canva tool.

Emphathize - Role of empathy in design thinking, Purpose of Empathy Map, Empathy Tools – Customer Journey Map, Personas, Coggle Tool.

3. Build a Customer Journey Map (CJM-Before-During-After) and identify touch points for any mock scenario or persona created during last experiment and frame 2-3 questions using HMW (How Might We).
4. Create an Empathy Map using Coggle design thinking tool.

Sample Empathy Map:

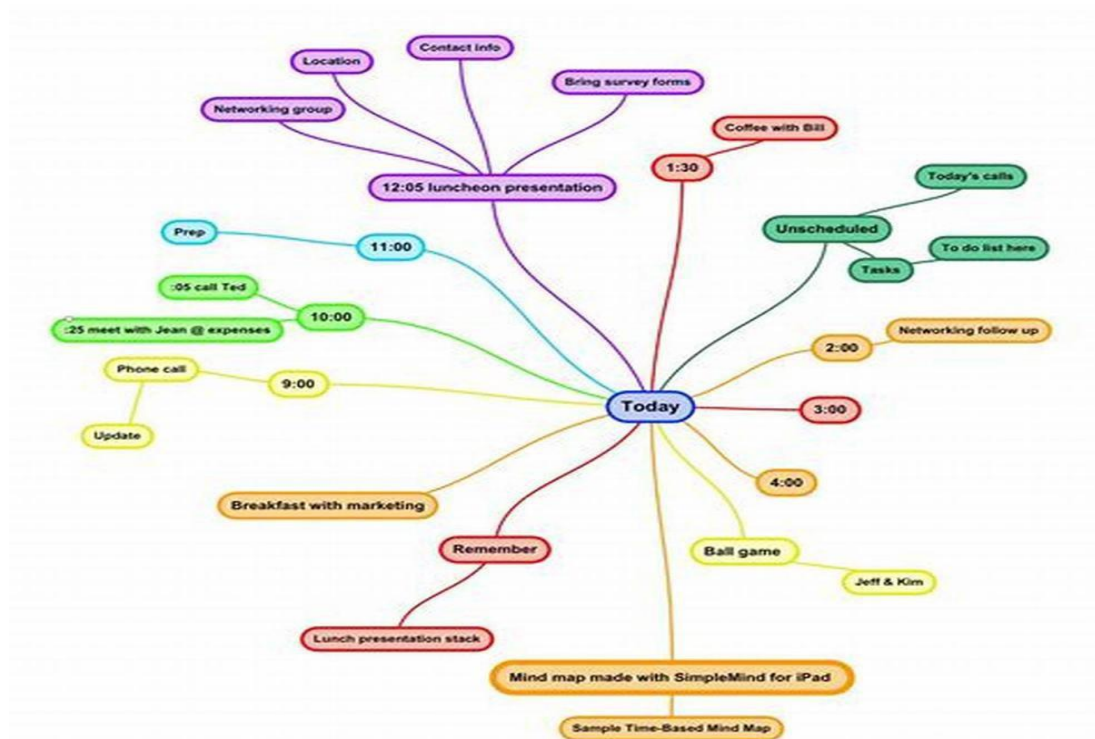


Ideation – Importance of visualizing and empathizing before ideating,
Applying the method, Ideation Tools

– Story board, Brainstorming, Mind Map, SCAMPER.

5. **Story boarding design ideas:** Consider a mock scenario and create user stories and storyboards to transform information about user needs into design concepts using any story board tool.
6. Create Mind Map for your problem statement using Coggle.

Sample Mind Map:



7. Perform Brain Storming Session with your team and record using the SCAMPER framework and finalize the best three innovative ideas.



Prototyping and Testing – Definition, Prototype examples, Need for Prototyping, Fidelity for prototypes, Process of prototyping, Introduction to Marvel POP Software, Testing prototypes with users.

8. Create an application prototype for product recommendation using **Marvel POP Software**.
9. Create a **low-fidelity paper prototype** by sketching out the product design and adding relevant functionality.
10. Test the prototype created in Exercise 9 by interacting with each member of the team, walking them through the design and gathering feedback. Use feedback grid with the following quadrants: what worked, what could be improved, questions, and ideas.

What worked?	What could be improved?
Questions	Ideas

RESOURCES

REFERENCE BOOKS:

1. Michael G. Luchs, Scott Swan , Abbie Griffin, *Design Thinking – New Product Essentials from PDMA*, Wiley, 2015.
2. Vijay Kumar, *101 Design Methods: A Structured Approach for Driving Innovation in Your Organization*, 2012.
3. Kathryn Mc Elroy, *Prototyping for Designers: Developing the best Digital and Physical Products*, O'Reilly, 2017.
4. S.Salivahanan, S.Suresh Kumar, D.Praveen Sam, *Introduction to Design Thinking*, Tata McGraw Hill, 1st Edition, 2019.

SOFTWARE/TOOLS:

1. Canva (<https://www.canva.com/>)
2. Coggle (<https://coggle.it/>)
3. Marvel POP

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/109/104/109104109/>
2. <https://nptel.ac.in/courses/110/106/110106124/>
3. <https://www.youtube.com/watch?v=q654-kmF3Pc&t=0s>
4. <https://www.youtube.com/watch?v=TNAdanuvwtc>
5. <https://www.youtube.com/watch?v=U-hzefHdAMk>
6. <https://www.youtube.com/watch?v=zbLxs6te5to>

Web Resources:

1. <https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process>
2. <https://www.ibm.com/design/thinking/page/toolkit>
3. <https://www.interaction-design.org/literature/article/define-and-frame-your-design-challenge-by-creating-your-point-of-view-and-ask-how-might-we>
4. <https://www.culturepartnership.eu/en/article/ten-tools-for-design-thinking>
5. https://www.mindtools.com/pages/article/newCT_02.htm

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22EC111002	TECHNOLOGY EXTENSION FOR SOCIETAL PROBLEMS	-	-	-	4	1
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: The course "Technology Extension for Societal Problems in ECE" is designed to provide students with in-depth project-based learning focused on identifying real-world problems in the field of Electronics and Communication Engineering (ECE) and leveraging technology to develop innovative solutions.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Create/Design engineering systems or processes to solve complex real world related to Electronics and Communication Engineering and allied societal problems using appropriate tools and techniques to arrive at innovative solutions.
- CO2.** Consider society, health, safety, environment, sustainability, economics and project management in solving complex real world and allied societal problems.
- CO3.** Perform individually or in a team besides communicating effectively in written, oral and graphical forms on systems or processes that are developed to solve complex realworld and allied societal problems.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Course Correlation Mapping	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Identification of real world and allied societal problems related to Electronics and Communication Engineering.

Industrial visits can be arranged by the faculty concerned

6 – 10 students can form a team (within the same discipline)

Minimum of four hours per week on self-managed team activity

Appropriate scientific methodologies to be utilized to solve the identified problem

Solution should be in the form of fabrication/coding/modeling/product design/process design/formulation of relevant scientific methodology(ies)

Public fund raising for implementation of the designed solution

Develop a strategy for implementation

Mobilization of necessary human resources and material

Implementation of the designed solution

Verification of the implemented solution

Consolidated report to be submitted for assessment

Participation, involvement and contribution in group discussions during the week with faculty concerned will be used as the modalities for the continuous assessment of the course.

Project outcome to be evaluated in terms of technical, economical, social, environmental, political and demographic feasibility.

Contribution of each group member to be assessed

Total Periods: 45

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

PROJECT BASED LEARNING

Projects relevant to the course will be provided by the course instructor at the beginning.

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22EC111001	INTERNSHIP	-	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Expose students to the industrial environment; Create competent professionals for the industry; sharpen the real time technical / managerial skills required at the job; Gain professional experience and understand engineer's responsibilities and ethics; Familiarize with latest equipment, materials and technologies; Gain exposure to technical report writing; Gain exposure to corporate working culture.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Analyze latest equipment, materials and technologies that are used in industry to solve complex engineering problems following relevant standards, codes, policies and regulations.
- CO2.** Analyze safety, health, societal, environmental, sustainability, economical and managerial factors considered in industry in solving complex engineering problems.
- CO3.** Perform individually or in a team besides communicating effectively in written, oral and graphical forms on practicing engineering.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
CO2	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
CO3	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
Course Correlation Mapping	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

Correlation Levels: 3: High; 2: Medium; 1: Low

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22EC108001	CAPSTONE PROJECT	-	-	-	-	10
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Identification of topic for the project work; Literature survey; Collection of preliminary data; Identification of implementation tools and methodologies; Performing critical study and analysis of the topic identified; Time and cost analysis; Implementation of the project work; Preparation of thesis and presentation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Create / design Commination Systems or processes to solve complex electronics engineering and allied problems using appropriate tools and techniques following relevant standards, codes, policies, regulations and latest developments.
- CO2.** Consider society, health, safety, environment, sustainability, economics and project management in solving complex Electronics and Communication engineering and allied problems.
- CO3.** Perform individually or in a team besides communicating effectively in written, oral and graphical forms on Electronics and Communication engineering processes.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
CO2	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
CO3	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2
Course Correlation Mapping	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2

Correlation Levels: 3: High; 2: Medium; 1: Low

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG102401	ENGLISH FOR PROFESSIONALS	2	-	2	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course deals with listening strategies, reading comprehension, grammar, vocabulary, pronunciation, Written, Verbal and Non-verbal communication, Channels of communication, Barriers to communication, Modes of technology-based communication, and Technical Communication

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the basics of Reading, Writing, Listening, and Speaking skills.
- CO2.** Analyze the rules of English grammar in speaking and writing.
- CO3.** Demonstrate knowledge of English pronunciation in speaking.
- CO4.** Apply the knowledge of reading strategies and vocabulary in communication.
- CO5.** Apply the strategies of writing in preparing a report.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	3	-	2
CO2	-	3	2	-	-	-	-	-	-	3	-	2
CO3	3	2	-	-	-	-	-	-	-	3	-	2
CO4	-	-	-	-	3	-	-	-	-	3	-	2
CO5	-	-	-	-	3	-	-	-	-	3	-	2
Course Correlation Mapping	3	3	2	-	3	-	-	-	-	3	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: SUPER HEROES – THE SCIENCE BEHIND SUPER HEROES (06 Periods)

Reading for Comprehension, Grammar, Speaking, Listening, Vocabulary, Writing, Verbal and Non-verbal communication.

Module 2: ALIENS – THE CYLINDER OPENS (06 Periods)

Reading for comprehension, Grammar, Vocabulary, Writing, Listening, and Channels of communication.

Module 3: INVENTORS – THE RAMAN EFFECT (06 Periods)

Reading comprehension, Listening, Writing, Grammar, Speaking, Pronunciation, and communication barriers.

Module 4: HEALTH AND NUTRITION – WHAT SHOULD YOU BE EATING (06 Periods)

Reading comprehension, Listening, Speaking, Grammar, Writing, Pronunciation, and Modes of technology-based communication.

Module 5: NEW-AGE ENTREPRENEURS – HOW A CHINESE BILLIONAIRE BUILT HER FORTUNE (06 Periods)

Reading comprehension, Vocabulary, Listening, Grammar, Writing, and Technical Communication

Total Periods: 30

EXPERIENTIAL LEARNING

PART-A

Any six modules among the following:

1. Conversation starters and role play
2. Reading comprehension
3. Listening comprehension
4. Vocabulary Building (business and job-related vocabulary)
5. Describing people, places, objects, and Events
6. Phonetics - Accent/ Rhythm/ Intonation
7. Tenses
8. Proposal Writing

PART-B

Any four modules among the following:

1. Communicating effectively is important to become successful in any business. Prepare a Case study of successful business personnel regarding communication competence.
2. Prepare a PowerPoint presentation on an orator and analyze the voice dynamics.
3. People face situations to convince or agree with the points they have. The college arranges a 5-day tour program to Goa. Prepare a video on persuasive talk and convince parents to get permission.
4. Write an article on the famous clichés of our time.
5. Prepare a poster on the effects of social media on youth.
6. Give a short talk on the importance of inventors and their role in present socio, political and economic changes.
7. Prepare a collage of entrepreneurs' pictures and their achievements.
8. NASA released recent photos of the universe with the help of the James Webb Space Telescope. Write down the expected impact on the existing theory on planets and the universe.
9. Obesity is the most common problem for people. List out the reasons for the problem and prepare food habits to overcome.
10. Epics of India deals with superheroes of those days. Compare the weapons used in the battles of Mahabharata with modern weapons.
11. Write a report on your recently invented product so that it should be sold as a hot cake in the market.
12. Illustrate the essential rules for good precis writing.

RESOURCES

TEXT BOOKS:

1. N.P. Sudharshana & C.Savitha, *English for Technical Communication*, Cambridge University Press. 2016.

REFERENCE BOOKS:

1. Kline J. A., *Speaking effectively: Achieving excellence in presentations*. Upper Saddle River, NJ: Pearson/Prentice Hall, 2004.
2. Kuiper, S. *Contemporary business report writing* Cincinnati, OH: Thomson/South, Western, 3rd Edition, 2007.
3. Locker, K. O. & Kaczmarek, S. K. *Business communication: Building critical skills*, McGraw Hill, 3rd Edition, 2007.
4. Mascull, B. *Business vocabulary in use: Advanced*. Cambridge, Cambridge University Press, 2004.
5. Matthews, C. B. & Matthews, M. *Quicksteps to winning business presentations: Make the most of your PowerPoint presentations*, McGraw Hill, 2007.

6. Marsh, C. *Strategic writing: Multimedia writing for public relations, advertising, sales and marketing, and business communication*, Pearson, 2005.
7. Munter, M. & Russell, L. *Guide to presentations*, Pearson, 2nd Edition, 2008.
8. Reardon, K. K. *The skilled negotiator: Mastering the language of engagement*, Jossey, Bass, 2004.
9. Stiff, J. B. *Persuasive communication*, Jossey, Bass, 2nd Edition 2003.

VIDEO LECTURES:

1. <https://learnenglish.britishcouncil.org/general/english/video/zone/the/day/elizabeth,became,queen>
2. <https://www.youtube.com/watch?v=CscHc8qSn1A>

Web Resources:

1. <https://galgotiacollege.edu/assets/pdfs/study,material/Notes,english.pdf>
2. <https://lecturenotes.in/subject/183>
3. <https://www.fluentu.com/blog/english/professional,english/>
4. <https://learnenglish.britishcouncil.org/business,english>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG102402	EMPOWERING YOUR ENGLISH	2	-	2	-	3
Pre-Requisite	-					
Anti-Requisite	22LG102401- English for Professionals					
Co-Requisite	-					

COURSE DESCRIPTION: This course deals with listening strategies, reading comprehension, grammar, vocabulary, pronunciation, Written, Verbal and Non-verbal communication, Channels of communication, Barriers to communication, Modes of technology-based communication, and Technical Communication

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Develop skills and techniques to speak and write with cohesion.

CO2. Understand the usage of English grammar in speaking and writing.

CO3. Demonstrate knowledge of right pronunciation in speaking.

CO4. Apply the knowledge to build vocabulary in communication.

CO5. Apply the strategies of writing in preparing a report and Email.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	3	-	2
CO2	-	3	2	-	-	-	-	-	-	3	-	2
CO3	3	2	-	-	-	-	-	-	-	3	-	2
CO4	-	-	-	-	3	-	-	-	-	3	-	2
CO5	-	-	-	-	3	-	-	-	-	3	-	2
Course Correlation Mapping	3	2	2	-	3	-	-	-	-	3	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: A TIME TO REMEMBER

(06 Periods)

Reading for Comprehension, Tenses, Speaking, Listening, Vocabulary, Writing - Email, Verbal and Non-verbal communication.

Module 2: TIME FOR CHANGE

(05 Periods)

Reading for comprehension, Degrees of Comparison, Vocabulary, Listening.

Module 3: ULTRA MARATHON

(05 Periods)

Reading comprehension, Listening, Vocabulary of sports, Pronunciation, speaking – Talk about favourite sport.

Module 4: HOTEL RESERVATIONS AND EXPENSES

(08 Periods)

HOTEL RESERVATIONS:

Reading comprehension – reading reviews, Speaking – calling to check into a hotel, make enquiries, framing questions, Grammar, Writing – writing reviews, Pronunciation.

EXPENSES:

Reading comprehension- analysing data, Vocabulary, Listening, Grammar - Tenses, Writing – writing a report. Speaking – Talk about making daily budget.

Module 5: BODY LANGUAGE

(06 Periods)

Reading comprehension, Vocabulary, Listening, Grammar, Speaking – Talking about importance of body language, giving mini presentations.

Total Periods: 30

EXPERIENTIAL LEARNING

PART-A

Any six modules among the following:

1. Conversation starters and role play
2. Reading comprehension
3. Listening comprehension
4. Vocabulary Building (business and job-related vocabulary)
5. Describing people, places, objects, and Events
6. Phonetics - Accent/ Tone/ Intonation
7. Grammar
8. Email Writing

PART-B

Any four modules among the following:

1. Identifying individual strengths and weaknesses raises self-awareness. Do a SWOT analysis and come up with an action plan to present in the classroom.
2. Prepare a sales pitch of your dream product/ app and explain USP.
3. "Gen -Z is a difficult generation". Do you agree with this statement? Tell why and how different Gen Z is.
4. Write an email to your Teacher of English explaining how a construction site near by is creating a hindrance to your learning.
5. Prepare a poster on the effects of social media on youth.
6. Give a short talk on the advantages and disadvantages of social media.
7. What are your thoughts on Mission Mars? Why do you think nations are investing heavily on this? Debate
8. Explain the downside of the development of current era.
9. Skills, Experience and education – which of these play an important role in life and why? Present your views
10. Talk about a time when you tried a weird / Awesome food. Describe your experience
11. Write an article on your experience of education. What are your recommendations to improve the system?

RESOURCES

TEXT BOOKS:

Jack C Richards, "*Interchange Fourth Edition*", Cambridge University Press. 2016.

REFERENCE BOOKS:

1. Kline, J. A. "*Speaking effectively: Achieving excellence in presentations. Upper Saddle River*", NJ: Pearson/Prentice Hall, 2004.
2. Kuiper, "S. *Contemporary business report writing*" (3rd ed.). Cincinnati, OH: Thomson/South,Western, 2007.
3. Locker, K. O. & Kaczmarek, "S. K. *Business communication*": Building critical skills (3rd ed.). New York: McGraw,Hill/Irwin, 2007.
4. Mascull, "B. *Business vocabulary in use: Advanced. Cambridge*": Cambridge University Press, 2004.
5. Matthews, C. B. & Matthews, and M. *Quicksteps to winning business presentations: Make the most of your PowerPoint presentations*. New York: McGraw,Hill, 2007.

6. Marsh, C. *Strategic writing: Multimedia writing for public relations, advertising, sales and marketing, and business communication*. Boston: Pearson/Ally and Bacon, 2005.
7. Munter, M. & Russell, L. *Guide to presentations*. (2nd ed.). Upper Saddle River: NJ: Pearson/Prentice Hall, 2008.
8. Reardon, K. K. *The skilled negotiator: Mastering the language of engagement*. San Francisco: Jossey, Bass, 2004.
9. Stiff, J. B. *Persuasive communication* (2nd ed.). New York: Guilford Press, 2003.
10. N.P. Sudharshana and C. Savitha, *English for Technical Communication*, Cambridge University Press. 2016

VIDEO LECTURES:

1. <https://learnenglish.britishcouncil.org/general/english/video/zone/the/day/elizabeth,became,queen>
2. <https://www.youtube.com/watch?v=CscHc8qSn1A>

Web Resources:

1. <https://galgotiacollege.edu/assets/pdfs/study,material/Notes,english.pdf>
2. <https://lecturenotes.in/subject/183>
3. <https://www.fluentu.com/blog/english/professional,english/>
4. <https://learnenglish.britishcouncil.org/business,english>

SCHOOL CORE

Course Code

22LG105402

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

Course Title

SOFT SKILLS

L T P S C

- - 2 - 1

COURSE DESCRIPTION: This course deals with an understanding of the fundamental soft skills and their practical social and workplace usage. It helps participants to communicate effectively and to carry themselves confidently and in harmony with their surroundings. They also learn how to identify and overcome the barriers in interpersonal relationships, and to employ oral and written communication, teamwork, leadership, problem-solving, and decision-making skills, to gain the best results.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge of career skills by analyzing the strategies of Goal Setting, Thinking Skills, interpersonal skills, and etiquette.
- CO2.** Analyze various situations by applying Assertive communication and Non-verbal forms in developing Interpersonal Skills.
- CO3.** Apply appropriate managerial strategies by analyzing the conflicts in various situations.
- CO4.** Demonstrate various communication styles by analyzing and applying Thinking Skills in diverse teams as an individual and a team member and during Interviews and Group Discussions.
- CO5.** Analyze and apply appropriate strategies of emotional intelligence and adaptability skills for personal and professional success.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	2	-	2	-	-	-	-	2
CO2	3	3	2	-	2	-	2	-	-	2	-	2
CO3	2	2	2	-	3	-	2	-	-	-	-	2
CO4	3	2	2	-	2	-	2	-	3	2	3	2
CO5	2	2	2	-	3	-	3	-	-	2	-	3
Course Correlation Mapping	3	2	2	-	3	-	2	-	3	2	3	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BODY LANGUAGE

Body language basics, Types of Body Language, Facial Expressions and their messages, Eye Contact Insights, Body Posture, Hand gestures, and finger movements

Module 2: ASSERTIVENESS

Communication Styles, Benefits, Asserting yourself, Tips, and Role Play

Module 3: GOAL SETTING

Seven Steps of Goal Setting, Self-Motivation, Personal Goal Setting, and Setting Career Goals

Module 4: THINKING SKILLS

Positive Thinking, Creative Thinking, Lateral Thinking, Logical Thinking, and Intuitive Thinking

Module 5: TEAM BUILDING

Learning Activities, Management Essentials, and Team Building Scenarios

Module 6: CONFLICT MANAGEMENT

Ways of Resolving Conflict, Personality Types and Conflict, Conflict Resolution Process, and Team Conflict

Module 7: EMOTIONAL INTELLIGENCE

Definition, understanding emotions, Identifying emotional intelligence, and self-assessment

Module 8: ADAPTABILITY SKILLS

Understanding organizational communication, Identifying adaptability skills, and self-assessment.

Module 9: GROUP DISCUSSIONS

Types of GD, Dos, and Don'ts, Dynamics of GD, Intervention, and Summarization Techniques

Module 10: INTERVIEW SKILLS

Planning, Opening Strategies, Answering Strategies, Teleconferencing, Videoconferencing, Practice questions, and Dress code

Module 11: INTERPERSONAL SKILLS

Starting a Conversation, Responding to a Conversation, Conversation Examples, Body Language, and Role Play

Module 12: ETIQUETTE

Basic Social Etiquette, Telephone Etiquette, Dining Etiquette, Conference Etiquette, and Email Etiquette

RESOURCES

REFERENCE BOOKS:

1. Manual.
2. Dr. K. Alex, *Soft Skills*, S. Chand & Company LTD, Latest Edition, New Delhi, 2018.
3. R. C. Sharma & Krishna Mohan, *Business Correspondence and Report Writing*, Tata Mc Graw, Hill Publishing Company Limited, New Delhi, 3rd Edition, 2012.
4. S.P. Dhanavel, *English and Soft Skills*, Orient Black Swan Private Limited, 2010.

VIDEO LECTURES:

1. <http://nptel.ac.in/courses/106102064>
2. <http://nptel.ac.in/courses/106106127/>

Web Resources:

1. http://psydilab.univer.kharkov.ua/resources/ucheba/softskills/Chapter_1_Introduction. PDF
2. <https://learning.tcsionhub.in/courses/tcs,ion/introduction,to,soft,skills/>
3. <https://goo.gl/laEHOY> (dealing with complaints)
4. <http://www.adm.uwaterloo.ca/infocecs/CRC/manual/resumes.html>
5. <https://goo.gl/FEMGXS>
6. <http://www.career.vt.edu/interviewing/TelephoneInterviews.html>
7. http://job,search,search.com/interviewing/behavioral_interviews
8. <https://www.thebalancecareers.com/what,are,soft,skills,2060852>

SCHOOL CORE

Course Code

22LG101403

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

Course Title

GERMAN LANGUAGE

L T P S C

2 - - - 2

COURSE DESCRIPTION: Oral communication; Basic grammar; Basic writing; Berufsdeutsch (Business German)

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01.** Demonstrate basic knowledge of the German language and verb conjugation.
- C02.** Comprehend and apply the knowledge of vocabulary and phrases in day-to-day real-life conversation.
- C03.** Apply the various sentence structures by examining the rules of grammar in speaking and writing.
- C04.** Analyze the various verb structure of English and German languages effectively in professional writing
- C05.** Apply the various verb structure of English and German languages effectively in professional writing

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	-	2	-	-	-	-
C02	3	-	-	-	-	-	-	2	-	-	-	-
C03	3	-	-	-	-	-	-	2	-	-	-	-
C04	3	-	-	-	-	-	-	2	-	-	-	-
C05	3	-	-	-	-	-	-	2	-	-	-	-
Course Correlation Mapping	3	-	-	-	-	-	-	2	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION

(06 Periods)

Introduction - German alphabet, numbers, days in a week, names of months, seasons. Grammar: Nouns –(i)Nominative case and (ii) Nominative personal pronouns, simple sentence, Verb Conjugation 1st and 2nd type, verb Conjugation 3rd type, 'Wh' questions (simple sentences) Nominative (definite and indefinite) Articles

Module 2: CITY AND FOOD

(06 Periods)

In the city: naming places and buildings, means of transport, basic directions. Food: drink, groceries and meals. Apartments: rooms, furniture, colours. Grammar: Nouns-articles negation–(kein and nicht); imperative and the accusative case; Nominative Possessive Pronouns.

Module 3: DAY-TO-DAY CONVERSATIONS

(06 Periods)

Everyday life, telling time, making appointments, leisure activities, and celebrations. Different types of professions, Health and the body, holidays and weather, Clothes and

Module 4: BASIC GRAMMAR

(06 Periods)

Grammar: Possessive articles, Prepositions (am, um, von, bis); Modal verbs, Separable verbs, accusative, past tense of 'to have' and 'to be', imperative sentences, dative case, perfect tense.

Module 5: BASIC WRITING

(06 Periods)

Translation from English to German and German to English, Contacts, Writing letters and Email Writing.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare a report on the importance of the German language in India
2. Why is German taught in Indian schools?

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Stefanie Dengler, Paul Rusch, Helen Schmitz, Tana Sieber, *Netzwerk Deutsch als Fremdsprache, Arbeitsbuch A1*, Goyal Publishers and Distributors Pvt. Ltd. 2015.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=o4GvYa-3BmY>
2. <https://www.youtube.com/watch?v=mrF9BizWmgk>
3. <https://www.youtube.com/watch?v=mojirClzQEs>
4. <https://www.youtube.com/watch?v=0osSyX0MmCM>
5. <https://www.youtube.com/watch?v=mMDotG5ucHA>

Web Resources:

1. <https://learngerman.dw.com/en/beginners/c-36519789>
2. <https://storylearning.com/learn/german/german-tips/basic-german-phrases>
3. <https://study.com/academy/lesson/how-to-write-a-letter-in-german.html>

SCHOOL CORE

Course Code

22LG101404

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

Course Title

FRENCH LANGUAGE

L T P S C

2 - - - 2

COURSE DESCRIPTION: Oral communication; Basic writing; Basic grammar

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate basic knowledge of the French language.

CO2. Comprehend and apply the knowledge of the alphabet in day-to-day real-life conversation.

CO3. Apply the various styles of greetings in speaking and writing.

CO4. Analyze the various conversations in French languages

CO5. Apply the French words for date and time.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	2	-	-	-	-
CO2	3	-	-	-	-	-	-	2	-	-	-	-
CO3	3	-	-	-	-	-	-	2	-	-	-	-
CO4	3	-	-	-	-	-	-	2	-	-	-	-
CO5	3	-	-	-	-	-	-	2	-	-	-	-
Course Correlation Mapping	3	-	-	-	-	-	-	2	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION

(06 Periods)

Introduction – Introduction, History of the French Language, Extent of the French Language, Reasons To Learn French, Book Organization, Learning French, Advice on Studying French

Module 2: THE ALPHABET

(06 Periods)

Letters, Punctuation, Acute Accent, Grave Accent, Tonic Accent, Stress

Module 3: GREETINGS

(06 Periods)

Greetings, Good-byes, Names, Vous vs. tu, Courtesy, Formal Speech Titles, Asking For One's Name

Module 4: CONVERSATIONS & NUMBERS

(06 Periods)

How are you?, Asking How One Is Doing, Cardinal Numbers and Ordinal Numbers

Module 5: THE DATE & TIME

(06 Periods)

Numbers 01-31, Seasons, Days of the week, Months of the Year, Numbers 30-60, Times of Day, Asking for the time.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare a report on the importance of the French language in India
2. Why is French taught in Indian schools?

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. The current, editable version of this book is available in Wikibooks, the open-content textbooks collection, at <http://en.wikibooks.org/wiki/French>

VIDEO LECTURES:

1. <https://www.bing.com/videos/riverview/relatedvideo?q=video+lecture+on+THE+ALPHABET+in+french&qpv=video+lecture+on+THE+ALPHABET+in+french&mid=D123409C16604E0FDE26D123409C16604E0FDE26&&FORM=VRD GAR>
2. https://www.youtube.com/watch?v=hd0_GZHHWeE

Web Resources:

1. <https://vdocument.in/french-lecture-notespdf.html?page=2>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MM101402	MULTIVARIABLE CALCULUS AND DIFFERENTIAL EQUATIONS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course contains various topics related to the calculus of the functions of two or more variables and differential equations. In particular, this contains topics like differentiation and integration of the functions of several variables together with their applications. It includes calculus of vector functions with applications. The methods of solving ordinary and partial differential equations are also incorporated for a better exposure.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Determine the extreme values of functions of two variables.
- CO2.** Evaluate multiple integrals in Cartesian, Polar and Spherical coordinates.
- CO3.** Demonstrate gradient, directional derivative, divergence, curl and Green's, Gauss, Stoke's theorems.
- CO4.** Solve higher order linear differential equations related to various engineering fields.
- CO5.** Identify solution methods for partial differential equations that model physical processes.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	2	1	-	-	-	-	-	-	-
CO2	2	3	-	3	1	-	-	-	-	-	-	-
CO3	3	2	-	3	1	-	-	-	-	-	-	-
CO4	3	2	-	3	1	-	-	-	-	-	-	-
CO5	3	3	-	3	1	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	-	3	1	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: MULTIVARIABLE CALCULUS (DIFFERENTIATION) (07 Periods)

Introduction to function of several variables, Jacobian and its properties, Functional dependence, Maxima and minima of functions of two variables, Lagrange's multiplier method.

Module 2: MULTIVARIABLE CALCULUS (INTEGRATION) (10 Periods)

Evaluation of Double integrals (Cartesian and Polar coordinates), Change of order of integration (Cartesian form only), Evaluation of triple integrals, Change of variables: Double integration from Cartesian to Polar coordinates, Triple integration from Cartesian to Spherical polar coordinates.

Module 3: MULTIVARIABLE CALCULUS (VECTOR CALCULUS) (11 Periods)

Vector Differentiation: Scalar and Vector fields: Gradient of a scalar field, Directional derivative, Divergence of a vector field, Solenoidal vector, Curl of a vector field, Irrotational vector, Laplacian operator.

Vector Integration: Line, Surface and Volume integrals, Vector integral theorems: Statement of Green's, Stoke's and Gauss divergence theorems, Verification and evaluation of vector integrals using them.

Module 4: ORDINARY DIFFERENTIAL EQUATIONS (10 Periods)

Second and higher order linear differential equations with constant coefficients: Non-Homogeneous equations with R.H.S terms of the type e^{ax} , $\sin ax$, $\cos ax$, polynomials in x , $e^{ax} V(x)$ and $x^n V(x)$, Method of variation of parameters, Equations reducible to linear differential equations with constant coefficients: Cauchy-Euler and Cauchy-Legendre differential equations.

Module 5: PARTIAL DIFFERENTIAL EQUATIONS (07 Periods)

Formation of partial differential equations by the elimination of arbitrary constants and arbitrary functions, Lagrange's linear equation, Method of separation of variables.

Total Periods: 45

EXPERIENTIAL LEARNING

1. American Airlines requires that the total outside dimensions (length + width + height) of a checked bag not exceed 62 inches. Suppose you want to check a bag whose height is equal to its width. What is the largest volume bag of this shape that you can check on an American Airlines flight?
2. An insulated rod of length l has its ends A and B maintained at 0°C and 100°C respectively until steady state conditions prevail. If B is suddenly reduced to 0°C and maintained at 0°C , establish an equation to find the temperature at a distance x from A at time t under the above conditions.
3. Apply the Gamma function; obtain the mass of an octant of the ellipsoid with the density at any point being $\propto kxyz$.

4. A person weighs 150lb walking exactly one revolution up a circular, spiral staircase of radius x ft. if the person rises 10ft then find the work done by the person. Consider different radii and find the work done by the person in each case.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. B. S. Grewal, *Higher Engineering Mathematics*, Khanna publishers, 44th edition, 2017.
2. Erwin kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 10th edition, 2011.

REFERENCE BOOKS:

1. Dennis G. Zill and Warren S. Wright, *Advanced Engineering Mathematics*, Jones and Bartlett, 6th edition, 2011.
2. N.P. Bali and Manish Goyal, *A Text Book of Engineering Mathematics*, Laxmi Publications, Reprint, 2008.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/111107108>
2. <https://nptel.ac.in/courses/111106100>
3. <https://nptel.ac.in/courses/111103021>

Web Resources:

1. http://www.efunda.com/math/math_home/math.cfm
2. <http://www.sosmath.com/>
3. <http://www.mathworld.wolfram.com/>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MM101404	TRANSFORM TECHNIQUES AND LINEAR ALGEBRA	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course focus on basic areas of theory and more advanced Engineering Mathematics topics which provide students with the relevant mathematical tools required in the analysis of problems in Engineering and scientific professions. This course includes Fourier series, Fourier Transforms, Laplace transforms, Inverse Laplace transform, solutions for linear systems, Eigen values and Eigen vectors, Linear transformation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate Fourier series to study the behaviour of periodic functions and their applications and Fourier transform to connect the frequency and time domain systems.
- CO2.** Apply the techniques of Laplace transform to solve ordinary differential equations.
- CO3.** Make use of echelon forms in finding the solution of system of linear equations. Compute Eigen values and Eigen vectors of square matrices.
- CO4.** Use the fundamental concept of a basis for a subspace to give a precise definition of dimensions and rank, and to solve problems in appropriate situations.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	1	-	-	-	-	-	-	-
CO2	3	3	-	3	1	-	-	-	-	-	-	-
CO3	3	2	-	1	1	-	-	-	-	-	-	-
CO4	3	2	-	3	1	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	-	2	1	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FOURIER SERIES & FOURIER TRANSFORMS

(09 Periods)

Introduction to Fourier series, Convergence of Fourier series (Dirichlet's conditions), Fourier series in $(-\infty, \infty)$, Half-range Fourier sine and cosine expansions in $(0, \infty)$, Fourier integral theorem (statement only), Fourier sine and cosine integrals; Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier transforms.

Module 2: LAPLACE TRANSFORMS

(09 Periods)

Definition of Laplace transforms, Existence conditions, Laplace transforms of standard functions, Properties of Laplace transforms (without proofs), Laplace transforms of derivatives, Laplace transforms of integrals, Multiplication by t^n , Division by t , Laplace transforms of periodic functions, Laplace transforms of unit step function and unit impulse function.

Module 3: INVERSE LAPLACE TRANSFORMS

(09 Periods)

Inverse Laplace transforms by different methods, Convolution theorem (without proof), Inverse Laplace transforms by convolution theorem, Applications of Laplace transforms to ordinary differential equations of first and second order with constant coefficients.

Module 4: LINEAR ALGEBRA – MATRICES

(09 Periods)

Rank of a matrix: Echelon form, Linear systems of equations: solving system of Homogeneous and Non-Homogeneous equations; Eigen values and Eigen vectors of a matrix and properties (without proofs), Diagonalization of a matrix by orthogonal transformation, Cayley-Hamilton Theorem.

Module 5: LINEAR ALGEBRA- VECTOR SPACES

(09 Periods)

Vector spaces, Linear dependence and independence of vectors, Basis, Dimension, Linear transformations (maps), Range and Kernel of a linear map, Rank and Nullity, Inverse of a linear transformation, Rank-Nullity theorem (without proof).

Total Periods: 45

EXPERIENTIAL LEARNING

1. A 100-gm mass is suspended from a spring with constant 50 N/m. It is set into motion by raising it 10 cm above its equilibrium position and giving it a velocity of 1 m/s downward. During the subsequent motion a damping force acts on the mass and the magnitude of this force is twice the velocity of the mass. If an impulse force of magnitude 2 N is applied vertically upward to the mass at $t = 3$ s, find the position of the mass for all time.
2. Develop a differential equation from an LRC circuit connected in series using Kirchhoff Voltage law and then solve using Laplace transform. Analyze the result by using any technology.
3. Check that the complex numbers $C = \{x + iy/i^2 = -1, x, y \in \mathbb{R}\}$, satisfy all of the conditions in the definition of vector space over C . Make sure you state carefully what your rules for vector addition and scalar multiplication.

4. Let Breakfast consists of orange juice, cereal, and eggs with the following nutritional information:

	OJ	Cereal	Eggs
Protein	0%	10%	20%
Vitamin C	20%	15%	0%
Calories	100	120	100

If you must have 30% protein, 30% Vitamin C and 300 calories for your breakfast, How many servings of OJ, Cereal, and Eggs should you have?

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. B. S. Grewal, *Higher Engineering Mathematics*, Khanna publishers, 44th edition, 2017.
2. David Poole, *Linear Algebra: A Modern Introduction*, Brooks/Cole, 2nd edition, 2005.

REFERENCE BOOKS:

1. Erwin kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 10th edition, 2011.
2. Belkacem Said-Houari, *Linear Algebra*, Springer International publish, 2017.
3. Bernard Kolman and David, R. Hill, *Introductory Linear Algebra- An applied first course*, Pearson Education, 9th Edition, 2011.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/111106111>
2. <https://nptel.ac.in/courses/111106051>

Web Resources:

1. <https://www.coursera.org/learn/matrix-algebra-engineers>
2. <https://www-users.cse.umn.edu/~mille003/fouriertransform.pdf>
3. <https://nitkkr.ac.in/docs/12-%20Laplace%20Transforms%20and%20their%20Applications.pdf>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MM102404	TRANSFORMATION TECHNIQUES AND LINEAR ALGEBRA	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	22MM101404 –TRANSFORMATION TECHNIQUES AND LINEAR ALGEBRA					
Co-Requisite	-					

COURSE DESCRIPTION: This course focus on basic areas of theory and more advanced Engineering Mathematics topics which provide students with the relevant mathematical tools required in the analysis of problems in Engineering and scientific professions. This course includes Fourier series, Fourier Transforms, Laplace transforms, Inverse Laplace transform, solutions for linear systems, Eigen values and Eigen vectors, Linear transformation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate Fourier series to study the behaviour of periodic functions and their applications and Fourier transform to connect the frequency and time domain systems.
- CO2.** Apply the techniques of Laplace transform to solve ordinary differential equations.
- CO3.** Make use of echelon forms in finding the solution of system of linear equations. Compute Eigen values and Eigen vectors of square matrices.
- CO4.** Use the fundamental concept of a basis for a subspace to give a precise definition of dimensions and rank, and to solve problems in appropriate situations.
- CO5.** Work independently or in teams to solve problems with effective communication.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	1	-	-	-	-	-	-	-
CO2	3	3	-	3	1	-	-	-	-	-	-	-
CO3	3	2	-	1	1	-	-	-	-	-	-	-
CO4	3	2	-	3	1	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-
Course Correlation Mapping	3	3	-	2	1	-	-	-	3	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FOURIER SERIES & FOURIER TRANSFORMS

(09 Periods)

Introduction to Fourier series, Convergence of Fourier series (Dirichlet's conditions), Fourier series in $(-\pi, \pi)$, Half-range Fourier sine and cosine expansions in $(0, \pi)$, Fourier integral theorem (statement only), Fourier sine and cosine integrals; Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier transforms.

Module 2: LAPLACE TRANSFORMS

(09 Periods)

Definition of Laplace transforms, Existence conditions, Laplace transforms of standard functions, Properties of Laplace transforms (without proofs), Laplace transforms of derivatives, Laplace transforms of integrals, Multiplication by t^n , Division by t , Laplace transforms of periodic functions, Laplace transforms of unit step function and unit impulse function.

Module 3: INVERSE LAPLACE TRANSFORMS

(09 Periods)

Inverse Laplace transforms by different methods, Convolution theorem (without proof), Inverse Laplace transforms by convolution theorem, Applications of Laplace transforms to ordinary differential equations of first and second order with constant coefficients.

Module 4: LINEAR ALGEBRA – MATRICES

(09 Periods)

Rank of a matrix: Echelon form, Linear systems of equations: solving system of Homogeneous and Non-Homogeneous equations; Eigen values and Eigen vectors of a matrix and properties (without proofs), Diagonalization of a matrix by orthogonal transformation, Cayley-Hamilton Theorem.

Module 5: LINEAR ALGEBRA- VECTOR SPACES

(09 Periods)

Vector spaces, Linear dependence and independence of vectors, Basis, Dimension, Linear transformations (maps), Range and Kernel of a linear map, Rank and Nullity, Inverse of a linear transformation, Rank-Nullity theorem (without proof).

Total Periods: 45

EXPERIENTIAL LEARNING

1. Find the constant, first sine and cosine terms in the Fourier series expansion of the function $y=f(x)$ from the given data through MATLAB.
2. Plot and visualize the first four terms of a Fourier series of a function $f(x)$ in $[0, 2\pi]$ using MATLAB.
3. Plot and visualize the first four terms of a Fourier series of a function $f(x)$ in $[-\pi, \pi]$ using MATLAB.
4. Solve and visualize solutions of the first order differential equations using Laplace transform through MATLAB code.
5. Solve and visualize solutions of the second order differential equations using Laplace transform through MATLAB code.

6. Write a MATLAB program to verify the Cayley-Hamilton theorem for the given square matrix and also to find A^n .
7. Find the Eigen values and Eigen vectors of the non symmetric matrix through MATLAB code.
8. Find the Eigen values and Eigen vectors of the symmetric matrix through MATLAB code.
9. Diagonalize the given square matrix through similarity transformation using MATLAB.
10. Diagonalize the given square matrix through orthogonal transformation using MATLAB

RESOURCES

TEXT BOOKS:

1. B. S. Grewal, *Higher Engineering Mathematics*, Khanna publishers, 44th edition, 2017.
2. David Poole, *Linear Algebra: A Modern Introduction*, Brooks/Cole, 2nd edition, 2005.

REFERENCE BOOKS:

1. Erwin kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 10th edition, 2011.
2. Belkacem Said-Houari, *Linear Algebra*, Springer International publish, 2017.
3. Bernard Kolman and David, R. Hill, *Introductory Linear Algebra- An applied first course*, Pearson Education, 9th Edition, 2011.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/111106111>
2. <https://nptel.ac.in/courses/111106051>

Web Resources:

1. <https://www.coursera.org/learn/matrix-algebra-engineers>
2. <https://www-users.cse.umn.edu/~mille003/fouriertransform.pdf>
3. <https://nitkkr.ac.in/docs/12-%20Laplace%20Transforms%20and%20their%20Applications.pdf>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MM101406	SPECIAL FUNCTIONS AND COMPLEX ANALYSIS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides fundamental knowledge of Beta and Gamma functions, Analyticity of a function. Further, this course focuses on differentiability, evaluation of complex integrals over a contour, Residues, evaluation of real integrals using Residue theorem.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Evaluate integrals by applying Beta and Gamma functions.
- CO2.** Analyze the analyticity of complex functions and apply Cauchy-Riemann equations & harmonic functions to solve engineering problems.
- CO3.** Determine the image of given region under the given conformal mapping
- CO4.** Identify singularities of complex functions and determine the values of integrals using complex variable techniques.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	3	1	-	-	-	-	-	-	-
CO2	3	3	-	3	1	-	-	-	-	-	-	-
CO3	3	3	-	3	1	-	-	-	-	-	-	-
CO4	3	3	-	3	3	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	-	3	2	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 SPECIAL FUNCTIONS (BETA AND GAMMA FUNCTIONS) (07 Periods)

Beta and Gamma functions and their properties, relation between beta and gamma functions, Evaluation of integrals using beta and gamma functions.

Module 2 ANALYTIC FUNCTIONS (10 Periods)

Analytic Functions: Elementary functions-separation of real and imaginary parts, Differentiation, analyticity, Cauchy-Riemann equations (both Cartesian and polar), harmonic functions, harmonic conjugate-construction of analytic function by Milne Thomson method, potential functions.

Module 3 CONFORMAL MAPPING (08 Periods)

Conformal Mapping: Definition and examples, Translation, Rotation, Inversion, Transformations $w \mapsto z^2, e^z$; Bilinear transformations and their properties.

Module 4 COMPLEX INTEGRATION (10 Periods)

Line integrals, Cauchy's integral theorem (without proof)-verification, Cauchy's integral formula (without proof), Generalized integral formula (without proof); Taylor's series, Laurent's series

Module 5 RESIDUE THEOREM (10 Periods)

Zeros of analytic functions, Singularities: Types of singularities, pole of order n .

Residues and evaluation of residue at poles, Cauchy's Residue theorem (without proof), evaluation of integrals using residue theorem, evaluation of real integrals (not having poles on real axis) of the type:

Total Periods: 45

EXPERIENTIAL LEARNING

1. Apply the Gamma function, obtain the mass of an octant of the ellipsoid
2. Discuss how to prepare a geographical map (Atlas) of the earth on a piece of paper using complex plane.
- 3.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. B. S. Grewal, *Higher Engineering Mathematics*, Khanna publishers, 44th edition, 2017.
2. J. W. Brown and R. V. Churchill, *Complex Variables and Applications*, Mc-Graw Hill, 7th edition, 2004.

REFERENCE BOOKS:

1. T. K. V. Iyengar, B. Krishna Gandhi, S. Ranganatham and M. V. S. S. N. Prasad, *Text book of Engineering Mathematics, Vol-III*, S. Chand & Company, 9th edition, 2013.
2. N. P. Bali and Manish Goyal, *A text book of Engineering Mathematics*, Laxmi Publications, Reprint, 2010.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/111/103/111103070/>
2. <https://youtube.videoken.com/embed/3Co68ALYRT>
3. <https://nptel.ac.in/courses/112/108/112108285/>
4. <https://nptel.ac.in/courses/111/106/111106141/>

Web Resources:

1. <https://ocw.mit.edu/courses/18-04-complex-variables-with-applications-spring-2018/download/>
2. <https://www.math.ucdavis.edu/~romik/data/uploads/notes/complex-analysis.pdf>
3. <https://mathworld.wolfram.com/BetaFunction.html>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MM101405	NUMERICAL METHODS, PROBABILITY AND STATISTICS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course contains various numerical methods to solve algebraic and transcendental equations and differential equations. This course also contains probability distributions and interpretation of hypothesis test for large and small samples.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Determine the approximate root of an equation and apply different methods to compute the value of interpolating polynomial at given point.
- CO2.** Evaluate integrals making use of quadrature formulae and solve ordinary differential equations numerically.
- CO3.** Use discrete and continuous distribution models to calculate probabilities for appropriate random variables.
- CO4.** Demonstrate and apply the basic concepts of inferences concerning means and proportions to the decision making process.
- CO5.** Interpret hypotheses test for small samples.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	3	2	-	-	-	-	-	-	-
CO2	3	3	-	3	2	-	-	-	-	-	-	-
CO3	3	3	-	3	2	-	-	-	-	-	-	-
CO4	3	3	-	3	2	-	-	-	-	-	-	-
CO5	3	3	-	3	2							
Course Correlation Mapping	3	3	-	3	2	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 ALGEBRAIC AND TRANSCENDENTAL EQUATIONS (09 Periods) **INTERPOLATION**

Solution of algebraic and transcendental equations: Bisection method and Newton- Raphson's method. Finite differences, relation between operators, interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Lagrange's formula.

Module 2 NUMERICAL DIFFERENTIATION AND INTEGRATION (10 Periods)

Numerical Differentiation- Newton's forward and backward difference formulae, numerical Integration - trapezoidal rule, Simpson's $1/3^{\text{rd}}$ and $3/8^{\text{th}}$ rules.

Module 3 RANDOM VARIABLE AND DISTRIBUTIONS (09 Periods)

Random variables (discrete and continuous), probability density functions, probability distribution: Binomial - Poisson - normal distribution and their properties (mathematical expectation and variance).

Module 4 TEST OF SIGNIFICANCE FOR LARGE SAMPLES (09Periods)

Formulation of null hypothesis, critical regions, level of significance. Large sample tests: Test for single proportion, difference of proportions, test for single mean and difference of means.

Module 5 TEST OF SIGNIFICANCE FOR SMALL SAMPLES (08 Periods)

Student's t-distribution (single mean, two means and paired t-test), Testing of equality of variances (F-test). Chi-square test for goodness of fit.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Write a Python program to solve algebraic equation by bisection method.
2. Write a Pseudo code on numerical integration using Simpson1/3 method.
3. What is the importance of probability distribution in computer science engineering?
4. If you draw from a normal distribution with known values of parameters, how do you generate draws in a uniform distribution?

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44/e, 2019.
2. S.S. Sastry, *Introductory Methods of Numerical Analysis*, Prentice Hall of India, 5th Edition, 2012.
3. Miller and Freund's, *Probability and Statistics for Engineers*, Prentice Hall of India, 8th Edition, 2011.

REFERENCE BOOKS:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 9th Edition, 2006.
2. T.K.V.Iyenger, Krishna Gandhi and others, *Probability & Statistics*, S.Chand.
3. S. C. Gupta and V. K. Kapoor, *Fundamentals of Mathematical Statistics*, Sultan Chand and Sons Publications, 11th Edition, 2012.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/127106019>
2. <https://nptel.ac.in/courses/111106112>
3. <https://nptel.ac.in/courses/111105041>
4. <https://nptel.ac.in/courses/111106112>

Web Resources:

1. <https://www.pdfdrive.com/introductory-methods-of-numerical-analysis-by-ss-sastry-d148704487.html>
2. https://faculty.ksu.edu.sa/sites/default/files/probability_and_statistics_for_engineering_and_the_sciences.pdf
3. <http://brharnetc.edu.in/br/wp-content/uploads/2018/11/21.pdf>
4. <http://www.mi.sanu.ac.rs/~gvm/Teze/Numerical%20methods%20In%20Computational%20Engineering.p>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MM102452	ENGINEERING PHYSICS	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a complete discussion about the wave theory of light, propagation of electromagnetic waves on a dielectric medium, and behavior of various semiconducting materials in addition to that dielectric, magnetic, nanomaterials, and superconducting materials. This course also provides hands-on experience on the above concepts.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Apply the concepts of light waves to interpret the concepts of Interference, Diffraction, and Polarization.
- CO2.** Demonstrate the concepts of electromagnetic wave propagation in optical fibers.
- CO3.** Understand the basic concepts of semiconductors in the functioning of various optoelectronic devices.
- CO4.** Demonstrate the basic concepts of dielectric and magnetic properties in the behavior of the various dielectric polarizations and magnetic materials.
- CO5.** Analyze the concepts of superconductors and nanomaterials to familiarize their applications in emerging fields.
- CO6.** Work independently and in teams to solve problems with effective communications.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	1	-	-	-	-	-
CO2	3	2	-	-	1	-	-	-	-	-	-	-
CO3	3	2	1	-	-	1	-	-	-	-	-	-
CO4	3	2	-	-	-	1	-	-	-	-	-	-
CO5	3	2	-	-	-	-	1	-	-	-	-	-
CO6	3	2	-	-	-	-	-	1	1	1	-	-
Course Correlation Mapping	3	2	1	-	1	1	1	1	1	1	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

MODULE 1: WAVE OPTICS

(09 Periods)

Interference: Introduction- Interference in thin films (reflected light) - Newton's rings.

Diffraction: Fraunhofer diffraction - Single slit diffraction (qualitative) - Double slit diffraction (qualitative).

Polarization: Polarization by reflection and double refraction - Nicol's prism - Half wave and Quarter wave plate - Engineering applications of interference, diffraction, and polarization.

Module 2: ELECTROMAGNETIC WAVES AND FIBER OPTICS

(09 Periods)

Electromagnetic Waves: Divergence, Curl of Electric and Magnetic Fields - Maxwell's Equations (qualitative).

Fiber Optics: Introduction to fiber optics - Total Internal Reflection - Critical angle of propagation - Acceptance angle, Acceptance cone - Numerical Aperture - V number (qualitative) - Classification of fibers based on Refractive index profile, modes - Applications of optical fiber - Fiber optic Sensors (temperature, displacement).

Module 3: SEMICONDUCTORS AND OPTOELECTRONIC DEVICES

(10 Periods)

Semiconductors: Introduction - Intrinsic semiconductors - Density of electrons in intrinsic semiconductor - Intrinsic carrier concentration - Fermi energy - Extrinsic semiconductors - Density of charge carriers in Extrinsic semiconductors (qualitative) - Drift and Diffusion currents - Direct and Indirect band gap semiconductors - Hall effect - pn junction

Optoelectronic devices: Light Emitting Diode (LED) - Photodiode - Semiconductor diode laser.

Module 4: DIELECTRICS AND MAGNETIC MATERIALS

(09 Periods)

Dielectric Materials: Introduction - Electric polarization - Types of polarizations (qualitative) - Frequency dependence of polarization - Lorentz (internal) field - Dielectric break down - Piezoelectricity - Applications of dielectrics.

Magnetic Materials: Introduction - Origin of magnetic moment - Classification of magnetic materials - Hysteresis loop - Soft and hard magnetic materials - Applications.

Module 5: SUPERCONDUCTORS AND NANOMATERIALS

(08 Periods)

Superconductors: Introduction - Critical parameters of Superconductors - Meissner effect - Types of Superconductors - BCS Theory - Applications of Superconductors.

Nanomaterials: Basic principles of nanomaterials - Synthesis of nanomaterials by Ball Milling and Pulsed Laser Deposition (PLD) methods - Properties of nanomaterials - Applications of nanomaterials.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 10 experiments shall be conducted)

1. Find the thickness of a human hair using the interference technique.
2. Determination of the radius of curvature of the lens (or) wavelength of monochromatic source by forming Newton's ring.
3. Estimate the wavelength of a given laser source by using a diffraction grating.
4. Determination of the numerical aperture of a given optical fiber and hence estimate its acceptance angle.
5. Estimation of the number of charge carriers of a given semiconducting specimen by calculating Hall coefficients using the Hall apparatus.
6. Calculation of forward and reverse resistances of a p-n junction diode by studying I-V characteristic curves.
7. Prediction of the energy gap of a given semiconductor diode by varying the temperatures.
8. Estimation of threshold voltages of different LEDs by plotting I-V curves.
9. Study the characteristics of Photodiode by varying the intensity of light.
10. Estimation of the magnetic field along the axis of a circular coil carrying current using Stewart Gee's method.
11. Determination of wavelength of light by plane diffraction grating using spectrometer by minimum deviation method.
12. Determination of particle size using laser source with help of diffraction technique.

RESOURCES

TEXT BOOKS:

1. M.N. Avadhanulu, P.G.Kshirsagar, and T.V.S Arun Murthy, *A Textbook of Engineering Physics*, S. Chand Publications, 11th edition, 2019.
2. R.K. Gaur and S.L. Gupta, *Engineering Physics*, Dhanpat Rai Publications (P) Ltd, 2015.
3. P.K. Palaniswamy, *Engineering Physics*, Scitech Publications India Private Limited, 2nd edition, 2009.
4. Serway and Jewett, *Physics for Scientists and Engineers with Modern Physics*, 6th Edition, Thomson Brooks, 2007.

REFERENCE BOOKS:

1. K. Thyagarajan, *Engineering Physics*, McGraw-Hill Education (India) Pvt. Ltd, 2016.
2. V. Rajendran, *Engineering Physics*, Tata McGraw Hill Publications Ltd, 7th Edition, New Delhi, 2014.
3. N.K. Verma, *Physics for Engineers*, PHI Pvt. Ltd., 2014.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/122/107/122107035>
2. <https://nptel.ac.in/courses/117102061>
3. <https://nptel.ac.in/courses/118104008>
4. <https://nptel.ac.in/courses/115107095>

Web Resources:

1. <http://www.freepdfbook.com/engineering-physics-mcgraw-hill/>
2. <https://quickstudyhelper.com/textbook-engineering-physics.html>
3. <https://salmanisaleh.files.wordpress.com/2019/02/physics-for-scientists-7th-ed.pdf>
4. https://www.researchgate.net/publication/344758634_Short_Notes_on_Engineering_Physics

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MM102451	APPLIED PHYSICS	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on optical fibers with structure and classification, ideas for designing acoustically good halls, production and detection of ultrasonic's with suitable industrial applications, studying the different paths of the particles using kinetics and kinematics relations, heat transfer mechanisms in material media, characteristics, and applications of modern Engineering materials.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate the concepts of electromagnetic wave propagation in optical fibers.
- CO2.** Apply the basic knowledge of acoustics and ultrasonics to provide solutions for various engineering problems.
- CO3.** Analyze and solve the problems associated with kinetics and kinematics.
- CO4.** Acquire basic knowledge in several heat transfer mechanisms and heat conduction through the compound media.
- CO5.** Understand the characteristics and applications of modern engineering materials.
- CO6.** Work independently and in teams to solve problems with effective communications.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	1	-	-	-	-	-	-	-
CO2	3	2	1	-	-	1	-	-	-	-	-	-
CO3	3	2	-	1	-	-	-	-	-	-	-	-
CO4	3	2	-	1	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	1	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	1	1	1	-	-
Course Correlation Mapping	3	2	1	1	1	1	-	1	1	1	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FIBER OPTICS

(08Periods)

Introduction-Structure of optical fiber-Total internal reflection-Acceptance angle, acceptance cone - Numerical aperture-Modes of propagation-Classification of optical fibers- V-number (qualitative)-Fabrication of optical fiber by double crucible technique-Applications of optical fibers-Sensors (temperature, displacement, liquid level detector).

Module 2: ACOUSTICS AND ULTRASONICS

(09 Periods)

Acoustics: Introduction-Classification of sound-Sound intensity level (decibel) - Reverberation-Reverberation time- Sabine's formula (qualitative)-Absorption coefficient and its determination -Factors affecting acoustics and their remedies-Basic requirements of an acoustically good hall.

Ultrasonics: Introduction to ultrasonic waves-Production of ultrasonic waves by magnetostriction method-Piezoelectric method-Detection of ultrasonics (qualitative)- Industrial applications (ultrasonic welding, ultrasonic soldering, and ultrasonic drilling).

Module 3: KINEMATICS AND KINETICS

(10 Periods)

Kinematics of particles: Introduction- Rectilinear motion (displacement-time curve, velocity-time curve, acceleration-time curve)- Curvilinear motion (velocity and angle of projection, equation of trajectory path, horizontal range) - Inclined projection (equation of trajectory, maximum height, time of flight of projectile, horizontal range, angle of projection).

Kinetics: Bodies in rectilinear translation- Kinetics of bodies rotating about a fixed axis -Work,Energy,Power -Work-Energy equation for translation.

Module 4: THERMAL PHYSICS

(8 Periods)

Introduction-Modes of heat transfer (conduction, convection, and radiation)-Coefficient of thermal conductivity-Rectilinear flow of heat along a uniform bar-Thermal conductivity of bad conductor (Lee's disc method)-Heat conduction through compound media(materials in series and parallel).

Module 5: MODERN ENGINEERING MATERIALS

(10 Periods)

Metallic glasses: Introduction-Preparation of metallic glasses by RF sputtering technique- Properties (structural, thermodynamic, mechanical, electrical, chemical, and optical), Applications of metallic glasses.

Shape memory alloys (SMA): Introduction-Shape memory effect and its types- Characteristics of SMA-Properties of NiTi alloy-Applications of SMA.

Composite materials- Introduction-Types and applications of composite materials.

Total periods:45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:(Minimum 10 experiments shall be conducted)

1. Estimate the numerical aperture and acceptance angle of an optical fiber.
2. Determination of the moment of inertia of a bar and acceleration due to gravity by using a compound Pendulum.
3. Find the moment of inertia of a Flywheel.
4. Estimate the moment of inertia of a rectangular body using the Bifilar Pendulum.
5. Determine the frequency of electrically driven tuning fork in transverse and longitudinal modes of vibration using Melde's Experiment.
6. Determination of coefficient of thermal conductivity of a bad conductor using Lee's disc apparatus.
7. Verify Newton's Law of Cooling for any two liquids.
8. Estimate the number of charge carriers per unit volume and hall coefficients of a given material using the Hall Effect.
9. Calculate the rigidity Modulus of a material of a wire using Torsional Pendulum
10. Determine the energy gap of material by varying temperatures.
11. Verify the three laws of stretched strings using a sonometer.
12. Estimate the particle size using a monochromatic light source (LASER).

RESOURCES

TEXT BOOKS:

1. M. N. Avadhanulu, P. G. Kshirsagar, T. V. S. Arun Murthy, *A Textbook of Engineering Physics* - S. Chand Publications, 11th edition, 2019.
2. S. S. Bhavikatti and K. G. Rajashekarappa, *Engineering Mechanics*, New Age International Publishers, 2nd edition, 2015.
3. R.K. Gaur and S.L. Gupta, *Engineering Physics*, Dhanpat Rai Publications (P) Ltd, 2015.
4. Serway and Jewett, *Physics for Scientists and Engineers with Modern Physics*, 6th Edition, Thomson Brooks, 2007

REFERENCE BOOKS:

1. B. K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Learning, 2012.
2. Brij Lal and N. Subrahmanyam, *Heat and Thermodynamics*, S. Chand and Company Ltd., 1995.
3. William D. Callister Jr., David G. Rethwisch, *Material Science and Engineering*, 9th Edition, Wiley 2013.

VIDEO LECTURES:

1. <http://nptel.ac.in/courses/112104212>
2. <http://nptel.ac.in/courses/105/106/105106053>
3. <https://nptel.ac.in/courses/115107095>
4. <https://archive.nptel.ac.in/courses/105/106/105106053/>

Web Resources:

1. <https://drive.google.com/file/d/1xd2jSCu9Q9SkNC0K6hEPJdwdJlCHR5ZF/view>
2. <https://www.jntufastupdates.com/jntuk-r20-1-2-engineering-mechanics-material/>
3. <https://salmanisaleh.files.wordpress.com/2019/02/physics-for-scientists-7th-ed.pdf>
4. https://www.researchgate.net/publication/344758634_Short_Notes_on_Engineering_Physics

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CM101402	PRINCIPLES OF BUSINESS ECONOMICS AND ACCOUNTANCY	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Business economics and demand analysis; theory of production and cost analysis; markets and pricing; principles of accounting and capital; final accounts and tally ERP 9.0

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate the principles of Business Economics and theories of Demand.
- CO2.** Apply the theories of Production and Cost to the managerial decision-making of an organization.
- CO3.** Determine the Price and Output relation in the different Market structures.
- CO4.** Demonstrate the principles of Accountancy and sources of Capital.
- CO5.** Analyze the profitability and soundness of an organization.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	1	-	3	-	2
CO2	3	2	-	-	-	-	-	1	-	3	-	2
CO3	3	2	-	-	-	-	-	1	-	3	-	2
CO4	3	2	1	-	-	-	-	1	-	3	-	2
CO5	3	2	1	-	-	-	-	1	-	3	-	2
Course Correlation Mapping	3	2	1	-	-	-	-	1	-	3	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BUSINESS ECONOMICS AND DEMAND ANALYSIS (09 Periods)

Definition - Nature and Scope of Business Economics - Demand: Determinants of demand - Demand function - Law of demand, assumptions, and exceptions - Elasticity of demand - Types of elasticity of demand - Demand forecasting and methods of demand forecasting.

Module 2 THEORY OF PRODUCTION AND COST ANALYSIS (09 Periods)

Production Function: Input-output relationship - Law of Variable proportion- Isoquants and Isocosts

Cost Concepts: Total, Average and Marginal Cost - Fixed vs. Variable costs - Opportunity Costs Vs Outlay Costs- Separable Costs Vs Joint Costs, Urgent Costs Vs Postponable Costs- Avoidable Costs Vs Unavoidable Costs

Break Even Analysis (BEA) - Assumptions, Merits and demerits - Determination of Break-Even Point (Simple problems).

Module 3 MARKETS AND PRICING (09 Periods)

Market Structure: Types of Markets - Features of perfect competition - Monopoly and monopolistic competition - Price and Output determination in perfect competition, monopoly and monopolistic Markets.

Pricing: Objectives and policies of pricing - Sealed bid pricing - Marginal cost pricing - Cost plus pricing - Going rate pricing - penetration Pricing -skimming Pricing - Block pricing - Peak load pricing - Cross subsidization.

Module 4 PRINCIPLES OF ACCOUNTING & CAPITAL (09 Periods)

Accountancy: Introduction - Concepts - Conventions - Double Entry Book Keeping - Journal - Ledger - Trial Balance (Simple problems)

Capital: Significance - Types of capital - Sources of Capital.

Module 5 FINAL ACCOUNTS & TALLY ERP 9.0 (09 Periods)

Introduction to Final Accounts - Trading account - Profit and Loss account and Balance Sheet with simple adjustments (Simple problems)

Tally ERP 9.0: Introduction - Create a company - Create ledger - Posting vouchers - Advantages of Tally.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare the Journal Entries by the students with practical examples.
2. Conduct an event about the market structure.
3. Do the problems on Financial Statements with practical examples.
4. Prepare a report regarding the demand and supply of electric vehicles in the Indian market.

5. From the following balances of Mr. Aravind as at 31.12.2016, prepare Trading, Profit and Loss Account for the year ended and Balance Sheet as at that date after making the necessary adjustments.

Debit Balances	Amount (Rs.)	Credit Balances	Amount (Rs.)
Drawing Account	6,000	Capital	80,000
Plant and Machinery	25,000	Sundry Creditors	10,000
Stock (opening)	15,000	Sales	1,20,000
Purchases	82,000	Returns outwards	1,000
Return Inwards	2,000	R.B.D.D.	400
Sundry Debtors	20,600	Discounts	800
Furniture & Fixtures	5,000	Rent of Premises sublet	1,200
Freight and Duty	2,000	Reserve Fund	5,000
Carriage outwards	500		
Rent, Rates & Taxes	4,600		
Printing & Stationery	800		
Trade Expenses	400		
Postage and Telegrams	800		
Insurance charges	700		
Salaries and Wages	21,300		
Cash in Hand	6,200		
Cash at Bank	25,500		
	2,18,400		2,18,400

Adjustments:

- Stock on 31.12.2006 was Rs.14,600.
- Write off Rs.600 as bad debts and provide 5% for R.B.D.D.
- Provide for depreciation on furniture 5% & Plant & Machinery at 20%.
- Insurance prepaid was Rs.100.
- Outstanding salaries Rs. 700
- A fire occurred on 25th December 2006 and stock worth Rs.5,000 was destroyed and the insurance company admitted a claim for Rs. 4500 only.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. H L Ahuja, *Business Economics (Thirteenth edition)*, S Chand Publishing, Jan 2016.
2. S.P. Jain and K.L. Narang, *Financial Accounting*, Kalyani Publishers, Ludhiana, 12th edition, 2018.

REFERENCE BOOKS:

1. Joseph G.Nellis and David Parker, *Principles of Business Economics*, Pearson Education Canada, 2nd edition, 2016.
2. Larry M. Walther, *Financial Accounting*, Create Space Independent PublishingPlatform, July 2017.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=xWKfKCnQqAE>
2. <https://www.youtube.com/watch?v=daYPYHbJ6Xc>

Web Resources:

1. <https://leverageedu.com/blog/scope-of-business-economics/>
2. <https://www.economicdiscussion.net/break-even-analysis/break-even-point-of-a-firm-meaning-determination-and-types/21785>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MG101401	ESSENTIALS OF LEADERSHIP	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course is designed for learners who desire to improve their leadership, communications, and workplace skills.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Differentiate between leadership and management
- CO2.** Identify the values common among great leaders.
- CO3.** Discuss the power of positive expectations and how to apply it as a leader
- CO4.** Assess what, how, and to whom you should delegate.
- CO5.** Describe what it means to be an ethical leader.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	-	1	-	-	-	-	-	-
CO2	1	1	2	1	-	1	-	-	-	-	-	-
CO3	2	-	2	-	1	-	-	-	-	2	-	-
CO4	1	2	-	1	-	-	-	-	-	2	-	-
CO5	1	2	1	-	-	-	-	-	-	2	2	-
Course Correlation Mapping	2	2	2	1	1	1	-	-	-	2	2	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Introduction

(06 Periods)

What is leadership, leadership vs management, leadership and change, Maxwell's 5 levels of leadership, how to move to the next level

Module 2: Leadership Values & Expectations

(06 Periods)

14 Leadership Values, what matters most exercise. Expectations, The Pygmalion Effect, impact of positive expectations, setting expectations

Module 3: Delegation

(06 Periods)

Definition, why delegate, delegate/empower, why people don't delegate, steps for delegation - the IDEALS model.

Module 4: Ethics

(06 Periods)

Definitions, introduction to ethics, ethics vs morals, self-assessment, Good People, Bad Choices examples, how to be an ethical leader, 8 Ethical Actions for Leaders.

Module 5: Commitment

(06 Periods)

Introduction, significance of commitment, Universal Laws of Leadership, tips towards being accountable and committed leader.

Total Periods:30

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Collect the case studies related to successful leaders and their traits.
2. Different Case Studies Will be Given to students as per the topic that will be collected and evaluated.
3. The case studies will be collected as Assignments and the same will be evaluated.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Anderson T, *Transforming leadership*, St. Lucie Press, Boca Raton, FL, 2nd ed 1998
2. Babiak, P. & Hare, R.D., *Snakes in suits: when psychopaths go to work*, Regan Books, New York, 2006

REFERENCE BOOKS:

1. Conger J, *Inspiring others: The language of leadership*, Academy of Management Executive, 5(1), 31-45, 1991
2. *Leadership Skills*. MTD Training & Ventus Publishing ApS, 2010

VIDEO LECTURES:

1. Marshall Goldsmith: The Essentials Of Leadership (fs.blog)
2. https://onlinecourses.nptel.ac.in/noc23_mg28/preview

Web Resources:

1. [cdn2.hubspot.net/hubfs/4654529/Expert landing pages/PeterCox/Resources/10 Leadership Essentials .pdf](https://cdn2.hubspot.net/hubfs/4654529/Expert%20landing%20pages/PeterCox/Resources/10%20Leadership%20Essentials.pdf)
2. [3-leadership-essentials-discovery-event-w.-no.-05.11.12.pdf](#) (imd.org)

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MG101402	ORGANIZATIONAL BEHAVIOUR	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course enables the students to know the principles in an organization, the system and process of effective controlling in the organization.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Interpret the scope of organizational behavior and its significance.
- CO2.** Understand the managerial strategies in achieving the organizational goals of an organization
- CO3.** Demonstrate the impact of motivation and leadership in group dynamics.
- CO4.** Solve organizational conflicts through negotiation and team building.
- CO5.** Improve the results – performance outcome through human behavior and organizational behaviour can aid them in their pursuit of the goals.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	2	-	2	-	2	-	2
CO2	1	-	2	1	-	2	-	-	-	-	-	2
CO3	2	-	2	-	1	-	-	-	-	2	-	2
CO4	1	2	-	1	-	-	-	-	-	2	-	2
CO5	1	2	1	-	-	-	-	-	-	2	2	2
Course Correlation Mapping	2	2	2	3	2	2		2		2	2	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Introduction

(06 Periods)

Nature and scope – Linkages with other social sciences- Individual roles and organizational goals – perspectives of human behavior - Perception– perceptual process

Module 2: Learning

(06 Periods)

Learning - Learning Process- Theories- (Pavlov, Skinner and Thorndike) - Personality and Individual Differences - Determinants of Personality - Values, Attitudes and Beliefs

Module 3: Motivation and Leadership

(06 Periods)

Definition and nature of motivation, Theories of Motivation (Maslow, Alderfer) -Leadership –Traits-Styles –Leadership skills– Challenges to leaders.

Module 4: Organizational conflicts

(06 Periods)

Causes and consequences-conflict and Negotiation Team Building, Conflict Resolution in Groups and problem solving Techniques.

Module 5: Organizational Communication

(06 Periods)

Communication, types and process, importance and barriers – Organizational change -change process - resistance to change – Organizational development and OD interventions.

Total Periods:30

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Collect the case studies related to recent topics in OB and other Contemporary OB Practices and Present them as a seminar.
2. Different Case Studies Will be Given to students as per the topic that will be collected and evaluated.
3. The case studies will be collected as Assignments and the same will be evaluated.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Robbins.P. Stephen (2006), Organizational Behaviour, Pearson Education, New Delhi.
2. Luthans Fred (1998), Organizational Behaviour, Tata Mc Graw Hill International Edition, New Delhi
3. K.Aswathappa "Organizational Behaviour-Text, Cases and Games", Himalaya PublishingHouse, New Delhi, 2008.

REFERENCE BOOKS:

1. Steven L Mc Shane, Mary Ann Von Glinow, Radha R Sharma: "OrganizationalBehaviour", TMH Education, NewDelhi,2008
2. PareekUdai (2007), Understanding Organizational Behaviour, Oxford University Press, New Delhi
3. Jerald Greenberg and Robert.A. Baron, (2009), Organizational Behaviour, PHI learning Private Ltd., New Delhi.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=Sg64udtQ300&list=PL3Y_p3e-Lne2no2K5cNa8y7ti1uqCjZw8
2. <https://www.youtube.com/watch?v=pHg3ZfGk5j0>

Web Resources:

1. <https://www.icmrindia.org>
2. <https://www.citeob.com/> 5 <https://www.ob-guide.com>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MG101403	PROJECT MANAGEMENT	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: To understand the importance of decision-making while implementing any project and interpret and discuss the results of qualitative and quantitative analysis

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand the basic introduction to project management
- CO2** Apply the methods of project identification and selection.
- CO3** Understand project allocation methods and evaluation.
- CO4** Analyse the techniques for project time, review, and cost
- CO5** Understand the factors of risk and quality of a project.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	-	-	-	-	-	-	-
CO2	1	1	2	2	-		2		1			-
CO3	2	2	1	2	1	-	-	1	-	-	2	
CO4	3	1	2	2	1	-	-	-	-	-	-	2
CO5	2	2	1	2	1	1	-	-	-	-	-	1
Course Correlation Mapping	2	2	2	2	1	1	2	1	1	-	2	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Introduction

(05 Periods)

Concept of project management, project definition and key features of projects, project life cycle phases, typical project management issues, basic project activities

Module 2: Project Identification and Selection

(06 Periods)

Identification and screening (brainstorming, strength and weakness in the system, environmental opportunities and threats), Project evaluation methods- Payback period, Net present value, Internal rate of return and project evaluation under uncertainty.

Module 3: Project Resource Management

(07 Periods)

Scheduling resources, resource allocation methods, project crashing and resource leveling, working of systems, design of systems, project work system design, project execution plan, project procedure manual project control system, planning scheduling and monitoring

Module 4: Time and Cost Management

(05 Periods)

Time Management-Network diagram, forward and backward pass, critical path, PERT and CPM, AOA and AON methods, tools for project network, Cost management-earned value method

Module 5: Risk and Quality Management

(07 Periods)

Risk identification, types of risk, risk checklist, risk management tactics, risk mitigation and contingency planning, risk register, communication management, Quality assurance and quality control, quality audit, methods of enhancing quality

Total Periods: 30

EXPERIENTIAL LEARNING

1. Refer to any video lecture on project evaluation methods and give a brief seminar using PPT
2. Select any company wherein you will get the details of activities and time and draw the project network diagram and submit a report.
3. Determine a crashing scheme for the above project so that the total project time is reduced by 3 weeks

Activity	Predecessor Activity	Normal Time (Weeks)	Crash Time (Weeks)	Normal Cost (Rs.)	Crash Cost (Rs.)
A	-	4	3	8,000	9,000
B	A	5	3	16,000	20,000
C	A	4	3	12,000	13,000
D	B	6	5	34,000	35,000
E	C	6	4	42,000	44,000
F	D	5	4	16,000	16,500
G	E	7	4	66,000	72,000
H	G	4	3	2,000	5,000

4. Collect any case study that discusses the process of probability calculation of success of the project and submit a report

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. R.Panneerselvam and P.Senthil Kumar (2013), Project Management, PHI Learning Private Limited.
2. Prasanna Chandra (2014), Projects: Planning, Analysis, Selection, Financing, implementation, and Review.

REFERENCE BOOKS:

1. A Guide to the Project Management Body of Knowledge: (PMBOK Guide) by Project Management Institute, 2013.
2. Gopala Krishnan & Rama Murthy, A Text book of Project Management, McMillan India.
3. S. Choudhary (2004), Project Management, Tata McGraw Hill Publication.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc19_mg30/preview
2. <https://archive.nptel.ac.in/courses/110/104/110104073/>

Web Resources:

1. <https://www.pmi.org/about/learn-about-pmi/what-is-project-management>
2. <https://www.manage.gov.in/studymaterial/PM.pdf>
3. <https://imada.sdu.dk/u/jbj/DM85/lec7.pdf>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG107601	PROFESSIONAL ETHICS AND HUMAN VALUES	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course deals with personal conviction, and ethics and describes the accepted principles and standards of conduct regarding moral duties and virtues as applied to an organization. Codes of professional ethics guide the stakeholders of an organization about the desirable and undesirable acts related to the profession.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate the principles of ethics, professional values, and social responsibility.
- CO2** Analyze the problems in the implementation of moral autonomy and use ethical theories in resolving moral dilemmas.
- CO3** Develop suitable strategies to resolve problems that arise in practicing professional ethics and Industrial standards.
- CO4** Function as a member, consultant, manager, advisor and leader in multi-disciplinary teams.
- CO5** Provide solutions to complex problems associated with professional ethics using analysis and interpretation.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	2	2	2	2	-	-	-
CO2	2	3	2	-	2	2	2	2	2	-	-	-
CO3	2	-	3	-	2	2	2	2	2	-	-	-
CO4	2	-	-	-	-	2	2	2	2	-	3	-
CO5	2	2	3	2	-	3	2	2	2	-	-	-
Course Correlation Mapping	2	3	3	2	2	2	2	2	2	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: PROFESSIONAL ETHICS

(06 Periods)

Scope and aim of ethics, Senses of ethics, Variety of moral issues, Types of inquiry, Moral dilemmas, Moral autonomy-Kohlberg's theory, Gilligan's theory, Consensus, and controversy.

Module 2: PROFESSIONAL IDEALS AND VIRTUES

(06 Periods)

Theories on virtues and ideals, Professions, Professionalism, Characteristics, Expectations, Professional responsibility, Integrity, Self-respect, Sense of responsibility, Self-interest, Customs and religion, Self-interest and ethical egoism, Customs and ethical relativism, Religion and divine command ethics, Use of ethical theories, Resolving moral dilemmas and moral leadership.

Module 3: SOCIAL EXPERIMENTATION

(06 Periods)

Experimentation, Similarities to standard experiments, Learning from the past and knowledge gained, responsible experimenters, Conscientiousness, Moral autonomy and accountability, The challenger case, Codes of ethics and limitations, Industrial standards and Problems with the law of engineering.

Module 4: RESPONSIBILITIES AND RIGHTS

(06 Periods)

Collegiality and loyalty, Respect for authority, Collective bargaining, Confidentiality, Conflict of interests, Occupational crime, Rights of engineers, Professional rights, Whistle-blowing, The BART case, Employee rights, and discrimination.

Module 5: HARMONY WITH PROFESSIONAL ETHICS

(06 Periods)

Acceptance of human values; Ethical Human Conduct; Basis for Humanistic Education, Constitution, and Universal Order; Competence in professional ethics; Case studies: Holistic technologies, Management Models and Production Systems; Transition from the present state to Universal Human Order: socially and ecologically responsible engineers, technologists and managers - enriching institutions and organizations.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Demonstrate orally using your experiences of what is naturally acceptable in a relationship – Feeling of respect or disrespect and what is naturally acceptable is to nurture or exploit others.
2. Identify community partners and discuss with a community partner or organization. Prepare a report by identifying and analysing the issues or opportunities.
3. Field experiences may be directed to include a range of time-intensive endeavours that require varying levels of student interaction. Prepare a report on visiting a Juvenile home.
4. Students read a speech in the classroom by former United Nations Secretary-General Kofi Annan on human values.
5. Students are encouraged to bring a daily newspaper to class or to access any news related to the need for human values and note down the points.

6. Bring out the relevance of engineering ethics theory and practice with relevance to current trends.
7. Professional ideals and virtues are important to everyone. Prepare a case study on the professional ideals and virtue of any one of the famous sports personalities from India.
8. Compare the present to the past in engineering experimentations concerning the change in professionalism.
9. Make a study on occupational crime and the role of modern technology in finding solutions.
10. Prepare a case study on how to maintain harmony with different cultural people using professional ethics.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Gaur R R, Sangal R & G P Bagaria, *Human Values and Professional Ethics*, Excel Books, New Delhi, 2010.
2. Govindarajan, M., Nata Govindarajan, M., Natarajan, S. and Senthilkumar, V. S., *Engineering Ethics*, Prentice Hall of India, 2004.
3. Mike W. Martin and Roland Schinzinger, *Ethics in Engineering*, Tata McGraw-Hill, 3rd Edition, 2007.

REFERENCE BOOKS:

1. S. Kannan and K. Srilakshmi, *Human Values and Professional Ethics*, Taxmann Allied Services Pvt Ltd., 2009.
2. Edmund G. Seebauer and Robert L. Barry, *Fundamental of Ethics for Scientists and Engineers*, Oxford University Press, 2001.
3. Charles F. Fledderman, *Engineering Ethics*, Pearson Education, 2nd Edition, 2004.
4. R. Subramanaian, *Professional Ethics*, Oxford Higher Education, 2013.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=jfGIq_EiXzI
2. <https://www.youtube.com/watch?v=QFH0tH54oUc>
3. <https://www.youtube.com/watch?v=JJshY11nX14>
4. <https://www.youtube.com/watch?v=TyP09S0UEzA>
5. https://www.youtube.com/watch?v=0QMwjV_ZVtc

Web Resources:

1. <https://siiet.ac.in/wp-content/uploads/2020/09/7.1.10-professional-ethics-manual.pdf>
2. <https://soaneemrana.org/onewebmedia/Professional%20Ethics%20and%20Human%20Values%20by%20R.S%20AAGARAZAN.pdf>
3. <https://india.oup.com/productPage/5591038/7421214/9780199475070>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CE107601	ENVIRONMENTAL SCIENCE	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on natural resources, ecosystems, biodiversity, environment pollution and control, social issues and environment, human population and environment.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze natural resources to solve complex environmental problems and natural resource management considering society, environment and sustainability.
- CO2** Analyze ecosystems and biodiversity to solve complex environmental problems by following environmental ethics considering society, environment and sustainability besides communicating effectively in graphical form.
- CO3** Analyze various types of pollution and their control measures to solve environmental problems through appropriate tools and techniques following latest developments considering society, ethics, environment and sustainability.
- CO4** Analyze social issues and its impact on environment, environmental acts to solve complex environmental problems considering society, environment and sustainability besides communicating effectively in graphical form.
- CO5** Analyze human population and its impact on environment to solve complex environmental problems through team work and using appropriate tools and techniques considering ethics, society, environment and sustainability.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	-	1	1	-	-	-	1	-
CO2	3	3	-	2	-	1	1	1	-	1	-	-
CO3	3	3	-	2	1	1	1	1	-	-	-	1
CO4	3	3	-	3	-	1	1	1	-	1	-	-
CO5	3	3	-	2	1	1	1	1	1	-	-	-
Course Correlation Mapping	3	3	-	3	1	1	1	1	1	1	1	1

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: NATURAL RESOURCES

(07 Periods)

Multidisciplinary nature of environment; Natural Resources: Renewable and non-renewable resources; Forest, Water, Mineral, Food and Energy resources -Causes, Effects, Remedies, Case studies; Role of an individual in conservation of natural resource and equitable use of resources for sustainable lifestyles.

Module 2: ECOSYSTEMS AND BIODIVERSITY

(07 Periods)

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem - Producers, Consumers, Decomposers; Food chains, Food webs, Ecological pyramids - Types; Characteristic features, Structure and functions of forest ecosystem, Desert ecosystem, Aquatic ecosystem.

Biodiversity: Concept and value of biodiversity, Role of biodiversity in addressing new millennium challenges, Hot spots of biodiversity, Threats to biodiversity, Man-wild life conflicts, Endemic, Endangered and extinct species of India, Conservation of biodiversity -In-situ and ex-situ.

Module 3: ENVIRONMENTAL POLLUTION AND CONTROL

(06 Periods)

Causes, Adverse effects and control measures of pollution - Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution, Nuclear pollution, Solid waste management - Urban waste, industrial waste; Latest developments in pollution control, Hazards and disaster management - Floods, Earthquakes, Tsunamis, Case studies.

Module 4: SOCIAL ISSUES AND THE ENVIRONMENT

(06 Periods)

Sustainable development, Urban problems related to energy, Environmental ethics -Issues, Solutions; Global warming, Acid rain, Ozone layer depletion, Nuclear accidents and case studies, Wasteland reclamation, Consumerism and waste products, Concept of green technologies, Environment justice: National Green Tribunal and its importance; Environment protection act, Air act, Water act, Wildlife protection act, Forest conservation act, Issues involved in enforcement of environmental legislation, Public environmental awareness.

Module 5: HUMAN POPULATION AND THE ENVIRONMENT

(04 Periods)

Population growth, Population characteristics and variation among nations, Population explosion, Family welfare programme, 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/Assignment/Seminar on Environmental assets - Water bodies/Forest/Grassland/Hill/Mountain.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Visit a nearby villages and know the status of availability of local resources that can be improved through proper education.
2. Make an awareness program in the villages for the development of natural resources, ecosystems and biodiversity.
3. Prepare a document by visiting a local urban waste dumping yard near to the Tirupatticity.
4. Visit a local village and find a barren land and make the land into a useful land by planting plants or providing the soil and fertilizers required to improve the soil.
5. Visit a local zoological park and identify the species variety and variability.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Anubha Kaushik and Kaushik, C.P., *Perspectives in Environmental Studies*, New Age International (P) Ltd. Publications, 6th Edition, 2018.
2. Erach Barucha, *Environmental Studies*, Orient Blackswan, 3rd Edition, 2021.

REFERENCE BOOKS:

1. Cunningham, W. P. and Cunningham, M. A., *Principles of Environmental Science*, Tata McGraw-Hill Publishing Company, New Delhi, 8th Edition, 2016.
2. Benny Joseph, *Environmental Studies*, Tata McGraw-Hill, 2nd Edition, 2009.
3. Anji Reddy, M., *Text Book of Environmental Science and Technology*, BS Publications, Revised Edition, 2014.
4. Rajagopalan, R., *Environmental Studies*, Oxford University Press, 3rd Edition, 2015.

VIDEO LECTURES:

1. <http://nptel.ac.in/courses/109/104/109104047>
2. <https://www.youtube.com/watch?v=mIPBPG-5dUw>

Web Resources:

1. <https://nptel.ac.in/courses/122102006>
2. <https://www.flame.edu.in/academics/ug/program-structure/major-minor/courses/environmental-studies>
3. https://www.tutorialspoint.com/environmental_studies/environmental_studies_environment.htm

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CE107602	DISASTER MITIGATION AND MANAGEMENT	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on disasters, earthquakes, floods, cyclones, droughts, landslides and disaster management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze the vulnerability of an area to natural and man-made disasters/hazards as per the guidelines to solve complex problems using appropriate techniques ensuring safety, environment and sustainability.
- CO2** Propose appropriate mitigation strategies for earthquake and tsunami impacts as per code of practice using suitable techniques ensuring safety, environment and sustainability besides communicating effectively in graphical form.
- CO3** Analyze the causes and impacts of floods, cyclones and droughts using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability besides communicating effectively in graphical form.
- CO4** Analyze the causes and impacts of landslides using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.
- CO5** Design disaster management strategies to solve pre, during and post disaster problems using appropriate tools and techniques following the relevant guidelines and latest developments ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	2	2	2	2	-	-	-	-
CO2	3	3	3	3	2	2	1	2	-	2	-	-
CO3	3	3	-	2	2	2	2	-	-	2	-	-
CO4	3	3	-	3	2	2	2	-	-	-	-	-
CO5	3	2	3	2	2	2	1	2	-	1	3	2
Course Correlation Mapping	3	3	3	3	2	2	2	2	-	2	3	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DISASTERS

(06 Periods)

Types of disasters - Natural disasters; Impact of disasters on environment, infrastructure and development; Concepts of hazards and vulnerability analysis, Hazard Assessment, Guidelines for hazard assessment and vulnerability analysis, Basic principles and elements of disaster mitigation.

Module 2: EARTHQUAKES

(06 Periods)

Introduction to earthquake, Intensity scale (MSK-64), Seismic zones and activity in India, Action plan for earthquake disaster preparedness, Elements at risk, Recovery and rehabilitation after earthquake, Concepts of Earthquake resistant design and construction of buildings; Tsunami – Onset, Types and causes, Warning, Elements at risk, Typical effects, Specific preparedness and mitigation strategies, Case studies.

Module 3: FLOODS, CYCLONES AND DROUGHTS

(07 Periods)

Floods and Cyclones: Onset, Types, Causes, Warnings, Elements at risk, Typical effects, Indian floods and cyclones, Hazard zones, Potential for reducing hazards, Mitigation strategies and community based mitigation, Case studies.

Droughts: Onset, Types and warning; Causes, Impact, Early warning and response mechanisms, Mitigation strategies, Droughts in India, Case studies.

Module 4: LANDSLIDES

(06 Periods)

Onset, Types and warning; Causes, Elements at risk, Indian landslides, Hazards zones, Typical effects, Mitigation strategies and community based mitigation, Case studies.

Module 5: DISASTER MANAGEMENT

(05 Periods)

Disaster management organization and methodology, Disaster management cycle, Disaster management in India – Typical cases and Cost-benefit analysis, Disaster management programs implemented by NGOs and Government of India, Usage of GIS and Remote sensing techniques in disaster management, Leadership and Coordination in Disaster management, Emerging trends in disaster management.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Perform hazard assessment and vulnerability analysis for any nearby town/city and prepare a detailed report of possible impacts of various disasters on environment, infrastructure and development.
2. Prepare a detailed report on the causes and effects of Tsunami that was occurred in the year 2004. Also discuss various advancements in Tsunami warning systems.
3. Identify the major causes of urban floods in cities like Chennai, Hyderabad & Mumbai and submit a report along with various mitigation strategies to reduce the impact of floods.
4. Prepare a detailed report on how various man-made activities are directly/indirectly related to the occurrence of landslides that occurred in recent days in India.
5. Visit AP State Disaster Response and Fire Services Department and record about various methods used by them in mitigating disasters and their management.

RESOURCES

TEXT BOOKS:

1. Sharma V. K., *Disaster Management*, Medtech Publishing, 2nd Edition, 2013.
2. Anand S. Arya, Anup Karanth, and Ankush Agarwal, *Hazards, Disasters and Your Community: A Primer for Parliamentarians*, GOI-UNDP Disaster Risk Management Programme, Government of India, National Disaster Management Division, Ministry of Home Affairs, New Delhi, Version 1.0, 2005

REFERENCE BOOKS:

1. Donald Hyndman and David Hyndman, *Natural Hazards and Disasters*, CengageLearning, USA, 5th Edition, 2015.
2. *Disaster Management in India*, A Status Report, Ministry of Home Affairs, Govt. of India, May 2011.
3. Rajendra Kumar Bhandari, *Disaster Education and Management: A Joyride for Students, Teachers, and Disaster Managers*, Springer India, 2014.
4. Singh R. B., *Natural Hazards and Disaster Management*, Rawat Publications, 2009.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/105104183>
2. <https://www.digimat.in/nptel/courses/video/124107010/L01.html>

Web Resources:

1. <https://egyankosh.ac.in/handle/123456789/25093>
2. <https://www.egyankosh.ac.in/handle/123456789/25912>
3. <https://www.nios.ac.in/media/documents/333courseE/12.pdf>
4. <https://ndmindia.mha.gov.in/images/public-awareness/Primer%20for%20Parliamentarians.pdf>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CE107603	RURAL TECHNOLOGY	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on technology for rural development, nonconventional energy, technologies for rural development, community development and it in rural development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Compare various technologies for rural development by solving rural problems through different schemes by considering ethics, society, environment and sustainability.
- CO2** Analyze non-conventional energy sources using appropriate tools and techniques to solve rural energy problems considering society, environment and sustainability besides communicating effectively in graphical form.
- CO3** Select appropriate technologies in different areas of rural development to solve rural issues following latest developments considering society, environment and sustainability.
- CO4** Relate water conservation, health, safety and rural employment issues for community development to solve rural problems through appropriate technologies considering ethics, society, environment and sustainability.
- CO5** Analyze the impact of IT, public and private partnership on rural development to solve complex rural problems using appropriate tools and techniques considering ethics, society, environment and sustainability.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	3	2	1	1	1	-	-	-	-
CO2	2	3	-	2	2	1	1	-	-	1	-	-
CO3	2	3	-	2	2	1	1	-	-	-	-	1
CO4	2	3	-	2	2	1	2	1	-	-	-	-
CO5	2	3	-	3	2	1	1	1		-	-	-
Course Correlation Mapping	2	3	-	3	2	1	2	1	-	1	-	1

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO RURAL DEVELOPMENT

(06 Periods)

India - Technology and rural development, Pre and post-independence period, Rural IndiaLife, Indian farmer, Role of science and technology in rural development, Rural technology and poverty eradication, Rural business hubs, Technology in improving rural infrastructure, Various organizations related to innovation, Issues of technology transfer - CAPART, NABARD, CSIR, NIF.

Module 2: NON CONVENTIONAL ENERGY

(06 Periods)

Definition of energy, Types of alternative sources of energy, Sources of non conventional energy – Solar energy: Solar pump in agriculture, Solar dryer, Solar cooker, Solar heater; Biogas, Recycling and management, Wastes conservation, Assessment and production of biomass products and their utilization.

Module 3: TECHNOLOGIES FOR RURAL DEVELOPMENT

(06 Periods)

Food and agro based technologies, Tissue culture, Nursery, Building and construction technologies, Cultivation and processing of economic plants, Cottage and social industries, Latest developments in rural technologies.

Module 4: COMMUNITY DEVELOPMENT

(06 Periods)

Water conservation, Rain water Harvesting, Drinking water Standards and simple treatments used, Environment and Sanitation, Bio fertilizers, Medical and aromatic plants, Employment generating technologies – Apiculture, Pisciculture, Aquaculture.

Module 5: IT IN RURAL DEVELOPMENT

(06 Periods)

Role of information technology (IT) in rural areas, Impact of IT in rural development, Need and necessity of technology, Corporate social responsibilities, Private sector participation (Activities in different spheres: Employment, Education, Health, Agriculture and service sectors) and Saansad Adarsh Gram Yojana (SAGY), Village adoption schemes.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Visit a nearby village and know the status of small scale industries which are implanted and to be established based on the availability of the local resources.
2. Visit a local village and make an awareness program on energy utilization using biomass products.
3. Make a awareness program in the villages for the rural development in terms of home-made products.
4. Construct rain water harvesting structures in nearby villages where water scarcity is more and prepare a document.
5. Develop a small IT application the village area which will be used for the growth of the village.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Viridi, M. S., *Sustainable Rural Technologies*, Daya Publishing House, 2nd Edition 2018.
2. Prabhath, S. V. and P. Ch. Sita Devi, *Technology and Rural India*, Serials Publications, 1st Edition, 2012.

REFERENCE BOOKS:

1. Chakravarthy, R., and Murthy, P. R. S., *Information Technology and Rural Development*, PacificBook International, 1st Edition, 2012.
2. Shivakanth Singh, *Rural Development Policies and Programmes*, Northern Book Centre, 1st Edition, 2002.
3. Katar Singh, and Anil Shishodia, *Rural Development: Principles, Policies, and Management*, SAGE Publications India Private Limited, 4th Edition, 2016.
4. Vinayak Reddy, A. and Yadagira Charyulu, M., *Rural Development in India: Policies & Initiatives*, New Century Publications, 1st Edition, 2008.

VIDEO LECTURES:

1. <http://nptel.ac.in/courses/109/104/109104047>
2. https://www.youtube.com/channel/UCEZxAQu3ZBuIN-pYMYO2i_A/videos
3. <https://www.youtube.com/watch?v=HnrIB-QmvlQ>

Web Resources:

1. en.wikibooks.org/wiki/Technologies_for_Rural_Development/Complete
2. <https://www.oecd-ilibrary.org/sites/ae6bf9cd-en/index.html?itemId=/content/component/ae6bf9cd-en>
3. <https://crdt.iitd.ac.in/>

SCHOOL CORE

Course Code

22LG107603

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

Course Title

SPOKEN ENGLISH

L T P S C

- 1 2 - 2

COURSE DESCRIPTION: This course deals with the development of fluency and intelligibility in spoken English. Through individual and group activities, students work on improving pronunciation, practicing conversation strategies, and delivering oral presentations.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Demonstrate knowledge of functional English for effective communication.

CO2 Analyze different types of vocabulary for fluency in communication

CO3 Apply correct usage of English grammar in writing and speaking.

CO4 Apply speaking strategies in terms of usage of English with accuracy, appropriacy, and fluency.

CO5 Analyze techniques to use communication skills for effective presentation.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	2	-	3	-	-	-
CO2	2	3	-	-	-	-	2	-	3	-	-	-
CO3	2	-	3	-	3	-	2	-	3	-	-	-
CO4	2	-	-	-	3	-	2	-	3	-	-	-
CO5	2	3	2	-	3	-	2	-	3	-	-	-
Course Correlation Mapping	2	3	3	-	3	-	2	-	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FUNCTIONAL ENGLISH

(06 Periods)

Concepts of Functional Spoken English, Self-Introduction; Listening and Speaking: Do's and Don'ts; Expressions: Ability, Admiration, Agreement, Annoyance, Appreciation, Pleasure, Sarcasm, Satisfaction, Surprise, Approval, Certainty, Doubt, Gratitude, Possibility, Fear, Worry, Condolences; Asking for: Advice, Clarification, Direction, Information, Permission; Making: Predictions, recommendations

Module 2: VOCABULARY BUILDING

(06 Periods)

Vocabulary for day-to-day conversations: Vegetables, Groceries, Fruits, Weather, Parts of a Human body, Dresses, Furniture; Relations: Birds, Cries of Animals, Food, Hospitality, Houses, Rooms, Tools, Airport, News Paper, Books, Gems, Corporate Vocabulary, Jobs, Occupations, Diseases; British and American spelling; Slang Words and Technical Jargons.

Module 3: FUNCTIONAL GRAMMAR – I

(06 Periods)

English Grammar and the Indian Student, Parts of Speech, Verb forms: Tenses, Voice and Speech.

Module 4: FUNCTIONAL GRAMMAR –II

(06 Periods)

Universal Auxiliaries: Sentence Structure, WH Questions, framing of Questions with answers; Question Tags, Subject and verb agreement, Spotting Errors.

Module 5: COMMUNICATION SKILLS:

(06 Periods)

Polite, Courteous and diplomatic expressions, Good manners and Etiquette, Conversation Techniques, Narrating Stories.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Critically analyse the value of Indian money and its impact on the common man and Prepare a PowerPoint Presentation.
2. Prepare a conversation between you and a sanitary officer regarding sanitary conditions in your locality.
3. The English Language has a rich vocabulary and it increases day by day. Present a seminar on the norms adhered to in adding new words and list out the words added in the last five years with their meaning.
4. Enact roleplays in different situations.
5. Participate in group discussions and debate on present issues
6. A conversation is an exchange of ideas, thoughts, and feelings between two or more persons. Explain it with suitable examples
7. Prepare a schedule and identify various committees to be formed for celebrating the Annual Day of a college and explain team involvement in the celebration.

8. Gather various ideas on discussing with parents the role of higher education and job opportunities.
9. Imagine you see a person wasting water. Write a dialogue objecting to such wastage of natural resources.
10. Since social media offers a wide reach easily, it becomes easier for bullies to spread gossip or issue threats. How do you think Cybercrime is a menace brought about by social media?

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG107602	ESSENTIAL LIFE SKILLS FOR HOLISTIC DEVELOPMENT	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course deals with different types of thinking skills, self-awareness, coping with stress and emotion, transformational skills, group and team dynamics, and leadership.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Understand different life skills required in personal and professional life.
- C02** Analyse well-defined techniques to cope with emotions and stress.
- C03** Apply appropriate thinking and problem-solving methods to solve problems.
- C04** Function effectively in a team and as an individual.
- C05** Demonstrate the qualities of an effective leader.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	-	-	-	2	-	2
C02	2	3	-	-	2	-	-	-	-	2	-	2
C03	2	3	-	-	2	-	-	-	-	2	-	2
C04	2	2	-	-	2	-	-	-	3	2	-	2
C05	2	2	-	-	-	-	-	-	-	2	-	3
Course Correlation Mapping	2	3	2	-	2	-	-	-	3	2	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: OVERVIEW OF LIFE SKILLS

(06 Periods)

Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem-solving, Effective Communication, interpersonal relationships, coping with stress, coping with emotion.

Ethics, Moral & Professional Values: Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE.

Module 2: STRESS MANAGEMENT

(06 Periods)

Stress Management: Stress, reasons, and effects, identifying stress, stress diaries, the four A's of stress management, techniques, **Approaches:** action-oriented, emotion-oriented, acceptance oriented, resilience, Gratitude Training, **Coping with emotions:** Identifying and managing emotions, harmful ways of dealing with emotions, PATH method, and relaxation techniques.

Module 3 TRANSFORMATIONAL SKILLS

(06 Periods)

Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.

Module 4 GROUP AND TEAM DYNAMICS

(06 Periods)

Introduction to Groups: Composition, formation, Cycle, thinking, Clarifying expectations, Problem Solving, Consensus, Dynamics techniques, Group vs Team, Team Dynamics, and Virtual Teams. Managing team performance and managing conflicts, Intrapreneurship.

Module 5 LEADERSHIP

(06 Periods)

Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions. Growing as a leader, managing diverse stakeholders, crisis management. Types of Leadership, Traits, Styles, VUCA Leadership, Levels of Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare an attitude test and measure the attitudes of your class.
2. Prepare a Case study on the Campus Interview pressure and stress of students using SWOT analysis.
3. Record and prepare videos of various cultural people and make a comment on their accents.
4. Prepare a short film of a leader of your choice and list out the best qualities.
5. Prepare a presentation on the impact of social media on leadership management.
6. 'Knowledge of present technologies helps us to live a harmonious life.' Make a video to justify the statement.
7. Identify life skills needed in our day-to-day life and explain their importance.
8. Come up with strategies to become successful in professional life.
9. Find methods and solutions to overcome the self-pity of a person.
10. Identify the persons who are irregular to class. Find out their problems and come up with solutions.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Dr. K Alex, "Soft Skills". S Chand & Company Pvt.Ltd.2013.
2. Monmohan Joshi, "Soft Skills". Bookboon.com, First Edition, 2017.

REFERENCE BOOKS:

1. Barun K. Mitra. "Personality Development & Soft Skills", First Edition; Oxford Publishers. 2011.
2. Kalyana. "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd. 2015.
Shalini Verma. "Development of Life Skills and Professional Practice"; First Edition;
3. Sultan Chand (G/L) & Company, 2014.
4. John C. Maxwell. "The 5 Levels of Leadership", Centre Street, A division of Hachette Book Group Inc. 2014.
5. Daniel Goleman, "Emotional Intelligence"; Bantam, 2006.
6. Remesh S., Vishnu R.G. "Life Skills for Engineers", Ridhima Publications, First Edition, 2016.
7. Butterfield Jeff. "Soft Skills for Everyone", Cengage Learning India Pvt Ltd; 1 edition, 2011.
8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India; 6 edition, 2015.
9. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=xM0fajUI7Bg>
2. <https://www.youtube.com/watch?v=HwLK9dBQn0g>
3. <https://www.youtube.com/watch?v=sxX5LoojdJw>
4. <https://www.youtube.com/watch?v=xJBgqW9-lzc>
5. <https://www.youtube.com/watch?v=QVwTVM1Iv1c>

Web Resources:

1. [https://www.clarke.edu/campus-life/health-wellness/counseling/articles- advice/developing-a-positive-attitude/](https://www.clarke.edu/campus-life/health-wellness/counseling/articles-advice/developing-a-positive-attitude/)
2. <https://www.skillsyouneed.com/ps/personal-swot-analysis.html>
3. <https://ecampusontario.pressbooks.pub/profcommsontario/chapter/cross-cultural-communication/>
4. <https://thepeakperformancecenter.com/educational-learning/thinking/#:~:text=There%20are%20several%20core%20thinking,storing%20and%20then%20retrieving%20information.>
5. <https://www.webmd.com/anxiety-panic/guide/stage-fright-performance-anxiety>
6. <https://www.ktunotes.in/ktu-syllabus-life-skills/>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MG107601	INNOVATION, INCUBATION, AND ENTREPRENEURSHIP	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: To sensitize students on the prospects, opportunities, and challenges in entrepreneurship and the potential for value creation from prospective idea

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand the basics of generating new business ideas
- CO2** Explain the concept of design thinking and product innovation.
- CO3** Illustrate the roles of digital technology in entrepreneurship.
- CO4** Understand the need for startup economics and market conditions
- CO5** Evaluate the reasons for successful entrepreneurship.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	-	-	-	-	-	-	-
CO2	1	1	1	-	-	-	-		1			-
CO3	2	2	1	-	-	-	-	1	-	-	2	
CO4	3	1	1	-	-	-	-	-	-	-	-	1
CO5	2	2	-	-	-	1	-	-	-	-	-	1
Course Correlation Mapping	2	2	1	1	-	1	-	1	1	-	2	1

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Introduction

(06 Periods)

Concept & Definition, Taking product or service ideas to creating value: Why should one choose to become an entrepreneur, Entrepreneurial mind-set, Intrapreneurship

Module 2: Product Innovation

(06 Periods)

Product innovation process, engineering design process and the concept of frugal engineering for developing innovative affordable products, effective user-interface.

Module 3: Digital Technology Entrepreneurship

(06 Periods)

Industry 4.0 landscape and innovations using digital technologies like AI, IOT, AR/VR, Cloud, SAAS, User Applications.

Module 4: Startup Economics & Market considerations

(06 Periods)

Economic consideration for starting a venture, Understanding Feasibility analysis, Understanding market, targeting customer and positioning product

Module 5: Successful Business Incubation

(06 Periods)

Business model innovation, Business process management, competitive advantages, Business model canvas, Bootstrapping.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Create and present a prototype of a new product of your choice.
2. Present at least three cases of successful business Ideas in recent times
3. Discuss in the group Entrepreneurship opportunities in terms of Orientation and Development.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Robert D. Hisrich, *Entrepreneurship*,
2. Kuratko & Hodgetts, *Entrepreneurship- Theory, Process & Practice*, Thompson South-Western Publication

REFERENCE BOOKS:

1. Peter Drucker, *Innovation and Entrepreneurship*, Harper Collins
2. Thomas N. Duening, Robert D. Hisrich and Michael A. Lechter, *Technology Entrepreneurship Taking Innovation to the Marketplace*, Elsevier
3. Prof. Nigel Cross, *Bloomsbury Design Thinking Understanding How Designers Think and Work*, 2019 Edition

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_mg63/preview
2. https://onlinecourses.nptel.ac.in/noc22_de08/preview

Web Resources:

1. <https://ciie.iitism.ac.in/files/CIIE-POLICY.pdf>
2. https://www.nios.ac.in/media/documents/249_Enterpreneurship/English_pdf/249_Enterpreneurship_Lesson_16.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22EE107601	INTELLECTUAL PROPERTY RIGHTS	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: The course is designed to provide comprehensive knowledge to the students regarding the general principles of intellectual property rights, Concepts and Theories, Criticisms of Intellectual Property Rights, and International Regime Relating to IPR. The course provides awareness on how to protect one's unique creation, claim ownership, knowledge of what falls under the purview of someone's rights and what doesn't, and safeguard their creations and gain a competitive edge over their peers.

COURSE OUTCOMES: *After successful completion of the course, students will be able to:*

- CO1** Understand the need and the concepts of intellectual property right and avenues for fulfilling intellectual property rights.
- CO2** Understand the legislative practices and protocols for the acquisition of trademarks and the judicial consequences for violating laws of trademark protection.
- CO3** Understand the legislative practices and protocols for the acquisition of copyrights and the judicial consequences for violating laws of copyright protection.
- CO4** Understand the fundamentals of patent laws, legislative practices, and protocols for acquisition of trade secrets and the judicial consequences for violating laws of trade secrets protection.
- CO5** Understand the importance of geographical indications and various laws and protocols for protecting geographical indications.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	1	-	-	3	-	-	-	2
CO3	3	-	-	-	1	-	-	3	-	-	-	2
CO4	3	-	-	-	1	-	-	3	-	-	-	2
CO5	3	-	-	-	1	-	-	3	-	-	-	2
Course Correlation Mapping	3	-	-	-	1	-	-	3	-	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (06 Periods)

Introduction and the need for intellectual property rights (IPR); types of intellectual property- Design; International organizations, agencies, and treaties.

Module 2: TRADEMARKS (06 Periods)

Introduction to trademark, Purpose, and function of trademarks, acquisition of trademark rights, protectable matter, selecting and evaluating trademark, trademark registration processes.

Module 3: LAW OF COPYRIGHTS (06 Periods)

Fundamental of copyright law, originality of material, rights of reproduction, rights to perform the work publicly, copyright ownership issues, copyright registration, a notice of copyright, and international copyright law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

Module 4: TRADESECRETS (06 Periods)

Trade secret law, determination of trade secret status, liability for misappropriations of trade secrets, protection for submission, trade secret litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

Module 5: GEOGRAPHICAL INDICATIONS (06 Periods)

The Geographical indications law in India, The objectives and features, the registry of geographical indications powers and functions. Types of goods offered. Protection: Agriculture goods, manufactured goods, and natural goods. Registration of indications and the requirements. Prohibition of misleading use of indications of geographical origins, prohibition of dilution of geographical origins.

EXPERIENTIAL LEARNING

1. Should conduct a survey based on the real scenario, where IPR is misused or unethically used and present an article.
2. Prepare an article on the registration processes of IPR practically (copy right/trademark/ patents).
3. Should study a case of conflict on trademarks/patents and should produce an article mentioning the circumstances and remedial measures.
4. Prepare an article on the latest development in the international intellectual property rights.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Deborah, E. Bouchoux, *Intellectual property: The law of Trademarks, Copyright, Patents, and Trade Secrets*, Cengage learning, 4th Edition, 2013.
2. Prabuddha Ganguli, *Intellectual property right - Unleashing the knowledge economy*, Tata McGraw Hill Publishing Company Ltd.
3. Marsha Aechols; *Geographical Indications for Food Products*, , Wolters, 2008

REFERENCE BOOKS:

1. Neeraj P., & Khusdeep D. *Intellectual Property Rights*. India, IN: PHI learning Private Limited. 1st Edition 2019.
2. Nithyananda, K V. *Intellectual Property Rights: Protection and Management*. India, IN: Cengage Learning India Private Limited. 2019

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/110105139>

Web Resources:

1. Subramanian, N., & Sundararaman, M. (2018). *Intellectual Property Rights – An Overview*. Retrieved from <http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf>
2. World Intellectual Property Organization. (2004). *WIPO Intellectual property Handbook*. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf
3. Cell for IPR Promotion and Management (<http://cipam.gov.in/>)
4. World Intellectual Property Organization (<https://www.wipo.int/about-ip/en/>)
5. Office of the Controller General of Patents, Designs & Trademarks (<http://www.ipindia.nic.in/>)

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22EE107602	FUNDAMENTALS OF RESEARCH METHODOLOGY	2	-	-	-	2
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: The course is developed for the students to understand the underlying concepts of research methodology and a systematic approach for carrying out research in the domain of interest. The course is emphasized on developing skills to recognize and reflect on the strength and limitations of different types of research; data collection methods, and methods of Processing and analyzing data. The course also emphasizes interpreting the findings and research articulating skills.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Understands the underlying concepts of research methodology, types of research and the systematic research process.
- C02** Understand the philosophy of research design, types of research design and develop skills for a good research design.
- C03** Understand the philosophy of formulation of a research problem, methods of data collection, review of literature and formulation of working hypothesis.
- C04** Understand various data processing and analyzing techniques and their significance in the research.
- C05** Develop skills to interpret the findings and research articulating skills along with the ethics of research.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	-	-	-	-	-	-
C02	3	-	1	-	-	-	-	-	-	-	-	-
C03	3	-	-	-	2	1	-	-	-	-	-	-
C04	3	2	-	-	3	1	-	-	-	-	-	-
C05	3	-	-	-	-	-	-	-	3	3	-	-
Course Correlation Mapping	3	2	1	-	3	1	-	-	3	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO RESEARCH METHODOLOGY (06 Periods)

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research and Scientific Method, Research Process, Criteria of Good Research.

Module 2: RESEARCH DESIGN (06 Periods)

Research design—Basic Principles, Need of research design, Features of good design, Important concepts relating to research design, Different research designs, Basic principles of experimental designs, Developing a research plan.

Module 3: RESEARCH FORMULATION (06 Periods)

Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Data collection – Primary and secondary sources; Critical literature review – Identifying gap areas from literature review, Development of working hypothesis.

Module 4: PROCESSING AND ANALYSIS OF DATA (06 Periods)

Processing Operations, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Relationship, Simple Regression Analysis.

Module 5: INTERPRETATION AND REPORT WRITING (06 Periods)

Interpretation: Meaning of interpretation; Techniques of interpretation; Precautions in Interpretation.

Report Writing: Significance, Different Steps, Layout, Types of reports, Mechanics of Writing a Research Report, Precautions in Writing Reports.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Should conduct a survey based on a hypothesis, analyze the data collected and draw inferences from the data.
2. Should review the literature on the given topic and should identify the scope/gaps in the literature and develop a research hypothesis.
3. Should study a case, formulate the hypothesis and identify an appropriate testing technique for the hypothesis.
4. Study an article and submit a report on the inferences and should interpret the findings of the article.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. C.R. Kothari, *Research Methodology: Methods and Techniques*, New Age International Publishers, 2nd revised edition, New Delhi, 2004.
2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. *An introduction to Research Methodology*, RBSA Publishers.

REFERENCE BOOKS:

1. R. Panneerselvam, *Research Methodology*, PHI learning Pvt. Ltd., 2009.
2. Singh, Yogesh Kumar. *Fundamental of research methodology and statistics*. New Age International, 2006.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/121106007>
2. https://onlinecourses.nptel.ac.in/noc22_ge08/preview
3. <https://www.youtube.com/watch?v=VK-rnA3-41c>

Web Resources:

1. <https://www.scribbr.com/category/methodology/>
2. <https://leverageedu.com/blog/research-design/>
3. <https://prothesiswriter.com/blog/how-to-formulate-research-problem>
4. <https://www.formpl.us/blog/hypothesis-testing>
5. <https://www.datapine.com/blog/data-interpretation-methods-benefits-problems/>
6. <https://leverageedu.com/blog/report-writing/>

PROGRAM CORE

Course Code

Course Title

L T P S C

22CS102002

PYTHON PROGRAMMING

3 - 2 - 4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Basics of Python programming, Control structures, Sequences, Sets, Dictionaries, Regular expressions, Functions, File handling, Object-oriented programming, Exception handling.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate knowledge on Python constructs, sequences, sets and dictionaries to solve basic computational problems
- CO2** Apply the concepts of regular expressions for searching patterns in strings
- CO3** Develop and use Python modules to provide solutions to problems
- CO4** Apply the knowledge of file operations in Python for file processing
- CO5** Design applications using object-oriented programming features – encapsulation, inheritance, polymorphism and exception handling
- CO6** Work independently to solve problems with effective communication

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	-	-	-
CO4	3	2	2	2	3	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	-	-	-
CO6	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	3	3	-	-	3	3	-	-	-	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO PYTHON PROGRAMMING

(07 Periods)

Introduction to Python, Tokens, Variables, Literals, Identifiers, Keywords, Special symbols, Operators, Fundamental datatypes, Expressions, Type conversions, Handling Input and output in Python.

Module 2: CONTROL STRUCTURES

(08 Periods)

Selection Statements: if statement, if-else statement, if-elif-else statement, nested-if statement.

Iterative Statements: while loop, for loop, break statement, continue statement, pass and else statements used with loops.

Module 3: SEQUENCES, SETS, DICTIONARIES AND REGULAR EXPRESSIONS

(11 Periods)

Sequences: Lists and operations – Creating, Inserting elements, Updating elements, Deleting elements, Searching and sorting, List comprehensions, Nested lists; Tuples – Creating, Searching and sorting, Nested tuples; Strings – Initializing a string and string operations, String handling methods, String formatting.

Sets: Set creation, Set operations.

Dictionaries: Operations on dictionaries, Dictionary methods, Sorting elements using lambdas.

Regular Expressions: Regular expressions, Sequence characters in regular expressions, Quantifiers in regular expressions, Special characters in regular expressions.

Module 4: FUNCTIONS AND FILE HANDLING

(09 Periods)

Functions: Need for functions, Function definition, Function call, Variable scope and lifetime, Return statement, Positional arguments, Keyword arguments, Default arguments and variable length arguments, Recursive functions, Lambda functions, Generators.

File Handling: Types of files, Opening and closing files, Reading and writing data.

Module 5: OBJECT ORIENTED PROGRAMMING AND EXCEPTION HANDLING

(10 Periods)

Object Oriented Programming: Introduction to object-oriented programming, Classes and objects, Inheritance and polymorphism, Abstract Classes and interfaces.

Exception Handling: Errors in a python program, Exceptions, Exception handling, Types of exceptions, Except block, Assert statement, User defined exceptions.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

Design a python script to perform the various computations for the amount payable by the customer for Challenger Computers Store. A customer buying two numbers of SSD device, one SSD device cost is Rs. 3575/-. The stores offer 15% of the total cost. The customer has to pay 9% CGST, and 9% SGST. Prepare the Net Amount to be payable by the customer.

Design a python script to compute and generate the electricity bill as per the following slab rates. Collect the meter reading inputs, such as current unit and previous unit.

Consumption Units	Rate (in Rupees/Unit)
0-200	3.0
201-250	4.5
251-300	5.2
301-400	6.5
Above 400	7.0

Design a python script to display the sum of numbers divisible by 4. The code must allow the user to accept a number and add it to the sum if it is divisible by 4. It should repeatedly accept numbers as long as the user wants to provide an input using an appropriate iterative statement and should display the final sum.

Food Corner home delivers vegetarian and non-vegetarian combos to its customer based on order. A vegetarian combo costs Rs.120 per plate and a non-vegetarian combo costs Rs.150 per plate. Their non-veg combo is really famous that they get more orders for their non-vegetarian combo than the vegetarian combo.

Apart from the cost per plate of food, customers are also charged for home delivery based on the distance in kms from the restaurant to the delivery point. The delivery charges are as mentioned below:

Distance in kms	Delivery charge in Rs per km
For first 3kms	0
For next 3kms	3
For the remaining	6

Given the type of food, quantity (no. of plates) and the distance in kms from the restaurant to the delivery point, write a python program to calculate the final bill amount to be paid by a customer. The below information must be used to check the validity of the data provided by the customer.

- Type of food must be 'V' for vegetarian and 'N' for non-vegetarian.
- Distance in kms must be greater than 0.
- Quantity ordered should be minimum 1.
- If any of the input is invalid, bill amount should be considered as -1.

- a) A list has the AP City Names [Tirupati, Kurnool, Kadapa]. Design a python script and perform the operations like, add 3 more AP City names Chittoor, Nellore, Guntur, insert Hyderabad in 3rd position, delete any two city names, update all city names as in Uppercase. Displays the list data, whenever an operation completes.
- b) Design a python script for given an integer tuple, for each element in the tuple, check whether there exists a smaller element on the next immediate position of the tuple. If it exists print the smaller element. If there is no smaller element on the immediate next to the element then print -1.

Example: Input: 4 2 1 5 3 Output: 2 1 -1 3 -1

- a) Sets n1 has the data {1, 3, 5, 7, 9}, n2 has the data {9, 5, 6, 8},
wd1=set(["Mon", "Tue", "Wed", "Thu", "Fri", "Sat", "Sun"]),
wd2=set(["Mon", "Tue", "Wed"]).
Design a python script to perform intersection, difference, and symmetric difference operations on the sets n1 and n2, and to perform superset, and subset operations on the sets wd1, and wd2.
- b) The dictionary city_pin has the data {'Tirupati': 517101, 'Hyderabad': 500002, 'Chittoor': 517001, 'Nellore': 524001}. Design a python script using lambda function to sort the dictionary on city name and produce the output and sort the dictionary on pincode and produce the output.

- c) The string has the data, Wel_str = "Welcome to AI ML DS". Design a python script to search the pattern "AI" using regular expression search and display the three location numbers of the pattern. First shows the pattern starts location, second shows the pattern end location, and the last shows pattern span locations.
- a) Design a python script for the mathematical puzzle, Towers of Hanoi. The puzzle has three rods and n disks. To move the entire stack to another rod, obeying the three rules (i) Only one disk can be moved at a time, (ii) Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack i.e., a disk can only be moved if it is the uppermost disk on a stack, (iii) No disk may be placed on top of a smaller disk.
- b) Design a python script to display the numbers that do not appear in the Fibonacci series of n numbers where n is given by the user. (If n is 8 then up to 8 Fibonacci numbers has to be printed Ex: 1 1 2 3 5 8 13 21 and in this series missing numbers should be traced and printed, Ex: missing numbers are: 4 6 7 9 10 11 12 14 15 16 17 18 19.
- a) Design a function Learner_Age_Days with two formal parameters name, age and it computes Learner's age in days, then displays learners name and age in days.
- (i) Design a driver code to call the function using positional arguments, keyword arguments
- (ii) Apply the necessary changes in Learner_Age_Days function, and design a driver code to call the function using default arguments.
- b) Design a python script using lambda and filter functions to construct an odd numbers list from numbers 1 to 10, and construct a negative numbers list from range of numbers -7 to 7 and to find the biggest number from a numbers list.
- a) Design a python script to create a new file Collect_Literals_Python.txt, collect the data from the keyboard about the contents of collection literals list, tuple, sets, dictionaries details, then write all the data into that file, and then close that file. Afterwards Open the Collect_Literals_Python.txt file in read mode, read the entire contents of the file Collect_Literals_Python.txt, then display all the contents of that file in monitor.
- b) The file feat_python1.txt has the contents of features of the Python programming language. Design a python script to open that file feat_python1.txt in read mode, open the new file in feat_python2.txt in write mode, then read entire contents of the file feat_python1.txt, then copy all the contents of that file into the new file feat_python2.txt
- a) Construct a Python script to implement the below requirements. Create a base class Basic_Info with data members name, rollno, gender and two member functions getdata() and display(). Derive a class Physical_Fit from Basic_Info which has data members height and weight and member functions getdata() and display(). Display all the information using object of derived class.
- b) Design a Python script to implement the below specifications, compute, and produce required output. Define a class REPORT with the following specification

Private members

Admno : 4-digit admission number
 Name : 20 characters
 Marks : A list of 5 floating point values
 Average : average marks obtained
 GETAVG() a function to compute the average obtained in five subjects.

Public members

READINFO() function to accept values for Adno, Name, Marks. Invoke the function GETAVG ().
 DISPLAYINFO() function to display all data members of report on the screen. You should give function definitions. Write driver code to demonstrate all the functions.

- a) The below scenarios will create Logical Error/Exception, and it will forcibly stop the execution in middle of the program. Design a Python Script the to handle these operations exceptions effectively, and avoid to stop the script execution in the middle.
- i. The variable num has the data 100, the value of num dividing by the value 0.
- ii. To importing a library file matheqn, this library file not available in Python.
- iii. A num_List has the values[10,20,30].To print the fifth value of num_List[5]
- iv. A dictionary has the data, Dict_Univ = {'1':"MBU", '2':"Tirupathi", '3':"CSE"}. to print the fifth key value Dict_Univ[5]

- b) Design a python script to collect the 10 students Python course mark. Check that entered mark is negative, then throw a user defined exception called Negative, otherwise store into the mark in the List Python_mark[].

RESOURCES

TEXT BOOKS:

1. R. Nageswara Rao, *Core Python Programming*, 3rd Edition, Dreamtech Press, 2021.
2. Paul J. Deitel, Harvey Deitel, *Python for Programmers with Big Data and Artificial Intelligence Case Studies*, Pearson, 2019.

REFERENCE BOOKS:

1. Charles Dierbach, *Introduction to Computer Science using Python: A Computational Problem Solving Focus*, Wiley India, 2016.
2. Christian Hil, *Learning Scientific Programming with Python*, 2nd Edition, Cambridge University Press, 2020.

SOFTWARE/TOOLS:

1. Python 3.10
2. Jupyter Notebook/JupyterLab/IDLE/Google CoLab

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc19_cs41/preview
2. <https://www.coursera.org/specializations/python>
3. <https://www.coursera.org/learn/python-for-applied-data-science-ai>
4. <https://www.youtube.com/watch?v=WGJJIrtnfpk>
5. https://www.youtube.com/watch?v=_uQrJ0TkZlc
6. <https://www.udemy.com/topic/python/>
7. <https://freevideolectures.com/course/2512/python-programming>

WEB RESOURCES:

1. <https://www.w3schools.com/python/>
2. <https://www.programiz.com/python-programming>
3. <https://www.geeksforgeeks.org/python-programming-language/>
4. <https://www.javatpoint.com/python-lists>
5. <https://www.learnpython.org/>

PROGRAM CORE

Course Code

22EE102403

Course Title

NETWORK ANALYSIS

L T P S C

3 - 2 - 4

Pre-Requisite Fundamentals of Electrical Engineering.

Anti-Requisite Electrical Circuits; Signals and Networks.

Co-Requisite -

COURSE DESCRIPTION: This course is designed to provide an overview on Networks and their analysing techniques. The course provides a deep insight and hands-on experience on the various concepts such as network analysis using network theorems, analysis of poly phase circuits, analysis of two-port networks and transients. The course also emphasis on design and analysis aspects of passive filters.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze electrical circuits, by applying network theorems and determine variouselectrical quantities.
- CO2** Analyze 3-phase circuits, to determine various electrical quantities and assert the relation between the circuit variables.
- CO3** Analyze network parameters of an isolated and interconnected two-port networks.
- CO4** Analyze transient behaviour of DC & AC circuits by using time domain approach and Laplace transform methods.
- CO5** Design an appropriate filter network for the given specifications.
- CO6** Work independently or in teams to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	3	-	-	-	-	-	-	-	2	-	-
CO2	3	3	-	1	1	-	-	-	-	-	-	-	-	-	-
CO3	3	3	1	1	-	1	-	-	-	-	-	-	2	-	-
CO4	3	3	1	1	3	1	-	-	-	-	-	-	2	-	-
CO5	3	3	3	1	-	2	-	-	-	-	-	-	2	-	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	2	-	-
Course Correlation Mapping	3	3	2	1	3	1	-	-	3	3	-	-	2	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: NETWORK THEOREMS

(11 Periods)

Superposition, Thevenin's, Norton's, Maximum power transfer, Millmann's and Reciprocity theorems for DC & AC Excitations (without proof).

Module 2: POLY-PHASE CIRCUITS

(07 Periods)

Advantages of poly-phase system; Analysis of three phase balanced and unbalanced systems; Measurement of active and reactive power in balanced and unbalanced systems-single wattmeter and two wattmeter methods.

Module 3: TWO-PORT NETWORKS

(09 Periods)

Network Functions - Driving point and transfer functions; Impedance parameters, admittance parameters, transmission (ABCD) parameters, hybrid parameters; conditions for reciprocity and symmetry; conversion of one parameter to another; interconnection of two-port networks in series, parallel and cascaded configurations.

Module 4: TRANSIENT ANALYSIS

(09 Periods)

Transient response of RL, RC and RLC for DC excitation and Sinusoidal excitation -Solution by using Differential equation and Laplace Transform methods.

Module 5: PASSIVE FILTERS

(09 Periods)

Classification of filters, filter networks; Analysis of filter networks - attenuation, phase shift, characteristic impedance in pass band and stop band, constant-K low pass and high pass filters, m-derived filters; Design of filters.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

Pre-Lab: *Demonstration of bread board and connections, component identification, Meters for measurement of electrical quantities.*

1. Verification of Superposition theorem.
2. Verification of Thevinan's and Nortorn's theorem.
3. Verification of Maximum power transfer theorem for DC and AC excitations.
4. Verification of Reciprocity theorem.
5. Measurement of active and reactive power in three phase circuits.
6. Measurement of reactive power using single wattmeter in three phase circuits.

Perform the Experiments using simulation tools

Pre-lab: *Demonstrate the fundamentals of MATLAB and SIMULINK tool box*

1. Determine Two-port network parameters for an isolated network.
2. Determine Two-port network parameters for an interconnected two two-portnetworks.

3. Design a RL and RC transient circuits for a specified time constant, for timer circuit applications.
4. Obtain transient response of a RLC circuit.
5. Design of Low pass filters for a given specifications.
6. Design of High pass filters for a given specifications.

RESOURCES

TEXT BOOKS:

1. Charles K. Alexander, Mathew N O Sadiku, *Fundamentals of Electric Circuits*, McGraw Hill Education (India) Private Limited, New Delhi, 5th Edition, 2013.
2. A. Sudhakar, Shyammoan S Palli, *Circuits and Networks Analysis and Synthesis*, McGraw Hill Education (India) Private Limited, New Delhi, 5th Edition, 2015.

REFERENCE BOOKS:

1. J.A.Edminister, M.D.Nahvi, *Theory and Problems of Electric Circuits*, Schaum's outline series, McGraw Hill, New Delhi, 4th Edition, 2004.
2. W H Hayt, J E Kemmerly, S M Durbin, *Engineering Circuit Analysis*, McGrawHill, New Delhi, 6th Edition, 2008.

SOFTWARE/TOOLS:

1. MATLAB

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/117106108/>
2. <https://nptel.ac.in/courses/108105159>

Web Resources:

1. <https://ocw.mit.edu/high-school/physics/exam-prep/electric-circuits/>
2. <https://circuitglobe.com/what-is-a-polyphase-system.html>
3. <https://khitguntur.ac.in/shmat/NA%20Unit-5%20%20TWO%20PORT%20NETWORK.pdf>
4. http://tuttle.merc.iastate.edu/ee201/topics/capacitors_inductors/RLC_transients.pdf
5. <https://www.electronics-tutorials.ws/category/filter/page/2>

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22EC102001	SEMICONDUCTOR DEVICES & CIRCUITS	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion and hands on experience on semiconductor devices like transistors, MOSFETs and their applications like amplifiers and oscillators.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand the operation of various semiconductor diodes.
- CO2** Analyze the applications of semiconductor diodes.
- CO3** Analyze various configurations and biasing techniques for BJT and FET.
- CO4** Design various Oscillators for desired specifications.
- CO5** Work independently and in teams to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	1	-	-	-	-	3	-	-
CO2	3	3	1	1	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	3	1	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-	3	-	-
Course Correlation Mapping	3	3	2	1	-	-	-	1	3	3	-	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: SEMICONDUCTOR DIODES

(08 Periods)

Introduction, Semiconductor diodes, ideal versus practical diodes, resistance levels, Diode equivalent circuits, transition and diffusion capacitance, reverse recovery time, diode specification sheet, zener diode, Light Emitting diode, Tunnel diode, schottky diode, varicap diode.

Module 2: DIODE CIRCUITS

(10 Periods)

Introduction, Series Diode configuration, Parallel and series-parallel configurations, Half-wave & Full wave rectifier, Clippers, Clampers, Zener Diode as voltage regulator, Problems.

Module 3: BIPOLAR JUNCTION TRANSISTOR

(10 Periods)

Introduction, Transistor construction, Operation, Common-base configuration, Transistor as an amplifier, Common-Emitter configuration, Common collector configuration, Operating point, Fixed biased configuration, Emitter-bias configuration, Voltage divider bias configuration, Collector feedback configuration, compensation Techniques, Problems.

Module 4: FIELD-EFFECT TRANSISTORS

(10 Periods)

JFET -construction, operation and characteristics, MOSFET - Device Structure and Physical Operation, Current-Voltage Characteristics, The MOSFET as an Amplifier and as a Switch, Biasing in MOS Amplifier Circuits, Small-Signal Operation and Models, The Depletion-Type MOSFET.

Module 5: OSCILLATORS

(07 Periods)

Introduction, Feedback Oscillators, Oscillation with RC Feedback Circuits, Wien Bridge Oscillator, Phase Shift Oscillator, Oscillation with LC Feedback Circuits, crystal oscillator.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Verification of switching action of a PN junction diode with V-I characteristics.
2. Rectify the AC signal and then to find out Ripple factor and percentage of Regulation in Half wave/Full wave rectifier with and without Capacitor filter.
3. Verify input and output characteristics of transistor in common base and common emitter configurations.
4. Study and draw the Drain and Transfer Characteristics of a JFET.
5. Design and analyze any biasing circuit using BJT.
6. Study the characteristics of an emitter follower circuit.
7. Design RC integrator and differentiator and determine their response to the square input.
8. Develop clipper circuit to clip positive and negative portions of the input waveform with two reference voltages.

9. Develop clamping circuits to clamp different positive and negative dc levels of the input signal.
10. Design and Verification of RC and LC Oscillators.
11. Study and experimental verification of MOSFET Transfer characteristics (with depletion and enhancement mode)

RESOURCES

TEXT BOOKS:

1. Millman & Halkias, *Integrated Electronics*, McGraw Hill Publications, 1992.
2. Boylestad & Nashlesky, *Electronic Devices & Circuit Theory*, PHI, 10th Edition.
3. Albert Malvino & David J. Bates, *Electronic Principles*, Tata McGraw Hill, 7th Edition 2007.

REFERENCE BOOKS:

1. Sedra, Smith, *Microelectronic Circuits*, Oxford University Press, 5th Edition, 2004.
2. David A. Bell, *Electronic Devices and Circuits*, Prentice Hall of India Private Limited, New Delhi, 2007.
3. Paul Horowitz and Winfield Hill, *The art of electronics*, Cambridge university press, 3rd Edition, 2011.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/108108112>
2. <https://www.coursera.org/specializations/semiconductor-devices>

Web Resources:

1. www.electronic_circuits.com
2. www.circuitstoday.com

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CS102032	PROBLEM SOLVING THROUGH JAVA	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	Object Oriented Programming Through Java					
Co-Requisite	-					

COURSE DESCRIPTION: This course introduces object-oriented programming using Java. It covers Java fundamentals, including platform independence, data types, control structures, and the principles of object-oriented programming. The course also explores the Java Collection Framework to develop efficient and reusable code using lists, sets, and maps.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1. Demonstrate** knowledge of Java fundamentals, including OOP principles, JVM architecture, data types, control structures, and program structure.
- CO2. Apply** concepts of classes, objects, constructors, method overloading, and access control to develop modular and reusable Java programs.
- CO3. Develop** object-oriented applications using inheritance, interfaces, abstract classes, and packages to promote code extensibility and reusability.
- CO4.** Design reliable solutions using exception handling and multithreading techniques to build robust and concurrent Java applications.
- CO5. Utilize** the Java Collection Framework and file handling APIs to store, manipulate, and persist data efficiently in real-world applications.
- CO6.** Work independently to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	2	2	3	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	3	3	-	-	3	3	-	-	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO JAVA AND OOPS FUNDAMENTALS (12 Periods)

Features of Java, Platform independence, JVM, JRE, JDK, Bytecode, Java program structure, OOP principles, Data types, Variables, Scope and life time of variables, Operators, Control statements, Type conversion and casting, Arrays. Concepts Of Classes And Objects: Introducing methods, Method overloading, Constructors, Constructor overloading, Usage of static with data and method, Access control, this key word, Garbage collection, String class, StringTokenizer, Introduction of Debugging tools such as GDB and online IDEs

Module 2: INHERITANCE, INTERFACE AND PACKAGES (9 Periods)

Inheritance basics, Types of inheritance, Member access rules, Usage of super key word, Method overriding, Usage of final, Abstract classes, Interfaces - differences between abstract classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces; Packages - defining, creating and accessing a package, importing packages, access control in packages.

Module 4: EXCEPTION HANDLING AND MULTITHREADING (8 Periods)

Exception Handling: Concepts of exception handling, Types of exceptions, Usage of try, catch, throw, throws and finally keywords, Built-in exceptions, Creating user defined exception; Multithreading: Concepts of multithreading, Differences between process and thread, Thread life cycle, Creating multiple threads using Thread class and Runnable interface, Synchronization, Thread priorities, Inter thread communication.

Module 3: COLLECTION FRAMEWORK (8 Periods)

Collection Framework: Collections Overview, Collection Interfaces - List, Set, Map, List - ArrayList, Linked List, Vector, Set - HashSet, TreeSet, Map - HashMap, Accessing a collection via an Iterator, comparator, comparable.

Module 5: FILE HANDLING IN JAVA (8 Periods)

Java IO classes and packages, Byte streams vs character streams, Reading with FileReader, BufferedReader, Scanner, Writing with FileWriter, BufferedWriter, Handling IOExceptions, Try-with-resources, File class for existence check, Creating, Deleting, Listing files and directories.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

(All source code should be maintained and version-controlled on GitHub)

1) INTRODUCTION TO JAVA AND OOPS FUNDAMENTALS

Leetcode: #342. Power of Four

Given an integer n , return *true* if it is a power of four. Otherwise, return *false*.
An integer n is a power of four, if there exists an integer x such that $n == 4^x$.

Example 1:

Input: $n = 16$

Output: true

Example 2:

Input: $n = 5$

Output: false

Example 3:

Input: $n = 1$

Output: true

Constraints:

- $-2^{31} \leq n \leq 2^{31} - 1$

✓ This problem enhances mathematical reasoning by exploring the concept of exponential patterns specific to base 4. It helps learners distinguish between powers of 2 and powers of 4 using both mathematical checks and bitwise operations.

2) **INTRODUCTION TO JAVA AND OOPS FUNDAMENTALS**

Leetcode: [#258. Add Digits](#)

Given an integer num, repeatedly add all its digits until the result has only one digit, and return it.

Example 1:

Input: num = 38

Output: 2

Explanation: The process is

38 --> 3 + 8 --> 11

11 --> 1 + 1 --> 2

Since 2 has only one digit, return it.

Example 2:

Input: num = 0

Output: 0

Constraints:

- $0 \leq \text{num} \leq 2^{31} - 1$

✓ This problem strengthens understanding of digit manipulation and recursive logic. It introduces students to mathematical optimization using the concept of digital root. Such problems improve reasoning for numerical pattern questions often seen in coding interviews.

3) **INHERITANCE, INTERFACE AND PACKAGES**

The university wants to maintain basic details of students along with specific information about graduate students. The base class, Student, holds general information about all students, while the derived class GraduateStudent adds specific information relevant to graduate students.

Program Specifications:

- **Create a class named Student** to store general student information:
 - String name: Name of the student.
 - int id: Student ID number.
 - String department: Department of the student.
 - Include a method named displayStudentInfo() to print the student's general information.
- **Create a class named GraduateStudent** that extends Student with an additional attribute:
 - String thesisTopic: The topic of the thesis for graduate students.
 - Include a method named displayThesisTopic() to print the graduate student's thesis topic.
- **Create a Main class** to capture user input for a graduate student, including their thesis topic, and display their details.

Input Format:

1. First, the user is prompted to enter the student's name (String).
2. Next, the user is asked to enter the student ID (Integer).
3. The user is prompted to enter the student's department (String).
4. Finally, the user is asked to enter the thesis topic of the graduate student (String).

Output Format:

- The output should display the student's general details first, followed by the thesis topic.
- Each label and its corresponding value should be separated by a colon (:) and a space.
- The output should print on separate lines.

Sample Input:

Enter the student's name:

Alice Johnson

Enter the student ID:

12345

Enter the student's department:

Computer Science

Enter the thesis topic:

Machine Learning in Healthcare

Sample Output:

Student Details:

Name: Alice Johnson

ID: 12345

Department: Computer Science

Thesis Topic: Machine Learning in Healthcare

4) INHERITANCE, INTERFACE AND PACKAGES

The cricket association wants to classify players based on their general profile, then further categorize them as either bowlers or specific types of fast bowlers. This classification helps manage player details at different levels of expertise.

This system will use **multilevel inheritance**:

1. The Player class will store basic details about any player.
2. The Bowler class will extend Player to add attributes specific to bowlers.
3. The FastBowler class will extend Bowler to add details unique to fast bowlers.

Program Specifications:

- **Create a Player class** with the following attributes:
 - String name: Name of the player.
 - String team: Team of the player.
 - int age: Age of the player.
 - Include a method displayPlayerInfo() to print general player information.
- **Create a Bowler class** extending Player with additional attributes:
 - int wicketsTaken: Number of wickets taken by the bowler.
 - double bowlingAverage: The bowling average of the bowler.
 - Include a method displayBowlerInfo() to print bowler-specific details.
- **Create a FastBowler class** extending Bowler with an additional attribute:
 - int averageSpeed: Average bowling speed (km/h).
 - Include a method displayFastBowlerInfo() to print fast bowler-specific details.

- **Create a Main class** to capture user input and display player details at each level of inheritance.

Input Format:

1. First, the user is prompted to enter the player's name.
2. Next, the player's team name.
3. Player's age.
4. Number of wickets taken.
5. Bowling average.
6. Average speed of bowling.

Output Format:

- The output should display the player's general details first, followed by bowler-specific details, and finally the fast bowler-specific details.

Sample Input:

Enter the player's name:
Jasprit Bumrah
Enter the player's team:
India
Enter the player's age:
29
Enter the number of wickets taken:
300
Enter the bowling average:
24.5
Enter the average speed:
140

Sample Output:

Player Details:
Name: Jasprit Bumrah
Team: India
Age: 29
Bowler Details:
Wickets Taken: 300
Bowling Average: 24.5
Fast Bowler Details:
Average Speed: 140 km/h

5) **EXCEPTION HANDLING AND MULTITHREADING**

ShopEasy, an online retailer, uses a simple internal application to calculate the price per item for each order. The application calculates the price per item by dividing the total price by the number of items ordered. During testing, the application encountered issues when the number of items ordered was zero, resulting in an `ArithmeticException`. To avoid application crashes and provide a smooth user experience, ShopEasy needs a solution that handles this exception gracefully. Write a Java program to help ShopEasy's team safely calculate the price per item. The program should:

1. Prompt the user to enter the total price of the items.
2. Prompt the user to enter the number of items.
3. Display the price per item by dividing the total price by the number of items.
4. If the number of items is zero, catch the `ArithmeticException` and display the message: Error: Number of items cannot be zero. Please enter a valid quantity.

5. Allow the user to re-enter the number of items if they initially entered zero.

Input Format

- Total price of items (integer or decimal).
- Number of items (integer).

Output Format

- Display price per item if calculated successfully.
- Display an error message if an `ArithmeticException` is encountered and prompt the user to enter a valid quantity.

Example 1**Sample Input 1:**

Enter the total price of the items: 150

Enter the number of items: 0

Sample Output 1:

Error: Number of items cannot be zero. Please enter a valid quantity.

Enter the number of items: 5

Price per item: 30.0

Explanation: The user initially entered 0 for the number of items, which would cause a division by zero error. The program catches this exception and prompts the user to re-enter a valid quantity. After entering 5, the program calculates $150 / 5 = 30.0$ and displays the result.

Example 2**Sample Input 2:**

Enter the total price of the items: 200

Enter the number of items: 4

Sample Output 2:

Price per item: 50.0

Explanation: In this case, the user entered a valid number of items, so the program calculates $200 / 4 = 50.0$ without encountering any errors.

6) EXCEPTION HANDLING AND MULTITHREADING

Sam wants to create a simple budget planner to manage monthly expenses. The planner will take inputs for the estimated monthly income and expected expenses. Sam may occasionally enter non-numeric values by mistake, which would cause a `NumberFormatException`. To handle this, Sam's budget planner needs to catch this exception, inform the user of the error, and prompt them to enter a valid number.

Problem Statement: Write a Java program that:

1. Prompts the user to enter the estimated monthly income and expected monthly expenses.
2. Calculates and displays the remaining balance by subtracting expenses from income.
3. If the user enters a non-numeric value for income or expenses, handle the `NumberFormatException` and display an error message: Error: Please enter a valid numeric value.
4. Re-prompt the user to enter valid values until they are correct.

Input Format

- Monthly income (string that should be convertible to a double).
- Monthly expenses (string that should be convertible to a double).

Output Format

- If both inputs are valid numbers, display the remaining balance after subtracting expenses from income.

- If an input is invalid, display an error message and re-prompt the user for valid input.

Example 1

Sample Input 1:

Enter your estimated monthly income: 5000

Enter your expected monthly expenses: 2000

Sample Output 1:

Remaining balance: ₹3000.00

Explanation:

The user entered valid numbers for income and expenses. The remaining balance is calculated as $5000 - 2000 = 3000.00$.

Example 2

Sample Input 2:

Enter your estimated monthly income: 4000

Enter your expected monthly expenses: two thousand

Sample Output 2:

Error: Please enter a valid numeric value.

Enter your expected monthly expenses: 2500

Remaining balance: ₹1500.00

Explanation:

The user initially entered a non-numeric value for expenses. The program catches the `NumberFormatException`, displays an error message, and prompts the user to enter a valid number for expenses. After re-entering 2500, the program calculates the remaining balance as $4000 - 2500 = 1500.00$.

7) COLLECTION FRAMEWORK

Leetcode: [#434. Number of Segments in a String](#)

Given a string *s*, return *the number of segments in the string*.

A **segment** is defined to be a contiguous sequence of **non-space characters**.

Example 1:

Input: *s* = "Hello, my name is John"

Output: 5

Explanation: The five segments are ["Hello,", "my", "name", "is", "John"]

Example 2:

Input: *s* = "Hello"

Output: 1

Constraints:

- $0 \leq s.length \leq 300$
- *s* consists of lowercase and uppercase English letters, digits, or one of the following characters " ! @ # \$ % ^ & * () _ + - = ' , . : " .
- The only space character in *s* is ' '.

✓ This problem enhances skills in string parsing and manipulation by focusing on identifying word boundaries. It helps learners handle edge cases involving multiple spaces and special characters. It builds a foundation for text processing tasks like tokenization and input validation.

8) COLLECTION FRAMEWORK

Leetcode: [#509. Fibonacci Number](#)

The **Fibonacci numbers**, commonly denoted $F(n)$ form a sequence, called the **Fibonacci sequence**, such that each number is the sum of the two preceding ones, starting from 0 and 1. That is,

$F(0) = 0, F(1) = 1$

$F(n) = F(n - 1) + F(n - 2)$, for $n > 1$.

Given *n*, calculate $F(n)$.

Example 1:

Input: *n* = 2

Output: 1

Explanation: $F(2) = F(1) + F(0) = 1 + 0 = 1$.

Example 2:**Input:** $n = 3$ **Output:** 2**Explanation:** $F(3) = F(2) + F(1) = 1 + 1 = 2$.**Example 3:****Input:** $n = 4$ **Output:** 3**Explanation:** $F(4) = F(3) + F(2) = 2 + 1 = 3$.**Constraints:**

- $0 \leq n \leq 30$

✓ This problem strengthens understanding of recursion and iterative problem solving through the Fibonacci sequence.

It helps learners practice dynamic programming techniques to optimize repeated calculations.

9) **FILE HANDLING IN JAVA****Contact Book System****Description:**

Create a simple Contact Book where users can add, view, search, and delete contacts stored in a text file. Each contact will include a name, phone number, and email.

File Format: contacts.txt

John Doe,9876543210,john@example.com

Jane Smith,9123456789,jane@example.com

✓ Learners will understand how to create, read, write, and update data in a text file using Java I/O streams. They will also learn how to parse structured text data and implement basic search functionality.

10 **FILE HANDLING IN JAVA****Student Marks Analyzer****Description:**

Develop a tool to store student names and marks in a file, calculate average marks, and identify top scorers.

File Format: marks.txt

CopyEdit

Alice,88

Bob,92

Charlie,79

✓ Learners will practice reading structured data from files and performing computations like average and maximum. They will gain skills in file parsing, string manipulation, and data aggregation using Java.

RESOURCES**TEXT BOOKS:**

1. Herbert Schildt, *Java: The Complete Reference*, 11th Edition, McGraw-Hill Education, 2019.
2. Paul Deitel, Harvey Deitel, *Java: How to Program*, 11th Edition, Pearson, 2017.

REFERENCE BOOKS:

1. Kathy Sierra, Bert Bates, *Head First Java*, 2nd Edition, O'Reilly Media, 2005.
2. Cay S. Horstmann, *Core Java Volume I – Fundamentals*, 11th Edition, Pearson, 2018.

SOFTWARE/TOOLS:

1. Java JDK (Java SE 17 or above)
2. Jupyter Notebook/JupyterLab/IDLE/Google CoLa IDEs: IntelliJ IDEA / Eclipse / NetBeans

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106105191>
2. <https://www.coursera.org/specializations/java-object-oriented>
3. <https://www.udemy.com/course/java-the-complete-java-developer-course/>
4. <https://www.youtube.com/playlist?list=PLsyebzWxl7oZ-fxL09xY5b2D0H8hZFPd>
5. <https://www.youtube.com/watch?v=eIrMbAQSU34>

WEB RESOURCES:

1. <https://www.geeksforgeeks.org/object-oriented-programming-oops-concept-in-java/>
2. <https://www.javatpoint.com/java-oops-concepts>
3. <https://www.programiz.com/java-programming/object-oriented-programming>
4. https://www.w3schools.com/java/java_oop.asp
5. https://www.tutorialspoint.com/java/java_object_classes.htm

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22EC102003	LINEAR IC APPLICATIONS	3	-	2	-	4
Pre-Requisite	Semiconductor Devices and Circuits					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: The physical world is inherently analog indicating that there is always need for analog circuitry. Today the growth of any industry is dependent upon electronics to a great extent. Integrated circuit is electronics and this course IC application acquaints the students with general analog principles and design methodologies using practical devices and applications. It focuses on process of learning about signal condition, signal generation, instrumentation, timing and control using various IC circuits. With modern digitization advantages we need to work with digital data and hence digital ICs play a crucial role in connecting physical world to the more sophisticated digital world. This course focuses on analysis, design and applications of modern digital integrated circuits.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** A thorough understanding of operational amplifiers and its characteristics with linear integrated circuits.
- CO2** Design different applications of op-amp, timer circuits and analyze PLL for specified applications.
- CO3** Design active filters using op-amp for audio processing applications.
- CO4** Attain the knowledge of functional diagrams and applications of IC 555 and PLL.
- CO5** Analyze different analog to digital and digital to analog converters for dataAcquisition system.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	2	-	2	-	1	-	-	-	-	3	-	-
CO2	1	2	3	-	-	-	-	1	-	-	-	-	3	-	-
CO3	2	3	-	-	-	-	-	1	-	-	-	-	2	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	1	2	3	2	-	2	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	2	3	3	1	-	2	-	1	-	-	-	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTEGRATED CIRCUITS

(9 Periods)

Classification, chip size and circuit complexity, basic information of Op-amp, ideal and practical Op-amp, internal circuits, Op-amp characteristics, DC and AC Characteristics, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential.

Module 2: OP-AMP AND APPLICATIONS

(10 Periods)

Basic information of Op-amp, instrumentation amplifier, ac amplifier, V to I and I to V converters, Sample & hold circuits, comparators, Schmitt trigger, introduction to voltage regulators, features of 723.

Module 3: ACTIVE FILTERS & OSCILLATORS

(10 Periods)

Introduction, 1st order LPF, HPF Butterworth Filters, Band pass, Band reject and all pass filters. Oscillator types and principle of operation – RC, Wien Bridge type. Waveform generators – triangular, square wave.

Module 4: TIMERS & PHASE LOCKED LOOPS

(9 Periods)

Introduction to 555 timer, functional diagram, monostable and astable operations and applications, PLL – introduction, block schematic, principles and description of individual blocks, Voltage Controlled Oscillator (IC 566).

Module 5: D-A AND A-D CONVERTERS

(9 Periods)

Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, Different types of ADCs – Flash type, successive approximation ADC, dual slope integration type ADC, DAC and ADC specifications.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES

1. Design and Simulate RC Phase shift oscillator circuit using Op-Amp 741.
2. Design and Simulate an Instrumentation Amplifier using Op-Amp 741 with required gain.
3. Design and Simulate applications of 555 timer (Monostable / Astable Multivibrator) with given duty cycle and frequency.
4. Design and Simulate an Active first and second order LPF / HPF filter for a given cut off frequency using Op-amp 741.
5. Design and Simulate D-A converter (R-2R ladder) using Op-amp 741 with required voltage levels.
6. Design and simulate a comparator circuit and setup a zero crossing detector with OP Amp 741 and plot the waveforms.
7. Design and verify an Active first and second order LPF / HPF filter for a given cutoff frequency using Op-amp 741.
8. Design and verify Astable Multivibrator using 555 timer with a given duty cycle and frequency.

9. Design and verify Monostable Multivibrator using 555 timer with a given duty cycle and frequency.
10. Design and verify D-A converter (R-2R ladder) using Op-Amp 741 with required voltage levels.
11. Design an Adder and Subtractor circuit using OP-Amp 741.
12. Design and setup a RC phase shift oscillator using Op-Amp 741 and
 1. Plot the output waveform
 2. Measure the frequency of oscillation
13. Design and set up a voltage controlled oscillator using IC566 and plot the waveforms.
14. Design and set up a low voltage regulator using IC723 and plot the regulation characteristics.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

SOFTWARE/Tools used:

1. Multisim tool (multisim live)

TEXT BOOKS:

1. Ramakanth A. Gayakwad, *Op-Amps & Linear ICs*, PHI, 3rd Edition, 1998.
2. D. Roy Chowdhury, *Linear Integrated Circuits*, New Age International (p) Ltd, 4th Edition, 2011.

REFERENCE BOOKS:

1. Op Amps and Linear Integrated Circuits-Concepts and Applications James M. Fiore, Cengage Learning/ Jaico, 2009.
2. David A. Bell, *Operational Amplifiers & Linear ICs*, Oxford University Press, 2nd Edition, 1997.

VIDEO LECTURES:

1. <https://www.digimat.in/nptel/courses/video/108108114/L01.html>
2. <https://www.youtube.com/watch?v=cITA0pONnMs>

Web Resources:

1. https://www.tutorialspoint.com/linear_integrated_circuits_applications/linear_integrated_circuits_applications_useful_resources.htm

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22EC102010	DIGITAL DESIGN	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	Digital Logic Design					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion and hands on experience on Number systems, Boolean algebra, Minimization of Boolean functions, Analysis and synthesis of digital circuits; Asynchronous Sequential Logic & Programmable Memories.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Design logical circuits by analyzing various Boolean functions and simplification methods to perform desired logical operations using logical gates.
- CO2** Design combinational logical circuits for performing various arithmetic operations and data encoding and decoding in various data lines.
- CO3** Analyze various sequential circuits for realizing counters and registers using flip-flops
- CO4** Design Asynchronous sequential logic and programmable memories for societal needs.
- CO5** Work independently or in teams to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	3	1	-	1	1	-	-	-	-	-	-	3	-
CO3	3	2	3	1	-	1	1	-	-	-	-	-	-	3	-
CO4	3	2	3	1	-	1	1	-	-	-	-	-	-	3	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-	-	3	-
Course Correlation Mapping	3	2	3	1	-	1	1	-	3	3	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: NUMBER SYSTEMS AND BOOLEAN ALGEBR *(10 Periods)*

Digital systems, Binary Numbers, Number base conversions, Complements of numbers, Binary codes, Error detection and correction codes. Boolean Algebra-Basic definition, Basic theorems and properties, Boolean Functions, Canonical & Standard forms, logic operations & Logic gates.

Module 2: GATE LEVEL MINIMIZATION (08 Periods)

The map method, four variable, Five variable K-map, POS & SOP Simplification, Don't care conditions, NAND & NOR Implementation, Tabular Method- Simplification of Boolean function.

Module 3: COMBINATIONAL LOGIC CIRCUIT DESIGN (09 Periods)

Combinational circuits, Adders, Subtractors, Binary Adder-Subtractor, Decimal Adder, carry look-a-head adder, Binary Multiplier, Magnitude comparator, Decoder, Encoders, Priority Encoder, Multiplexers.

Module 4: SEQUENTIAL LOGIC CIRCUIT DESIGN (10 Periods)

Sequential Circuits, Latches, Flip-Flops-SR, D, JK & T, Introduction to Registers-Universal Shift Registers, State table and state diagrams, State Reduction & Assignment, Sequence Detector, Design of counters-Modulo-n, Johnson, Ring, Up/Down.

Module 5:	ASYNCHRONOUS SEQUENTIAL LOGIC & PROGRAMMABLE MEMORIES	(08 Periods)

Introduction, Analysis procedure, Design Procedure-Primitive Flow Table, Reduction of State and Flow Tables-Implication Table and Implied States, Hazards.

Programmable Memories: ROM, PLA, PAL.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

Part-A: Realize the following in hardware

(Minimum **Five** Experiments are to be conducted)

1. Realize gates using NAND & NOR gates.
2. Optimize and Realize a given Boolean Function.
3. Design and Realize BCD to Excess-3 Code Converter.
4. Design and Realize Adder and Subtractor using Multiplexer based on logic gates/ IC74153.
5. Design and Realize a BCD to 7-Segment Decoder using Logic Gates/ ICs.
6. Design and Realize a Hexadecimal to Binary Encoder using IC74148 and IC74157.
7. Design and Realize a Sequence Generator using IC7495.
8. Design and Realize Asynchronous and Synchronous counters using IC7476 (JK-Flip Flop).

LIST OF EXERCISES:**Part-B: Simulation using any EDA tool**

(Minimum **Ten** Experiments are to be conducted)

1. Design of 4 bit a. binary adder
b. binary adder-subtractor
2. Design of 3 bit Magnitude comparator.
3. Design of BCD Adder
4. Design of 3 to 8 decoder & 8 to 3 encoder for an engineering application.
5. Design of 16 to 1 multiplexer using two 8 to 1 multiplexer.
6. Design SR, JK, T and D Flip-flops using logic gates.
7. Design and implementation of 3-bit synchronous up/down counter.
8. Design a ring counter using flip flops.

RESOURCES**TEXT BOOKS:**

1. M. Morris Mano, *Digital Design*, Pearson education, 5th Edition, 2013.
2. Charles H. Roth, *Fundamentals of Logic Design*, Thomson Publications, 5th Edition, 2004.

REFERENCE BOOKS:

1. A. Anand Kumar, *Switching Theory and Logic Design*, PHI Learning Private Limited, 3rd Edition, India, 2017.
2. ZviKohavi and NirahK.Jha, *Switching theory and Finite Automata Theory*, TataMcGraw-Hill, 2nd Edition, 1978.

SOFTWARE/TOOLS:

1. Digital Schematic tool (DSCH2)

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_ee75/preview
2. https://onlinecourses.nptel.ac.in/noc20_cs63/preview

Web Resources:

1. <https://www.digitalelectronicsdeeds.com/>
2. https://www.tutorialspoint.com/digital_circuits/digital_circuits_useful_resources.htm

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22EC104002	ELECTRONIC CIRCUIT ANALYSIS AND DESIGN	3	-	2	4	5
Pre-Requisite	Semiconductor Devices and circuits.					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Demonstrate Single Stage Amplifiers; Multi Stage amplifiers; Frequency Response; Negative Feedback Amplifiers; Oscillators; Large Signal Amplifiers; Tuned Amplifiers.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Design and analysis of single and multistage amplifiers using BJT and FET
- CO2** Analyze transistors at high frequencies using Hybrid- π Model to determine the gain and bandwidth.
- CO3** Analyze the effect of negative feedback on amplifier characteristics and Derive the characteristics.
- CO4** Know the classification of the power and tuned amplifiers and their analysis with performance comparison
- CO5** Work independently and in teams to solve problems with effective communication

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	1	-	1	-	-	3	-	-	-	3	-	-
CO2	2	3	-	1	-	-	-	-	-	-	-	-	1	-	-
CO3	2	3	2	1	-	-	-	-	3	-	-	-	3	-	-
CO4	3	2	-	-	-	1	-	-	3	-	-	2	3	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-	3	3	-
Course Correlation Mapping	2	3	3	1	-	1	-	-	3	3	-	2	3	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BJT small signal Amplifiers

(12 Periods)

Transistor modeling using h-Parameters, CE, CB and CC circuit analysis using h-parameters, Simplified hybrid model, Analysis of CE amplifier with emitter resistance. Classification of Amplifiers, Distortion in amplifiers, methods of coupling, two-stage RC coupled amplifier, effect of coupling and bypass capacitors, multistage frequency effects, Cascode amplifier, Darlington pair.

Module 2: High Frequency Transistor models

(10 Periods)

The Hybrid- π ($\square$) – Common Emitter transistor model, Hybrid- $\square$ conductance, Hybrid- $\square$ capacitances, validity of Hybrid- $\square$ model, determination of high-frequency parameters in terms of low-frequency parameters CE short circuit current gain, current gain with resistive load, frequency response and gain band width product.

FET: Analysis of common Source and common drain Amplifier circuits at high frequencies.

Module 3: Negative Feedback Amplifiers

(07 Periods)

Feedback principle and concept, Classification of feedback amplifiers, feedback topologies, characteristics of negative feedback amplifiers, Generalized analysis of Voltage series, Voltage shunt, Current series and Current shunt configurations, simple problems.

Module 4: Power Amplifiers

(08 Periods)

Classification of amplifiers, Class-A Power Amplifier- Power conversion Efficiency, Transformer Coupled power Amplifier; Push-Pull and Complimentary Symmetry Class-B power amplifier, Class-AB power amplifier, Principle of operation of class-C power amplifier, Thermal stability and Heat sinks.

Module 5: Tuned Amplifiers

(08 Periods)

Introduction, Q-Factor, Small Signal Tuned Amplifiers, Effect of Cascading Single Tuned Amplifiers on Bandwidth, Double-tuned amplifier, Effect of Cascading Double Tuned Amplifiers on Bandwidth, Stagger Tuned Amplifiers, Stability of Tuned Amplifiers, Class-CTuned amplifier

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

Part-A: Simulation using any EDA tool

(Minimum **Six** Experiments are to be conducted)

1. Single stage BJT Amplifier
2. Two Stage RC- Coupled Amplifier
3. Single Stage JFET Amplifier
4. Cascode Amplifier
5. RC Phase Shift Oscillator
6. Hartley and Colpitts Oscillator

7. Voltage-Series Feedback Amplifier
8. Class A Power Amplifier
9. Class B Complementary Symmetry Amplifier

LIST OF EXERCISES:

Part-B: Realize using Hardware

(Minimum **Four** Experiments are to be conducted)

1. Single stage BJT Amplifier
2. Two Stage RC- Coupled Amplifier
3. Single Stage JFET Amplifier
4. RC Phase Shift Oscillator
5. Hartley and Colpitts Oscillator
6. Class A Power Amplifier
7. Class B Complementary Symmetry Amplifier

PROJECT BASED LEARNING

1. Design a 4-watt amplifier for an audio application.
2. Develop a circuit for home security system with an alarm.
3. Develop a circuit for water level indication in an overhead tank.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Jacob Millman and Christos C. Halkias, *Integrated Electronics*, McGraw-Hill Education, 2nd edition, 2010.
2. S. Poorna Chandra, B. Sasikala "Electronics Laboratory Primer", S. Chand & Company Ltd. 1st Reprint Edition 2014

REFERENCE BOOKS:

1. Donald A. Neamen, *Microelectronics: Circuit Analysis and Design*, 4th edition, MC Graw Hill, 2010
2. David A. Bell, *Electronic Devices and Circuits*, Oxford University press, 5th Edition, 2014.
3. S. Salivahanan, N. Suresh Kumar, A Vallvaraj, *Electronic Devices and Circuits*, 3rd Edition, MC Graw Hill Education, 2013
4. Md H Rashid, *Introduction to PSpice Using OrCAD for Circuits and Electronics*, PHI, 3rd edition, 2012

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/108105158>

Web Resources:

1. <https://zlibrary.to/pdfs/millman-halkias-integrated-electronics-pdf>
2. <https://www.pdfdrive.com/electronics-laboratory-primer-e189265511.html>
3. <https://www.vlab.co.in/>

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22AI101001	DISCRETE MATHEMATICAL STRUCTURES	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on discrete mathematics to make students to think logically and mathematically and apply these techniques in solving problems. Topics include mathematical logic, functions, relations, deterministic algorithms and analysis techniques based on counting methods, recurrence relations, trees and graphs.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01.** Apply mathematical logic and truth tables to validate precise statements.
- C02.** Understand the concepts of sets, relations and functions.
- C03.** Analyze and apply the concepts of mathematical induction, counting principles and properties of algebraic structures to solve computational Problems.
- C04.** Formulate problems and solve recurrence relations using substitution method and generating functions.
- C05.** Apply trees and graphs to solve the problems in computer applications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C01	3	3	-	2	2	-	-	-	-	-	-	-	3	-	-	-
C02	3	-	-	2	2	-	-	-	-	-	-	-	3	-	-	-
C03	3	3	-	3	2	-	-	-	-	-	-	-	3	-	-	-
C04	3	2	-	3	2	-	-	-	-	-	-	-	3	-	-	-
C05	3	-	-	3	2	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	3	3	-	3	2	-	-	-	-	-	-	-	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: MATHEMATICAL LOGIC AND NORMAL FORMS

(08 Periods)

Mathematical Logic: Introduction, Statements and Notation, Connectives, Well- formed formulae, Truth tables, Tautology, Equivalence, Implications.

Normal forms: Disjunctive normal form, Conjunctive normal form, Principle disjunctive normal form, Principle conjunctive normal form.

Module 2: RELATIONS AND FUNCTIONS

(08 Periods)

Relations: Cartesian product of sets, Relations, Properties of binary relations, Equivalence, Compatibility and Partial ordering relations, Hasse diagram and related applications, Lattices as partially ordered sets, Definition and examples, Properties of Lattices.

Functions: Types of functions, Composition of functions and inverse of functions

Module 3: INDUCTION, COUNTING AND ALGEBRAIC STRUCTURES

(09 Periods)

Induction, Counting: Mathematical Induction – The Basics of Counting – The Pigeonhole Principle – Principle of Inclusion-Exclusion.

Algebraic Structures: Algebraic systems, Examples and general properties, Semi groups and Monoids, Groups, Subgroups, Homomorphism, Isomorphism

Module 4: GENERATING FUNCTIONS AND RECURRENCE RELATIONS

(11 Periods)

Generating Functions: Generating functions of sequences, Calculating coefficients of generating functions.

Recurrence Relations: Recurrence relations, Solving recurrence relations by substitution and generating functions, The method of characteristic roots, Solutions of homogeneous recurrence relations.

Module 5: GRAPHS AND TREES

(09 Periods)

Graphs: Basic concepts of Graph theory, Planar and Complete graph, Matrix representation of Graphs, Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest path algorithms.

Trees: Introduction to Trees, Properties of Trees, Spanning Trees, Depth-First Search, Breadth-First Search, Minimum Spanning Trees.

Total Periods: 45

EXPERIENTIAL LEARNING

The following is the sample. Faculty shall frame according to the course domain.

1. Let $a > 1$ be a positive integer. Pretend you want to divide n people into some number of teams, each of size a or $a + 1$. Show that this is possible provided n is larger than values in the Fibonacci polynomial $a^2 - a - 1 = a(a - 1) - 1$.
2. Identify the relations on the set of bits $B = \{0, 1\}$ that are partial orders and those that are equivalence relations.
3. Pretend you are writing traffic accident software and want to categorize accidents by the day of the week on which they occur. Pretend there are n accident reports to categorize.
 - (a) What is the size of the sample space? That is, in how many ways can the n accident reports be distributed over 7 days?
 - (b) In how many ways can all n accidents occur on one single day?
 - (c) In how many ways can all n accidents occur on only two days?
 - (d) Let's look at the other end: In how many ways can all n accidents occur on seven, and no less, days.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw Hill, 8th Edition, 2019.
2. Jon Pierre Fortney, Discrete Mathematics for Computer Science, CRC Press, Taylor & Francis Group, 1st Edition, 2021.

REFERENCE BOOKS:

1. Richard Johnsonbaugh, "*Discrete Mathematics*", Prentice Hall, 8th Edition, 2019.
2. Narasing Deo, Graph Theory with application to Engineering and Computer Science, Prentice Hall India 2016.
3. J.P. Trembly and R. Manohar, *Discrete Mathematical Structures with Applications to Computer Science*, Tata McGraw Hill, 37th Edition, 2017.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106106183>
2. <https://nptel.ac.in/courses/106106094>
3. <https://nptel.ac.in/courses/111107058>

WEB RESOURCES:

1. <https://www.coursera.org/learn/discrete-mathematics>
2. <https://people.cs.pitt.edu/~milos/courses/cs441/>
3. <https://web.stanford.edu/class/cs103x/cs103x-notes.pdf>
4. https://edurev.in/studytube/Propositional-Logic-Discrete-Mathematical-Structur/8e588945-d315-41f0-a31e-0dc45829eb04_v

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22EC101005	SIGNALS AND SYSTEMS	3	-	-	-	3
Pre-Requisite	Transformation Techniques and Linear Algebra					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on analysis of signals and systems; Representation of signals using Fourier series and Fourier transforms; Time-Domain and Frequency-Domain aspects of signals and systems; concept of convolution and correlation; Sampling and types of sampling; Applications of Laplace transform of signals; Z-Transform of discrete-time sequences.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Understand the basic operations on signals & sequences and determine the response of LTI systems using convolution.
- C02** Apply Fourier series and transform to analyse spectral characteristics of continuous-time periodic and aperiodic signals.
- C03** Analyse the properties of correlation and convolution to extract signals from noisy signal in various applications.
- C04** Analyse sampling & its effects and reconstruct signals using interpolation.
- C05** Apply Laplace and Z-transformation techniques to analyse the characteristics of systems.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
C02	3	2	-	2	3	-	-	-	-	-	-	-	-	-	3
C03	3	3	-	2	-	2	-	-	-	-	-	-	-	-	3
C04	3	3	-	2	-	-	-	-	-	-	-	-	-	-	3
C05	3	2	-	2	3	-	-	-	-	-	-	-	-	-	3
Course Correlation Mapping	3	3	-	2	3	2	-	-	-	-	-	-	-	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO SIGNALS AND SYSTEMS

(12 Periods)

Elementary signals- Unit Impulse and Unit Step Functions, Exponential and Sinusoidal Signals. Classification of Continuous- Time and Discrete-Time Signals, Basic operations on signals, Classification of Continuous-Time and Discrete-Time Systems, Basic System Properties, Linear Time-Invariant Systems -Discrete-Time LTI Systems- The Convolution Sum, Continuous-Time LTI Systems -Convolution Integral, Properties of Linear Time Invariant Systems.

Module 2: FOURIER SERIES AND FOURIER TRANSFORM

(09 Periods)

Fourier series: Representation of Fourier series, Continuous time periodic signals, Dirichlet's conditions, Trigonometric and Exponential Fourier Series with examples.

Fourier Transforms: Deriving Fourier Transform from Fourier series, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of CT Fourier Transform, Systems characterized by Linear constant coefficient differential equations. The Magnitude Phase Representation of the Fourier Transform, The Magnitude-Phase Representation of the Frequency Response of LTI Systems

Module 3: CORRELATION OF SIGNALS

(08 Periods)

Cross correlation and auto correlation of functions, properties of correlation function, Energy density spectrum, Power density spectrum, Relation between auto correlation function and energy/power spectral density function. Relation between convolution and correlation, Detection of periodic signals in the presence of noise by correlation in radar systems, Extraction of signal from noise by filtering.

Module 4: SAMPLING

(07 Periods)

Representation of a Continuous-Time Signal by its Samples - Sampling Theorem, Reconstruction of a Signal from Its Samples Using Interpolation. Effect of under sampling - Aliasing, Discrete-Time Processing of Continuous-Time Signals

Module 5: LAPLACE AND Z-TRANSFORMS

(09 Periods)

Laplace Transforms: The Laplace Transform, The Region of Convergence for Laplace Transforms, The Inverse Laplace Transform, Statements of Properties of the Laplace Transform, Some Laplace Transform Pairs, Analysis and Characterization of LTI Systems Using the Laplace Transform.

Z-Transforms: Introduction, The Z-Transform, The Region of Convergence for ZTransform, The Inverse Z-Transform, statements of Properties of Z-Transform.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Record sound from different sources and create an audio library
2. Analyse Fourier transform of various signals from audio library
3. Design a Filter to eliminate noise in the Recorded signals

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Alan V. Oppenheim, Alan S. Willsky, & S. Hamid, *Signals and Systems*, Pearson Higher Education, 2nd Edition, 2008.
- 2.

REFERENCE BOOKS:

1. Simon Haykin and B. Van Veen, *Signals & Systems*, John Wiley, 2nd Edition, 2010.
2. A. Anand Kumar, *Signals & Systems*, PHI, 2011.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/108104100>
2. <https://www.udemy.com/course/signals-and-systems-from-basics-to-advance>
3. <https://freevideolectures.com/subject/signals-systems/>
4. <https://www.edx.org/course/signals-and-systems-part-1>

Web Resources:

1. Hilbert Transform: <https://ieeexplore.ieee.org/document/5609110>
2. Impulse Response Application: <https://ieeexplore.ieee.org/document/629264>
3. Sampling: https://www.researchgate.net/publication/325846982_sample_and_sampling_designs

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CB102002	COMPUTER NETWORKS	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to computer networks; Protocols of physical layer, data link layer, medium access control sub layer, network layer, transport layer, application layer.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

- CO1.** Analyze the types of network topologies, layers and protocols.
- CO2.** Evaluate sub netting and routing algorithms for finding optimal paths in networks.
- CO3.** Solve problems related to flow control, error control and congestion control in data transmission.
- CO4.** Assess the impact of wired and wireless networks in the context of network protocols Like DNS, SMTP, HTTP, and FTP.
- CO5.** Apply ethical principles and standards for developing network-based solutions.
- CO6.** Work independently and in teams to solve network related problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	3	-	-	-	-	-	-	-	3	3	3	2
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	3	3	2
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	2
CO4	3	2	2	2	2	-	-	-	-	-	-	-	3	3	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	3	-	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	3	3	-	3	-	-	-	-	3	3	-	-	3	3	3	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:

MODULE 1: INTRODUCTION AND PHYSICAL LAYER

(09 Periods)

Network hardware, Network software, Reference models - OSI, TCP/IP; Example networks - Internet; Wireless LANs - 802.11.

Physical Layer - Guided transmission media, Wireless transmission, Switching - Circuit switching, Packet switching.

MODULE 2: DATA LINK LAYER AND MEDIUM ACCESS CONTROL SUBLAYER (09 Periods)

Data Link Layer: Data link layer design issues, Error detection and correction - CRC, Hamming codes; Elementary data link protocols, Sliding window protocols.

Medium Access Control Sub layer: ALOHA, Carrier sense multiple access protocols, Collision free protocols, Ethernet, Data link layer switching - Repeaters, Hubs, Bridges, Switches, Routers, Gateways.

MODULE 3: NETWORK LAYER

(09 Periods)

Network layer design issues, Routing algorithms - Shortest path algorithm, Flooding, Distance vector routing, Link state routing, Hierarchical routing, Broadcast routing, Multicast routing, Any cast routing; Congestion control algorithms, Network layer in the internet - The IP version 4 protocol, IP addresses, IP version 6, Internet control protocols, OSPF, BGP.

MODULE 4: TRANSPORT LAYER

(09 Periods)

UDP - Segment header, Remote procedure call, Real-time transport protocols; TCP - service model, Protocol, Segment header, Connection establishment, Connection release, Sliding window, Timer management, Congestion control.

MODULE 5: APPLICATION LAYER

(09 Periods)

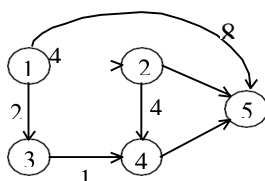
Domain Name System (DNS) - Name space, Domain resource records, Name servers; Electronic mail - Architecture and services, User agent, Message formats, Message transfer, Final delivery; The World Wide Web - Architectural overview, HTTP, FTP.

Total Periods: 45

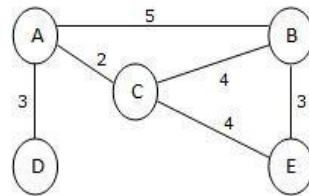
EXPERIENTIAL LEARNING:

LIST OF EXERCISES:

1. Implement the following data link layer framing methods.
 - i) Character count
 - ii) Character stuffing
 - iii) Bit stuffing
2. Implement the frame sorting technique used in buffers.
3. Design and develop a program to compute checksum for the given frame 1101011011 using CRC-12, CRC-16, and CRC-CCIP. Display the actual bit string transmitted. Suppose any bit is inverted during transmission. Show that this error is detected at the receiver's end.
4. Implement Dijkstra's algorithm to compute the shortest path for the given graph.



5. Develop a program to obtain routing table for each node using Distance Vector Routing Algorithm by considering the given subnet with weights indicating delay between Nodes.



6. Write a program to simulate flow-based routing.
7. Write a program to simulate random early detection congestion control algorithm.
8. Using TCP/IP sockets, write a client-server program to open a file available in the server.
9. Write a program for congestion control using leaky bucket algorithm.
10. Write a program for the Mail Client
- i) POP Client: Gives the server name, user name and password retrieve the mails and allow manipulation of mail box using POP commands.
 - ii) SMTP Client: Gives the server name, send email to the recipient using SMTP commands.
11. Write a program for HTTP server to implement the commands - GET, POST, HEAD and DELETE. The server must handle multiple clients.

Exercises on Packet Tracer Simulator Tool:

12. a) Study of basic network commands and network configuration commands.
- i) ping ii) nslookup iii) netstat iv) ifconfig
- b) Create a network topology and configure a network topology with four PCs, two switches, and two routers.

REFERENCE BOOKS:

1. Andrew S. Tanenbaum and David J. Wetherall, *Computer Networks*, Pearson, 5th Edition, 2015.
2. A. Jesin, *Packet Tracer Network Simulator*, Packt Publishing, 2014.

SOFTWARE/TOOLS USED:

1. C/Python/Java
2. Network simulator tool - Packet Tracer
3. Virtual Labs (Computer Networks Lab - http://vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/explist.php)

ADDITIONAL LEARNING RESOURCES:

1. <https://www.itprc.com/packet-tracers/>
2. <https://www.nsnam.org/docs/tutorial/html/>
3. http://www.tcpipguide.com/free/t_OSIRferenceModelLayers.htm

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_cs18/preview
2. <https://www.coursera.org/learn/tcpip>

WEB RESOURCES:

- <https://www.cisco.com/c/en/us/solutions/small-business/resourcecenter/networking/networking-basics.html>
- [https://memberfiles.freewebs.com/00/88/103568800/documents/Data.And.Computer.C](https://memberfiles.freewebs.com/00/88/103568800/documents/Data.And.Computer.Communications.8e.WilliamStallings.pdf)ommunications.8e.WilliamStallings.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CS102003	DATA STRUCTURES	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides an overview of data structure concepts, arrays, stack, queues, trees, and graphs. Discussion of various implementations of these data objects, programming styles, and run-time representations.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the concept of Dynamic memory management, data types, algorithms, Big O notation.
- CO2.** Understand basic data structures such as arrays, linked lists, stacks and queues.
- CO3.** Solve problem involving graphs, trees and heaps.
- CO4.** Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	3	3	3	2	-	-	-	-	-	-	-	-	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

MODULE 1: INTRODUCTION TO DATA STRUCTURES & STACK, QUEUE (10 Hours)

Introduction: Introduction to Data Structures, Basic Concepts and Notations, Abstract Data Types, Analysis and Efficiency of Algorithms, Time and Space Complexity.

Stack, Queue: Stack, Stack operations, Implementation using arrays, applications of stack, Queue, Queue operations, Implementation using arrays, various Queue Structures, applications of queue.

MODULE 2: LINKED LISTS (08 Hours)

Linked lists: Single linked list, double linked list, circular linked list, operations on linked lists, Applications of Linked List.

Implementation of stack using Pointers, Implementation of Queue using Pointers.

MODULE 3: SEARCHING, SORTING & HASH TABLES (08 Hours)

Searching Techniques: Linear Search, Binary Search and Fibonacci Search.

Sorting Techniques: Selection Sort, Insertion sort, Bubble sort, Merge Sort, Quick Sort, Heap sort, Radix Sort.

Hash Tables: Hash Functions, Collision Handling Schemes, Applications.

MODULE 4: TREES (10 Hours)

Trees: Vocabulary and Definitions, Binary Tree, Implementation, Binary Tree Traversal, Binary Search Tree, Implementation, Balanced Search Trees: AVL Trees, Implementation, Splay Trees, Red- Black Trees.

MODULE 5: GRAPH THEORY (09 Hours)

Graph Theory: Graphs Terminology, Graph ADT, Data Structures for Graphs- Adjacency Matrix Structure, Graph Traversals, Shortest Paths, Minimum Spanning Trees- Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Floyd-Warshall Algorithm

Total Periods: 45

Experiential Learning

1. Demonstrate recursive algorithms with examples.
2. Develop a program to perform operations of a Stack and Queue using arrays.
3. Implement and perform different operations on Single, Double and Circular Linked Lists.
4. Develop a program to perform operations of Stack and Queue using Linked Lists
5. Develop programs to implement Stack applications.
6. Implement Circular Queues.
7. Implement various Searching techniques.
8. Develop programs for different Sorting techniques
9. Develop a program to represent a Tree data structure.
10. Develop a program to demonstrate operations on Binary Search Tree.
11. Demonstrate Graph Traversal Techniques.
12. Develop a program to find Minimum cost Spanning tree.

RESOURCES

TEXT BOOKS:

1. Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Second Edition, 2002, Pearson.
2. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Third Edition, 2010, PHI.
3. Data Structures and Algorithms Made Easy by Narasimha Karumanchi, 2020, Career Monk Publications.

REFERENCE BOOKS:

1. Fundamental of Data Structures in C, Horowitz, Sahani, Anderson-Freed, Second Edition, 2008, Universities Press.
2. Classic Data Structures, Debasis Samanta, Second Edition, 2009, PHI

VIDEO RESOURCES:

1. <https://nptel.ac.in/courses/106102064>
2. <https://www.coursera.org/learn/data-structures>
3. <https://www.youtube.com/watch?v=zWg7U0OEAoE&list=PLBF3763AF2E1C572F>

WEB RESOURCES:

1. <https://www.geeksforgeeks.org/data-structures/>
2. <https://www.javatpoint.com/data-structure-tutorial>
3. https://www.tutorialspoint.com/data_structures_algorithms/data_structures_basics.htm

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22AI102001	OPERATING SYSTEMS	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Operating Systems Operations; Process Scheduling; Process Synchronization, Deadlocks; Paging and Segmentation, Disk Scheduling; File Concepts, I/O Interface; Concepts of Protection and Security.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze performance of CPU scheduling algorithms
- CO2** Design solutions for process synchronization problems by using semaphores and monitors
- CO3** Devise solutions for deadlocks using deadlock handling mechanisms
- CO4** Solve memory management problems using page replacement and disk scheduling algorithms
- CO5** Identify efficient file allocation methods for optimal disk utilization & analyse services of I/O subsystems and mechanisms of security & protection
- CO6** Work independently to solve problems with effective communication

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	2	-	-	-	-	-	-	-	3	-	-	2
CO2	2	2	3	-	2	-	-	-	-	-	-	-	3	-	-	2
CO3	2	2	3	-	2	-	-	-	-	-	-	-	3	-	-	2
CO4	2	2	3	-	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	3	-	3	-	-	-	-	-	-	-	-	3	-	-	2
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	2	2	3	3	2	-	-	-	3	3	-	-	3	-	3	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 INTRODUCTION TO OPERATING SYSTEM AND (08 Periods) **PROCESS MANAGEMENT**

Introduction: Definition, Operating System Structure and Services, System Calls.

Process Management: Process Scheduling, Process Control Block, Inter Process Communication, Threads, Multithreading Models, CPU Scheduling Criteria, Scheduling Algorithms, Multiprocessor Scheduling.

Module 2 PROCESS SYNCHRONIZATION AND DEADLOCKS (10 Periods)

Process Synchronization: Critical Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Synchronization Problems, Monitors.

Deadlocks: System Model, Deadlock characterization, Methods for handling deadlocks, Prevention, Detection, Avoidance, Recovery from deadlock.

Module 3 MEMORY MANAGEMENT AND SECONDARY STORAGE (10 Periods)

Memory Management: Swapping, Contiguous Allocation, Paging, Segmentation, Segmentation with Paging.

Virtual Memory: Demand Paging, Page Replacement Algorithms, Copy-on-Write, Thrashing.

Secondary Storage Structure: Overview of Mass Storage Structure, Disk Structure, Disk Scheduling, Disk Management.

Module 4 FILE AND I/O SYSTEMS (08 Periods)

File System: File concept, Access Methods, Directory Structure, File System Structure, i-node, File System Implementation, Directory Implementation, Allocation Methods.

I/O System: I/O Hardware, Application I/O Interface, Kernel I/O subsystem.

Module 5 PROTECTION AND SECURITY (09 Periods)

Protection: Goals, Principles, Domain of Protection, Access Matrix, Implementation of Access Matrix, Access Control, Revocation of Access Rights.

Security: Security Problem, Program Threats, System and Network Threats, User Authentication, Implementing Security Defenses, Firewalling to Protect Systems and Networks, Computer-Security Classifications.

Total Periods: 45

EXPERIENTIAL LEARNING

1. a) Write a program to implement Process System Calls.
 b) Write a program to implement I/O System Calls.
2. Write a program to implement named and unnamed pipes.
3. Demonstrate File Permissions.
4. Analyze the following CPU Scheduling Algorithms:
 a) FCFS b) SJF (Preemptive) c) Priority d) Round Robin
5. Design solutions for the following synchronization problems:
 a) Producer Consumer Problem b) Dining Philosophers Problem.
6. Design Banker's Algorithm for Deadlock Avoidance. Find the safe sequence. If Maximum request of any one process is changed, detect whether a deadlock has occurred or not. Consider the number of resources are three and Jobs are five.
7. Implement the following Algorithms:
 a) First Fit b) Best Fit c) Worst Fit
8. Implement the following Page Replacement Algorithms
 a) FIFO b) LFU c) LRU d) Optimal
9. Implement the following Disk Scheduling Algorithms
 a) FCFS b) SSTF c) SCAN d) CSCAN
10. Implement the following file allocation strategies:
 a) Contiguous Allocation b) Linked Allocation

RESOURCES

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, Wiley India Edition, 9th Edition, 2016.

REFERENCE BOOKS:

1. William Stallings, Operating Systems, Internals and Design Principles, Pearson Education, 7th Edition, 2013.
2. Andrew S. Tanenbaum, Modern Operating Systems, PHI, 3rd Edition, 2009.

SOFTWARE/TOOLS:

1. Software: Windows, Linux OS, Fedora OS, Ubuntu OS

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_cs72/preview
2. <https://www.udemy.com/course/operating-systems-from-scratch-part1/>

WEB RESOURCES:

1. Operating-systems · GitHub Topics · GitHub
2. Operating System Introduction (w3schools.in)
3. What is Operating System (OS)? Definition and Functions - javatpoint
4. Operating System Tutorial - GeeksforGeeks

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22EC104009	DIGITAL SIGNAL PROCESSING	2	-	2	4	4
Pre-Requisite	Signals and Systems					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides an analysis on Continuous and discrete signals and sequences; systems; DFT and FFT algorithms for the analysis of discrete sequences; design and realization of Digital IIR and FIR filters.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

- CO1** Analyze discrete-time systems using suitable transforms.
- CO2** Apply Discrete and Fast Fourier Transforms to analyze the response of linear systems.
- CO3** Design IIR and FIR digital filters by applying transformation and windowing Techniques.
- CO4** Realize IIR and FIR digital filters using various structures.
- CO5** Work independently and in teams to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	2	1	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	2	3	-	-	-	-	-	-	-	-	3	-
CO3	3	2	3	2	2	-	-	-	-	-	-	-	-	3	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-	-	3	-
Course Correlation Mapping	3	3	3	2	3	-	-	-	3	3	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FREQUENCY ANALYSIS OF DISCRETE TIME SIGNALS (06 Periods)

Fourier series for DT periodic signal and power density spectrum, the Fourier transform of DT aperiodic signals, convergence of the Fourier transform and energy density spectrum, Solution for difference equations of digital filters using Z-transforms.

Module 2: DISCRETE AND FAST FOURIER TRANSFORMS (07 Periods)

Discrete Fourier Transforms (DFT): Properties of DFT, linear filtering methods based on DFT, frequency analysis of signals using DFT.

Fast Fourier transforms (FFT): Radix-2 Decimation in time (DIT) and Decimation in frequency (DIF) FFT algorithms.

Module 3: IIR FILTER DESIGN (06 Periods)

Design of IIR digital filters from analog filters-IIR filter design by approximation of derivatives, impulse invariance and bilinear transformation. Characteristics of commonly used analog filters, Frequency transformations.

Module 4: FIR FILTER DESIGN (06 Periods)

Symmetric and anti-symmetric FIR filters, Design of linear phase FIR digital filters using windows- Barlett, Blackman, Hamming and Hanning. Frequency sampling technique.

Module 5: REALIZATION OF DISCRETE-TIME SYSTEMS (05 Periods)

Structural realization of IIR Systems-direct, cascade and parallel form structures.

Structural realization of FIR Systems-direct, cascade-form structures and Lattice structures.

Total Periods: 30

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Introduction to Code Composer Studio and Digital Signal Processor.
2. Verify linear convolution of aperiodic sequences using CCS on DSP processors and also verify using MATLAB.
3. Verify the circular convolution on Periodic sequences using CCS on DSP processors and also verify using MATLAB.
4. Verify N-point DFT & IDFT using CCS on DSP processors and also verify using MATLAB.
5. Verify N-point FFT algorithm using CCS on DSP processors and also verify using MATLAB.
6. Find the frequency response of analog Butterworth prototype filters (LP/HP/BP/BR) using MATLAB.
7. Find the frequency response of analog chebyshev prototype filters (LP/HP/BP/BR) using MATLAB.
8. Design FIR filter (LP/HP/BP/BR) using following windowing techniques with MATLAB
 1. Barlett window
 2. Blackman window

9. Design FIR filter (LP/HP/BP/BR) using following windowing technique with MATLAB
 1. Hamming window
 2. Hanning window
10. Design FIR filter (LP/HP/BP/BR) using Frequency sampling technique with MATLAB.
11. Implement IIR Butterworth filter (LP/HP/BP/BR) using bilinear transformation techniques with MATLAB.
12. Implement IIR Chebyshev filter (LP/HP/BP/BR) using impulse-invariance transformation techniques with MATLAB.

PROJECT BASED LEARNING

1. Voice biometric speaker recognition
2. Identification of Musical Instruments
3. Speaker recognition system based on MFCC
4. Disease detection based on ECG
5. Implementation of 5-Band Audio Equalizer in MATLAB

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. J. G. Proakis and D.G. Manolakis, "*Digital Signal Processing: Principles, Algorithms and Applications*," Prentice Hall, Fourth Edition, 2007.
2. B.Venkataramani, M. Bhaskar, "*Digital Signal Processors – Architecture, Programming and Applications*," TATA McGraw Hill, Second Edition, 2010.

REFERENCE BOOKS:

1. Alan. V. Oppenheim, Ronald.W. Schafer and John.R. Buck, "*Discrete-Time Signal Processing*," Pearson Education, Second Edition, 2006.
2. Emmanuel C. Ifeachor & Barrie. W. Jervis, "*Digital Signal Processing*," Pearson Education / Prentice Hall, Second Edition, 2002.

VIDEO LECTURES:

1. <https://www.digimat.in/nptel/courses/video/117102060/L01.html>
2. <https://archive.nptel.ac.in/courses/108/105/108105055/>
3. <https://www.coursera.org/specializations/digital-signal-processing>
4. <https://www.coursera.org/learn/dsp1>

Web Resources:

1. https://www.tutorialspoint.com/digital_signal_processing/digital_signal_processing_useful_resources.htm

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22EC103011	VLSI SYSTEM DESIGN	3	-	-	4	4
Pre-Requisite	Digital Design.					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Logic Families; CMOS Technology; Stick Diagrams and Layouts; Subsystem design; Programmable Interconnect structures; Memories.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze logic families, steady state and dynamic characteristics of CMOS, to improve performance characteristics of digital ICs.
- CO2** Analyze electrical properties of MOS circuits for VLSI/ULSI chip fabrication.
- CO3** Develop stick diagrams and layouts of CMOS circuits for miniaturization by analyzing gate delays and scaling effects.
- CO4** Design subsystems for High speed digital electronics to compensate tradeoff among area, speed and power requirements

CO-PO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	3	2	-	-	-	2	-	-	-	-	3	-	-
CO4	3	2	3	2	-	1	1	2	-	-	-	-	3	-	-
Course Correlation Mapping	3	3	3	2	-	1	1	2	-	-	-	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DIGITAL LOGIC FAMILIES

(08 Periods)

Introduction to logic families, RTL, DTL, Transistor-Transistor logic, Emitter Coupled Logic, I^2L , CMOS logic, CMOS steady state and dynamic electrical behavior.

Module 2: FABRICATION AND ELECTRICAL PROPERTIES OF MOS

(10 Periods)

Fabrication Process for NMOS and CMOS technology, Basic Electrical Properties of MOS: $I_{ds} - V_{ds}$ relationships, Second order effects of MOSFETs-Latch up, Hot carrier Effects, channel length modulation, Threshold Voltage V_T , g_m , g_{ds} and ω_0 ; Pass Transistor, NMOS inverter, Pull up to pull down ratio for an NMOS inverter, CMOS Inverter.

Module 3 CMOS CIRCUIT DESIGN PROCESS

(10 Periods)

VLSI design flow, MOS layers, stick diagrams, NMOS design style, CMOS design style, lambda based design rules, layouts for inverters, sheet resistance, capacitances of layers, Gate delays, Delay estimation, Scaling, Limitations of Scaling.

Module 4 SUB SYSTEM DESIGN – I

(08 Periods)

Adders – Transmission based Adder, Carry look-ahead adder, Manchester carry chain adder, Carry Skip Adder, Carry Select Adder; Barrel Shifter, Multipliers – Array Multiplier, Booth Multiplier; ALUs.

Module 5 SUB SYSTEM DESIGN – II

(09 Periods)

Counters- Synchronous and Asynchronous Counter; High Density Memory Elements - Design Approach, FPGAs, Programmable Interconnect structures - Fusible links, Antifuse via link, UV Erasable, Electrically Erasable; CPLDs, Cell based Design Methodology.

Total Periods: 45

PROJECT BASED LEARNING:

Projects relevant to the contents of the course will be provided by the course instructor at the beginning.

1. FPGA Implementation of Matrix Vector Multiplication Using Xilinx System generation.
2. Image and Video Processing applications using Xilinx System generation.
3. Chip design for Turbo Encoder module for In vehicle system.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Kamran Eshraghian, Douglas A. Pucknell and sholeh Eshraghian, Essentials of VLSI Circuits and Systems, PHI, 2005.
2. Morris Mano, Digital Design, Prentice Hall, 3rd Edition, 2003

REFERENCE BOOKS:

1. John F.Wakerly, Digital Design Principles & Practices, Pearson Education Asia, 4th Edition, 2008.
2. John M. Rabaey, Digital Integrated Circuits: A Design Perspective, PHI, 2nd Edition,

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=9SnR3M3CI4>
2. <https://www.digimat.in/nptel/courses/video/108107129/L01.html>
3. <https://www.youtube.com/watch?v=Y8FvvzcocT4>

Web Resources:

1. https://www.tutorialspoint.com/vlsi_design/vlsi_design_useful_resources.htm
2. <https://ocw.mit.edu/courses/6-374-analysis-and-design-of-digital-integrated-circuits-fall-2003/pages/lecture-notes/>

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22EC101012	COMPUTER ORGANIZATION	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course describes Basic structure and operation of a digital computer; Organization and functional principles of the arithmetic and logic unit, control unit, memory unit and I/O unit; Concepts of pipelining and parallel processing techniques; Multicore computers.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Analyze computer arithmetic algorithms for fixed-point and floating-point binary operations.
- C02** Analyze the architecture, organization and functions of the components of a digital computer.
- C03** Design digital circuits for the given functional description of micro-operations and memory elements.
- C04** Investigate the performance of memory systems, I/O systems, pipelined processors and multiprocessors to evaluate the cost-performance trade-offs.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
C02	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
C03	1	2	3	-	-	-	-	-	-	-	-	-	3	-	-
C04	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: COMPUTER ARITHMETIC & REGISTER TRANSFER AND MICROOPERATIONS (09 Periods)

Computer Arithmetic: Fixed point representation, Floating point representation, Addition and subtraction, Binary multiplication algorithms (Booth Algorithm).

Register Transfer and Microoperations: Register transfer, Bus and memory transfers, Arithmetic microoperations, Logic microoperations, Shift microoperations, Arithmetic logic shift unit.

Module 2: BASIC COMPUTER ORGANIZATION AND DESIGN (08 Periods)

Instruction codes, Computer registers, Computer instructions, Instruction formats, Addressing modes, Timing and control, Instruction cycle, Input-Output and Interrupt.

Module 3: MICRO PROGRAMMED CONTROL AND INPUT-OUTPUT ORGANIZATION (10 Periods)

Micro Programmed Control: Control memory, Address sequencing, Design of control unit, Hardwired control, Micro programmed control.

Input-Output Organization: Peripheral devices, Input-Output interface, Modes of transfer, Priority interrupt – Daisy chaining priority, Parallel priority interrupt, Priority encoder; Direct Memory Access, Input-Output Processor – CPU-IOP communication.

Module 4: THE MEMORY SYSTEM (09 Periods)

Semiconductor RAM memories – Internal organization, Static memories, Dynamic RAMs, Synchronous and Asynchronous DRAMs, Structure of larger memories; Read-only memories, Cache memories – Mapping functions.

Module 5: PIPELINE AND VECTOR PROCESSING, MULTIPROCESSORS, MULTICORE COMPUTERS (09 Periods)

Pipeline and Vector Processing: Parallel processing, Pipelining, Instruction pipeline, Vector processing, Array processors.

Multiprocessors: Characteristics of multiprocessors, Interconnection structures, Inter-processor arbitration.

Multicore Computers: Hardware performance issues, Software performance issues, Multicore organization, Intel Core i7-990X.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Describe the register reference instructions.
2. Draw a timing diagram assuming that SC is cleared to '0' at the time T4 if control signal D4 is active D4 T4:SC□0, D4 is activated with the positive clock transmission associated with T1.
3.
 1. Explain how registers are connected to common bus in the computer with a neat diagram.
 2. List various types of computer instructions and give examples to each category.
4. Explain about address sequencing in micro programmed control unit with an example.
5. Explain types of interrupts with examples.
6. Write a note on Direct Memory Access (DMA).
7. Explain about CPU-IOP communication.
8. Distinguish between parallel processing and pipelining processing.
9. Discuss about the Register transfer with symbols and examples.
10. Design a 4-bit arithmetic logic shift unit.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. M. Morris Mano, Rajib Mall, *Computer System Architecture*, Revised 3rd Edition, Pearson Education, 2017.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, *Computer Organization and Embedded Systems*, 6th Edition, McGraw Hill, 2012.

REFERENCE BOOKS:

1. William Stallings, *Computer Organization and Architecture: Designing for Performance*, 11th Edition, Pearson Education, 2018.
2. Andrew S. Tanenbaum, Todd Austin, *Structured Computer Organization*, 6th Edition, Pearson, 2016.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106105163/>
2. Bilkent Online Courses, Bilkent University, Lectures by William Sawyer, <https://www.youtube.com/watch?v=CDO28Esqmcg>
3. Lecture -1 Introduction to Computer Architecture - YouTube
4. NPTEL : NOC:Computer Architecture and Organization (Computer Science and Engineering)(digimat.in)

Web Resources:

1. <https://www.geeksforgeeks.org/last-minute-notes-computer-organization/>
2. <https://www.javatpoint.com/computer-organization-and-architecture-tutorial>

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22EC104013	MICROCONTROLLER AND INTERFACING	3	-	2	4	5
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: 8051 Microcontroller - Architecture, programming, interrupts and applications

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

- CO1** Analyze various components of a computer system and criterion for choosing a microcontroller for realizing a prototype.
- CO2** Analyze Architectural features and Instruction Set of 8051 for control applications.
- CO3** Develop Programs at Assembly level using various on Chip resources for realizing Medium Scale Applications.
- CO4** Design microcomputer-based systems with the knowledge of Interfaces and Peripherals with 8051 to solve various engineering problems.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	3	-	-	1	-	-	-	-	-	-	3	-	-
CO4	3	2	3	1	-	1	-	1	-	-	-	-	3	-	-
Course Correlation Mapping	3	3	3	1	-	1	-	1	-	-	-	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO MICROCONTROLLERS (09 Periods)

Major components of a computer system, Role of CPU, Major Components & Purpose, Microprocessors Vs Microcontrollers, Concept of Embedded Systems, Criterion for considering a Microcontroller.

Module 2: ARCHITECTURE OF 8051 (09 Periods)

Compare various members of 8051 Family, 8051 Architecture, Register Organization – General & Special purpose, Pin out details, Extended mode (External Memory Interfacing), Timing details, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.

Module 3: PROGRAMMING 8051 AT ASSEMBLY LEVEL (09 Periods)

Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions.

Module 4: PROGRAMMING ON-CHIP RESOURCES AT ASSEMBLY LEVEL (09 Periods)

8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode-2 on a port pin. 8051 Serial Communication- Basics of Serial Data Communication, RS-232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.

Module 5: 8051 INTERFACING (09 Periods)

8255 Introduction, Interfacing 8051 to: LED, 7 –Segment display, LCD, Keyboard, ADC, DAC, Sensor Interfacing, Relay, DC Motor, Stepper Motor.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Arithmetic operations using internal and external memory.
2. Programs using special instructions like SWAP, bit/byte, set/ reset etc.
3. Bank Switching & Branch operations.
4. Timer Programming.
5. Serial communication programming
6. Program related with handling external interrupts
7. Interface LCD.
8. Interfacing LED.
9. Interfacing of matrix keypad.
10. Interfacing of ADC.
11. Interfacing of multi digit 7 segment displays.

12. Interfacing of stepper motor and DC motor.
13. Interfacing of DAC.

PROJECT BASED LEARNING

1. GPS tracker and alcohol detector with engine locking system using GSM.
2. SMS based LPG gas leakage detection system using GSM.
3. RFID Based Attendance System with SMS indication using GSM modem.
4. Microcontroller based Line Follower Robot.
5. Microcontroller based Moving Message Display On LCD.
6. Low-cost LPG leakage detector with buzzer indication using Microcontroller.
7. Fingerprint based attendance management system.
8. SMS based Fire detection system using Smoke and Temperature sensor.
9. Low-Cost Alcohol detector with buzzer indicator mini project using 8051.
10. Voice Operated Home Appliance Control System.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay, "*The 8051 Microcontroller and Embedded Systems-using assembly and C,*" PHI, 2006/ Pearson 2008

REFERENCE BOOKS:

1. Kenneth J. Ayala, "*The 8051 Microcontroller-Architecture, Programming & Applications*", 3rd Edition, Cengage learning, June 2004.

VIDEO LECTURES:

1. Lecture 1 Introduction - YouTube
2. Introduction to 8051 Microcontroller | Part 1 | Bharat Acharya Education - YouTube
3. Lecture 3 Introduction (Contd.) - YouTube
4. Lecture 26 : 8051 Microcontroller(Contd.) - YouTube
5. Lecture 39 : 8051 Programming Examples (Contd.) - YouTube

Web Resources:

1. 8051 Microcontroller Mini Projects - Matlab Projects | Matlab Project | Best IEEE Matlab Projects
2. 8051 Microcontroller Projects List from Microtronics (projectsof8051.com)
3. Microcontrollers - 8051 Architecture (tutorialspoint.com)
4. 8051 MicroController - javatpoint

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CS102005	DATABASE MANAGEMENT SYSTEMS	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Introduction to database systems; Database design; Relational model; Relational algebra; SQL queries; Constraints and triggers; PL/SQL; Schema refinement and normal forms; Transaction management; Concurrency control; Overview of storage and indexing.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Apply the concepts of ER-modelling and normalization to design viable data models for a given problem.
- CO2.** Formulate relational database schemas, apply suitable integrity constraints, for querying databases.
- CO3.** Use SQL to store, query, and manipulate data in relational databases.
- CO4.** Develop PL/SQL blocks to centralize database applications for maintainability and reusability.
- CO5.** Analyze transaction processing, concurrency control and storage methods for database management.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3	-
CO2	3	3	-	-	-	-	2	-	-	-	-	-	3	-	3	-
CO3	3	3	3	-	-	-	-	-	-	-	2	-	3	-	3	-
CO4	2	3	3	-	-	-	-	2	-	-	-	-	3	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	3	3	3	-	-	-	2	2	-	-	2	-	3	-	3	-

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO DATABASE SYSTEMS AND DATABASE DESIGN (09 Periods)

Introduction to Database Systems: Database system applications, Purpose of database systems, View of data - Data abstraction, Instances and schemas, Data models; Database languages - Data Definition Language, Data Manipulation Language; Database architecture, Database users and administrators.

Introduction to Database design: Database design and ER diagrams, Entities, attributes and entity sets, Relationships and relationship sets, Additional features of ER model, Conceptual Design with ER model.

Module 2: RELATIONAL MODEL, RELATIONAL ALGEBRA AND TUPLE CALCULUS (08 Periods)

Relational Model: Creating and modifying relations, Integrity constraints over relations, Enforcing integrity constraints, Querying relational data, Logical database design, Introduction to views, Destroying/altering tables and views.

Relational Algebra and Tuple calculus: Preliminaries, Relational Algebra operators and tuple calculus.

Module 3 SQL AND PL/SQL (09 Periods)

SQL: Form of basic SQL query, Nested queries, Aggregate operators, Null values, Complex integrity constraints in SQL, Triggers and active databases.

PL/SQL: Generic PL/SQL block, PL/SQL data types, Control structure, Procedures and functions, Cursors, Database triggers.

Module 4 SCHEMAREFINEMENTANDTRANSACTIONS (10 Periods)

Schema Refinement: Problems caused by redundancy, Decompositions, Problems related to decomposition, Functional dependencies, Reasoning about FDs, First normal form, Second normal form, Third normal form, Boyce-Codd normal form, Multivalued dependencies, Fourth normal form, Join dependencies, Fifth normal form.

Transactions: Transaction concept, Transaction atomicity and durability, Concurrent Executions – Serializability, Recoverability, Implementation of isolation, Testing for serializability.

Module 5 CONCURRENCYCONTROL,STORAGEANDINDEXING (09 Periods)

Concurrency Control: Lock Based Protocols, Timestamp Based Protocols, Validation Based Protocols, Multiple Granularity, Deadlock Handling.

Storage and Indexing: Data on external storage, File organizations and indexing – Clustered indexes, Primary and secondary indexes; Index data structures – Hash based indexing, Tree based indexing; B and B+ Trees, Comparison of file organizations.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

Week 1:

Design and analyze an ER Model for the following use case.

The Library Management System database keeps track of readers with the following considerations –

- The system keeps track of the staff with a single point authentication system comprising login Id and password.
- Staff maintains the book catalog with its ISBN, Book title, price(in INR), category(novel, general, story), edition, author Number and details.
- A publisher has publisher Id, Year when the book was published, and name of the book.
- Readers are registered with their user_id, email, name (first name, last name), Phone no (multiple entries allowed), communication address. The staff keeps track of readers.

Choose appropriate Entities and attributes and relationships and draw the complete ER diagram.

Week 2:

- a) Implement Data Definition Language commands -Create, Alter, Drop, Truncate, and Rename.
- b) Implement Data Manipulation Language commands - Insert, Select, Update, and Delete.
- c) Implement Single Row functions - Character, Numeric and Date functions.

Week 3:

Implement various types of integrity constraints - NOT NULL constraint, DEFAULT constraint, UNIQUE constraint, PRIMARY key, FOREIGN key, CHECK constraint.

Week 4:

- a) Implement group functions with different operators such as aggregate operators, group by, having and order by.
- b) Implement nested and correlated nested queries using set operators and set comparison operators.

Week 5:

- a) Creation of views, synonyms, sequence, indexes and save point.
- b) Implement various types of joins - outer join and inner join.

Basic PL/SQL:

Week 6:Construct PL/SQL block for the following.

- a) To determine whether a number is palindrome
- b) To determine whether a number is an Armstrong number
- c) To find greatest of three numbers
- d) To display Fibonacci series

Control Structures:

Week 7:

- a) Write a program in PL/SQL to update the salary of a specific employee by 20% if the salary less than 30000/- and 10% when the salary in between 30000/- and 60000/- and 5% when the salary is above 60000/- and display the salary with a suitable message.
- b) Write a PL/SQL program to display the description of the grade against a student's grade using CASE statement.

Exception Handling:

Week 8:

- a) Develop a PL/SQL program that displays the name and address of a student whose ID is given. If there is no student with the given student ID in the database, the program should raise a run-time exception NO_DATA_FOUND, which should be captured in the EXCEPTION block.
- b) Construct the user-defined exceptions to get the salary of an employee and check it with the job's salary range. If the salary is below the range, raise an exception BELOW_SALARY_RANGE. If the salary is above the range, raise the exception ABOVE_SALARY_RANGE.

Functions:

Week 9:

- a) Write a function that accepts two numbers A and B and performs the following operations.
 - Addition
 - Subtraction
 - Multiplication
 - Division
- b) Write a PL/SQL block that reverses the given number.

Procedures:

Week 10:

- a) Write a procedure that accepts two numbers and displays their sum.
- b) Write procedures to demonstrate IN, IN OUT and OUT parameters.

Cursors:

Week 11:

- a) Write a block in PL/SQL to create a Cursor that displays the employee name and number of jobs he or she has done in the past.
- b) Write a program in PL/SQL to create a cursor to display the name and salary of each employee in the EMPLOYEES table whose salary is less than that specified by a passed-in parameter value.

Triggers:

Week 12:

Develop a suitable employee database application by considering appropriate attributes.

- a) Whenever the inserted or updated salary is more than 10 lacs per month a trigger should be fired.
- b) Whenever, the inserted or updated salary is less than 5000 per month a trigger should be activated.

RESOURCES

TEXT BOOKS:

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw Hill, 3rd Edition, 2014.
2. Abraham Silberschatz, Henry. F. Korth, S. Sudarshan, Database System Concepts, McGraw Hill, 7th edition, 2019.

REFERENCE BOOKS:

1. Ivan Bayross, SQL, PL/SQL: The Programming Language of Oracle, BPB publications, 4th Edition, 2017.
2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, 7th Edition, Pearson, 2015.

SOFTWARE/TOOLS:

1. Oracle SQL plus

VIDEO RESOURCES:

1. <https://www.youtube.com/watch?v=c5HAWKX-suM>
2. <https://www.udemy.com/course/introduction-to-database-system/>
3. <https://www.coursera.org/courses?query=database%20management>

WEB RESOURCES:

1. https://swayam.gov.in/nd1_noc19_cs46/preview
2. <https://www.classcentral.com/course/swayam-introduction-to-database-systems-17660>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS104002	MOBILE APPLICATION DEVELOPMENT	3	-	2	4	5

Pre-Requisite Object Oriented Programming through Java

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Mobile platforms; Mobile User Interface and tools; Introduction to Android; Activities; Views; Menus; Database Storage; SMS; e-mail; Displaying Maps; Building a Location Tracker Web Services Using HTTP; Sockets Programming; Communication between a Service and an Activity; Introduction to iOS.

COURSE OUTCOMES: *After successful completion of this course, the students will be able to:*

- CO1.** Demonstrate knowledge on mobile platforms, mobile user interface and user interface design requirements.
- CO2.** Design user interfaces by analyzing user requirements.
- CO3.** Develop mobile applications for Messaging, Location-Based Services, And Networking.
- CO4.** Develop mobile applications and publish in different mobile platforms.

CO-PO-PSO Mapping Table:

Course Outcome	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	1	2	3	2	-	-	-	-	-	-	-	-	3	-	-	-
CO3	1	2	2	2	3	2	2	1	-	-	-	-	3	-	-	2
CO4	1	2	3	2	3	2	2	1	-	-	-	-	3	-	-	-
Course Correlation Mapping	3	2	3	2	3	2	2	1	-	-	-	-	3	-	-	2

Correlation Level: 3-High; 2-Medium; 1-Low

DETAILED SYLLABUS:

Module - I: INTRODUCTION AND MOBILE USER INTERFACE DESIGN (08 periods)

Mobile web presence, Mobile applications, Marketing, App as a mobile web app; User interface design - Effective use of screen real estate, Mobile application users, Mobile information design, Mobile platforms, Tools of mobile interface design.

Android versions, Features and architecture, Required tools, Android application launching.

Module - II: ACTIVITIES, INTENTS AND ANDROID USER INTERFACE (09 periods)

Activities, Linking activities using intents, Calling Built – In Applications Using Intents, Displaying notifications, Components of a screen, Adapting to display orientation, Managing changes to screen orientation, Utilizing the action bar, Listening for UI notifications.

Module-III: ADVANCED USER INTERFACE AND DATA PERSISTENCE (10 periods)

Basic views, Picker views, List view, Image view, Menus with views, Web view, Saving and loading user preferences, Persisting data to files, Creating and using databases.

ModuleIV: MESSAGING, LOCATION-BASED SERVICES, AND NETWORKING (09 Periods)

SMS messaging, Sending e-mail, Displaying maps, Getting location data, Monitoring a location, Consuming web services using HTTP.

Module- V: ANDROID SERVICES, PUBLISHING ANDROID APPLICATIONS AND IOS (09 Periods)

Services, Communication between a service and an activity, Binding activities to services, Threading, Preparing for publishing, Deploying APK files.

iOS tools, iOS project, Debugging iOS apps, Objective-C basics, Hello world app, Building the derby app in iOS.

Total Periods: 45

Experiential Learning

1. Develop an application that uses GUI components, Font and Colours
2. Develop an application that uses Layout Managers and event listeners.
3. Write an application that draws basic graphical primitives on the screen.
4. Develop an application that makes use of databases.
5. Develop an application that makes use of Notification Manager.
6. Implement an application that uses Multi-threading.
7. Develop a native application that uses GPS location information
8. Implement an application that writes data to the SD card.
9. Implement an application that creates an alert upon receiving a message
10. Write a mobile application that makes use of RSS feed

MINI-PROJECT

11. Develop a mobile application to send an email.
12. Develop a Mobile application for simple needs

TEXT BOOKS:

1. J. F. DiMarzio, "Beginning Android Programming with Android Studio," Wiley India, Fourth Edition, 2017.
2. Wei – Meng Lee, "Beginning Android 4 Application Development", Wrox, 2017.
3. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development," Wiley India, First Edition, 2012.

REFERENCE BOOKS:

1. Neils Smyth "Android Studio Development Essentials," Creative Space Independent publishing platform, Seventh edition 2016.
2. Paul Deital and Harvey Deital, "Android How to Program," Detial associates publishers, First Edition, 2013.

SOFTWARE/TOOLS:

1. Software: Eclipse / Net beans / JDK 1.7
2. Java compatible web browser

VIDEO LECTURES::

1. <https://www.youtube.com/playlist?list=PLknSwrodgQ72X4sKpzf5vT8kY80HKcUSe>
2. <https://www.udemy.com/topic/android-development/free/>
3. <https://www.udemy.com/course/mobile-application-development-using-android/>

WEB RESOURCES:

1. <https://developer.android.com/>
2. <https://egyankosh.ac.in/handle/123456789/70868>
3. <https://www.tru.ca/distance/courses/comp2161.html>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI104002	OBJECT ORIENTED PROGRAMMING THROUGH JAVA	3	-	2	4	5

Pre-Requisite Programming for Problem Solving

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is emphasize on the fundamentals structure design with classes including development, testing, implementation and documentation. This course also focuses on understanding and practical mastery of object oriented concepts such as classes, objects, data abstraction, methods, method overloading, inheritance and polymorphism. By end of the course, students will acquire the basic knowledge and skills necessary to implement object-oriented programming techniques in software development using Java.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Apply object oriented programming constructs to solve computational problems.
- CO2.** Use Exception handling and multithreading mechanisms to create efficient software applications.
- CO3.** Create Web based applications using collections frameworks to solve real world problems.
- CO4.** Design and develop GUI using applets and swings for internet and system based applications.
- CO5.** Work independently or in team to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	3	-	-	-	2	-	-	-	-	2	3	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	2	-	3	-	-	-
CO4	2	3	3	-	-	-	-	2	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	3	3	2	-	-	-	2	2	3	3	2	2	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: OOPS FUNDAMENTALS

(09 Periods)

Introduction: History of Java, Byte code, JVM, Java buzzwords, OOP principles, Data types, Variables, Scope and life time of variables, Operators, Control statements, Type conversion and casting, Arrays.

Concepts Of Classes And Objects: Introducing methods, Method overloading, Constructors, Constructor overloading, Usage of static with data and method, Access control, this key word, Garbage collection, String class, StringTokenizer.

Module 2: INHERITANCE, INTERFACE AND PACKAGES

(09 Periods)

Inheritance basics, Types of inheritance, Member access rules, Usage of super key word, Method overriding, Usage of final, Abstract classes, Interfaces - differences between abstract classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces; Packages - defining, creating and accessing a package, importing packages, access control in packages.

Module 3 EXCEPTION HANDLING AND MULTITHREADING

(10 Periods)

Exception Handling: Concepts of exception handling, Types of exceptions, Usage of try, catch, throw, throws and finally keywords, Built-in exceptions, Creating user defined exception;

Multithreading: Concepts of multithreading, Differences between process and thread, Thread life cycle, Creating multiple threads using Thread class and Runnable interface, Synchronization, Thread priorities, Inter thread communication.

Module 4 COLLECTION FRAMEWORK

(08 Periods)

Collection Framework: Collections Overview, Collection Interfaces - List, Set, Map, List - ArrayList, Linked List, Vector, Set - HashSet, TreeSet, Map - Hashtable, HashMap, Accessing a collection via an Iterator, comparator, comparable.

Module 5 GUI PROGRAMMING

(09 Periods)

GUI Programming With Applets: Applets - Applet Class, Applet skeleton, Simple Applet; Delegation event model - Events, Event sources, Event Listeners, Event classes, handling mouse and keyboard events.

Exploring Swing Controls: JLabel and Image Icon, JText Field, JButton, JCheckBox, JRadioButton, JTabbed Pane, JList, JCombo Box.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

OOPS Fundamentals

1. a) Develop a Java application for generating Electricity bill.
Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff. If the type of the EB connection is domestic, calculate the amount to be paid as follows:
 - First 100 units - Rs. 1 per unit
 - 101-200 units - Rs. 2.50 per unit
 - 201 -500 units - Rs. 4 per unit
 - >501 units - Rs. 6 per unitIf the type of the EB connection is commercial, calculate the amount to be paid as follows:
 - First 100 units - Rs. 2 per unit
 - 101-200 units - Rs. 4.50 per unit
 - 201 -500 units - Rs. 6 per unit
 - > 501 units - Rs. 7 per unit
- b) Design a class to represent a Student details include the Student ID, Name of the Student, Branch, year, location and college. Assign initial values using Constructor. Calculate average of marks of 6 subjects and calculate attendance percentage.
2. a) Create a class Student which has data members as name, branch, roll no, age, sex, marks in five subjects. Display the name of the student and his percentage who has more than 70%.Use array of objects.
- b) Write a program to perform addition of two complex numbers using constructor overloading. The first constructor which takes no argument is used to create objects which are not initialized, second which takes one argument is used to initialize real and imaginary parts to equal values and third which takes two argument is used to initialized real and imaginary to two different values.

Inheritance

- 3 a) Create a base class basic_info with data members name, roll no, sex and two member functions getdata and display. Derive a class physical_fit from basic_info which has data members height and weight and member functions getdata and display. Display all the information using object of derived class.
- b) Create class first with data members book no, book name and member function getdata and putdata. Create a class second with data members author name, publisher and members getdata and showdata. Derive a class third from first and second with data member no of pages and year of publication. Display all these information using array of objects of third class.
- 4 A High School application has two classes: The Person superclass (Name, age, Gender) and the Student subclass (RegNo, Dept, CGPA).Using inheritance, create two new classes, Teacher and College Student. Teacher will be like Person but will have additional properties such as salary (the amount the teacher earns) and subject (e.g., "Computer Science", "Chemistry", "English", "Other"). The College Student class will extend the Student class by adding a year (current level in college) and major (e.g., "Electrical Engineering", "Communications", "Undeclared"). Create objects and test the functionality of all the methods.
- 5 Develop a java application for generating pay slip on different category of employees using the concept of inheritance.

Exception Handling and Multithreading

- 6 Consider two integers x and y as input and compute the value of x/y. Implement a class which raise an exception if x and y are not signed integers or if y is zero.
- 7
 - a) Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number
 - b) Write a program that creates three threads. First thread displays "Good Morning" every one second, the second thread displays "Hello" every two seconds and the third thread displays "Welcome" every three seconds.

Collection Framework

- 8 Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -, *, % operations. Add a text field to display the result. Handle any possible exceptions like divide by zero.

GUI Programming

- 9
 - a) Write a java program that simulates a traffic light. The program lets the user select one of three lights: Red, Yellow or Green with radio buttons. On selecting a button an appropriate message with "STOP" or "READY" or "GO" should appear above the buttons in selected color. Initially, there is no message shown.
 - b) Write an Applet that computes the payment of a loan on the amount of the loan, the interest rate and the number of months. It takes one parameter from the browser. Monthly; if true, the interest rate is per month, otherwise the interest rate is annual.
 - c) Write a java programs to find factorial of a number. User is allowed to enter a number into the text field whose factorial is to be determined. On pressing the button the value of the text field is firstly converted into integer and then processed to find its factorial. The result will get displayed in another text field. (Hint: use swings).

PROJECT BASED LEARNING:

Faculty shall provide Projects relevant to the contents of the course.

Sample Projects:

1. CALENDER APPLICATION

Develop a calendar application that uses many windows properties to make it colorful, for example, to indicate the vacation, it uses the red foreground color. The calendar can be used for two purposes. First to see the date and month as usual calendars and second to find out the day corresponding to given date. Some of the salient features of the project are

1. It uses various windows properties to make the program colorful although it has lack of graphics.
2. It entirely uses java code which is written in simple manner with lots of comments and important notes can be added.
3. The date with such notes appears different than others with red background color
4. The months can be navigated using arrow keys.

2. TICKET RESERVATION SYSTEM

Develop Ticket reservation system to manage details of seats, passenger, trains, Bookings and stations. The features required to be implemented are as follows

1. Provides searching facility based on factors such as seats, trains, booking and stations
2. Manage the information of passengers
3. Shows the information of the seats and trains
4. Provide filter on train, booking, time and station
5. Information Management of booking
6. Export excel report for trains, passengers and station
7. Export pdf for booking details

RESOURCES

TEXT BOOKS:

1. Herbert Schildt, "Java the complete reference", 11th edition, McGraw Hill, Education, 2018.
2. C. Thomas Wu, "An Introduction to Object-Oriented Programming with Java 5th edition", McGraw-Hill Higher Education 2010.

REFERENCE BOOKS:

1. J. Nino and F.A. Hosch, "An Introduction to programming and OOPS design using Java", 3rd edition, John Wiley & sons, 2008.
2. P. Radha Krishna, "Object Oriented Programming through Java", 1st edition, Universities Press, 2007.

SOFTWARE/TOOLS:

1. Software: Eclipse / Net beans / JDK 1.7
2. Java compatible web browser

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106105191>
2. <https://www.udemy.com/course/java-tutorial/>

WEB RESOURCES:

1. https://www.tutorialspoint.com/java/java_tutorial.pdf
2. <https://www.guru99.com/java-tutorial.html>

PROGRAM ELECTIVE

Course Code

Course Title

L T P S C

22CS102007

LINUX PROGRAMMING

3 - 2 - 4

Pre-Requisite Programming for Problem Solving

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Concepts on Linux Programming; Shell Programming; Process, Signals and File System Structure; Inter process Communications and Socket Programming for Client-Server Interaction.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge on
 - ☐ Shell programming
 - ☐ File Structure and System Calls
 - ☐ Processes management and handling signals,
 - ☐ IPC and Sockets
- CO2.** Analyze shell scripts and system calls related to Linux Environment.
- CO3.** Design shell scripts and system calls for specified computational problems
- CO4.** Use appropriate shell scripts and system calls for solving complex problems.
- CO5.** Provide appropriate Linux solutions for real time applications

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3
CO2	3	3	-	-	-	-	2	-	-	-	-	-	3	-	3
CO3	3	3	3	-	-	-	-	-	-	-	2	-	3	-	3
CO4	2	3	3	-	-	-	-	2	-	-	-	-	3	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	3	3	3	-	-	-	2	2	-	-	2	-	3	-	3

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT

MODULE-I: INTRODUCTION TO LINUX AND LINUX ENVIRONMEN (09 Periods)

The GNU project and the Free Software Foundation, Linuxdistributions, Programming Linux - Linux programs, Text editors, The C Compiler; Program arguments - getopt, getopt_long. Environment variables - Use of environment variables, The environ variable, Time and Date, User information, Host information.

MODULE-II: SHELL PROGRAMMING (09 Periods)

Necessity of shell programming, Pipes and redirection - Redirecting output, Redirecting input, Pipes, The Shell as a programming language - Interactive programs, Creating a script, Making a script executable, Shell syntax - Variables, Conditions, Control structures, Functions, Commands, Command execution.

MODULE-III: FILE SYSTEM STRUCTURE AND SYSTEM CALLS (09 Periods)

Linux File Structure and Commands: File structure - Directories, Files and devices, System calls and Device drivers; Library functions - Low-level file access, write, read and open commands, Initial permissions, Other system calls for managing files; File and directory maintenance commands - chmod, chown, unlink, link, symlink, mkdir, rmdir, chdir, getcwd. Input-Output Commands: The standard I/O library commands - fopen, fread, fwrite, fclose, fflush, fseek, fgetc, getc, and getchar, fputc, putc and putchar, fgets and gets; Formatted input and output commands - printf, fprintf, sprintf, scanf, fscanf, sscanf.

MODULE-IV: PROCESS AND SIGNALS (08 Periods)

Process structure - Process table, Viewing processes, System processes, Process scheduling; Starting new processes - Waiting for a process, Zombie processes, Input and output redirection, Threads; Signals - Sending signals, Signal sets.

MODULE-V: INTER-PROCESS COMMUNICATION AND SOCKETS (10 Periods)

Inter-Process Communication: Pipe definition, Process pipes, Sending output to popen - Passing more data, popen, implementation, The pipe call; Parent and child processes - Reading closed pipes, pipes used as standard input and output; Named pipes - FIFOs, Accessing a FIFO, Client/Server using FIFOs. Socket Connections: Socket attributes, Creating a socket, Socket addresses, Naming a socket, Creating a socket queue, Accepting connections, Requesting connections, Closing a socket, Socket communications, Host and network byte ordering.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Write a shell script to find the sum, the average and the product of the four integers entered
2. Write a shell program to exchange the values of two variables
3. Find the lines containing a number in a file
Echo "Enter filename"
Read filename
Grep [0-9] \$filename
4. Write a shell script to display the digits which are in odd position in a given 5 digit number
5. Write a shell program to reverse the digits of five digit integer.
6. Write a shell program to convert all the contents into the uppercase in a particular file.
7. Find occurrence of particular digit in inputted number.
8. Write a shell program to find the position of substring in given string.
9. Write shell script to print alternate digits when a 7 digit number is passed as input
10. Write shell script to generate fibonacci series

TEXT BOOK:

1. Neil Matthew and Richard Stones, Beginning Linux Programming, Wiley Dreamtech, Fourth Edition, 2008.

REFERENCE BOOKS:

1. Richard Petersen, Linux: The Complete Reference, TataMcGraw-Hill, Sixth edition, 2007.
2. Sumitabha Das, Your UNIX: The Ultimate Guide, TataMcGraw-Hill, 2007.

SOFTWARE/TOOLS:

1. <https://learn.microsoft.com/en-us/windows/wsl/install>
2. <https://www.geeksforgeeks.org/essential-linuxunix-commands/>

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=k4Ww6gFeF0M>
2. <https://www.youtube.com/watch?v=vLPdBp9vv9Y>
3. <https://www.youtube.com/watch?v=lqYSCSgFefM&list=PL6UwySlcwEYIZGsbXnUxsojD0yeUA67lb>

WEB RESOURCES:

1. <https://www.udemy.com/course/bash-shell-scripting-crash-course-for-beginners>
2. <https://www.geeksforgeeks.org/essential-linuxunix-commands>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT104001	WEB TECHNOLOGIES	3	-	2	4	5
Pre-Requisite	Object Oriented Programming through Java					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Hyper Text Markup Language (HTML); Features of HTML5; Cascading Style Sheets (CSS); JavaScript; JQuery; Bootstrap; Hypertext Preprocessor (PHP); MySQL.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

- CO1.** Demonstrate knowledge on web page design elements, dynamic content and database connection.
- CO2.** Analyze user requirements to develop web applications.
- CO3.** Design client-server applications using web technologies.
- CO4.** Demonstrate problem solving skills to develop enterprise web applications.
- CO5.** Apply HTML, CSS, JavaScript, JQuery, Bootstrap and PHP technologies for device independent web application development.
- CO6.** Apply web technologies to develop interactive, dynamic and scalable web applications for societal needs.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	2	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	2	2	3	-
CO5	3	2	2	2	2	3	-	-	-	-	-	-	2	2	3	-
CO6	-	-	-	2	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	2	2	3	-	-	3	3	-	-	3	2	3	-

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT:

Module-1: HTML

(09 periods)

Introduction: Fundamentals of HTML, Working with Text, Organizing Text in HTML, Working with Links and URLs, Creating Tables, Working with Images, Canvas, Forms, Frames and Multimedia.

HTML5: Introduction, HTML5 Document Structure, Creating Editable Content, Checking Spelling Mistakes, Exploring Custom Data Attributes, Client-Side Storage, Drag and Drop Feature, Offline Web Applications, Web Communications, Cross-Document Messaging and Desktop Notifications.

Module-2: CSS AND JAVASCRIPT

(10 periods)

CSS: Introduction, CSS Selectors, Inserting CSS in an HTML document, Backgrounds, Fonts, and Text Styles, Creating Boxes, Displaying, Positioning and Floating Elements, Features of CSS3, Media Queries.

Javascript: Overview of JavaScript, JavaScript Functions, Events, Image Maps and Animations, JavaScript Objects, Working with Browser and Document Objects, JQuery - Introduction, JQuery Selectors, Events, Methods to access HTML elements and attributes, Introduction to AJAX.

Module-3: BOOTSTRAP

(09 periods)

Getting Started with Bootstrap, Creating Responsive Layouts Using Bootstrap CSS - Basic HTML structure for Bootstrap, Responsive classes, Rendering images, The grid system, Constructing data entry forms, Packaged Components in Bootstrap - The page header, Glyphicons, The navigation bar, Badges, Alerts, Toolbars and button groups, Panels.

Module-4: INTRODUCTION TO PHP

(09 periods)

Introduction, Data Types, Variables, Constants, Expressions, String Interpolation, Control Structures, Functions, Arrays, Embedding PHP Code in Web Pages, Object Oriented PHP.

Module-5: PHP WEB FORMS AND MYSQL

(08 periods)

PHP Web forms: PHP and Web Forms, Sending Form Data to a Server, Working with Cookies and Session Handlers

PHP with MySQL: Interacting with the Database, Prepared Statement, Database Transactions.

Total Periods: 45

EXPERIENTIAL LEARNING

List of Exercises:

1. Design the following static web pages of an online book store web application.

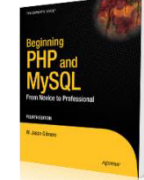
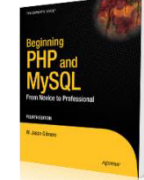
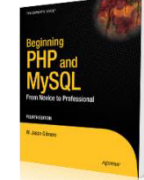
a. Home Page:

Logo	Name of the Book Store			
<i>Home</i>	<i>Latest Arrivals</i>	<i>Best Sellers</i>	<i>Contact Us</i>	<i>Search</i>
Computers Electronics Electrical Bio-Tech	Description of the Book Store (Images, Scroll Text, etc)		Username Password Sign-in New User Create an Account	

b. Catalogue Page:

The catalogue page should display the following details of available books.

i. Snap shot of cover page	ii. Title of the text book	iii. Author name
iv. Publisher	v. Price	vi. More details link.

Logo	Name of the Book Store									
<i>Home</i>	<i>Latest Arrivals</i>	<i>Best Sellers</i>	<i>Contact Us</i>	<i>Search</i>						
Computers Electronics Electrical Bio-Tech	<table border="1"> <tr> <td></td> <td> HTML5 Black Book Kogent Learning Solutions Dreamtech Press Rs. 570/- </td> <td>More Details</td> </tr> <tr> <td></td> <td> Beginning PHP and MySQL 4th Edition W Jason Gilmore Apress Rs. 520/- </td> <td>More Details</td> </tr> </table>					HTML5 Black Book Kogent Learning Solutions Dreamtech Press Rs. 570/-	More Details		Beginning PHP and MySQL 4th Edition W Jason Gilmore Apress Rs. 520/-	More Details
	HTML5 Black Book Kogent Learning Solutions Dreamtech Press Rs. 570/-	More Details								
	Beginning PHP and MySQL 4th Edition W Jason Gilmore Apress Rs. 520/-	More Details								

c. Registration Page:

Design the Registration page with the following fields and navigate it with create an account link.

i. First Name	ii. Last Name	iii. Gender
iv. Date of Birth	v. Username	vi. Password
vii. Confirm Password	viii. Address	ix. Postal Code
x. Mobile No.	xi. Email-Id	

2. a. Design a web page to store username and password information using the local storage concept.
- b. Design a web page to store employee information including Name, Emp. Id, Department, Salary and Address on a client's machine using a real SQL database.

3. Apply the following styles to all web pages of online book store web application.
 - a. Fonts and Styles: font-family, font-style, font-weight and font-size
 - b. Backgrounds and colors: color, background-color, background-image and background-repeat
 - c. Text: text-decoration, text-transformation, text-align and text-indentation, text-align
 - d. Borders: border, border-width, border-color and border-style
 - e. Styles for links: A: link, A: visited, A:active, A:hover
 - f. Selectors, Classes, Layers and Positioning elements.
4. Write a JavaScript/JQuery code to validate the following fields of the Registration web page.
 - a. First Name/Last Name - should contain only alphabets and the length should not be less than 8 characters.
 - b. Username - It should contain combination of alphabets, numbers and underscore. It should not allow spaces and special symbols.
 - c. Password - It should not less than 8 characters in length and it contains one uppercase letter and one special symbol.
 - d. Date of Birth - It should allow only valid date; otherwise display a message stating that entered date is invalid. Ex. 29 Feb. 2009 is an invalid date.
 - e. Postal Code: It must allow only 6 digit valid number.
 - f. Mobile No. - It should allow only numbers and total number of digits should be equal to 10.
 - g. e-mail id - It should allow the mail id with the following format:
Ex. mailid@domainname.com
5. Design a web page with the following features using HTML5, JavaScript and JQuery
 - a. Displaying of images with Custom animated effects
 - b. Playing of selected video from the list of videos
 - c. Showing the animated text in increasing and decreasing font size
 - d. Changing the size of the area in a web page using DIV tag
 - e. Hiding and Showing elements in a web page.
6. Design a web page with the following features using Bootstrap and Media Query.
 - a. Components
 - b. Responsive tables
 - c. Responsive images and videos
 - d. Toolbars, Buttons and Lists
7.
 - a. Deploy and navigate web pages of online book store using WAMP/XAMPP web server.
 - b. Write a PHP program to read user name and favorite color from the HTML form. Display the name of the user in green color and sets user favorite color as a background for the web page.
8. Write a PHP code to read the username and password entered in the Login form of the online book store and authenticate with the values available in cookies. If user enters a valid username and password, welcome the user by username otherwise display a message stating that, entered details are invalid.
9. Write a PHP code to read user details entered through the registration web page and store the same into MySQL database.
10. Write a PHP code for storing books details like Name of the book, author, publisher, edition, price, etc into MySQL database. Embed a PHP code in catalogue page of the online book store to extract books details from the database.

RESOURCES

TEXT BOOKS:

1. Kogent Learning Solutions Inc, *HTML 5 Black Book: Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP and JQuery*, Dreamtech Press, FirstEdition, 2011.
2. W. Jason Gilmore, *Beginning PHP and MySQL*, APress, Fourth Edition, 2011.

REFERENCE BOOKS:

1. Snig Bahumik, *Bootstrap Essentials*, PACKT Publishing, First Edition, 2015 (e-book).
2. Thomas A. Powell, *The Complete Reference: HTML and CSS*, Tata McGraw Hill, Fifth Edition, 2010.
3. Andrea Tarr, *PHP and MySQL*, Willy India, First Edition, 2012.

VIDEO LECTURES:

1. <https://www.w3schools.com/php/DEFAULT.asp>

WEB RESOURCES:

1. <https://www.w3schools.com/php/DEFAULT.asp>
2. <https://www.w3schools.com/js/>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT101001	SOFTWARE ENGINEERING	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Concepts of Software Engineering; SoftwareProcess Models; Conventional and Agile Process Models; SoftwareRequirements Engineering Process; System Analysis; Architectural Design; User Interface Design and Re-engineering; Software Testing; Risk and QualityManagement.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

- CO1.** Demonstrate knowledge on Fundamental concepts of software engineering and analyze process models required to develop a software system.
- CO2.** Analyze software requirements and model requirements for the given scenario.
- CO3.** Apply design concepts and metrics for software development.
- CO4.** Apply testing strategies and techniques for quality software.
- CO5.** Analyze risks in software development life cycle and apply risk strategies to mitigate risks.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	2	3	-	-	-	3	3	2	-	-	2	-	-	-	3	-
CO3	2	3	3	2	-	2	2	-	-	-	3	-	-	-	3	-
CO4	2	-	-	-	2	3	-	-	-	-	-	-	-	-	3	-
CO5	2	3	-	-	2	3	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	2	3	3	2	2	3	3	2	-	-	3	-	-	-	3	-

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT:

MODULE 1: SOFTWARE ENGINEERING AND SOFTWARE PROCESS (09 Periods)

Engineering Layers; The Software Process, Software Engineering Practice, Software myths.

Process models: A Generic Process Model, Prescriptive Process Models-The Waterfall Model, Incremental Process Models, Specialized Process Models; The Unified Process, Agile Development-Agility, Agile Process, Extreme Programming (XP), Scrum, Lean Software Development (LSD), Dynamic System Development Method, Agile Modeling (AM), Agile Unified Process (AUP), The Cleanroom strategy.

MODULE 2: REQUIREMENTS ENGINEERING AND MODELING (09 Periods)

Requirements Engineering: Functional and non-functional requirements, The software requirements document, Requirements specifications, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

Requirements Modeling: Requirements Analysis, Data Modeling Concepts, Flow-Oriented Modeling, Scenario based Modeling, UML Models that supplement the Use Case Case study on Requirements modeling for Web and Mobile Apps.

MODULE 3: DESIGN ENGINEERING AND METRICS (09 Periods)

Design Engineering: Design within the context of Software Engineering, The Design process, Design concepts, Software Architecture, Architectural Styles, Architectural design, Pattern based Design-Design Patterns, Pattern based software design.

Process and Project Metrics: Metrics in the process and project domains, Software Measurement, Metrics for software quality.

MODULE 4: SOFTWARE TESTING STRATEGIES AND APPLICATIONS (09 Periods)

Testing strategies: A strategic approach to software testing, Strategic issues, Test strategies for conventional software, Test strategies for object oriented software, Validation testing, System testing, The art of debugging.

Testing Conventional Applications: Software testing fundamentals, White box testing-Basis path testing, Control structure testing; Black box testing, Object oriented testing methods.

MODULE 5: RISK, QUALITY MANAGEMENT AND REENGINEERING (09 Periods)

Risk and Quality Management: Reactive and Proactive risk strategies, Software risks, Risk Mitigation Monitoring and Management (RMMM), RMMM plan, Software quality factors, Defect Amplification Model, Formal Technical Reviews (FTR), Software Quality Assurance (SQA)-Tasks, Goals and Metrics; Software reliability.

Reengineering: Introduction, Business Process Reengineering (BPR), Software Reengineering, Restructuring, Reverse engineering, Forward engineering.

Total Periods: 45

EXPERIENTIAL LEARNING:

CASE STUDY 1: RECRUITMENT PROCEDURE FOR SOFTWARE INDUSTRY

Problem Statement: In the software industry the recruitment procedure is the basic thing that goes in the hand with the requirement as specified by the technical management team. HR first gives an advertisement in leading Newspapers, Journals, Weeklies and Websites. The job seekers can apply for it through by Post or by e-mail to the company. The technical skill and the experience of the candidates are reviewed and the short listed candidates are called for the interview. There may be different rounds for interview like the written test, technical interview, and HR interview. After the successful completion of all rounds of interview, the selected candidates' names are displayed. Meanwhile HR gives all the details about the salary, working hours, terms and conditions and the retirement benefit to the candidate.

CASE STUDY 2: ONLINE AUCTION SALES

Problem Statement: The online auction system is a design about a website where sellers collect and prepare a list of items they want to sell and place it on the website for visualizing. To accomplish this purpose the user has to access the site. In case it's a new user he has to register. Purchaser's login and select items they want to buy and keep bidding for it. Interacting with the purchasers and sellers through messages does this. There is no need for customer to interact with the sellers because every time the purchasers bid, the details will be updated in the database. The purchaser making the highest bid for an item before the close of the auction is declared as the owner of the item. If the auctioneer or the purchaser doesn't want to bid for the product then there is a fixed cutoff price mentioned for every product. He can pay that amount directly and own the product. The purchaser gets a confirmation of his purchase as an acknowledgement from the website. After the transaction by going back to the main menu where he can view other items.

TEXT BOOKS:

1. Roger S. Pressman, *Software Engineering - A Practitioner's Approach*, McGraw-Hill, Eight Edition, 2015.
2. Ian Sommerville, *Software Engineering*, Pearson Education, Ninth Edition, 2011.

REFERENCE BOOKS:

3. K. K. Aggarwal and Yogesh Singh, *Software Engineering*, New Age International Publishers, Third Edition, 2007.
4. Shelly Cashman Rosenblatt, *Systems Analysis and Design*, Thomson Publications, Sixth Edition, 2006.

ADDITIONAL LEARNING RESOURCES:

1. <https://nptel.ac.in/courses/106105087/>
2. <https://nptel.ac.in/courses/106105182/>

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc20_cs68/
2. <https://www.coursera.org/courses?query=software%20engineering>

WEB RESOURCES:

1. <https://www.mltut.com/best-coursera-courses-for-software-engineering/>
2. <https://medium.com/javarevisited/10-best-software-development-courses-certifications-from-coursera-4ccc59aae201>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS103001	OBJECT ORIENTED MODELING AND DESIGN	3	-	-	4	4

Pre-Requisite Software Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Introduction to UML, Basic structural modeling; Advanced structural modeling, Class and object diagrams; Basic behavioral modeling; Advanced behavioral modeling; Architectural modeling.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge on principles of object oriented analysis and design through UML Diagrams.
- CO2.** Analyze user requirements and identify suitable structural and behavioral modeling components.
- CO3.** Design and develop UML models for real time software applications.
- CO4.** Solve real world problems by applying structural and behavioral modeling techniques.
- CO5.** Use unified modeling language in preparing blue prints for software solutions.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3	-
CO2	3	3	-	-	-	-	2	-	-	-	-	-	3	-	3	-
CO3	3	3	3	-	-	-	-	-	-	-	2	-	3	-	3	-
CO4	2	3	3	-	-	-	-	2	-	-	-	-	3	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	3	3	3	-	-	-	2	2	-	-	2	-	3	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

MODULE-I: INTRODUCTION TO UML AND BASIC STRUCTURAL MODELING (11 Periods)

Introduction to UML: Importance of modeling, Principles of modeling, Object oriented modeling, An overview of UML, Conceptual model of the UML, Architecture, Software development life cycle. Basic Structural Modeling: Classes-Terms and concepts, Common modeling techniques; Relationships-Modeling simple dependencies, Single inheritance and structural relationships; Common mechanisms, Diagrams.

MODULE -II: ADVANCED STRUCTURAL MODELING, CLASS AND OBJECT DIAGRAMS (07 Periods)

Advanced Structural Modeling: Advanced classes, Advanced relationships, Interfaces, Types and roles, Packages, Instances. Class and Object Diagrams: Terms and concepts, Modeling techniques for class diagram-Modeling simple collaboration, Logical database schema, Forward and reverse engineering; Introduction to object diagrams.

MODULE -III: BASIC BEHAVIORAL MODELING (09 Periods)

Basic Behavioral Modeling-I: Interactions-Terms and concepts, Modeling a flow of control; Interaction diagrams-Terms and concepts, Modeling flows of control by time ordering and control by organization, Forward and reverse engineering. Basic Behavioral Modeling-II: Use cases-Terms and concepts, Modeling the behavior of the element; Use case Diagrams-Terms and concepts, Modeling the context of a system, Requirement of a system, Forward and reverse engineering; Activity Diagrams-Terms and concepts, Modeling a workflow, modeling an operation, Forward and reverse engineering.

MODULE -IV: ADVANCED BEHAVIORAL MODELING (07 Periods)

Events and signals-Modeling a family of signals, exceptions; State machines-Modeling the lifetime of an object; Introduction to processes and threads, Time and space-Modeling timing constraints, Distribution of objects and objects that migrate; State chart diagrams-Modeling reactive objects, Forward and reverse engineering.

MODULE -V: ARCHITECTURAL MODELING (11 Periods)

Component-Terms and concepts, Modeling executables and libraries, Modeling tables, Files and documents, Modeling an API; Deployment-Modeling processors and devices, Modeling the distribution of components; Component diagrams-Modeling source code, Executable release, Physical database, Adaptable systems, Forward and reverse engineering; Deployment diagrams-Modeling an embedded systems, Client/Server system, Fully distributed systems, Forward and reverse engineering.

Total Periods: 45

EXPERIENTIAL LEARNING

Case-Studies

1. **AUTOMATED TELLER MACHINE (ATM)** Problem Statement: Software is designed for supporting a computerized ATM banking network. All the process involved in the bank is computerized these days. All the accounts maintained in the bank and also the transactions effected, including ATM transactions are to be processed by the computers in the bank. An ATM accepts a relevant cash card, interacts with user, communicates with the central system to carry out the transaction, dispenses cash, and prints receipts. The system to be designed and implemented must include appropriate record keeping and security provisions. The system must handle concurrent access to the same account.
2. **ONLINE TICKET RESERVATION FOR RAILWAYS** Problem Statement: Computer play an integral part of the day in today's life. It makes the entire job easier and faster, every job is computerized so that the ticket reservation can be done over the online ticket reservation system. During the booking of the ticket reservation, passenger has to select origin, date of journey, destination, class of train etc. The reservation counter keeps track of passenger's information. Thus, the system will have all the details about the trains and facilities provided by them. There are various trains with the different level of convenience for the passengers.

The whole database will be maintained by database administrator. There are varieties of trains where the passengers can select the train according to the convenience for their destination journey. The journey could be within the state or across the India. Each train has the three types of classes i.e. Sleeper class, First class and AC compartment. Design the application for the above problem description.

MINI-PROJECT

1. Prepare the complete UML diagrams required for the online student course registration system for university, and hospital management system.

TEXT BOOK:

1. Grady Booch, James Rumbaugh and Ivar Jacobson, The Unified Modeling Language User Guide, Pearson Education, Second Edition, 2009.

REFERENCE BOOKS:

1. Magnus Penker, Brian Lyons, David Fado and Hans-Erik Eriksson, UML 2 Toolkit, WILEY-Dreamtech India Pvt. Ltd., 2006.
2. Pascal Roques, Modeling Software Systems Using UML2, WILEY-Dreamtech India Pvt. Ltd, 2004.

Software/Tools used:

1. C/Python/Java
2. Network simulator tool - Packet Tracer
3. Virtual Labs (Computer Networks Lab – http://vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/explist.php)

ADDITIONAL LEARNING RESOURCES:

1. <https://www.itprc.com/packet-tracers/>
2. <https://www.nsnam.org/docs/tutorial/html/>
3. http://www.tcpiptide.com/free/t_OSIRferenceModelLayers.htm

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_cs18/preview
2. <https://www.coursera.org/learn/tcpip>

WEB RESOURCES:

1. <https://www.cisco.com/c/en/us/solutions/small-business/resourcecenter/networking/networking-basics.html>
2. <https://memberfiles.freewebs.com/00/88/103568800/documents/Data.And.Computer.Communications.8e.WilliamStallings.pdf>

PROGRAM ELECTIVE

Course Code

Course Title

L T P S C

22CS101008

SOFTWARE ARCHITECTURES

3 - - - 3

Pre-Requisite Software Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course focuses on software architecture, qualities and terminologies, architecture models, Software architecture implementation, Software Architecture analysis, design and documentation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Describe the Fundamentals of software architecture, qualities and terminologies
- CO2** Understand the fundamental principles and guidelines for software architecture design architectural styles, patterns, and frameworks
- CO3** Use implementation techniques of Software architecture for effective software development
- CO4** Apply core values and principles of software architectures for enterprise application development

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3
CO2	3	3	-	-	-	-	2	-	-	-	-	-	3	-	3
CO3	3	3	3	-	-	-	-	-	-	-	2	-	3	-	3
CO4	2	3	3	-	-	-	-	2	-	-	-	-	3	-	-
Course Correlation Mapping	3	3	3	-	-	-	2	2	-	-	2	-	3	-	3

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENTS:

Module 1	INTRODUCTION TO SOFTWARE DEVELOPMENT AND METHODOLOGY	(09 Periods)

Overview of Software development methodology and software quality model, different models of software development and their issues. Introduction to software architecture, evolution of software architecture, software components and connectors, common software architecture frameworks, Architecture business cycle – architectural patterns – reference model.

Module 2 SOFTWARE ARCHITECTURE MODELS (09 Periods)

Structural models, framework models, dynamic models, process models. Architectures styles: dataflow architecture, pipes and filters architecture, call-and return architecture, data-centered architecture, layered architecture, agent based architecture, Micro-services architecture, Reactive Architecture, Representational state transfer architecture etc.

Module 3	SOFTWARE ARCHITECTURE TECHNOLOGIES	IMPLEMENTATION	(09 Periods)

Software Architecture Description Languages (ADLs), Struts, Hibernate, Node JS, Angular JS, J2EE – JSP, Servlets, EJBs; middleware: JDBC, JNDI, JMS, RMI and CORBA etc. Role of UML in software architecture.

Module 4 SOFTWARE ARCHITECTURE ANALYSIS AND DESIGN (09 Periods)

Requirements for architecture and the life-cycle view of architecture design and analysis methods, architecture-based economic analysis: Cost Benefit Analysis Method (CBAM), Architecture Tradeoff Analysis Method (ATAM). Active Reviews for Intermediate Design (ARID), Attribute Driven Design method (ADD), architecture reuse, Domain – specific Software architecture.

Module 5 SOFTWARE ARCHITECTURE DOCUMENTATION (09 Periods)

principles of sound documentation, refinement, context diagrams, variability, software interfaces. Documenting the behavior of software elements and software systems, documentation package using a seven-part template.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare the complete UML diagrams required for the online student course registration system for university, and hospital management system.
2. Study report for any of the MVC based Frameworks

TEXT BOOKS

1. Bass, L., P. Clements, & R. Kazman, "Software Architecture in Practice", 2 Ed, Prentice-Hall.
2. Jim Keogh, "J2EE – Complete Reference", Tata McGraw Hill.
3. Dikel, David, D. Kane, and J. Wilson, "Software Architecture: Organizational Principles and Practices", Prentic -Hall.

REFERENCE BOOKS

1. Bennett, Douglas, "Designing Hard Software: The Essential Tasks", Prentice-Hall, 1997.
2. Clements, Paul, R. Kazman, M. Klein, "Evaluating Software Architectures: Methods and Case Studies", Addison Wesley, 2001.
3. Albin, S. "The Art of Software Architecture", Indiana: Wiley, 2003.
4. Robert Mee, & Randy Stafford, "Patterns of Enterprise Application Architecture", Addison-Wesley, 2002.
5. Witt, B., T. Baker and E. Meritt, "Software Architecture and Design: Principles, Models and Methods", Nostrand Reinhold, 1994.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=gcs8_l3fkVo
2. https://onlinecourses.nptel.ac.in/noc22_cs39/preview

WEB RESOURCES:

1. <https://www.scribd.com/document/241663793/LAB-MANUAL-Software-Architecture-Pune-University>
2. <https://kvrsoftwares.blogspot.com/2019/04/4-1-software-architecture-and-design.html>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101135	SENSORS AND MEASURING INSTRUMENTS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on the Science of Measurement; Construction and principle of operation of Ammeters, Voltmeters, Ohmmeters; Potentiometers; Design of Bridges, Signal Analysers and Oscilloscopes; Transducers; Display Devices, and Recorders.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Select the suitable measuring instruments to measure parameters like voltage, current, resistance by applying fundamental concepts of Measuring.
- C02** Identify the suitable transducers for the measurement of non-electrical parameters.
- C03** Design AC and DC bridges for measurement of resistance, capacitance, and Inductance.
- C04** Analyze the characteristics of the signal using suitable signal analyser.
- C05** Apply suitable display devices and recorders based on the application.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	3	-	-	3	-	-	-	-	-	-	-	2	-	-
C02	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
C03	3	3	3	-	-	-	-	-	-	-	-	-	2	-	-
C04	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
C05	3	-	-	-	-	3	-	-	-	-	-	-	2	-	-
Course Correlation Mapping	3	3	3	-	3	3	-	-	-	-	-	-	2	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: MEASUREMENTS AND MEASURING DEVICES

(07 Periods)

Introduction to Measurement System: Elements of a Generalized Measurement System, Types of Errors.

Characteristics of Transducers: Transducer Principle, Classification of transducers, Static Characteristics of transducers: Accuracy, Precision, Threshold, Resolution, Sensitivity, Linearity, Span and Calibration. Dynamic characteristics of transducers: Fidelity, Measuring Lag, Dynamic Error, Speed of Response and Statistical Analysis.

Measuring Devices: Ammeters – Multi range, Universal Shunt, Extending Ranges; DC voltmeters – Multi range, Range extension, AC voltmeters – Rectifier type, Thermocouple Type; Ohmmeters – Series type and Shunt type.

Module 2: SENSORS AND THEIR APPLICATIONS

(08 Periods)

Resistive Sensor: Potentiometer, Strain gauges & its types and applications.

Capacitive Sensors: Change in overlapping area, dielectric constant and distance between the plates and applications.

Inductive sensors: Variable reluctance, Eddy current, linear variable differential transformers, Hall Effect. Piezoelectric sensors and applications.

Ultrasonic sensor: Attenuation, Transit time, Doppler Effect and applications.

Temperature Sensors: Resistance temperature detector (RTD), Thermistors principle and types, Thermocouples and applications.

Module 3: BRIDGES

(10 Periods)

Measurement of Resistance: Medium Resistance Measurement: Wheatstone bridge, Kelvin Bridge; Low Resistance Measurement: Kelvin double bridge; High Resistance Measurement: Direct deflection methods.

Measurement of Inductance: Maxwell Bridge, Hay's Bridge and Anderson Bridge.

Measurement of capacitance: De Sauty's Bridge and Schering bridge, Q-meter.

Module 4: SIGNAL ANALYZERS AND OSCILLOSCOPES

(11 Periods)

Signal Analyzers: Wave analysers -Frequency Selective Wave Analyzer, Heterodyne Wave Analyser, Application of Wave Analyzers, Harmonic Distortion Analyzers, Total Harmonic Distortion; Spectrum Analyzers – Basic Spectrum Analyzer, Spectral Displays, Spectra of Different Spectrum Analyzers.

Oscilloscopes: Oscilloscope Block diagram, Cathode Ray Tube, Vertical Deflection System, Delay Line, Horizontal Deflection System - Triggered Sweep, Delayed sweep; CRO Probes, Dual Beam & Trace CROs, Measurement of Amplitude, Frequency and Phase (Lissajous method), Sampling Oscilloscope, Analog Storage Oscilloscope, Digital Storage Oscilloscope.

Module 5: DISPLAY DEVICES AND RECORDERS

(09 Periods)

Display Devices: Segment Displays – Seven Segment Display, LCD, TFT-LCD, Display, BCD to 7 Segment Converter, Plasma display panels.

Recorders: Objectives and Requirements of Recording Data, Recorder Specifications, Strip Chart Recorder and X-Y Recorder, Potentiometric Recorder, Digital Data Recording, Recorder Selections for Particular Applications.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Convert Linear displacement in to voltage using linear variable differential transducer set up.
2. Simulate wheat stone using Multisim and find change in resistance.
3. Simulate Wein bridge using Multisim and find change in capacitance.
4. Develop a model and verify the working of seven segment display.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. H.S. Kalsi, *Electronic instrumentation*, TMH, 3rd Edition, 2015.
2. A.K. Sawhney, *A Course in Electrical & Electronic Measurement and Instrumentation*, Dhanpat Rai & Company Private Limited, New Delhi, 18th Edition, 2007.

REFERENCE BOOKS:

1. David A. Bell *Electronic Instrumentation & Measurements*, PHI, 2nd Edition, 2003.
2. A.D. Helfrick and W.D. Cooper, *Modern Electronic Instrumentation and Measurement Techniques*, PHI, 5th Edition, 2006.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/108/105/108105153/>
2. https://swayam.gov.in/nd1_noc19_ee44/preview

Web Resources:

1. Digital Audio Signal Processing:
<https://fmipa.umri.ac.id/wp-content/uploads/2016/03/Udo-Zolzer-digital-audio-signal-processing.9780470997857.40435.pdf>
2. https://www.google.co.in/books/edition/Audio_Engineering_Explained/tsT9kq4m_G8C?hl=en&gbpv=1&kptab=overview
3. List of Audio editing Software: <https://www.investopedia.com/best-audio-editing-software-5191187>
4. Learn Audio Editing - for Beginners: <https://youtu.be/hrQXWaMyPew>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC102015	NANOSTRUCTURES AND NANOTECHNOLOGY	3	-	2	-	4
Pre-Requisite	Engineering Physics, Engineering Chemistry					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course describes on Nanostructures – Classification and Peculiarities, Characterization and Properties of Nanomaterials, Micro Electro-Mechanical Systems (MEMS) & Nano Electro-Mechanical Systems (NEMS), Carbon Nanotubes (CNT) – Properties and Synthesis, Interdisciplinary Applications of Nanomaterials.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

- CO1** Analyze the peculiarities of nanostructured materials, their characterization and properties to solve structural, mechanical and electrical problems in manufacturing Nanostructures.
- CO2** Apply physical techniques to fabricate nanostructured materials
- CO3** Analyze the chirality of carbon nanotube and synthesize for various applications.
- CO4** Identify the appropriate nanomaterial in Quantum Devices, Emitters, Photo electrochemical Cells, Photonic Crystals and Plasmon Waveguides for societal application.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program specific outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	2	2	-	2	2	-	-	-	-	-	3	-	-
Course Correlation Mapping	3	3	2	2	3	2	2	-	-	-	-	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

MODULE 1: INTRODUCTION TO NANOSTRUCTURED MATERIALS (09 Periods)

Gleiter's classification of nanostructured materials, Classification of nanostructures by dimensionality, Concept of —surface form engineeringl in nanomaterial science, Extended internal surface, Increasing of surface energy and tension, Grain boundaries, Instability of 3D0 NSM due to grain growth.

MODULE 2: CHARACTERIZATION OF NANOMATERIALSAND (11 Periods) PROPERTIES

Structural Characterization: X-ray diffraction (XRD), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Chemical Characterization: Optical spectroscopy, Electron spectroscopy, Ionic spectrometry, Physical Properties of Nanomaterials: Melting points and lattice constants, Mechanical properties, Optical properties Electrical conductivity.

MODULE 3: FABRICATION OF NANOSTRUCTURES BY PHYSICAL (09 Periods) TECHNIQUES

Introduction, Lithography, Nanomanipulation and Nanolithography, Soft Lithography, Assembly of Nanoparticles and Nanowires, Other Methods for Microfabrication.

MODULE 4: CARBON NANOTUBES (CNT) – PROPERTIES AND (08 Periods) SYNTHESIS

Dimensions, Chirality, Material Properties, Mechanical Properties, Electrical Properties, Optical Properties, Thermal Properties, Nanotube Growth Methods, Chemical Vapor Deposition, Thermal Chemical Vapor Deposition, Applications

MODULE 5: INTERDISCIPLINARY ARENA OF NANOMATERIALS (08 Periods)

Molecular Electronics and Nanoelectronics, Nanobots, Biological Applications of Nanoparticles, Catalysis by Gold Nanoparticles, Band Gap Engineered Quantum Devices, Nano mechanics Carbon Nanotube Emitters, Photoelectrochemical Cells, Photonic Crystals and Plasmon Waveguides

Total no. of Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Demonstration of Clean room.
2. Demonstration of Clean bench.
3. Demonstration of substrate.
4. Cleaning process of substrate.
5. Deposition of filter by sol-gel method.
6. Deposition of thermal evaporation.
7. Annealing Process using Digital Vacuum evaporator.
8. Fabrication of Schottky Diode.
9. Fabrication of MOSFET Device.
10. Device characterization for assessing the performance of the fabricated device.

RESOURCES

TEXT BOOKS:

1. Pokropivny, Vladimir, RynnoLohmus, Irina Hussainova, Alex Pokropivny, and Sergey Vlassov, —Introduction to nanomaterials and nanotechnology, Tartu, Estonia: Tartu University Press, 2007.
2. Guozhong Cao and Ying Wang, —Nanostructures and Nanomaterials: Synthesis, Properties, and Applications”, Imperial College Press, 2004.

REFERENCE BOOKS:

1. Bhushan, Bharat, “Springer Handbook of Nanotechnology, 2nd edition, 2006.
2. A I Gusev and A ARempel, “Nanocrystalline Materials, Cambridge International Science Publishing, 1st Indian edition, 2008.
3. Kamal K. Kar, “Carbon Nanotubes: Synthesis, Characterization and Applications”, Research Publishing Services, 1st edition, 2011.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/103103033>
2. <https://nptel.ac.in/courses/118102003>
3. <https://nptel.ac.in/courses/118104008>

Web Resources:

1. Introduction to Nanotechnology- nanohub.org
2. <https://www.coursera.org/learn/sensor-manufacturing-process-control>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101016	MICRO ELECTRO MECHANICAL SYSTEMS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Overview of Micro Electro Mechanical Systems (MEMS), working principles of microsensors and microactuators, materials, microfabrication processes, MEMS accelerometers, packaging of Microsystems and applications over different fields.

COURSE OUTCOMES: On successful completion of the courses, the students will be able to:

- CO1** Analyze MEMS Components like microsensors and microactuators.
- CO2** Use standard micro fabrication techniques and device packaging methods in manufacturing MEMS devices.
- CO3** Understand types of MEMS accelerometers.
- CO4** Analyze efficient and cost-effective MEMS devices for societal applications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO2	1	3	3	2	1	-	-	-	-	-	-	-	3	-	-
CO3	2	3	1	-	2	2	-	-	-	-	-	-	3	-	-
CO4	3	2	1	1	1	2	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	3	3	2	1	1	2	-	-	-	-	-	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

MODULE 1: INTRODUCTION TO MEMS AND MICROSYSTEMS (09 Periods)

Introduction to MEMS, Energy domains and transducers, sensors and actuators, Microsystems versus MEMS, miniaturization, MEMS materials.

MODULE 2: MICROSENSORS & ACTUATORS (09 Periods)

Microsensors: Classification of physical sensors, Integrated, Intelligent, or Smart sensors, Sensor Principles and Examples: Thermal sensors, Pressure, Flow, Inertial, Gyro sensors, Bio Sensors.

Microactuators: Electromagnetic and Thermal microactuation, Mechanical design of microactuators, Microactuator examples, microvalves, micropumps, micromotors.

MODULE 3: MEMS ACCELEROMETERS (09 Periods)

Micro accelerometers for MEMS, Temperature and Damping analysis, Piezoelective accelerometer, Piezoresistive accelerometer, Piezocapacitive accelerometer technology.

MODULE 4: MEMS FABRICATION AND PACKAGING (10 Periods)

Review of Fabrication process-Photolithography, ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition, deposition by Epitaxy, Czochralski process.

Micromachining technology of MEMS, Microstereolithography; Introduction to microsystem packaging, objectives and general considerations in packaging design, three levels of microsystem packaging.

MODULE 5: MEMS APPLICATIONS (09 Periods)

Applications of MEMS in the automotive industry, avionics and space applications and commercial applications, RF MEMS, optical MEMS, Introduction to Bio MEMS and microfluidics.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Demonstration of working principle of
 - A) accelerometers for airbag sensors,
 - B) microphones,
 - C) projection display chips,
 - D) blood and tire pressure sensors,
 - E) optical switches,
 - F) analytical components such as lab-on-chip, biosensors
 - G) Pressure sensors.
 - H) Humidity sensors.
 - I) Temperature sensors.
2. Demonstration of the significance of gold, copper, aluminum and titanium in MEMS.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. G.K.Ananthasuresh, K.J.Vinoy, *Micro and Smart Systems*, Wiley India, 1st edition, 2010 Education (India) Pvt. Ltd., 2002.

REFERENCE BOOKS:

1. Tai-Ran Hsu, *MEMS & Microsystems, Design and Manufacture*, McGraw Hill
2. Nitaigour Premchand Mahalik, *MEMS*, McGraw Hill Education (India) Pvt. Ltd., eighth reprint, 2013.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc22_ee36/preview
2. <https://nptel.ac.in/courses/112108092>
3. https://onlinecourses.nptel.ac.in/noc21_ee32/preview
4. <https://archive.nptel.ac.in/courses/108/108/108108113/>
5. <https://archive.nptel.ac.in/courses/117/105/117105082/>
6. <https://www.coursera.org/learn/sensor-manufacturing-process-control>

Web Resources:

1. <https://ocw.mit.edu/courses/6-777j-design-and-fabrication-of-microelectromechanical-devices-spring-2007/>
2. <https://www.udemy.com/course/micro-electromechanical-systems-mems-technology/>
3. <https://learning.edx.org/course/course-v1:EPFLx+memsX+3T2018/home>
4. <https://edu.epfl.ch/coursebook/en/mooc-micro-and-nanofabrication-mems-MICRO-621>
5. <https://www.lorainccc.edu/engineering/mechatronics/micro-electromechanical-systems-mems-short-term-certificate/>
6. <https://nptel.ac.in/courses/117105082>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101137	AUTOMOTIVE ELECTRONICS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Automotives systems; ECUs; Sensors; Actuators; Communication Protocols ; Control Systems; Future Automotives trends like Electric Vehicles.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Acquire an overview of automotive components, subsystems and basics of automotive systems and design electronics
- C02** Use and apply available automotive sensors and actuators in various electronic control system while designing automotive system design.
- C03** Understand the networking of various modules in automotive systems, communication protocols and Infotainment systems
- C04** Recognize different control systems in today's automotive industry
- C05** Apply knowledge of modern technologies in future automotive design

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	3	-	3	-	-	-	-	-	-	-	-	3	3	-
C02	3	3	-	-	-	-	-	-	-	-	-	-	3	3	-
C03	3	3	2	3	-	-	-	-	-	-	-	-	3	3	-
C04	3	3	-	-	-	-	-	-	-	-	-	-	3	3	-
C05	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-
Course Correlation Mapping	3	3	2	3	-	-	-	-	-	-	-	-	3	3	-

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO AUTOMOTIVE ELECTRONICS (09 Periods)

Introduction to Modern Automotive Systems, Evolution of Automotive Electronics, Need for electronics in automobiles, Application areas of Electronic Systems in modern automobiles. Electronic Engine Control, Electronic Fuel control, Electronics Ignition, Automotive Transmissions, Electronic Control Unit(ECU) Design Circle: V-Model development circle, Component of ECU, Examples of ECU`s in automotive.

Module 2: AUTOMOTIVE SENSORS AND ACTUATORS (10 Periods)

Airflow rate sensor (MAS), Engine Crankshaft Angular Position Sensor, Hall Effect Position Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure(MAP), Throttle Angle Sensor(TAS), Engine Coolant Temperature(ECT) Sensor, Air Bag Sensors.

Automotive Ignition control Actuators, Fuel Injector Actuator, Solenoids, Various types of electronic motors and piezoelectric force generators, Relays (Solid state relays and electromechanical relays), Electro Pneumatic: Pneumatic motors, Electro Hydraulic Valves.

Module 3: COMMUNICATION PROTOCOLS AND INFOTAINMENT SYSTEMS (09 Periods)

Overview of Automatic Communication Protocols: CAN,LIN, Flex Ray, MOST, D2B and DSI, Communication Interface with ECUs, TCP/IP for Automotive applications, Infotainment Systems: Application of telematics in automotive domains, Global Positioning System(GPS)

Module 4: AUTOMOTIVE CONTROL SYSTEMS (09 Periods)

Digital Engine control features, Vehicle Motion Control systems: Typical Cruise Control systems, Stepper motor-based actuator for cruise control, Antilock Breaking System(ABS),Electronically controlled power steering systems

Module 5: FUTURE TRENDS IN AUTOMOTIVE (08 Periods)

Hybrid and Electric Automotive, Autonomous Vehicles and driving challenges, Blockchain trends,V2X Technology, Electric Vehicles

Total Periods:45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Diagnosis of ignition system.
2. Fault finding of relay & fuses in car using Off Board Diagnostics Systems (OBDS).
3. Fault finding location of sensor in car using OBDS
4. LabCar for the development of telematic functions and Car to X-based business models
5. Simulation of Vehicle systems using MATLAB/LabView/Simulink
6. Design of the entire Electrical Vehicle Model using MATLAB/Simulink
7. Modelling of Novel Vehicle Architecture using MATLAB/Simulink

8. Mathematical modeling and simulation of dynamic Automotive systems
9. Develop a steering-control strategy for autonomous driving taking input from CAN message.
10. Tune the automotive engine controller using mapped engine model.

RESOURCES

TEXT BOOKS:

1. William B. Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier Publishing
2. Robert Bosch GmbH (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley & Sons Inc., 2007
3. Automotive Sensors(Sensor Technology)-2009 by John Turner and Joe Watson

REFERENCE BOOKS:

1. Ronald K Jurgen: "Automotive Electronics Handbook", 2nd Edition McGraw-Hill,1999
2. James D Halderman: "Automotive Electricity and Electronics", PHI Publications.
3. Iqbal Husain: "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press,2003.
4. G. Meyer, J.Valldorf and W Gessner: "Advanced Microsystems for Automatic Applications",Springer 2009.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/107/106/107106088/>
2. <https://bit.do/NPTEL-Automotive-Electronics&v=BOP8qLQzhDc>

Web Resources:

1. https://www.youtube.com/watch?v=_Bjn-tGKPvc
2. <https://training.uplatz.com/online-it-course.php?id=automotive-electrics-and-automotive-electronics-469>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC104017	EMBEDDED SYSTEMS	3	-	2	4	5
Pre-Requisite	Microcontrollers and Interfacing.					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This Course describes on MSP430 Architecture; Instruction Set; Programming; On-Chip Resources; Communication with peripherals; Embedded system design approaches

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze MSP430 Architecture, Instruction Set, addressing modes to develop programs for various control applications using Assembly and Embedded C
- CO2** Solve Problems by analyzing MSP430 On Chip Resources such as Timer, Clock System, Low Power Modes/techniques and Interrupt Structure.
- CO3** Realize Mixed Signal Processing and Networking Applications, by analyzing onChip Resources such as Comparator, ADC, Temperature Sensor, PWM and Communication Peripherals
- CO4** Analyze Language, IDE Support, Processor IC & Design Technologies, and System Modeling Techniques to capture behavior of Embedded Prototype using suitable model

CO-PO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	1	-	-	-	-	-	-	-	-	2	1	-
CO2	3	3	2	3	2	2	-	-	-	-	-	-	2	2	-
CO3	3	3	3	2	2	2	-	2	-	-	-	-	1	2	2
CO4	3	2	3	2	2	2	-	2	-	-	-	-	1	1	1
Course Correlation Mapping	3	3	3	2	2	2	-	2	-	-	-	-	2	2	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: ARCHITECTURE OF MSP430

(09 Periods)

Embedded Systems – Introduction, MSP430 - Anatomy of microcontroller, Memory, Software, Pin out (MSP430G2553), Functional Block diagram, Memory, CPU, and Memory mapped input and output, Clock generator; Exceptions- Interrupts and Resets.

Module 2: PROGRAMMING MSP430

(09 Periods)

Development Environment, Aspects of C for Embedded Systems, Assembly Language, Register Organization, Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set, Example programs- Light LEDs, Read input from a switch; Automatic Control-Flashing light by delay, use of subroutines and Functions; Basic Clock System, Interrupts and Low Power Modes

Module 3: TIMERS AND MIXED SIGNAL SYSTEMS

(09 Periods)

Timers - Watchdog Timer, RTC, Timer_A, Measurement in capture mode, PWM generation; Mixed Signal Systems- Comparator_A, ADC10 SAADC –Architecture, operation- Single Conversion, Temperature Sensor on ADC10, DTC in ADC10; ADC12 –Comparison with ADC10.

Module 4: COMMUNICATION PERIPHERALS & PROTOCOLS

(09 Periods)

MSP430 Communication Interfaces- USART, USCI, USI; Communication Protocols- SPI, Inter-integrated Circuit Bus, USB, CAN.

Module 5: EMBEDDED SYSTEM DESIGN

(09 Periods)

Processor Technology, IC Technology, Design Technology, Tradeoffs. Model VS. Language, System Modelling – Data Flow Model, FSM, FSMD, HCFSM, PSM, Concurrent Process Model & implementation.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Introduction to MSP430 launch pad and Programming Environment
2. Practice on usage of Instruction Set
3. Read input from switch and Automatic control/flash LED (software delay).
4. Interrupts programming example using GPIO.
5. Configure watchdog timer in watchdog & interval mode.
6. Configure timer block for signal generation (with given frequency).
7. Read Temperature of MSP430 with the help of ADC.
8. Test various Power Down modes in MSP430.
9. Generation of Pulse Width Modulation.
10. Use Comparator to compare the signal threshold level.
11. Speed Control of DC Motor.

12. Master slave communication between MSPs using SPI.
13. Networking MSPs using Wi-Fi

PROJECT BASED LEARNING:

1. Create an Morse Code Machine
2. Create a project to control an Analog Gauge machine using MSP430G2553.
3. Design an Wi-Fi Controller door lock using MSP430 and mobile phone.
4. Design an RGB mood lamp using MSP430 for low power Control.
5. Control your robot using an Android app to perform various tasks in difficult environmental conditions

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. John H. Davies, MSP430 Microcontroller Basics, Newnes Publications, 1st Edition, 2008.
2. Santanu Chattopadhyay, Embedded System Design, PHI, 2010.
3. Frank Vahid, Tony D. Givargis, Embedded System Design – A Unified Hardware/Software Introduction, John Wiley, January 2006

REFERENCE BOOKS:

1. Chris Nagy, Embedded Systems Design using the TI MSP30 Series, Newnes Publications, October 2003.
2. Jorgeon Staunstrup, Wayne Wolf, Hardware/Software Co-design Principles and Practice, Springer 2009.
3. Patrick R Schizont, A Practical Introduction to Hardware/Software Co-design, Springer publications, January 2010

VIDEO LECTURES:

1. <https://www.udemy.com/course/bootlaoder-design-with-msp430/>
2. <https://in.coursera.org/learn/introduction-embedded-systems>
3. <https://archive.nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee98/>

Web Resources:

1. <https://www.ti.com/microcontrollers-mcus-processors/msp430-microcontrollers/overview.html>
2. <https://www.olimex.com/Products/MSP430/Starter/MSP430-EASYWEB-2/resources/MSP430-Internet-Connectivity.pdf>
3. <https://link.springer.com/book/10.1007/978-3-031-79828-3>
4. https://www.udemy.com/course/mcu_msp430/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC104018	ADVANCED MICROCONTROLLERS	3	-	2	4	5
Pre-Requisite	Microcontroller and Interfacing					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course is designed to provide an overview on system design using industry standard Peripheral Interface Controller. The course provides a deep insight about its architecture, Programming at assembly and high levels, various resources -operation and their applications demanding interfacing to external peripherals to solve various engineering problems efficiently.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze Architectural features of PIC family of Microcontrollers for control applications.
- CO2** Analyze PIC18 Architecture and Instruction Set to develop computing applications.
- CO3** Develop Programs for PIC18 using ports, timers and associated on Chip resources for Specified Applications.
- CO4** Design microcomputer based systems with the knowledge of Interfaces and Peripherals of PIC18 to Solve various engineering problems.
- CO5** Work independently or in teams to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	2	3	-	-	1	-	-	-	-	-	-	-	3	-
CO4	3	2	3	1	-	1	-	1	-	-	-	-	-	3	-
CO5															
Course Correlation Mapping	3	3	3	1	-	1	-	1	-	-	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: PIC ARCHITECTURE

(09 Periods)

Architecture of PIC18, Register Organization, Memory Organization - ROM space & RAM.

Module 2: PIC PROGRAMMING

(09 Periods)

Data formats & Directives, Instruction Set: Arithmetic, Logic, branching, Bit wise, bank switching, Simple PIC Programs.

Module 3: PORTS, TIMERS AND PROGRAMMING

(09 Periods)

Pin description of PIC18F452, Basic Port Structure, I/O port programming; Macros and modules, Structure of Timer 0 & its Programming using Assembly and C, Counter programming, Structure of timers 1, 2 and 3 & their Programming.

Module 4: PIC-SERIAL PORTS AND INTERRUPTS

(09 Periods)

Basics of communication – Serial/Parallel, RS232 & PIC18 connection to RS232, Serial Port Structure & programming; PIC18 interrupts, Programming timer interrupts, Programming serial interrupts

Module 5: PIC INTERFACING

(09 Periods)

7 segment LED and LCD interfacing, keyboard interfacing, interfacing ADC, DAC, Interfacing DC motor, stepper motor, PWM using CCP.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

Programs using PIC Microcontroller

1. Arithmetic operations.
2. Logical & Branch operations
3. Bit manipulation operations.
4. Macros & Modular programming.
5. Time Delay programs.

Interfacing with PIC microcontrollers

1. Interface switches, LEDs, 7-segment display.
2. Interfacing of PIC18 with Keyboard and LCD.
3. Interfacing of PIC18 with DAC.
4. Interfacing using serial communication & DC Motor
5. Interfacing Stepper Motors

PROJECT BASED LEARNING:

1. Digital Dice Roller with PIC.
2. Create a Command Line Interface over UART
3. Log Weather data
4. Automated water Dispenser.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Muhammad Ali Mazidi, Rolin D. McKinlay, Danny Causey, *PIC Microcontroller and Embedded Systems: Using C and PIC18*, Pearson Education, 2015.

REFERENCE BOOKS:

1. Ramesh S. Gaonkar, *Fundamentals of Microcontrollers and Applications in Embedded Systems (With PIC18 Microcontroller Family)*, Penram International, 2010.

VIDEO LECTURES:

1. <https://skills.microchip.com/introduction-to-the-8-bit-pic-mcu-timer0>
2. <https://nptel.ac.in/courses/117104072>

Web Resources:

1. <http://crystal.uta.edu/~zaruba/CSE3442/>
2. <https://owd.tcnj.edu/~hernande/ELC343/>
3. <http://www.ciebookstore.com/Content/Images/uploaded/PIC18-Study-Guide-CIE.pdf>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101019	FPGA ARCHITECTURES AND APPLICATIONS	3	-	-	-	3
Pre-Requisite	VLSI System Design					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on evolution of programmable devices, design with PLDs, FPGA-organization, programming, Xilinx-XC2000, XC3000, XC4000 architectures, programming technologies, anti-fuse programmed FPGAs, design applications.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Implement Boolean functions using programmable logic devices to develop a digital system.
- CO2** Analyze FPGA's and its programmable technologies to assess the impact of digital functions in the development of digital system.
- CO3** Analyze Xilinx & Actel based FPGA architectures, place and route designs for high speed digital Circuits.
- CO4** Develop various sub systems using FPGA for specified applications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	1	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	3	-	-	1	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	3	3	3	-	-	1	-	-	-	-	-	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DESIGNING OF PROGRAMMABLE LOGIC DEVICES (10 Periods)

Introduction, Simple Programmable Logic Devices – Read Only Memories, Programmable Logic Arrays, Programmable Array Logic, Sequential Programmable Logic Devices (22CEV10), Implementation of a serial Adder with Accumulation.

Module 2: FIELD PROGRAMMABLE GATE ARRAYS (10 Periods)

Finishings: Introduction to FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, Applications of FPGAs.

Module 3: SRAM PROGRAMMABLE FPGAS (08 Periods)

Introduction, Programming Technology, Device Architecture, the Xilinx XC2000, XC3000 and XC4000 Architectures

Module 4: ANTI-FUSE PROGRAMMED FPGAS (09 Periods)

Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures.

Module 5: DESIGN APPLICATIONS (08 Periods)

General Design Issues, A Fast Video Controller, A Position Tracker for a Robot Manipulator, A Fast DMA Controller, Designing Counters with ACT devices, Introduction to G2 Modular Platforms.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Design and Implementation of wending machine.
2. Design and Implementation of traffic light controller.
3. Develop a sequence generator.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Stephen M. Trimberger, Field Programmable Gate Array Technology, Springer International Edition, Eighth Indian Reprint 2015.
Robert Lafore, Data Structures & Algorithms in Java, 2nd Edition, Pearson, 2007.
2. Charles H. Roth Jr, Lizy Kurian John, Digital Systems Design using VHDL, 3rd edition, Cengage Learning, 2017.

REFERENCE BOOKS:

1. John V. Oldfield, Richard C. Dorf, Field Programmable Gate Arrays, Wiley India, 2008.
2. Pak K. Chan/Samiha Mourad, Wayne Wolf, Digital Design Using Field Programmable Gate Arrays, Pearson Low Price Edition, 2009.

VIDEO LECTURES:

1. Architecture All Access: Modern FPGA Architecture - Bing video
2. EEVblog #496 - What Is An FPGA? - Bing video
3. Introduction to FPGA Part 10 - Metastability and Clock Domain Crossing | Digi-Key Electronics - Bing video

Web Resources:

1. FPGA Design for Embedded Systems | Coursera
2. FPGA Design Resources | Microchip Technology
3. Programming an FPGA: An Introduction to How It Works (xilinx.com)
4. Embedded design with FPGAs: Hardware resources - Embedded.com

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EE101406	LINEAR CONTROL SYSTEMS	3	-	-	-	3
Pre-Requisite	Signals and Systems					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Concepts of control systems, transfer function of various physical systems, time response analysis, frequency response analysis, controller design, and state space analysis.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Develop the mathematical model for various physical systems to determine the transfer function by applying fundamental principles.
- CO2** Analyze the time response of first and second-order systems to evaluate steady-state errors.
- CO3** Analyze the stability of a system in the time domain and investigate the stability of the given system using the root locus technique.
- CO4** Analyze the stability of a system in the frequency domain and design a compensator for a system to meet the desired specifications using the Bode plot technique.
- CO5** Apply the state space method to model the system to investigate controllability and observability.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	1	-	-	-	-	-	-	-	2	1	2
CO2	3	3	-	1	-	-	-	-	-	-	-	-	2	1	2
CO3	3	3	3	1	1	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	1	1	-	1	-	-	-	-	-	1	2	2
CO5	3	3	-	--	1	-	-	-	-	-	-	-	2	1	2
Course Correlation Mapping	3	3	3	1	1	-	1	-	3	3	-	-	2	1	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: MATHEMATICAL MODELING OF SYSTEMS

(09 Periods)

Introduction to control systems — Classification of open loop and closed loop control systems with examples; Modelling of physical systems — Transfer function of mechanical systems, electrical systems, Armature control and field control of DC motor – electrical analogy of mechanical systems; Block diagram reduction, Signal flow graph.

Module 2: TIME RESPONSE ANALYSIS

(09 Periods)

Standard test signals; Time response of first and second order systems — Time-domain specifications, steady state error — static and dynamic error constants; Effects of Proportional, Integral and Derivative controllers.

Module 3: STABILITY ANALYSIS

(09 Periods)

Introduction to stability, Stability in terms of location of roots, Routh-Hurwitz stability criterion – Relative stability; Root locus — rules to construct root loci, effect of adding pole and zero on root loci.

Module 4: FREQUENCY RESPONSE ANALYSIS

(09 Periods)

Frequency domain specifications, Bode plot, Polar plot and Nyquist Stability Criterion Correlation between time and frequency response; Design of Lag and Lead Compensators using bode plot.

Module 5: STATE SPACE ANALYSIS

(09 Periods)

Concept of state, state variable, state model; Transfer function to state space and statespace to transfer function representation; Modelling of physical system in state space; State transition matrix and its properties – solution of state equations – diagonalization of state matrix; Controllability and observability using Kalman's test.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Transfer function of DC Motor to investigate speed torque characteristics.
2. Transfer function of AC Servo Motor to investigate speed torque characteristics.
3. Time response of first and Second-order Systems with the unit step as input.
4. Investigating the system response by the addition of poles and zeroes for a transfer function.
5. Effect of P, PD, PI, PID Controller on Second order system.
6. Investigate the stability of a system using root locus
7. Design of Lag and Lead Compensators using root locus
8. Stability analysis with Bode Plot for given open loop system.

9. Design a Lag and Lead Compensators using bode plot.
10. Stability analysis for the given system using Nyquist Stability Criteria
11. State space model for classical transfer function and vice versa.
12. Design of Classical and State Space Controller.

(Note: The following activities are indicative only; the detailed experiential learning activities will be provided in the course handout)

RESOURCES

TEXT BOOKS:

1. A. Anandkumar, *Control Systems*, PHI learning Pvt Ltd., 2nd edition, 2014.
2. Katsuhiko Ogata, *Modern Control Engineering*, Pearson Education Publishers, 5th edition, 2010.

REFERENCE BOOKS:

1. Nagrath I.J. and Gopal M, *Control Systems Engineering*, New Age International Publications, 5th edition, 2010.
2. Richard C. Dorf and Robert H. Bishop, *Modern Control Systems*, Prentice Hall, 12th edition, 2010.
3. Benjamin C. Kuo and Farid Golnaraghi, *Automatic Control Systems*, John Wiley & Sons Publications, 8th edition, 2002.
4. Nagoorkani, *Control Systems*, RBA Publications, 2nd edition, 2006.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=vVFDm_____CdQw&list=PLA74601484F6994D8
2. <https://www.youtube.com/watch?v=u6kYU3qcR3c&list=PLA74601484F6994D8&index=2>
3. <https://www.youtube.com/watch?v=vPQvS9Xxlnk&list=PLA74601484F6994D8&index=31>
4. <https://www.youtube.com/watch?v=FXbKYT1G6Xs&list=PLA74601484F6994D8&index=35>

Web Resources:

1. NPTEL_CONTROL SYSTEMS: <https://nptel.ac.in/courses/107/106/107106081/>
2. EDX_INTRODUCTION TO CONTROL SYSTEMS: <https://www.edx.org/course/introduction-to-control-system-design-a-first-look>

PROGRAM ELECTIVE

Course Code

22EC104026

Course Title

IMAGE PROCESSING

L T P S C

3 - 2 4 5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Image processing becomes a very important aspect in various industries ranging from process industry to medical field. This course will introduce various image processing techniques, algorithms and their applications.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Apply various transformations on images by analyzing basic operations on images.

CO2 Understanding of image enhancement in both spatial and frequency domains

CO3 Apply restoration techniques based on noise models and degradation function to restore the images, pertaining to health and societal applications.

CO4 Use appropriate image compression and segmentation techniques on the images.

CO5 Understand the basics of morphological operations.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	2	3	-	-	-	-	-	-	-	-	-	3
CO2	1	3	-	2	-	-	-	-	-	-	-	-	-	-	3
CO3	1	2	-	2	3	-	-	-	-	-	-	-	-	-	3
CO4	1	2	-	2	3	-	-	-	-	-	-	-	-	-	3
CO5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	
Course Correlation Mapping	2	2	-	2	3	-	-	-	-	-	-	-	-	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FUNDAMENTALS OF IMAGE PROCESSING

(09 Periods)

Fundamental steps in Image Processing, Image sampling & quantization, some basic relationships between pixels, Mathematical tools for image processing.

Image Transforms: Unitary transforms, 2D-DFT, Hadamard transform, Walsh transform, DCT, properties of transforms.

Module 2: IMAGE ENHANCEMENT

(11 Periods)

Spatial Domain methods: Basic Intensity transformation functions, Histogram processing, Fundamentals of Spatial Filtering, Smoothing spatial filters, Sharpening spatial filters.

Frequency Domain methods: Basics of filtering in frequency domain, Correspondence between filtering in the spatial and frequency domains, Image smoothing using frequency domain filters, Image sharpening using frequency domain filters, Homomorphic filtering.

Module 3: IMAGE RESTORATION and RECONSTRUCTION

(09 Periods)

Image degradation/Restoration model, Noise models, Restoration in the presence of Noise only-spatial filtering - mean, order- statistic and adaptive filters. Estimating the degradation function, Inverse filtering, Weiner filtering, Constrained least squares filtering.

Module 4: IMAGE COMPRESSION AND SEGEMENTATION

(11 Periods)

Image Compression: Fundamentals of redundancies, Compression models, Huffman coding, Arithmetic coding, JPEG Compression standard.

Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region based segmentation.

Module 5: MORPHOLOGICAL IMAGE PROCESSING

(05 Periods)

Dilation and erosion, Opening and closing, Some basic morphological algorithms.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Introduction to Image Processing Toolbox
2. To read, write, view images, conversion between different formats and
3. Manipulations on images (addition, subtraction, division, logical).
4. Computation of Mean, Standard Deviation, Correlation coefficient of the givenImage.
5. Image enhancement techniques on 8-bit image:
 - A) Brightness improvement
 - B) Brightness reduction
 - C) Thresholding
 - D) Negativeof an image
 - E) Log transformation
 - F) Power Law transformation

6. Read an image, plot its histogram then do histogram equalization. Comment about the result.
7. Read an image and apply
 - 1) Gaussian 3x3 mask for blurring
 - 2) High pass filter mask with different masks
 - 3) Laplacian operator with centre value positive and negative
 - 4) High boost filtering.
8. FFTs, Image filtering: smoothing and sharpening
9. Implement inverse filter and Wiener filter over image and comment on them.
10. Determination of edge detection using operators.
11. Write a program for erosion and dilation, opening & closing using inbuilt and without inbuilt function.

PROJECT BASED LEARNING

1. Take a print document, perform preprocessing and try to segment into characters
2. Find out the application of image processing in medical field. Do the simulation of the application that you have identified of image processing.
3. Face recognition application.
4. Train and Apply Denoising Neural Networks.
5. Pretrained Deep Neural Networks (Deep Learning Toolbox)
Learn how to download and use pretrained convolutional neural networks for classification, transfer learning and feature extraction.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Rafael C. Gonzalez & Richard E. Woods, Digital Image Processing, Pearson Education, 4th Edition, 2018.
2. S Jayaraman, S Esakkirajan, T Veerakumar, Digital Image Processing, Tata McGrawHill Education, Second Edition, 2020.

REFERENCE BOOKS:

1. Anil K. Jain, Fundamentals of Digital Image processing, Prentice Hall, 2007.
2. Pratt W.K, Digital Image ProcessingI, 3rd ed., John Wiley & Sons, 2007
3. Vipula Singh, Digital Image Processing with MATLAB & LabVIEW, Elsevier, 2019.
4. Chris Solomon, Toby Breckon, "Fundamentals of Digital Image Processing a Practical Approach with Examples in Matlab", John Wiley & Sons.
5. <https://in.mathworks.com/help/images/deep-learning.html>

VIDEO LECTURES:

1. <https://www.youtube.com/@digitalimageprocessing3396/playlists>
2. <https://www.youtube.com/@Ekeeda/playlists>
2. https://www.youtube.com/playlist?list=PL3rE2jS8zxAykFjinlf6EsucLv5EA03_m

Web Resources:

1. <https://in.mathworks.com/videos/image-processing-made-easy-81718.html>
2. https://in.mathworks.com/videos/introduction-to-matlab-with-image-processing-toolbox-90409.html?s_tid=srchtitle_image%20processing%20tool%20box_2
3. https://in.mathworks.com/videos/edge-detection-with-matlab-119353.html?s_tid=srchtitle_image%20processing%20tool%20box_4

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC102028	INTERNET OF THINGS AND APPLICATIONS	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course is designed to provide Basics of IoT; Sensors; IoT Design Methodology; Basics of Arduino and Raspberry Pi; IoT Application Development using Raspberry Pi and Arduino; Data Acquisition with Python and Tkinter; Connecting to the Cloud; Blynk Application with Raspberry Pi.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate knowledge on Principles of IoT and Sensors
- CO2** Design basic IoT Applications using Arduino.
- CO3** Design IoT Applications using Raspberry Pi.
- CO4** Perform Data Acquisition and analysis using Cloud and Tkinter.
- CO5** Develop Real-time applications using Blynk with Raspberry Pi

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	2	-	-	-	-	-	-	-	-
CO2	2	2	3	-	-	2	3	-	-	-	-	-	-	-	-
CO3	2	2	3	-	-	1	1	-	-	-	-	-	-	-	-
CO4	2	2	2	3	-	1	1	1	-	-	-	-	-	-	-
CO5	2	2	2	2	3	-	-	-	1	1	-	-	-	-	-
Course Correlation Mapping	2	2	3	3	3	2	2	1	1	1	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO INTERNET OF THINGS (08 Periods)

Characteristics of IoT, Design principles of IoT, IoT Architecture and Protocols, Enabling Technologies for IoT, IoT levels and IoT vs M2M. Sensors – Classification of Sensors, Working Principle of Sensors, Criteria to choose a Sensor, Generation of Sensors.

Module 2: IoT Design Methodology & Basics of Arduino (08 Periods)

Design methodology, Challenges in IoT Design, IoT System Management, IoT Servers.

Introduction to Arduino, Arduino IDE, Basic Commands for Arduino, Connecting LEDs with Arduino, Connecting LCD with Arduino.

Module 3: BASICS OF RASPBERRY Pi (12 Periods)

Introduction to Raspberry pi, Installation of NOOBS on SD Card, Installation of Raspbian on SD Card, Terminal Commands, Installation of Libraries on Raspberry Pi, Getting the static IP address of Raspberry Pi, Run a Program on Raspberry Pi, Installing the RemoteDesktop Server, Pi Camera, Face Recognition using Raspberry Pi, Installation of I2C driver on Raspberry Pi, SPI (serial peripheral interface) with Raspberry Pi, Programming a Raspberry Pi, Play with LED and Raspberry Pi, Reading the digital input, Reading an edge triggered input, Interfacing of Relay with Raspberry Pi, Interfacing of Relay with Raspberry Pi, Interfacing of LCD with Raspberry Pi, Interfacing LCD with Raspberry Pi in I2C mode, Interfacing of DHT11 sensor with Raspberry Pi, Interfacing of ultrasonic sensor with Raspberry Pi, Interfacing of camera with Raspberry pi.

Module 4: DATA ACQUISITION WITH PYTHON AND TKINTER & COMMUNICATING TO CLOUD (09 Periods)

Basics-CSV file, Storing Arduino data with CSV file, Plotting random numbers using matplotlib, Plotting real-time from Arduino, Integrating the plots in the Tkinter window. Smart IoT Systems, DHT11 Data Logger with ThingSpeak Server, Ultrasonic Sensor Data Logger with ThingSpeak Server, Air Quality Monitoring System and Data Logger with ThingSpeak Server, Landslide Detection and Disaster Management System, Smart Motion Detector and Upload Image to gmail.com.

Module 5: BLYNK APPLICATION WITH RASPBERRY Pi (08 Periods)

Introduction to Blynk, Creating new project with Blynk, Home Appliance Control with Blynk App, Cayenne Application with Raspberry Pi, Introduction to Cayenne, LED blink with Cayenne App.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. A) Design and Simulate LED 7-Segment Display interfacing with Arduino.
B) Design and Simulate Servo motor interfacing with Arduino.
2. A) Design and Simulate ultrasonic sensor and LCD interfacing with Arduino.
B) Design and Simulate Flame Sensor interfacing with Arduino.
3. Design and Implement to capture Gas Sensor and send sensor data to cloud from your NodeMCU device using Arduino IDE.
4. Design and Implementation of Humidity and Temperature Monitoring Using Arduino and

upload data to cloud using MQTT.

5. Design and Implementation of an IoT ECG (Electrocardiogram) System to record hearts electrical activity
6. Design and Simulate controlling an LED 7-Segment Display with Raspberry Pi.
7. Design and implementation of Raspberry Pi Home Security System with Camera and PIR Sensor with Email Notifications.
8. Design and Implement to upload Light sensor (TSL) data to cloud through Raspberry Pi.
9. Design and Implementation of Motion Detector with NodeMCU and BLYNK.
10. Design and Implementation of Fire notification IoT system with BLYNK.

RESOURCES

TEXT BOOKS:

1. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, *Internet of Things with Raspberry Pi and Arduino*, CRC Press, 2019.
2. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press. Availability: https://www.amazon.in/Introduction-IoT-Sudip-Misra/dp/1108959741/ref=sr_1_1?dchild=1&keywords=sudip+misra&qid=1627359928&sr=8-1

REFERENCE BOOKS:

1. Jan Holler and Vlasios Tsiatsis, *From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence*, Elsevier Ltd., 2014.
2. David Hanes and Gonzalo Salgueiro, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things*, Cisco Press, 2017.
3. Adrian McEwen and Hakin Cassimally, *Designing the Internet of Things*, Wiley India.
4. Simon Monk, *Programming Aurdino*, Second Edition, McGraw-Hill Education, 2016.
5. Matt Richardson and Shawn Wallace, *Getting Started with Raspberry Pi*, O'Reilly, 2014.
6. Rahul Dubey, *An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications*, Cengage Learning India Pvt. Ltd, 2019

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. <https://nptel.ac.in/courses/106105166>

Web Resources:

1. <https://docs.arduino.cc/arduino-cloud/getting-started/iot-cloud-getting-started>
2. <https://tutorials-raspberrypi.com/raspberry-pi-sensors-overview-50-important-components/>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101402	INTRODUCTION TO SOFT COMPUTING	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: : This course provides a detailed discussion on Soft computing techniques concepts, Supervised learning networks, Genetic algorithms, Fuzzy logic, Hybrid soft computing techniques and applications.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Investigate soft computing techniques for solving computational problems.
- C02** Design efficient neural architectures to model patterns for a given learning problem.
- C03** Investigate and solve optimization problems using genetic algorithms.
- C04** Apply fuzzy logic and reasoning to handle uncertainty in engineering problems.
- C05** Develop intelligent solutions using hybrid soft computing techniques to solve problems of multidisciplinary domains.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	-	-	-	-	-	-
C02	3	3	3	1	-	-	-	-	-	-	-	-
C03	3	2	-	-	-	-	-	-	-	-	-	-
C04	3	2	-	-	-	-	-	-	-	-	-	-
C05	3	3	3	-	-	2	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	1	-	2	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 INTRODUCTION TO SOFT COMPUTING AND SUPERVISED LEARNING NETWORKS (10 Periods)

Introduction to Soft Computing: Neural networks, Application scope of neural networks, Fuzzy logic, Genetic algorithm, Hybrid systems, Soft computing.

Artificial Neural Networks: Fundamentals, Basic Models, Terminologies, Linear Separability, Hebb network.

Supervised Learning Networks: Perceptron Networks- Theory, Perceptron learning rule, Architecture, Flowchart for training process, Perceptron training algorithm for single and multiple output classes, Perceptron network testing algorithm; Back-Propagation Network - Theory, Architecture, Flow chart for training process, Training algorithm, Learning factors of back-propagation network, Testing algorithm for back-propagation network.

Module 2 UNSUPERVISED LEARNING NETWORKS (08 Periods)

Fixed weight competitive nets – Maxnet, Mexican Hat Net, Hamming network; Kohonen self-organizing feature maps – Theory, Architecture, Flowchart, Training algorithm; Learning vector quantization – Theory, Architecture, Flowchart, Training algorithm, Variants; Counter propagation networks – Theory, Full counter propagation Net, Forward-only counter propagation Net; Adaptive resonance theory network – Fundamental architecture, Fundamental operating principle, Fundamental algorithm.

Module 3 GENETIC ALGORITHMS (09 Periods)

Genetic algorithms - Biological background, Traditional optimization and search techniques, Genetic algorithm and search space, Genetic algorithms vs. traditional algorithms, Basic terminologies in genetic algorithm, Simple GA, General genetic algorithm, Operators in genetic algorithm, Stopping condition for genetic algorithm flow, Constraints in genetic algorithm, Problem solving using genetic algorithm, Adaptive genetic algorithms, Hybrid genetic algorithms, Advantages and limitations of genetic algorithm, Applications of genetic algorithm.

Module 4 FUZZY LOGIC (11 Periods)

Introduction to fuzzy logic, Classical sets, Fuzzy sets, Membership function – Features, Fuzzification, Methods of membership value assignments; Fuzzy arithmetic and measures – Fuzzy arithmetic, Extension principle, Fuzzy measures, Measures of fuzziness, Fuzzy integrals; Fuzzy rule base and approximation reasoning - Truth values and tables in fuzzy logic, Fuzzy propositions, Formation of rules, Compound rules, Aggregation of fuzzy rules, Fuzzy reasoning, Fuzzy inference systems, Overview of fuzzy expert system; Fuzzy decision making, Fuzzy logic control systems.

Module 5 HYBRID SOFT COMPUTING TECHNIQUES AND APPLICATIONS (07 Periods)

Hybrid Soft Computing Techniques: Genetic neuro hybrid systems, Genetic fuzzy hybrid and fuzzy genetic hybrid systems.

Applications of Soft Computing: Optimization of traveling salesman problem using genetic algorithm approach, Genetic algorithm-based internet search technique, Soft computing-based hybrid fuzzy controllers, Soft computing-based rocket engine control.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Write a program to implement Activation Functions.
2. Write a program to Generate ANDNOT, XOR function using McCulloch-Pitts neuralnet.

RESOURCES

TEXT BOOKS:

1. S.N.Sivanandam and S.N.Deepa, "*Principles of soft computing*", 3rd edition, Wiley India,2019

REFERENCE BOOKS:

1. S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications, PHI Learning Private Ltd, 2011.
2. Udit Chakraborty, Samir Roy, Soft Computing: Neuro-Fuzzy and Genetic Algorithms, Pearson, 2013.
3. Saroj Kaushik, Sunita Tewari, *Soft Computing: Fundamentals, Techniques and Applications*, McGraw Hill, 2018.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106105173/>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS102003	DATA VISUALIZATION	3	-	2	-	4

Pre-Requisite	Python Programming
Anti-Requisite	-
Co-Requisite	-

Course Description: This course provides a detailed discussion on Data Visualization elements, tools, visualization of maps, Dashboard design using Power BI and Tableau.

Course Outcomes: After successful completion of the course, students will be able to:

- C01.** Demonstrate knowledge on Data Visualization concepts.
- C02.** Apply data visualization tools to perform ETL process and create charts.
- C03.** Develop customized Map visualizations
- C04.** Demonstrate skills in developing Dashboards as per business requirements.
- C05.** Perform Data Analysis using Power BI.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C01	3	-	-	-	-	-	-	-	-	-	-	-	3	-	3	3
C02	3	3	3	-	3	2	-	-	-	-	-	-	3	-	3	3
C03	3	3	3	3	3	-	-	-	-	-	-	-	3	-	3	3
C04	2	3	2	3	2	2	-	-	-	-	-	-	3	-	3	3
C05	3	3	3	3	3	3	-	-	-	-	-	-	3	-	3	3
C06	-	-	-	2	-	-	-	-	3	3	-	-		-	-	-
Course Correlation Mapping	3	3	3	3	3	3	-	-	3	3	-	-	3	-	3	3

Correlation Levels: 3:High 2:Medium 1:Low

COURSE CONTENT:

Module 1: INTRODUCTION

(09 periods)

Definition of Data Visualization, The data visualization process, Data visualization importance in reports and statements; Data types, relationships, and visualization formats, Basic principles for data visualization, Layout and design: communicative elements, Prioritize patterns in visualizations: Gestalt, Storytelling for social and market communication, Trends in market research and data visualization dashboards

Module 2: DATA VISUALIZATION TOOLS

(09 periods)

Data Visualization and Benefits Data Visualization Tools, Data Visualization Tools- Google Data Studio, Tableau, Qlikview, Power BI; Features, Data Access from Data Sources, Data transformation-Extraction, Transformation and Load (ETL), Messy data, Data formats and schemas, Data blending or fusion, Methods for data cleansing, Data profiling, Open source data-cleansing tools; Bar Chart, Pie Chart, Data Tables, Scatter Chart, Time Series Chart, Scorecards, Bullet Charts, and Area Chart.

Module 3: MAPS

(09 periods)

Heat Map-Introduction, Uses of Heat map, Procedure to Create Heat Map in Tableau; Geo Map-Introduction -Need of map visualization, Uses of Geo map, Types of maps, Procedure to create Geo map / Symbol map in Tableau; Symbol Map- Introduction, Procedure to create Symbol Map; Filled Map; Editing Location in Map- Add more fields to view, Edit locations in the Special Values menu, Edit ambiguous locations, Edit unknown locations.

Module 4: DASH BOARDS

(09 periods)

Introduction- Definition, Key Metrics for Dashboard, Benefits of Dashboard, Types of Dashboard, Customized Dashboard; Creating a Dashboard- Creating a Dashboard using Google Data Studio, Creating a dashboard in Tableau; Formatting a Dashboard- Dashboard Size, Steps to set overall dashboard size, Group items using layout containers, Tile or float dashboard items; Actions In Dashboard- Highlight Action, Dashboard Filters, URL Action; Sharing Reports- Share with specific users and groups, Sharing the link of report, Embedding report, Download the report

Module 5: POWER BI

(09 periods)

Understanding Power BI, Key Features of Power BI, Advanced features of Power BI, Variants of Power BI, Data sources and modeling, Data transformation and relationships, chart types for visualization, format options of charts, Data Analysis Expressions functions include aggregate, counting, logical and date functions for creating calculated columns and measures.

Total Periods: 45

EXPERIENTIAL LEARNING:

List of Exercises:

1. Connect data sources to Tableau.
 - i). Text files, Excel files, Access Databases, SQL Server
 - ii). Dimensions and measures of data, Perform changing data types, Apply filters, Merge multiple data sources.
2. Create Univariate charts
 - i) Create Tables
 - ii) Create common visualizations (bar charts, line charts etc.) and sort the graphs
 - iii) Show aggregate measures and top 10 items
3. Create Maps and Perform customization of maps
4. Calculate user-defined fields using functions
5. Assemble a dashboard layout and apply filters.
6. Perform interactions with text, visual tooltips and actions.
7. Drill down between dash boards.
8. Perform advanced visualization using Tableau.
9. Create a data story in Tableau.
10. Create a graph for telecom billing data:
 - i). Bar chart for customer segment vs average bill
 - ii). Sort them based on average current charges
 - iii). Create a set based on last five groups
 - iv). What is the count of accounts and average bill for the subset.
11. Design a dashboard to show units in stock by product and a total sale by year.
(Demonstration on List of Power BI chart types for visualization).

Design a dashboard to check the total amount of sales made in each month and find out which month had the highest and lowest sales. Use a simple clustered column chart. Drag the date column on the axis and the sales on to the values then change the color of the bars by going to the format option and selecting data colors. (*Demonstration on format options of charts*).

RESOURCES

TEXT BOOKS:

1. Visualize It! A Comprehensive Guide to Visualization
2. Dr. S. Karpagavalli, Introduction To Data Visualization Tools, Blue Hill Publishers, 1st Edition, 2020.

REFERENCE BOOKS:

1. Teo Lachev, "Applied Microsoft Power BI," Prologika, Seventh Edition, 2022.
2. Alberto Ferrari and Marco Russo, "Introducing Microsoft Power BI," Microsoft Press, 2016.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=TPMIZxRRaBQ>
2. <https://www.youtube.com/watch?v=yjDPgvQX-9I>

WEB RESOURCES:

1. <https://docs.microsoft.com/en-us/power-bi/fundamentals/power-bi-overview>.
2. <https://www.edureka.co/blog/power-bi-tutorial/>

3. <https://mindmajix.com/power-bi-visualization-types>
4. <https://intellipaat.com/blog/tutorial/power-bi-tutorial/>
5. <https://docs.microsoft.com/en-us/powerapps/maker/canvas-apps/sharepoint-scenario-build-report>.
6. <https://www.projectpro.io/article/power-bi-microsoft-projects-examples-and-ideas-for-practice/533>.

SOFTWARE/ TOOLS USED:

1. <https://www.tableau.com/products/techspecs>
2. <https://www.tableau.com/tft/activation>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101017	DATA MINING	3	-	-	-	3
Pre-Requisite	Database Management Systems					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course emphasizes on the fundamental concepts of Data Mining. The course also covers concepts such as Data Pre-processing, Operational Database Systems and Data Warehouses, Mining Frequent Patterns, Classification and Prediction, Clustering, Data warehousing and Mining tools. The course also focuses on New Trends and Research Frontiers and Visualization of Multi-Dimensional Data.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Apply data pre-processing techniques to produce refined data.
- CO2.** Apply Association rules and classification techniques for data categorization.
- CO3.** Use clustering techniques for grouping similar data items and identify outliers.
- CO4.** Understand Data Mining trends and applications.
- CO5.** Implement Visualization of Multi-dimensional Data

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	2	2	2	-	-	-	-	-	-	-	3	-	-	-
CO4	2	3	3	-	-	2	-	-	-	-	-	-	3	-	-	-
CO5	2	2	3	-	2	-	-	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	-	2	2	-	-	-	-	-	-	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 DATA MINING AND DATA PREPROCESSING (08 Periods)

Introduction to Data Mining, kinds of data, kinds of patterns, major issues in Data Mining, Data Pre-processing, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Discretization.

Module 2 ASSOCIATIONS AND CLASSIFICATION (10 Periods)

Basic Concepts, Frequent itemset Mining Methods, pattern evaluation methods- From Association Mining to Correlation Analysis, Classification, Decision Tree Introduction, Bayesian Classification Methods, Rule Based Classification, Prediction: Linear Regression.

Module 3 CLUSTER ANALYSIS (09 Periods)

Cluster Analysis: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods-k-Means and K-Medoids, Hierarchical methods-Agglomerative and divisive method, Density-Based Method-DBSCAN, Grid-Based Method- STING, Outlier Analysis.

Module 4 DATA MINING TRENDS (09 Periods)

Mining Complex Data Types: Mining sequence data, Mining other kinds of data: Spatial, Text, Multimedia and Web data.

Data Mining Trends: Mining Complex Data Types, Methodologies of Data Mining, Data Mining Applications, Data Mining and Society, Data Mining Trends.

Module 5 VISUALIZATION OF MULTI-DIMENSIONAL DATA (09 Periods)

Introduction, Diagrams for Multidimensional visualization, Kiviat diagrams, 3D Scattergram, 3D Line Graph, Chernoff Faces, Volume Rendering, **Visual Data Mining** - Animation

Total Periods: 45

EXPERIENTIAL LEARNING:

1. Create a dataset using ARFF and CSV formats and load into the Weka Explorer.
2. List all the categorical attributes and the real-valued attributes separately in 'German credit' data set.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, Elsevier, Third Edition, 2013.

REFERENCE BOOKS:

1. K.P. Soman, Shyam Diwakar and V. Ajay, Insight into Data mining Theory and Practice, Easter Economy Edition, Prentice Hall of India, 2006.
2. G. K. Gupta, Introduction to Data Mining with Case Studies, Easter Economy Edition, Prentice Hall of India, 2006.
3. Tan P.N, Steinbach M. and Kumar V., Introduction to Data Mining, Addison-Wesley, 2006.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview
2. <https://www.coursera.org/specializations/data-mining-foundations-practice>
3. [Data Mining | Coursera](#)

WEB RESOURCES:

1. [Data Mining. Concepts and Techniques, 3rd Edition \(The Morgan Kaufmann Series in Data Management Systems\) \(sabanciuniv.edu\)](#)

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT102003	CLOUD COMPUTING	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Fundamental Cloud Computing and Virtualization, Understanding Cloud Models and Architectures, Understanding Cloud Services, Applications and Capacity Planning, Exploring Platform as a Service (PaaS) and Exploring Infrastructure as a Service (IaaS).

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on basic concepts and terminologies of Cloud Computing and Virtualization.

CO2. Demonstrate knowledge on Cloud deployment models, Service models and Architectures.

CO3. Analyze Cloud services, Applications and Capacity Planning.

CO4. Use different PaaS application frameworks to construct Cloud applications.

CO5. Develop web applications through Google, Microsoft and Amazon web services as per societal needs.

CO6. Work independently or in teams to construct Cloud applications and present with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	2	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	2	2	3	-
CO5	3	2	2	2	2	3	-	-	-	-	-	-	2	2	3	-
CO6	-	-	-	2	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	2	2	-	-	-	3	3	-	-	3	2	3	-

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT:

Module-1: FUNDAMENTAL CLOUD COMPUTING AND VIRTUALIZATION (10 periods)

Cloud Computing: Origin and influences, Basic concepts and terminology, Goals and benefits, Risks and challenges, Roles and boundaries and Cloud characteristics.

Introduction to Virtualization: Characteristics, Taxonomy of virtualization technologies, Pros and cons of virtualization, Virtualization Technologies: Xen, VMware and Hyper-V.

Module-2: UNDERSTANDING CLOUD MODELS AND ARCHITECTURES (08 periods)

Cloud Models: NIST model, Cloud Cube model, Deployment models: Public, Private, Hybrid and Community; Service models: IaaS, PaaS and SaaS.

Understanding Cloud Architecture: Exploring the Cloud Computing Stack: Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications; Connecting to the Cloud: The Jolicloud Netbook OS and Chromium OS - The Browser as an Operating System.

Module-3: UNDERSTANDING CLOUD SERVICES, APPLICATIONS AND CAPACITY PLANNING (09 periods)

Understanding Cloud Services and Applications: Infrastructure as a Service (IaaS): IaaS workloads, Pods, aggregation, and silos; Platform as a Service (PaaS), Software as a Service (SaaS): SaaS characteristics, Open SaaS and SOA, Salesforce.com and CRM SaaS; Identity as a Service (IDaaS): Identity, Networked identity service classes, Identity system codes of conduct, IDaaS interoperability; Compliance as a Service (CaaS).

Capacity Planning: Defining Baseline and Metrics: Baseline measurements, System metrics, Load Testing, Resource ceilings, Server and instance types; Network Capacity and Scaling.

Module-4: EXPLORING PLATFORM AS A SERVICE (PaaS) (10 periods)

PaaS Application Frameworks: Drupal, Eccentex AppBase 3.0, LongJump, Squarespace, WaveMaker and Wolf Frameworks.

Exploring Platform as a Service using Google Web Services: Surveying the Google Application Portfolio, Google Toolkit and Working with the Google App Engine.

Exploring Platform as a Service using Microsoft Cloud Services: Exploring Microsoft Cloud Services, Defining the Windows Azure Platform, Windows Live: Windows Live Essentials, Windows Live Home and Windows Live for Mobile.

Module-5: EXPLORING INFRASTRUCTURE AS A SERVICE (IaaS) (08 periods)

Understanding Amazon Web Services, Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2): Amazon Machine Images, Pricing models, System images and software, Creating an account and instance on EC2; Working with Amazon Storage Systems: Amazon Simple Storage System (S3), Amazon Elastic Block Store (EBS) and CloudFront; Understanding Amazon Database Services: Amazon SimpleDB, Amazon Relational Database Service (RDS) and Choosing a database for AWS.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Create a Virtual Machine on Virtual Box with Ubuntu 14LTs files, 2GB RAM and 200GB Hard Disk configuration through Infrastructure as a Service (IaaS).
2. Create a Virtual Machine on Virtual PC with Windows, 2GB RAM and 200GB Hard Disk configuration through Infrastructure as a Service (IaaS).
3. Create Virtual Private Cloud (VPC) with subnets, route table and Internet gateway using AWS Management Console.
4. Create a virtual machine instance with 2GB RAM and 200 GB hard disk configuration on Amazon Web Services (AWS) cloud through Elastic Compute Cloud (EC2) service and develop a home web page for online bookstore information.
5. Develop a catalogue web page for online bookstore and create a Simple Storage Service (S3) bucket on Amazon Web Services (AWS) cloud and upload catalogue web page into S3 bucket.
6. Compute the following tasks through AWS Lambda function in an event-driven environment using Qwiklabs Cloud:
 - i. Create an AWS Lambda function
 - ii. Configure an Amazon S3 bucket as a Lambda Event Source
 - iii. Trigger a Lambda function by uploading an object to Amazon S3
 - iv. Monitor AWS Lambda S3 functions through Amazon CloudWatch Log.
7. Compute the following tasks through Amazon DynamoDB using Qwiklabs Cloud:
 - i. Create an Amazon DynamoDB table
 - ii. Enter data into an Amazon DynamoDB table
 - iii. Query an Amazon DynamoDB table
 - iv. Delete an Amazon DynamoDB table.
8. (a) Perform the following operations through Google Cloud Pub/Sub using Qwiklabs Cloud:
 - i. Setup a topic to hold data
 - ii. Subscribe to a topic to access the data
 - iii. Publish and then consume messages with a pull subscriber.(b) Create an Google Assistant environment through Actions and Dialogflow for building an Assistant application that generates quotes when prompted by a user using Qwiklabs Cloud.
9. (a) Implement a Python Program using Watson studio in IBM Cloud Environment
(b) Deploy and Run any application in IBM CloudEnvironment
(c) Develop a chat bot using Watson Assistant in IBM CloudEnvironment.
10. (a) Create two data centers in different regions with 10-20 physical host, 6-10 userbases, 100-250 executable instructions length per request using Cloud Analyst simulation tool.
(b) Evaluate and generate reports for 10(a) with different Service Broker and Load Balancing Policies. Sketch out the comparison report on different policies.

11. Create an instance for connecting, monitoring and visualizing Internet of Things (IoT) device data through Thingspeak cloud.
12. Mini Project: Form a group of maximum 3 members as a team and assign unique projects for each team.

RESOURCES

TEXT BOOKS:

1. Barrie Sosinsky, *Cloud Computing Bible*, Wiley India Pvt Ltd, 2011 (Reprint 2017).
2. Thomas Erl and RicardoPuttini, *Cloud Computing- Concepts, Technology and Architecture*, Pearson, 2014 (Seventh Impression 2017).

REFERENCE BOOKS:

1. Rajkumar Buyya, Christian Vecchiloa and S Thamarai Selvi, *Mastering Cloud Computing*, McGraw Hill Education, 2013 (Reprint 2017).
2. George Reese, *Cloud Application and Architectures*, O'Relly, 2009 (Reprint 2017).

WEB RESOURCES:

1. "Exploring the Google Toolkit", <https://code.google.com/>, drafted on 23 December, 2019.
2. "Understanding Amazon Web Services", <https://aws.amazon.com/>, drafted on 23 December, 2019.
3. "Exploring Microsoft Cloud Services", <https://www.microsoft.com/windowsazure>, drafted on 23 December, 2019.
4. "Qwiklabs – Hands-on Cloud Environment", <https://www.qwiklabs.com/>, drafted on 23 December, 2019.
5. "IBM Cloud Envrioment", <https://www.ibm.com/in-en/cloud>, drafted on 23 December, 2019.
6. "Cloud Analytics Simulation Tool", <http://www.cloudbus.org/cloudsim/>, drafted on 23 December, 2019.
7. "Thingspeak Cloud", <https://thingspeak.com/>, drafted on 23 December, 2019.

SOFTWARE/TOOLS:

1. Virtual Box and Virtual PC Software
2. Cloud Analyst Simulation Tool
3. Amazon Web Services (AWS), Qwiklabs, IBM Bluemix and Thingspeak Cloud

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS101005	DISTRIBUTED SYSTEMS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course focuses on the fundamental principles and models underlying all aspects of distributed computing. It includes topics that covers the principles underlying the theory, algorithms, and systems aspects of distributed computing.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Identify the design issues; select appropriate system and mode of execution to address challenges in creating distributed systems.
- CO2.** Utilize the concept of causality between events for designing and analyzing distributed systems.
- CO3.** Record the global state of a distributed system for analyzing, testing, or verifying properties associated with distributed executions.
- CO4.** Implement various approaches for solving distributed mutual exclusion problem and compare their feature and performance.
- CO5.** Study several distributed dead lock detection techniques based on various strategies and solve dead lock problem

CO-PO Mapping Table:

Course Outcomes	Program Outcomes										Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	2	-	-	-	-	-	3	-
CO3	3	3	3	-	-	-	-	-	-	-	2	-	3	-
CO4	2	3	3	-	-	-	-	2	-	-	-	-	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	3	3	3	-	-	-	2	2	-	-	2	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION

(09 Periods)

Relation to parallel multiprocessor/multicomputer systems - Message-passing systems versus shared memory systems - Synchronous versus asynchronous executions - Design issues and challenges - A model of distributed executions - Models of communication networks - Past and future trends of an event-driven Models of process communications

Module 2: LOGICAL TIME

(09 Periods)

A framework for a system of logical clocks - Scalar time - Vector time - Efficient implementations of vector clocks - Jard-Jourdan's adaptive technique - Matrix time - Virtual time - Physical clock synchronization: NTP

Module 3: GLOBAL STATE AND SNAPSHOT RECORDING ALGORITHMS

(09 Periods)

Global state and snapshot recording algorithms - Snapshot algorithms for FIFO channels - Variations of the Chandy-Lamport algorithm - Snapshot algorithms for non-FIFO channels - Snapshot in a causal delivery system - Monitoring global state

Module 4: DISTRIBUTED MUTUAL EXCLUSION ALGORITHMS

(09 Periods)

Lamport's algorithm - Ricart-Agrawala algorithm - Singhal's dynamic information structure algorithm - Lodha and Kshemkalyani's fair mutual exclusion algorithm - Quorum-based mutual exclusion algorithms - Maekawa's algorithm - Agarwal-El Abbadi quorum-based algorithm - Token-based algorithms - Suzuki-Kasami's broadcast algorithm - Raymond's tree-based algorithm.

Module 5: DEADLOCK DETECTION IN DISTRIBUTED SYSTEMS

(09 Periods)

System model - Models of deadlocks - Knapp's classification of distributed deadlock detection algorithms - Mitchell and Merritt's algorithm for the single resource model - Chandy-Misra-Haas algorithm for the AND model - Chandy-Misra-Haas algorithm for the OR model - Distributed shared memory - Abstraction and advantages - Memory consistency models.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Implement concurrent client-server application
2. Implement concurrent day-time client-server application.
3. Create CORBA based server-client application.
4. Implementing Publish/Subscribe Paradigm using Web Services, ESB and JMS.
5. Test open source ESB using web service.

RESOURCES

TEXT BOOKS:

1. Kshemkalyani AjayD, Mukesh Singhal, Distributed Computing: Principles, Algorithms and Systems, Cambridge Press, 2011.

REFERENCE BOOKS:

1. George Coulouris, Jean Dollimore, Time Kindberg, Distributed Systems Concepts and Design, Fifth Edition, Pearson Education, 2012.
2. Pradeep L Sinha, Distributed Operating Systems: Concepts and Design, PrenticeHall ofIndia, 2007.
3. TanenbaumAS, VanSteenM, Distributed Systems: Principles and Paradigms, Pearson Education, 2007.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=UEAMfLPZZhE>
2. <https://www.digimat.in/nptel/courses/video/106106168/L01.html>

WEB RESOURCES:

1. <https://www.cl.cam.ac.uk/teaching/2122/ConcDisSys/dist-sys-notes.pdf>
2. <https://lass.cs.umass.edu/~shenoy/courses/677content/CourseNotes.pdf>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB102001	CRYPTOGRAPHY AND NETWORK SECURITY	3	-	2	-	4
Pre-Requisite	COMPUTER NETWORKS					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of cryptographic algorithms, Substitution techniques, Symmetric ciphers, Block cipher operations, Cryptographic data integrity algorithms, Key management and distribution, User authentication, Transport level security, Electronic mail security, IP security.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Apply the knowledge of network security concepts, symmetric and public key cryptosystems for securing information.
- CO2.** Apply hash functions, message authentication codes and digital signatures for providing data integrity in information security applications.
- CO3.** Use key management and distribution techniques, user authentication techniques for assuring mutual trust among users.
- CO4.** Demonstrate knowledge on network and Internet security techniques for addressing the security threats.
- CO5.** Work independently and in teams to solve security problems with effective communication

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	3	-	-	-	3	-	-	-	-	3	3	3	2
CO2	3	3	-	3	-	-	-	-	-	-	-	-	3	3	3	2
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	3	3	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3	2
CO5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	3	3	-	3	-	-	-	3	3	3	-	-	3	3	3	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION

(09 Periods)

Computer security concepts, Security attacks, Security services, Security mechanisms, Model for network security, Symmetric cipher model, Substitution techniques - Monoalphabetic ciphers and Polyalphabetic ciphers.

Module 2: SYMMETRIC CIPHERS

(07 Periods)

Stream ciphers and block ciphers, Data Encryption Standard (DES), Advanced Encryption Standard (AES) - Structure, Transformation Functions; Block Cipher Operation - Multiple encryption and triple DES, Cipher block chaining mode, Cipher feedback mode, Output feedback mode, Counter mode.

Module 3: PUBLIC KEY CRYPTOGRAPHY AND CRYPTOGRAPHIC DATA INTEGRITY ALGORITHMS

(09 Periods)

Public Key Cryptography: RSA, Diffie-Hellman key exchange, Elgamal cryptographic system.

Cryptographic Data Integrity Algorithms: Hash Functions - Simple hash functions, Secure Hash Algorithm SHA-512; Message Authentication Codes - Requirements, Functions, Security of MACs, HMAC; Digital signatures - Schnorr Digital signature scheme;

Module 4: MUTUAL TRUST

(10 Periods)

Key Management and Distribution: Symmetric key distribution using symmetric and asymmetric encryption, Distribution of public keys, X.509 certificates, Public key infrastructure.

User Authentication: Remote user authentication principles, Kerberos, Personal identity verification.

Module 5: NETWORK AND INTERNET SECURITY

(10 Periods)

Transport Level Security: Web security considerations, Transport layer security, HTTPS.

Electronic Mail Security: S/MIME, Pretty Good Privacy, DNSSEC.

IP Security: Overview, Policy, Encapsulating security payload.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Construct a Caesar cipher and convert the word "the Network security" into Cipher text with $k=3$.
2. Generate the Cipher text for the message "BALLOON" using play fair Cipher.
3. Generate the cipher text for the message "me" and also regenerate the message from the cipher text using hill cipher and with the key

$$\begin{pmatrix} 9 & 4 \\ 5 & 7 \end{pmatrix}$$

4. Construct a cipher for the word "the Network security" using rail fence of Depth = 2.
5. Perform the Simple DES on the following data and calculate the cipher text for the plain text "10100101" and the key is "0010010111"

P10:	3	5	2	7	4	10	1	9	8	6
P8:	6	3	7	4	8	5	10	9		
E/P:	4	1	2	3	2	3	4	1		
S0		0	1	2	3					
	0	1	0	3	2					
	1	3	2	1	0					
	2	0	2	1	3					

	3	3	1	3	2					
S1		0	1	2	3					
	0	0	1	2	3					
	1	2	0	1	3					
	2	3	0	1	0					
	3	2	1	0	3					
P4:	2	4	3	1						
IP:	2	6	3	1	4	8	5	7		
IP ⁻¹ :	4	1	3	5	7	2	8	6		

6. Using Fermat's theorem, find $4^{225} \bmod 13$.
7. Consider a one-way authentication technique based on asymmetric encryption:
A → B: ID_A
B → A: R₁
A → B: E(PR_a, R₁)
 - a. Explain the protocol.
 - b. What type of attack is this protocol susceptible to?
8. Consider a one-way authentication technique based on asymmetric encryption:
A → B: ID_A || E(PU_B, R_A)
B → A: R_A
 - a. Explain the protocol.
 - b. What type of attack is this protocol susceptible to?
9. Investigate the network access control scheme used at your College. Draw a diagram and describe the principal components.
10. List some commonly used cloud-based data services. Explore and compare these services based on their use of encryption, flexibility, efficiency, speed, and ease of use. Study security breaches on these services in recent past. What changes were made by the services after these attacks?

RESOURCES

TEXT BOOKS:

1. William Stallings, *Cryptography and Network Security: Principles and Practice*, 8th Edition, Pearson, 2020

REFERENCE BOOKS:

1. William Stallings, *Network Security Essentials: Applications and Standards*, 6th Edition, Pearson, 2018.
2. Douglas R. Stinson, Maura B. Paterson, *Cryptography: Theory and Practice*, 4th Edition, CRC Press, 2018.
3. Atul Kahate, *Cryptography and Network Security*, 3rd Edition, McGraw Hill, 2017.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=JoeiLuFNBc4&list=PLBlnK6fEyqRgJU3EsOYDTW7m6SUmW6kII&index=1>
2. <https://www.coursera.org/learn/crypto#syllabus>
3. <https://nptel.ac.in/courses/106105031>

WEB RESOURCES:

1. <https://www.javatpoint.com/computer-network-security>
2. <https://www.tutorialspoint.com/cryptography/index.htm>
3. <https://www.geeksforgeeks.org/cryptography-introduction/>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101001	CYBER SECURITY ESSENTIALS	3	-	-	-	3

Pre-Requisite -
Anti-Requisite Computer Networks
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Cyber Security Fundamentals, Cyber Security Fundamentals, Attacker techniques and motivations, Fraud techniques, Threat infrastructure, Exploitation, Malicious code, Defense and analysis techniques, Intrusion detection techniques

COURSE OBJECTIVES:

- To impart knowledge on network security concepts, attacker techniques, Exploitation, defense and analysis techniques
- To develop skills on attacker techniques and malicious code to application against cyber threats
- To inculcate attitude among students to solve societal problems using cyber security concepts to defend the attacks in system.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understanding the fundamental concepts of cyber security concepts
- CO2.** Identify the pattern of launching attacker and fraud techniques to reduce risk and impact of cyber-attacks.
- CO3.** Identify the vulnerabilities using the SQL injection and web exploitation techniques in a system for securing data.
- CO4.** Apply code obfuscation techniques to prevent any unauthorized party from accessing logic of an application
- CO5.** Apply honey pots and malicious code-naming techniques to defend against attacks in memory.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	3	3	3
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	3	-
CO5	3	2	3	2	-	-	-	-	-	-	-	-	3	3	3	-
Course Correlation Mapping	3	3	3	2	-	-	-	-	-	-	-	-	3	3	3	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:

Module 1: CYBER SECURITY FUNDAMENTALS

(10 Periods)

Network Security Concepts: Information assurance fundamentals, Basic cryptography, Symmetric encryption, Public key encryption, The Domain Name System(DNS), Firewalls, Virtualization, Radio-Frequency Identification.

Module 2: ATTACER TECHNIQUES

(09 Periods)

Attacker techniques and motivations: Anti forensics, proxy usage, Tunneling techniques: HTTP, DNS, ICMP, Intermediaries, Steganography and other concepts, Detection and prevention.

Fraud techniques: Phishing, smishing, vishing and mobile malicious code, rogue antivirus, click fraud.

Threat infrastructure: Botnets, Fast Flux, Advanced Fast Flux.

Module 3: EXPLOITATION

(09 Periods)

Shellcode, Integer overflow vulnerabilities, Stack based buffer overflows, Format string vulnerabilities, SQL injection, Malicious PDF files, Race conditions, Web exploit tools, DoS conditions, Brute force and dictionary attacks.

Module 4: MALICIOUS CODE

(10 Periods)

Worms, viruses, Evading detection and elevating privileges: obfuscation, Virtual Machine obfuscation Persistent software techniques,Token kidnapping, Virtual machine Detection, Rootkits, Spyware, Attacks against privileged user accounts and escalation of privileges, Stealing information and Exploitation.

Module 5: DEFENSE AND ANALYSIS TECHNIQUES

(07 Periods)

Importance of memory forensics, Capabilities of memory forensics, Memory analysis frameworks, Dumping physical memory, Installing and using volatility, Finding hidden processes, Volatility analyst pack.

Honeypots, Malicious code naming, Automated malicious code analysis systems, Intrusion detection techniques.

Total Periods: 45

EXPERIENTIAL LEARNING:

Network Security Basics:

Configuring firewalls: Set up and configure firewall rules to control incoming and outgoing network traffic.

Intrusion detection/prevention systems (IDS/IPS): Deploy and manage IDS/IPS solutions to detect and mitigate network threats.

Virtual private networks (VPNs): Configure VPN connections to secure remote access and data transmission over public networks.

Operating System Security:

Hardening operating systems: Implement security best practices and configurations to strengthen the security posture of operating systems.

Patch management: Develop and execute patch management strategies to keep systems up to date with security patches and updates.

User access controls: Configure user permissions, access levels, and authentication mechanisms to prevent unauthorized access.

TEXT BOOKS:

1. James Graham, Richard Howard, Ryan Olson, "Cyber Security Essentials", CRC Press, 2011.(Rs.6900)
2. Chwan-Hwa(john) Wu,J. David Irwin, "Introduction to Cyber Security", CRC Press T&F Group.

REFERENCE BOOKS:

1. Nina Godbole and SunitBelpure, "Cyber Security Understanding Cyber Crimes,Computer Forensics and Legal Perspectives" , Wiley publications.
2. B.B.Gupta, D.P.Agrawal, HaoxiangWang, "Computer and Cyber Security: Principle s, Algorithm, Applications, and Perspectives", CRC Press, ISBN 9780815371335, 2018.

VIDEO LECTURES:

1. <https://www.coursera.org/learn/introduction-to-cybersecurity-essentials>
2. <https://www.udemy.com/course/cybersecurity-essentials/>

WEB RESOURCES:

1. <https://github.com/topics/cybersecurity>
2. <https://www.youtube.com/watch?v=nzZkKoREEGo>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI102002	ARTIFICIAL INTELLIGENCE	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Introduction to Artificial Intelligence, Designing intelligent agents, Solving general purpose problems, Search in complex environments, Probabilistic reasoning, Represent knowledge and reason under uncertainty, Robotics, Ethics and safety in AI.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01.** Architect intelligent agents using artificial intelligence techniques and principles.
- C02.** Analyze and interpret the problem, identify suitable solutions using heuristic functions, optimization algorithms and search algorithms.
- C03.** Select and apply appropriate knowledge representation to build Bayesian network models to reason under uncertainty.
- C04.** Investigate robot hardware and frameworks for intelligent robotic perception.
- C05.** Demonstrate knowledge on ethical implications of intelligent machines for providing privacy, trust, security and safety.
- C06.** Work Independently to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C01	3	1		-	-	-	-	-	-	-	-	-	-	3	-	-
C02	3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
C03	3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
C04	3	-	-	-	-	1	-	-	-	-	-	-	-	3	-	-
C05	-	-	-	-	-	1	-	2	-	-	-	-	-	3	-	-
C06	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	3	2	2	-	-	2	-	2	3	3	-	-	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 INTRODUCTION TO ARTIFICIAL INTELLIGENCE (09 Periods)

Foundations of artificial intelligence, History of artificial intelligence, State of the art, Risks and benefits of AI, Intelligent agents – Agents and environments, The concept of rationality, Structure of agents.

Module 2 PROBLEM SOLVING BY SEARCHING **(09 Periods)**

Problem solving agents, Search algorithms, Uninformed search strategies, Informed search strategies – Greedy best-first search, A* search; Heuristic functions.

Module 3 SEARCH IN COMPLEX ENVIRONMENTS **(09 Periods)**

Local search algorithms and optimization problems – Hill-climbing search, Simulated annealing, Local beam search, Evolutionary algorithms; Optimal decisions in games – The minimax search algorithm, Optimal decisions in multiplayer games, Alpha-Beta pruning, Move ordering; Monte Carlo tree search, Kalman Filter.

Module 4 PROBABILISTIC REASONING **(09 Periods)**

Representing Knowledge in an uncertain domain, Semantics of Bayesian networks, Probabilistic reasoning over time – Time and uncertainty, Inference in temporal models, Hidden Markov models, Kalman Filter.

Module 5 ROBOTICS, ETHICS AND SAFETY IN AI **(09 Periods)**

Robots, Robot hardware, Robotic perception, Alternative robotic frameworks, Application domains.

Limits of AI, Ethics of AI – Surveillance, security and privacy, Fairness and bias, Trust and transparency, AI safety.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Design and implement agent programs for Table-driven agents using the agent function of vacuum-cleaner world. The agent cleans the current square if it is dirty, otherwise it moves to the other square.
2. Implement agent programs for Simple reflex agents and Model-based reflex agents using the agent function of vacuum-cleaner world.
3. Solve the travelling sales man problem using Hill Climbing search algorithm
4. Design and implement solution for 8-puzzle problem using Greedy Best First Search.
5. Find the shortest path between a starting location and destination location in a graph using A* search algorithm.
6. Implement MiniMax algorithm for finding an optimal decision in a tic-toc game.
7. Implement Monte-Carlo Tree search intended to run on small game trees.
8. Solve the monty hall problem using Bayesian Network.
9. The game involves three doors, given that behind one of these doors is a car and the remaining two have goats behind them. So you start by picking a random door, say #2. On the other hand, the host knows where the car is hidden and he opens another door, say #1 (behind which there is a goat). Here's the catch, you're now given a choice, the host will ask you if you want to pick door #3 instead of your first choice i.e. #2.
Implement Kalman Filter to track the aircraft by determining the position and velocity of aircraft.
10. Design and implement a stock prices forecasting model using Hidden Markov Model.

RESOURCES

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 4th Edition, 2020.

REFERENCE BOOKS:

1. Stephen Lucci, Danny Kopec, Artificial Intelligence in the 21st Century, Mercury Learning and Information, 3rd Edition, 2018
2. Rich, Knight, Nair: Artificial intelligence, Tata McGraw Hill, Third Edition, 2009.
3. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Education, 2017.
4. Saroj Kaushik, Artificial Intelligence, Cengage Learning, 2011.

SOFTWARE/TOOLS:

1. Python
2. pandas, matplotlib

VIDEO LECTURES:

1. <https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence>
2. <http://aima.cs.berkeley.edu/>
3. <https://ai.google/education/>
4. <https://www.coursera.org/courses?query=artificial%20intelligence>
5. <https://www.edureka.co/blog/artificial-intelligence-with-python/>

WEB RESOURCES:

1. <http://www.airesources.org/>
2. <https://allthingsai.com/>
3. <https://designmodo.com/ai-tools-designers/>
4. <https://www.ulethbridge.ca/teachingcentre/chatgpt-ai-resources>

PROGRAM ELECTIVE

Course Code

Course Title

L T P S C

22AI102003

MACHINE LEARNING

3 - 2 - 4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Introduction to machine learning, Bayesian concept learning, Supervised learning, Unsupervised learning, Artificial neural networks, Ensemble learning.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Analyze the process of machine learning modeling and evaluation to automatically infer a general description for a given learning problem.
- CO2.** Analyze the underlying mathematical models within machine learning algorithms and learning tasks.
- CO3.** Design and implement machine learning solutions for classification, regression, and clustering problems.
- CO4.** Design and implement efficient neural architectures to model patterns for a given learning problem.
- CO5.** Develop intelligent solutions to solve societal problems related to computer vision, information security, healthcare and other areas.
- CO6.** Work Independently to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	1		-	-	-	-	-	-	-	-	-	3	-
CO5	1	3	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	3	3	3	-	-	3	3	-	-	-	-	3	-

Correlation Levels:

3: High;

2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO MACHINE LEARNING (09 Periods)

Machine Learning: Human learning, Types of human learning, Machine learning, Types of machine learning, Applications of machine learning, Issues in machine learning.

Preparing to Model: Machine learning activities, Types of data, Exploring structure of data, Data quality and remediation.

Module 2: MODELING AND EVALUATION, BAYESIAN CONCEPT LEARNING (09 Periods)

Modeling and Evaluation: Selecting a model, Training a model, Model representation and interpretability, Evaluating performance of a model, Improving performance of a model.

Feature Engineering: Feature transformation, Feature subset Selection.

Bayesian Concept Learning: Introduction, Importance, Bayes' theorem, Bayes' theorem and concept learning, Bayesian belief network.

Module 3: SUPERVISED LEARNING (10 Periods)

Classification: Classification model, Classification learning steps, K-Nearest Neighbor, Support vector machines, Decision Tree - Decision tree representation, Problems for decision tree learning, Decision tree learning algorithm, Hypothesis space search, Inductive bias in decision tree learning, Issues in decision tree learning.

Regression: Introduction, Simple linear regression, Improving accuracy of the linear regression model, Multiple linear regression, Assumptions and problems in regression analysis, Polynomial regression model, Logistic regression.

Module 4: UNSUPERVISED LEARNING (07 Periods)

Introduction, Unsupervised vs supervised learning, Applications of unsupervised learning, Clustering as a machine learning task, Types of clustering techniques, Partitioning methods, K-Medoids, Hierarchical clustering, DBSCAN.

Module 5: ARTIFICIAL NEURAL NETWORKS, ENSEMBLE LEARNING (10 Periods)

Artificial Neural Networks: Neural network representations, Appropriate problems for neural network learning, Perceptrons, Multilayer networks and Backpropagation algorithm, Convergence and local minima, Representational power of feedforward networks, Hypothesis space search and inductive bias, Hidden layer representations, Generalization, Overfitting, Stopping criterion.

Ensemble Learning: Bagging, Boosting, Gradient boosting.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Introduction to Python machine learning libraries.
2. Use Naïve Bayes classifier to solve the credit card fraud detection problem.
3. Implement K-Nearest Neighbor algorithm to solve classification problem.

4. Implement CART algorithm for decision tree learning. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. Explore the problem of overfitting in decision tree and develop solution using pruning technique.
5. Perform Exploratory Data Analysis on the given dataset. Implement CART algorithm for decision tree learning. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
6. Train an SVM Classifier with Linear Kernel. Use an appropriate data set for building the SVM Classifier and apply this knowledge to classify a new sample.
7. Build linear regression and multiple regression models to predict the price of the house (Boston House Prices Dataset).
8. Build a polynomial regression model for predicting the salary of the employees.
9. Build a neural network that will read the image of a digit and correctly identify the number.
10. Solve classification problem by constructing a feedforward neural network using Backpropagation algorithm. (Wheat Seed Data)

RESOURCES

TEXT BOOKS:

1. Tom M. Mitchell, Machine Learning, McGraw Hill, 1997.
2. Saikat Dutt, Subramanian Chandramouli, Amit kumar das, Machine Learning, Pearson, 2019.

REFERENCE BOOKS:

- 1 Manaranjan Pradhan, U Dinesh Kumar, Machine Learning Using Python, Packt Publishing, 2019.
- 2 Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd Edition, O'Reilly, 2019.
- 3 Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 4th Edition, 2020.
- 4 Shai Shalev Shwartz, Shai Ben David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.

SOFTWARE/TOOLS:

1. Python
2. Scikit-learn/Keras/TensorFlow

VIDEO LECTURES:

- 1 <https://nptel.ac.in/courses/106106202/>
- 2 <https://www.coursera.org/learn/machine-learning>
- 3 https://onlinecourses.nptel.ac.in/noc23_cs18/preview
- 4 https://onlinecourses.nptel.ac.in/noc23_cs87/preview
- 5 https://onlinecourses.nptel.ac.in/noc23_ee87/preview
- 6 <https://www.coursera.org/learn/ntumlone-algorithmicfoundations>
- 7 <https://www.coursera.org/specializations/machine-learning-introduction>
- 8 <http://ndl.iitkgp.ac.in/document/YkxIRXFvZXJrTDBkVzVVZI9ESjl6eXpRZkxRc2lhOWhlVXBhUVVWaxXZINDNyZUVldU9LdYvd20wbkQ4MC92UQ>
- 9 <https://www.coursera.org/learn/unsupervised-learning-recommenders-reinforcement-learning>

WEB RESOURCES:

1. <https://www.ibm.com/topics/machine-learning>
2. <https://www.simplilearn.com/tutorials/machine-learning-tutorial/what-is-machine-learning>
3. https://www.w3schools.com/python/python_ml_getting_started.asp
4. <https://developers.google.com/machine-learning/crash-course>
5. <https://www.greenteapress.com/thinkstats/>
6. <https://info.deeplearning.ai/machine-learning-yearning-book>
7. <https://www.kaggle.com/code/kanncaa1/machine-learning-tutorial-for-beginners>
8. <https://machinelearningmastery.com/machine-learning-in-python-step-by-step/>

PROGRAM ELECTIVE

CourseCode	CourseTitle	L	T	P	S	C
22AI101020	PATTERN RECOGNITION TECHNIQUES	3	-	-	-	3

Pre-Requisite Numerical Methods, Probability and Statistics

COURSE DESCRIPTION: This course provides a discussion on the fundamental principles and techniques of pattern recognition. The course further delves into feature space inspection, transformation and dimensionality reduction of feature space using principal component analysis, independent component analysis, multiple-discriminant analysis and introduces bag of words approach. The course then covers Bayesian decision theory, parameter-estimation methods and special classifiers.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge on the fundamental concepts, principles of pattern recognition and apply them to design and develop effective pattern recognition system.
- CO2.** Identify and select appropriate features, inspect feature spaces and apply transformations, normalization to feature space for effective comparison and classification.
- CO3.** Apply dimensionality reduction methods to reduce the complexity of feature spaces, enhance classification accuracy and extract meaningful information from high dimensional data.
- CO4.** Analyze and apply Bayesian, minimax classifier to interpret optimal decision regions and make decisions under uncertainty.
- CO5.** Apply parameter estimation methods to estimate the parameters of probability distributions.
- CO6.** Apply different classification techniques to diverse datasets and evaluate their performance using appropriate metrics.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	1	2	1	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	2	2	1	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	1	2	-	-	-	-	-	-	-	-	-	-	3	-
CO5	2	3	-	1	1	-	-	-	-	-	-	-	-	-	3	-
CO6	2	2	2	3	-	-	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	3	3	2	2	1	-	-	-	-	-	-	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSECONTENT

Module 1: FUNDAMENTALS AND FEATURES (10 Periods)

Goals of pattern recognition, Structure of a pattern recognition system, Abstract view of pattern recognition, Design of a pattern recognition system, Features-Types of features and their traits, Feature space inspection, Transformations of feature space, Measurement of distances in feature space, Normalization.

Module 2: DIMENSIONALITY REDUCTION OF FEATURE SPACE (09 Periods)

Selection and construction of features, Dimensionality reduction of the feature space- Principal component analysis, Kernelized principal component analysis, Independent component analysis, Multiple discriminant analysis, Dimensionality reduction by feature selection, Bag of words.

Module 3: BAYESIAN DECISION THEORY (07 Periods)

General considerations, The maximum a posteriori classifier, Bayesian classification-The Bayesian optimal classifier, Reference example-Optimal decision regions, The minimax classifier, Normally distributed features, Arbitrarily distributed features.

Module 4: PARAMETER ESTIMATION (09 Periods)

Maximum likelihood estimation, Bayesian estimation of the class-specific distributions, Bayesian parameter estimation, Least squared estimation error, Constant penalty for failures, Parameter free methods-The Parzen window method; Dimensionality of the feature space, Overfitting.

Module 5: SPECIAL CLASSIFIERS (10 Periods)

Linear discriminants, The perceptron, Linear regression, Artificial neural networks, Auto encoders, Deep learning, Matched filters, Classification of sequences, Classification with nominal features-Random forests, String matching, Grammars; Classifier-Independent concepts -Learning theory, Empirical evaluation of classifier performance, Boosting, Rejection.

TotalPeriods:45

EXPERIENTIAL LEARNING

1. Perform dimensionality reduction using Principal Component Analysis

- Start by acquiring a dataset suitable for PCA. Use publicly available datasets or explore data repositories like Kaggle or UCI Machine Learning Repository. Choose a dataset with multiple numerical features.
- **Preprocess the Data:** Before applying PCA, preprocess the dataset by handling missing values, scaling features, and dealing with any categorical variables. PCA works best with numerical data, so ensure that all features are numeric.
- **Implement PCA:** Next, implement PCA using a machine learning library such as scikit-learn in Python. Import the necessary libraries, load your dataset, and apply PCA to the feature matrix. Specify the desired number of principal components to retain.
- **Analyze Explained Variance:** After applying PCA, analyze the explained variance ratio to understand how much variance each principal component captures. Plot a cumulative explained variance plot to determine the optimal number of principal components to retain.
- **Visualize Principal Components:** To gain insights from the data, visualize

the principal components. Select two or three principal components and create scatter plots, coloring the data points based on their class or target variable. This visualization can help identify patterns, clusters, or separability in the transformed feature space.

- **Feature Reconstruction:** Perform feature reconstruction by reconstructing the original features using a subset of the principal components. This step helps understand the contribution of each principal component to the overall data reconstruction.
- **Evaluate Performance:** If the dataset includes a target variable, evaluate the performance of a machine learning algorithm (e.g., classification or regression) on the original dataset and compare it with the performance on the PCA-transformed dataset.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Jürgen Beyerer, Matthias Richter, Matthias Nagel, Pattern Recognition: Introduction, Features, Classifiers and Principles, 1st edition, De Gruyter, 2017.

REFERENCE BOOKS:

1. Theodoridis, S. and Koutroumbas, K., Pattern Recognition. 3rd edition, Elsevier, 2006.
2. Bishop CM, Nasrabadi NM, Pattern Recognition and Machine Learning, Springer, 2006.

VIDEOLECTURES:

1. <https://www.nptelvideos.com/course.php?id=569>
2. <https://freevideolectures.com/course/3530/pattern-recognition-i>
3. <https://www.youtube.com/watch?v=ey8vSVqM1x4>
4. <https://youtu.be/ZGULAomeJ-k>

WEB RESOURCES:

1. <https://www.geeksforgeeks.org/pattern-recognition-introduction/>
2. <https://www.analyticsvidhya.com/blog/2020/12/an-overview-of-neural-approach-on-pattern-recognition/>
3. <https://www.educba.com/pattern-recognition-algorithms/>
4. https://www.w3schools.com/ai/ai_recognition.asp

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS102034	PROBLEM SOLVING THROUGH PYTHON	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	Python Programming					
Co-Requisite	-					

COURSE DESCRIPTION: This course covers Python programming basics such as input/output, data types, operators, and control structures. It includes data structures, functions, recursion, object-oriented concepts, and exception handling. Data visualization is introduced using Matplotlib and Seaborn with practical examples.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge on Python syntax, data types, operators, and control structures.
- CO2.** Apply decision-making and looping constructs to implement logic-driven programs.
- CO3.** Develop solutions using strings, data structures, functions, recursion, and file handling techniques.
- CO4.** Design object-oriented solutions using classes, inheritance, encapsulation, and polymorphism.
- CO5.** Create and customize visual representations of data using Matplotlib and Seaborn for effective analysis.
- CO6.** Work independently to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	2	2	3	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	3	3	-	-	3	3	-	-	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO PYTHON, INPUT/OUTPUT AND OPERATORS (9 Periods)

Features of Python, history, installation, interpreter vs compiler, Python environments: IDLE, Jupyter, VS Code; Input using input(), output using print(), formatted strings using f-strings and format(), Data types: int, float, str, bool; dynamic typing, type conversions: explicit, implicit; arithmetic, relational, logical, bitwise, assignment, membership, identity operators, expression evaluation, operator precedence and associativity, Single-line and multi-line comments.

Module 2: DECISION MAKING AND LOOPING (8 Periods)

Conditional statements using if, if-else, elif, nested conditions, Loops: for loop, while loop, break, continue, pass; enumerate() and zip() function, else with loops, List and dictionary comprehensions, combining loops with conditionals for iterative logic, basic exception handling using try-except.

Module 3: DATA STRUCTURES, STRINGS, FUNCTIONS & FILE HANDLING (10 Periods)

Strings: creation, indexing, slicing, immutability; common methods: upper, lower, find, replace, split, join; Data structures: lists, tuples, dictionaries, sets, operations and use cases; Functions: definition, parameters, return values, default/keyword arguments; recursion concepts and examples (factorial, Fibonacci), function integration with strings and collections, Lambda functions, map() and filter().

File Handling: Types of files, Opening and closing files, Reading and writing data.

Module 4: OBJECT-ORIENTED PROGRAMMING IN PYTHON (9 Periods)

Classes and objects, defining classes, instance variables and methods, Constructors (__init__), destructors, encapsulation with access conventions: public, protected, private; Inheritance and its types, method overriding, polymorphism, abstraction using abstract classes (abc module).

Module 5: DATA VISUALIZATION (9 Periods)

Importance and purpose of data visualization, Numpy, pandas, Matplotlib: line graphs, bar charts, histograms, scatter plots; Seaborn: heatmaps, pair plots, regression plots, customization with labels, legends, titles, styles, practical examples using real-world datasets.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

(All source code should be maintained and version-controlled on GitHub)

13. INTRODUCTION TO PYTHON, INPUT/OUTPUT AND OPERATORS

Leetcode: [#136. Single Number](#)

Given a **non-empty** array of integers nums, every element appears *twice* except for one. Find that single one.

You must implement a solution with a linear runtime complexity and use only constant extra space.

Example 1:

Input: nums = [2,2,1]

Output: 1

Example 2:

Input: nums = [4,1,2,1,2]

Output: 4

Example 3:

Input: nums = [1]

Output: 1

Constraints:

- $1 \leq \text{nums.length} \leq 3 \times 10^4$
- $-3 \times 10^4 \leq \text{nums}[i] \leq 3 \times 10^4$
- Each element in the array appears twice except for one element which appears only once.

✓ This problem strengthens understanding of bit manipulation, especially the XOR operation. It helps learners implement space-efficient algorithms with $O(1)$ space complexity. It reinforces the concept of identifying unique elements in arrays using linear time complexity.

14. INTRODUCTION TO PYTHON, INPUT/OUTPUT AND OPERATORS**Leetcode: #91. Number of 1 Bits**

Given a positive integer n , write a function that returns the number of set bits in its binary representation (also known as the [Hamming weight](#)).

Example 1:

Input: $n = 11$

Output: 3

Explanation:

The input binary string **1011** has a total of three set bits.

Example 2:

Input: $n = 128$

Output: 1

Explanation:

The input binary string **10000000** has a total of one set bit.

Example 3:

Input: $n = 2147483645$

Output: 30

Explanation:

The input binary string **1111111111111111111111111111101** has a total of thirty set bits.

Constraints:

- $1 \leq n \leq 2^{31} - 1$

✓ This problem builds a strong foundation in binary number systems and bitwise operations. It enhances understanding of bit manipulation techniques such as using masks and shifting. It is a common interview question that helps in mastering low-level operations and optimizing performance.

15. DECISION MAKING AND LOOPING**Leetcode: #202. Happy Number**

Write an algorithm to determine if a number n is happy.

A **happy number** is a number defined by the following process:

- Starting with any positive integer, replace the number by the sum of the squares of its digits.
- Repeat the process until the number equals 1 (where it will stay), or it **loops endlessly in a cycle** which does not include 1.
- Those numbers for which this process **ends in 1** are happy.

Return true if n is a happy number, and false if not.

Example 1:

Input: $n = 19$

Output: true

Explanation:

$$1^2 + 9^2 = 82$$

$$8^2 + 2^2 = 68$$

$$6^2 + 8^2 = 100$$

$$1^2 + 0^2 + 0^2 = 1$$

Example 2:**Input:** $n = 2$ **Output:** false**Constraints:**

- $1 \leq n \leq 2^{31} - 1$

✓ This problem enhances understanding of mathematical simulations and cycle detection techniques. It reinforces the use of hashing or fast/slow pointer methods to detect loops in sequences. It is useful for practicing digit-based operations and implementing custom iterative logic.

16. DECISION MAKING AND LOOPING**Leetcode: [#400. Nth Digit](#)**

Given an integer n , return the n^{th} digit of the infinite integer sequence $[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, \dots]$.

Example 1:**Input:** $n = 3$ **Output:** 3**Example 2:****Input:** $n = 11$ **Output:** 0

Explanation: The 11th digit of the sequence 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, ... is a 0, which is part of the number 10.

Constraints:

- $1 \leq n \leq 2^{31} - 1$

✓ This problem strengthens skills in mathematical pattern recognition and number positioning. It helps learners practice identifying digit positions in number sequences without generating the entire sequence. It's also great for improving performance-focused logic building, especially in avoiding brute-force solutions.

17. DATA STRUCTURES, STRINGS, FUNCTIONS & RECURSION**Leetcode: [#169. Majority Element](#)**

Given an array `nums` of size n , return *the majority element*.

The majority element is the element that appears more than $\lfloor n / 2 \rfloor$ times. You may assume that the majority element always exists in the array.

Example 1:**Input:** `nums = [3,2,3]`**Output:** 3**Example 2:****Input:** `nums = [2,2,1,1,1,2,2]`**Output:** 2**Constraints:**

- $n == \text{nums.length}$
- $1 \leq n \leq 5 * 10^4$
- $-10^9 \leq \text{nums}[i] \leq 10^9$

✓ This problem helps learners understand frequency analysis and the concept of majority elements in arrays. It introduces efficient techniques like the Boyer-Moore Voting Algorithm, improving algorithmic thinking. Useful in scenarios involving data consensus, polling systems, and real-time analytics.

18. DATA STRUCTURES, STRINGS, FUNCTIONS & RECURSION**Leetcode: [#50. Pow\(x, n\)](#)**

Implement [`pow\(x, n\)`](#), which calculates x raised to the power n (i.e., x^n).

Example 1:**Input:** $x = 2.00000, n = 10$

Output: 1024.00000

Example 2:

Input: $x = 2.10000$, $n = 3$

Output: 9.26100

Example 3:

Input: $x = 2.00000$, $n = -2$

Output: 0.25000

Explanation: $2^{-2} = 1/2^2 = 1/4 = 0.25$

Constraints:

- $-100.0 < x < 100.0$
- $-2^{31} \leq n \leq 2^{31}-1$
- n is an integer.
- Either x is not zero or $n > 0$.
- $-10^4 \leq x^n \leq 10^4$

✓ This problem enhances understanding of exponentiation algorithms and introduces the concept of binary exponentiation (fast power). It is useful for solving mathematical computations efficiently, especially for large powers or negative exponents.

19. OBJECT-ORIENTED PROGRAMMING IN PYTHON

Shopping Cart Management System

Description:

Create a console-based system where users can browse a catalog, add/remove items from their cart, view the cart, and check out.

Features:

- Add a product (name, price, quantity)
- View available products
- Add product to cart
- Remove product from cart
- View cart contents and total bill
- Checkout (clear cart)

OOP Concepts Used:

- **Classes & Objects:** Product, CartItem, and ShoppingCart
- **Encapsulation:** Each class manages its own data through getters/setters
- **Abstraction:** Operations like addToCart() and calculateTotal() abstract complex logic
- **ArrayList:** Used to manage cart and product lists dynamically

✓ Learners will understand how to build and manage object-oriented relationships between entities like products and carts. They will apply key principles like encapsulation, abstraction, and class interaction to simulate real-world shopping behavior.

20. OBJECT-ORIENTED PROGRAMMING IN PYTHON

Library Management System

Description:

Develop a console application where librarians can manage books and students, issue or return books, and track availability.

Features:

- Add new books (title, author, ISBN)
- Register students
- Issue books to students
- Return books
- Search books by title or author
- View all issued or available books

OOP Concepts Used:

- **Classes & Objects:** Book, Student, LibrarySystem
- **Inheritance (optional):** A User superclass for Student and Librarian
- **Encapsulation:** Secure handling of student and book data
- **Collections:** Use of ArrayList or HashMap to manage books and students
- **Polymorphism:** Overloaded search methods (searchByTitle(), searchByAuthor())

✓ Learners will gain experience in designing real-world systems using multiple interrelated classes and data models. They will practice OOP principles such as encapsulation, inheritance, and method overloading in a functional application context.

21. DATA VISUALIZATION**COVID-19 Data Visualization Dashboard****Description:**

Create a basic data visualization dashboard that reads COVID-19 data from a CSV file and presents key insights such as daily case trends, country-wise statistics, and death/recovery rates.

Features:

- Line chart for daily new cases
- Bar chart for total cases by country
- Pie chart for recovery vs death rate comparison

Tools/Libraries:

Python, pandas, matplotlib, seaborn (optional: plotly for interactivity)

✓ Learners will practice importing and cleaning real-world datasets and generating meaningful visualizations using standard plotting libraries. They will learn to choose appropriate chart types to communicate different aspects of the data effectively.

22. DATA VISUALIZATION**Student Performance Analyzer****Description:**

Build a simple visualization tool that analyzes students' academic performance from a dataset of marks, attendance, and grades.

Features:

- Bar chart for subject-wise average marks
- Histogram for overall marks distribution
- Scatter plot for correlation between attendance and performance

Tools/Libraries:

Python, pandas, matplotlib, seaborn

✓ Learners will develop skills in working with structured educational data and generating statistical visualizations. They will understand how data visualization can reveal patterns and support academic decision-making.

RESOURCES

TEXT BOOKS:

3. R. Nageswara Rao, *Core Python Programming*, 3rd Edition, Dreamtech Press, 2021.
4. Paul J. Deitel, Harvey Deitel, *Python for Programmers with Big Data and Artificial Intelligence Case Studies*, Pearson, 2019.

REFERENCE BOOKS:

3. Charles Dierbach, *Introduction to Computer Science using Python: A Computational Problem Solving Focus*, Wiley India, 2016.
4. Christian Hil, *Learning Scientific Programming with Python*, 2nd Edition, Cambridge University Press, 2020.

SOFTWARE/TOOLS:

3. Python 3.10
4. Jupyter Notebook/JupyterLab/IDLE/Google CoLab

VIDEO LECTURES:

6. https://onlinecourses.nptel.ac.in/noc19_cs41/preview
7. <https://www.coursera.org/specializations/python>
8. <https://www.coursera.org/learn/python-for-applied-data-science-ai>
9. <https://www.youtube.com/watch?v=WGJJlRtnfpk>
10. https://www.youtube.com/watch?v=_uQrJ0TkZlc
11. <https://www.udemy.com/topic/python/>
12. <https://freevideolectures.com/course/2512/python-programming>

WEB RESOURCES:

6. <https://www.w3schools.com/python/>
7. <https://www.programiz.com/python-programming>
8. <https://www.geeksforgeeks.org/python-programming-language/>
9. <https://www.javatpoint.com/python-lists>
10. <https://www.learnpython.org/>

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS102036	DATA STRUCTURES AND ALGORITHMS WITH PYTHON	3	-	2	-	4
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course offers a comprehensive understanding and hands-on experience of core data structures and algorithms. It covers linked lists, stacks, queues, trees, graphs, searching and sorting methods, heaps, and hashing techniques. The course focuses on implementing these structures, analyzing their performance, and applying them to real-world problems such as expression evaluation, graph traversal, data organization, and efficient data retrieval using hashing.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge of basic and advanced data structures such as linked lists, stacks, queues, trees, graphs, and their applications.
- CO2.** Apply searching and sorting algorithms to organize and retrieve data efficiently.
- CO3.** Develop optimized algorithms and solutions using tree and graph data structures to effectively address complex problems in data organization and pathfinding.
- CO4.** Design solutions using heap and hashing to handle prioritized tasks and for quick data access.
- CO5.** Work independently to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO5	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	3	3	-	-	3	3	-	-	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: LINKED LIST, STACK, AND QUEUE (10 Periods)

Singly linked list, doubly linked list, circular linked list, node structure, dynamic memory allocation, Linked list operations: insertion, deletion, traversal, searching in various types; Stack ADT, LIFO principle, push, pop, peek operations, array and linked list implementation, expression evaluation, parentheses matching, function call tracking, Queue ADT, FIFO principle, operations: enqueue, dequeue, front, circular queue, priority queue.

Module 2: BINARY TREE, BINARY SEARCH TREE, AND AVL TREE (10 Periods)

Binary tree structure, types: full, complete, perfect, nodes, height, depth terminology; Tree traversals: preorder, inorder, postorder using recursion and iteration; Binary Search Tree (BST): properties, insertion, deletion, searching; AVL tree basics, balance factor, left and right rotations, self-balancing mechanism; Applications in efficient searching, sorting, dynamic data organization.

Module 3: GRAPHS (10 Periods)

Graphs: vertices, edges, degree, types: directed, undirected, weighted, unweighted; Graph representations: adjacency matrix, adjacency list, trade-offs and use cases; Graph traversal algorithms: BFS, DFS and their applications; Shortest path algorithms: introduction to Dijkstra's, Bellman-Ford, Cycle detection methods, checking connectivity in graphs, Topological sorting.

Module 4: SEARCHING AND SORTING (8 Periods)

Linear search, binary search: working principles, implementation, time complexity analysis, Sorting algorithms : bubble sort, selection sort, insertion sort, merge sort, quick sort, ; Advanced sorting: counting sort, radix sort and when to apply them; Comparison: stability, in-place vs out-of-place, time and space complexity analysis; Applications in real-world data organization and optimization problems.

Module 5: HEAPS AND HASHING (7 Periods)

Heap types: max-heap, min-heap, heap properties, array-based representation; Heap operations: insertion, deletion, heapify, building heap from unsorted array; Priority queues, heap sort algorithm and real-time scheduling examples; Hashing: hash functions, hash tables, use cases for constant-time retrieval; Collision handling: separate chaining, linear probing, quadratic probing, double hashing.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

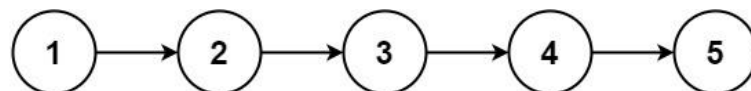
(All source code should be maintained and version-controlled on GitHub)

23. LINKED LIST, STACK, AND QUEUE

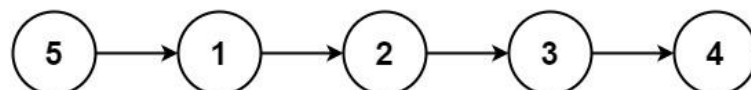
Leetcode: [#61. Rotate List](#)

Given the head of a linked list, rotate the list to the right by k places.

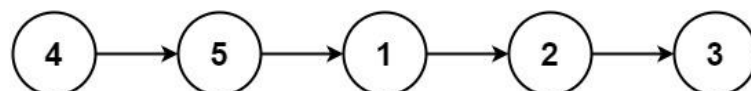
Example 1:



rotate 1



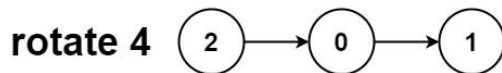
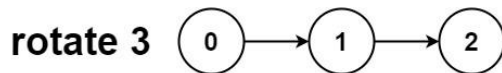
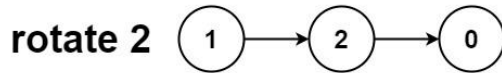
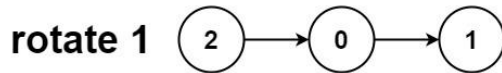
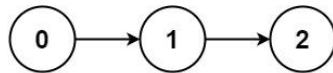
rotate 2



Input: head = [1,2,3,4,5], k = 2

Output: [4,5,1,2,3]

Example 2:



Input: head = [0,1,2], k = 4

Output: [2,0,1]

Constraints:

- The number of nodes in the list is in the range [0, 500].
- $-100 \leq \text{Node.val} \leq 100$
- $0 \leq k \leq 2 * 10^9$

✓ This problem strengthens understanding of linked list manipulation and handling circular rotations. It encourages learners to optimize traversal using modulo operations and manage edge cases like empty lists or large k values.

Helps build logic around pointer updates and real-world cyclic data structures.

24. LINKED LIST, STACK, AND QUEUE

LeetCode: [#1249. Minimum Remove to Make Valid Parentheses](#)

Given a string s of '(', ')', and lowercase English characters.

Your task is to remove the minimum number of parentheses ('(' or ')', in any positions) so that the resulting *parentheses string* is valid and return **any** valid string.

Formally, a *parentheses string* is valid if and only if:

- It is the empty string, contains only lowercase characters, or
- It can be written as AB (A concatenated with B), where A and B are valid strings, or
- It can be written as (A), where A is a valid string.

Example 1:

Input: s = "lee(t(c)o)de)"

Output: "lee(t(c)o)de"

Explanation: "lee(t(co)de)" , "lee(t(c)ode)" would also be accepted.

Example 2:

Input: s = "a)b(c)d"

Output: "ab(c)d"

Example 3:

Input: s = "))(("

Output: ""

Explanation: An empty string is also valid.

Constraints:

- $1 \leq \text{s.length} \leq 10^5$

- `s[i]` is either '(', ')', or lowercase English letter.

✓ This problem enhances understanding of stack-based validation and greedy algorithms for maintaining syntactic correctness. It helps learners manage open-close matching logic and handle unbalanced expressions efficiently.

25. BINARY TREE, BINARY SEARCH TREE, AND AVL TREE

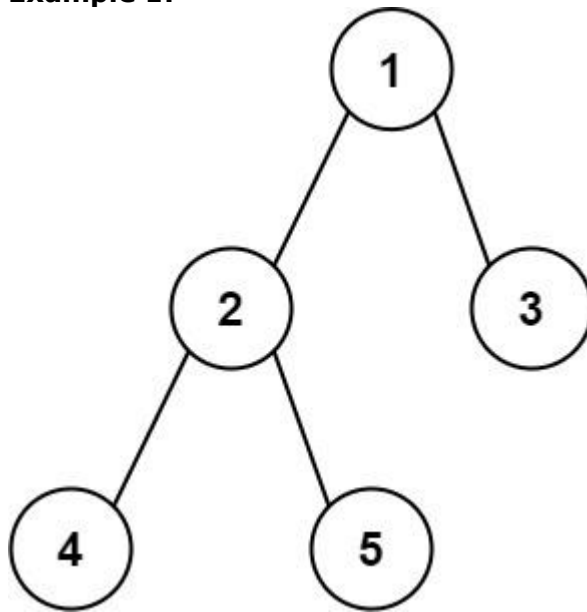
Leetcode: [#543. Diameter of Binary Tree](#)

Given the root of a binary tree, return the length of the **diameter** of the tree.

The **diameter** of a binary tree is the **length** of the longest path between any two nodes in a tree. This path may or may not pass through the root.

The **length** of a path between two nodes is represented by the number of edges between them.

Example 1:



Input: root = [1,2,3,4,5]

Output: 3

Explanation: 3 is the length of the path [4,2,1,3] or [5,2,1,3].

Example 2:

Input: root = [1,2]

Output: 1

Constraints:

- The number of nodes in the tree is in the range [1, 10⁴].
- -100 ≤ Node.val ≤ 100

✓ This problem helps learners understand tree traversal, particularly depth-first search (DFS). It develops logic to compute height of subtrees and track maximum path length between any two nodes. Ideal for mastering recursive strategies and handling tree-based interview problems.

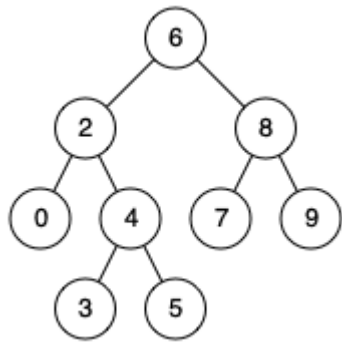
26. BINARY TREE, BINARY SEARCH TREE, AND AVL TREE

Leetcode: [#235. Lowest Common Ancestor of a Binary Search Tree](#)

Given a binary search tree (BST), find the lowest common ancestor (LCA) node of two given nodes in the BST.

According to the [definition of LCA on Wikipedia](#): "The lowest common ancestor is defined between two nodes p and q as the lowest node in T that has both p and q as descendants (where we allow **a node to be a descendant of itself**)."

Example 1:

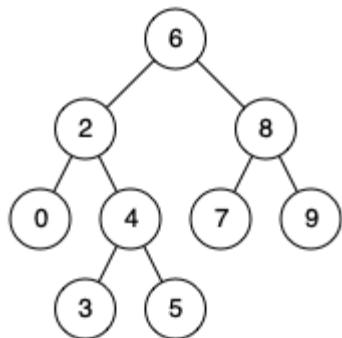


Input: root = [6,2,8,0,4,7,9,null,null,3,5], p = 2, q = 8

Output: 6

Explanation: The LCA of nodes 2 and 8 is 6.

Example 2:



Input: root = [6,2,8,0,4,7,9,null,null,3,5], p = 2, q = 4

Output: 2

Explanation: The LCA of nodes 2 and 4 is 2, since a node can be a descendant of itself according to the LCA definition.

Example 3:

Input: root = [2,1], p = 2, q = 1

Output: 2

Constraints:

- The number of nodes in the tree is in the range $[2, 10^5]$.
- $-10^9 \leq \text{Node.val} \leq 10^9$
- All Node.val are **unique**.
- $p \neq q$
- p and q will exist in the BST.

✓ This problem reinforces BST traversal techniques and deepens understanding of tree properties. It helps learners identify how value-based decisions can guide efficient traversal paths. Useful for building foundational logic for divide-and-conquer problems in trees and graphs.

27. GRAPHS AND GRAPH ALGORITHMS

LeetCode: #210. Course Schedule II

There are a total of numCourses courses you have to take, labeled from 0 to numCourses - 1. You are given an array prerequisites where prerequisites[i] = [a_i, b_i] indicates that you **must** take course b_i first if you want to take course a_i.

- For example, the pair [0, 1], indicates that to take course 0 you have to first take course 1.

Return *the ordering of courses you should take to finish all courses*. If there are many valid answers, return **any** of them. If it is impossible to finish all courses, return **an empty array**.

Example 1:

Input: numCourses = 2, prerequisites = [[1,0]]

Output: [0,1]

Explanation: There are a total of 2 courses to take. To take course 1 you should have finished course 0. So the correct course order is [0,1].

Example 2:

Input: numCourses = 4, prerequisites = [[1,0],[2,0],[3,1],[3,2]]

Output: [0,2,1,3]

Explanation: There are a total of 4 courses to take. To take course 3 you should have finished both courses 1 and 2. Both courses 1 and 2 should be taken after you finished course 0.

So one correct course order is [0,1,2,3]. Another correct ordering is [0,2,1,3].

Example 3:

Input: numCourses = 1, prerequisites = []

Output: [0]

Constraints:

- $1 \leq \text{numCourses} \leq 2000$
- $0 \leq \text{prerequisites.length} \leq \text{numCourses} * (\text{numCourses} - 1)$
- $\text{prerequisites}[i].\text{length} == 2$
- $0 \leq a_i, b_i < \text{numCourses}$
- $a_i \neq b_i$
- All the pairs $[a_i, b_i]$ are **distinct**.

✓ This problem strengthens your understanding of topological sorting, especially using BFS (Kahn's algorithm) or DFS. It helps learners grasp cycle detection in directed graphs, critical for scheduling and dependency resolution problems.

28. GRAPHS AND GRAPH ALGORITHMS

Leetcode: [#200. Number of Islands](#)

Given an $m \times n$ 2D binary grid `grid` which represents a map of '1's (land) and '0's (water), return *the number of islands*.

An **island** is surrounded by water and is formed by connecting adjacent lands horizontally or vertically. You may assume all four edges of the grid are all surrounded by water.

Example 1:

Input: `grid = [`
 `["1","1","1","1","0"],`
 `["1","1","0","1","0"],`
 `["1","1","0","0","0"],`
 `["0","0","0","0","0"]`
 `]`

Output: 1

Example 2:

Input: `grid = [`
 `["1","1","0","0","0"],`
 `["1","1","0","0","0"],`
 `["0","0","1","0","0"],`
 `["0","0","0","1","1"]`
 `]`

Output: 3

Constraints:

- `m == grid.length`
- `n == grid[i].length`
- `1 <= m, n <= 300`
- `grid[i][j]` is '0' or '1'.

✓ This problem enhances understanding of graph traversal techniques like DFS or BFS in 2D matrices. It builds foundational skills for flood fill algorithms, useful in image processing and geographic data analysis.

29. **SEARCHING AND SORTING**

Leetcode: [#35. Search Insert Position](#)

Given a sorted array of distinct integers and a target value, return the index if the target is found. If not, return the index where it would be if it were inserted in order. You must write an algorithm with $O(\log n)$ runtime complexity.

Example 1:

Input: `nums = [1,3,5,6]`, `target = 5`

Output: 2

Example 2:

Input: `nums = [1,3,5,6]`, `target = 2`

Output: 1

Example 3:

Input: `nums = [1,3,5,6]`, `target = 7`

Output: 4

Constraints:

- $1 \leq \text{nums.length} \leq 10^4$
- $-10^4 \leq \text{nums}[i] \leq 10^4$
- `nums` contains **distinct** values sorted in **ascending** order.
- $-10^4 \leq \text{target} \leq 10^4$

✓ This problem strengthens understanding of binary search, a fundamental divide-and-conquer technique. It trains learners to efficiently handle insert position logic within sorted data structures. The concept is widely applicable in search engines, database indexing, and algorithm optimization tasks.

30. **SEARCHING AND SORTING**

Leetcode: [#324. Wiggle Sort II](#)

Given an integer array `nums`, reorder it such that `nums[0] < nums[1] > nums[2] < nums[3] ...`.

You may assume the input array always has a valid answer.

Example 1:

Input: `nums = [1,5,1,1,6,4]`

Output: `[1,6,1,5,1,4]`

Explanation: `[1,4,1,5,1,6]` is also accepted.

Example 2:

Input: `nums = [1,3,2,2,3,1]`

Output: `[2,3,1,3,1,2]`

Constraints:

- $1 \leq \text{nums.length} \leq 5 * 10^4$
- $0 \leq \text{nums}[i] \leq 5000$
- It is guaranteed that there will be an answer for the given input `nums`.

✓ This problem develops an understanding of array rearrangement patterns, particularly wiggle sort. It enhances knowledge of median finding, index mapping, and three-way

partitioning techniques. Useful in scenarios where alternating highs and lows are required, such as stock price modeling or load balancing.

31. HEAPS AND HASHING

Leetcode: [#242. Valid Anagram](#)

Given two strings *s* and *t*, return true if *t* is an anagram of *s*, and false otherwise.

Example 1:

Input: *s* = "anagram", *t* = "nagaram"

Output: true

Example 2:

Input: *s* = "rat", *t* = "car"

Output: false

Constraints:

- $1 \leq s.length, t.length \leq 5 * 10^4$
- *s* and *t* consist of lowercase English letters.

✓ This problem strengthens skills in string manipulation and frequency counting. It helps learners efficiently compare character distributions using hash maps or arrays. An essential concept for solving problems related to permutations, anagrams, and string matching.

32. HEAPS AND HASHING

Leetcode: [#49. Group Anagrams](#)

Given an array of strings *strs*, group the anagrams together. You can return the answer in **any order**.

Example 1:

Input: *strs* = ["eat", "tea", "tan", "ate", "nat", "bat"]

Output: [["bat"], ["nat", "tan"], ["ate", "eat", "tea"]]

Explanation:

- There is no string in *strs* that can be rearranged to form "bat".
- The strings "nat" and "tan" are anagrams as they can be rearranged to form each other.
- The strings "ate", "eat", and "tea" are anagrams as they can be rearranged to form each other.

Example 2:

Input: *strs* = [""]

Output: [[""]]

Example 3:

Input: *strs* = ["a"]

Output: [["a"]]

Constraints:

- $1 \leq strs.length \leq 10^4$
- $0 \leq str[i].length \leq 100$
- *strs*[*i*] consists of lowercase English letters.

✓ This problem enhances skills in hashing and grouping techniques by organizing strings based on sorted keys or frequency maps. It deepens understanding of how to identify anagrams efficiently by leveraging string transformations. Key for mastering problems involving categorization, data grouping, and string manipulation.

RESOURCES

TEXT BOOKS:

1. Data Structures and Algorithms in Python – Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser (2013)
2. Problem Solving with Algorithms and Data Structures Using Python – Bradley N. Miller, David L. Ranum (2011)

REFERENCE BOOKS:

1. Python Algorithms: Mastering Basic Algorithms in the Python Language – Magnus Lie Hetland (2014)
2. Data Structures and Algorithms Made Easy” by Narasimha Karumanchi

SOFTWARE/TOOLS:

1. Python 3.10
2. Eclipse IDE / Jupyter Notebook / Google Colab / VS Code / Online IDE

VIDEO LECTURES:

1. https://www.youtube.com/@abdul_bari
2. https://www.youtube.com/watch?v=AT14ICXuMKI&list=PLdo5W4Nhv31bbKJzrsKfMpo_grxuLI8LU
3. <https://www.youtube.com/watch?v=RBSGKIAvoiM&list=PLqM7aIHxFySGg7t9DoeGvZsPmkGz1WfKc>
4. <https://www.youtube.com/c/TakeUForward/playlists>
5. <https://www.youtube.com/watch?v=RBSGKIAvoiM&pp=ygUYZGF0YSBzdHJ1Y3R1cmVzIHR1dG9yaWFs>
6. https://www.youtube.com/watch?v=VTLCohNyACE&list=PLfqMhTWNBTte137I_EPQd34TsqV6IO55pt&pp=0gcJCV8EOCosWNin
7. <https://www.youtube.com/@CodingWithTamil>

WEB RESOURCES:

1. <https://www.geeksforgeeks.org/data-structures/>
2. <https://www.programiz.com/dsa>
3. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
4. <https://visualgo.net/en> (for visualizing trees, graphs, heaps, etc.)
5. <https://www.interviewbit.com/data-structure-interview-questions/>

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101010	NATURE-INSPIRED ALGORITHMS	3	-	-	-	3
Pre-Requisite	Differential Equations and Multivariable Calculus					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Optimization, Classical optimization techniques, Nature inspired algorithms, Genetic algorithm, Particle swarm optimization, Ant colony optimization, Bee colony optimization, Cuckoo search algorithm, Firefly algorithm, Bat algorithm, Gray wolf optimization, Elephant herding optimization, Applications of nature inspired algorithms.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

- CO1.** Demonstrate knowledge on optimization and classical optimization techniques to find optimal solutions for a given problem.
- CO2.** Analyze the key components and mathematical aspects of nature inspired algorithms.
- CO3.** Design efficient solutions for optimization problems using nature inspired algorithms.
- CO4.** Investigate the applications of nature inspired algorithms to solve wide range of optimization problems.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:

Module 1 INTRODUCTION TO OPTIMIZATION (09 periods)

Introduction to Optimization: Fundamentals of optimization, Types of optimization problems, Examples of optimization, Formulation of optimization problems, Classification of optimization algorithms, Traveling salesman problem, Knapsack problem.

Classical Optimization Techniques: Mathematical model of optimization, Linear programming – Simplex method, Revised simplex method, Kamarkar's method, Duality theorem, Decomposition principle, Transportation problem; Nonlinear Programming – Quadratic programming, Geometric programming; Dynamic programming, Integer programming, Stochastic programming, Lagrange multiplier method.

Module 2 NATURE INSPIRED ALGORITHMS AND GENETIC ALGORITHM (08 periods)

Nature Inspired Algorithms: Traditional vs nature inspired algorithms, Bio-inspired algorithms, Swarm intelligence, Meta heuristics, Diversification and intensification, No free lunch theorem, Parameter tuning and control, Algorithm.

Genetic Algorithm: Basics, Genetic operators, Example of GA, Algorithm, Schema theory, Prisoner's dilemma problem, Variants and hybrids of GA.

Module 3 PARTICLE SWARM, ANT COLONY, BEE COLONY AND CUCKOO SEARCH OPTIMIZATION ALGORITHMS (10 periods)

Particle Swarm Optimization: Swarm behavior, Algorithm, Variants of algorithm.

Ant Colony Optimization: Ant colony characteristics, Ant colony optimization – Travelling salesman problem, algorithm; Variants of algorithm.

Bee Colony Optimization: Honey bee characteristics, Algorithm, Variants of algorithm.

Cuckoo Search Algorithm: Cuckoo bird behavior, Levy flights, Algorithm, Variants of algorithm.

Module 4 FIREFLY, BAT, GRAY WOLF AND ELEPHANT HERDING OPTIMIZATION ALGORITHMS (09 periods)

Firefly Algorithm: Firefly behavior and characteristics, Algorithm, Variants and applications.

Bat Algorithm: Behavior of bats in nature, Algorithm, Variants and applications.

Gray Wolf Optimization: Gray wolf characteristics, Gray wolf optimization, Variants and applications.

Elephant Herding Optimization: Elephant herding behavior, Algorithm, Pseudo code, Variants of the algorithm.

Module 5 APPLICATIONS OF NATURE INSPIRED ALGORITHMS (09 periods)

Image processing, Classification, clustering and feature selection, Traveling salesman problem, Vehicle routing, Scheduling, Software testing, Deep belief networks, Swarm robots, Data mining and deep learning – Clustering, Support vector machines, Artificial neural networks, Optimizers for machine learning, Deep learning.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Usage of Cuckoo Search Algorithm for Data Clustering
2. How to Solve vehicle routing problem with nature-inspired algorithms

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

TEXT BOOKS:

1. A.Vasuki, Nature-Inspired Optimization Algorithms, CRC Press, 2020.
2. Xin-SheYang, Nature-Inspired Optimization Algorithms, Elsevier, 2nd Edition, 2020.

REFERENCE BOOKS:

1. Xin-SheYang, Xing-ShiHe, Mathematical Foundations of Nature-Inspired Algorithms, Springer, 2019.
2. George Lindfield, John Penny, Introduction to Nature-Inspired Optimization, Elsevier, 2017.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/112103301>
2. <https://www.coursera.org/learn/operations-research-algorithms>
3. <https://www.udemy.com/course/bio-inspired-artificial-intelligence-algorithms-for-optimization/>

WEB RESOURCES:

1. <https://www.hindawi.com/journals/jam/2015/359203/>
2. <https://www.baeldung.com/cs/nature-inspired-algorithms>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7300069/>

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI102006	DEEP LEARNING	3	-	2	-	4
Pre-Requisite	22AI102003 - Machine Learning					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: : This course provides a detailed Machine learning with shallow neural networks, Training deep neural networks, Backpropagation, Gradient based strategies, Teaching deep learners, Recurrent neural networks, Applications of Recurrent neural networks, Convolutional Architectures-AlexNet; VGG,GoogleNet; ResNet.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01.** Acquire working knowledge of neural networks and explore the different parameters of the network.
- C02.** Construct a generative model for learning probability distribution using RBM.
- C03.** Analyze temporal sequential input data using gated memory based neural units.
- C04.** Utilize Convolutional Neural Network for analyzing visual imagery and utilize transfer learning approaches for reducing the training efforts.
- C05.** Apply encoder-decoder architecture for image denoising, and learning representation of a set of data.
- C06.** Work Independently to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C01	3	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-
C02	3	2	2	-	-	-	-	-	-	-	-	-	-	-	3	-
C03	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
C04	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
C05	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
C06	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	-	-	-	-	-	3	3	-	-	-	-	3	-

Correlation Level: 3-High; 2-Medium; 1-Low

COURSE CONTENT

Module 1 MACHINE LEARNING WITH SHALLOW NEURAL NETWORKS (09 Periods)

Neural Architectures for Binary Classification Models, Neural Architectures for Multiclass Models, Backpropagated Saliency for Feature Selection, Autoencoders- Basic Principles, Nonlinear Activations, Deep Autoencoders, Application to Outlier Detection.

Module 2 TRAINING DEEP NEURAL NETWORKS *(09 Periods)*

Backpropagation: Backpropagation with the Computational Graph Abstraction, Dynamic Programming, Backpropagation with Post-Activation and Pre-Activation variables, Examples of Updates for Various Activations, Loss Functions on Multiple Output Nodes and Hidden Nodes, Backpropagation Tricks for Handling Shared Weights; Setup and Initialization Issues.

Gradient based Strategies: Learning Rate Decay, Momentum-Based Learning, Parameter-Specific Learning Rates, Cliffs and Higher-Order Instability, Gradient Clipping, Second-Order Derivatives, Polyak Averaging, Local and Spurious Minima.

Module 3 GENETIC ALGORITHMS **(09 Periods)**

The Bias-Variance Trade-Off, Generalization Issues in Model Tuning and Evaluation, Penalty-Based Regularization, Ensemble Methods, Early Stopping, Unsupervised Pretraining, Regularization in Unsupervised Applications.

Module 4 RECURRENT NEURAL NETWORKS (09 Periods)

Recurrent Neural Networks: Expressiveness of Recurrent Networks, The Architecture of Recurrent Neural Networks, The Challenges of Training Recurrent Networks. Long Short-Term Memory (LSTM), Gated Recurrent Units (GRUs).

Applications of Recurrent Neural Networks: Automatic Image Captioning, Sequence-to-Sequence Learning and Machine Translation, Sentence-Level Classification, Time-Series Forecasting and Prediction, End-to-End Speech Recognition.

Module 5 CONVOLUTIONAL NEURAL NETWORKS (09 Periods)

The Basic Structure of a Convolutional Network, Training a Convolutional Network, Convolutional Architectures-AlexNet,VGG,GoogleNet,ResNet, Visualizing the Features of a Trained Network, Convolutional Autoencoders, Applications of Convolutional Neural Networks-Content-Based Image Retrieval, Object Detection, Natural Language and Sequence Learning.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Perform splitting of data for training, testing, and validation using k-fold cross validation.
2. Construct and implement multi-layer feed forward neural network for hand written digit classification problem.
3. Implement the image dimensionality reduction problem using aAutoEncoder architecture.
4. Perform hyper parameter tuning using Bayesian optimization technique for a Convolution Neural Network.
5. Analyze the effectiveness of various optimization algorithm with a image classification problem.
6. Solve the overfitting problem in a neural architecture using DropOut technique.
7. Solve a seq2seq problem (machine translation) using LSTM Recurrent Neural Architecture.
8. Solve a time series forecasting (stock prediction) using LSTM RNN.
9. Implement a binary and multi class image classification using Convolution Neural Network.
10. Study the efficiency of the transfer learning approach for a classification problem on the following architectures; VGG-16, Alexnet, and ResNet

RESOURCES

TEXT BOOKS:

1. Charu C Aggarwal, Neural Networks and Deep Learning, Springer, 2018. Publishing.

REFERENCE BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, 2016
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Saroj Kaushik, Sunita Tewari, *Soft Computing: Fundamentals, Techniques and Applications*, McGraw Hill, 2018.

SOFTWARE/Tools used:

Environment : Google CoLab
Programming Language : Python 3.8
Machine Learning Library : Tensor Flow 2.1 and Keras

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106106184>
2. https://www.coursera.org/specializations/deep-learning?utm_source=deeplearningai&utm_medium=institutions&utm_campaign=WebsiteCoursesDLSTopButton

ADDITIONAL LEARNING RESOURCES:

1. <https://www.simplilearn.com/tutorials/deep-learning-tutorial/what-is-deep-learning>
2. <https://www.udemy.com/course/data-science-logistic-regression-in-python/>
3. <https://www.udemy.com/course/data-science-deep-learning-in-python/>

SPECIALIZATION ELECTIVE

Course Code

Course Title

L T P S C

22AI101021

Generative AI

3 - - - 3

Pre-Requisite - Deep Learning

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:

This course provides a comprehensive exploration of large language models (LLMs) and their applications. The training of LLMs is examined in-depth, including data collection, bidirectional token prediction, and fine-tuning, along with emergent properties and biases. The course also addresses data privacy and safety, covering post-processing, reinforcement learning, and best practices. Finally, it explores the workings, security, and ethical considerations of major AI chatbots such as ChatGPT, Microsoft Copilot, etc.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the Fundamentals of Large Language Models
- CO2.** Demonstrate the methodologies used in training LLMs, including data collection, Fine-tuning LLMs, and bidirectional token prediction.
- CO3.** Implement safety-focused improvements for LLM-generated content, including post-processing detection algorithms and content filtering.
- CO4.** Apply emotional attachment and social penetration theories to human-chatbot interactions.
- CO5.** Develop and utilize simple prompts to effectively interact with AI chatbots, and critically assess their reasoning, summarizing capabilities, and truthfulness.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	2	3	3	3	-	1	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	2	3	1	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	3	3	2	-	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	2	2	2	2	3	2	-	-	-	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 Large language models

(09 Periods)

Introduction, Large language models: The power of AI, Evolution of natural language processing, Conversational LLMs, OpenAI's ChatGPT Google's Bard/LaMDA Microsoft's Bing AI, Meta's LLaMa/Stanford's Alpaca

Module 2 Training large language models

(09 Periods)

Introduction, Training LLMs, Exploring open web data collection, Demystifying autoregression and bidirectional token prediction, Fine-tuning LLMs, The unexpected: Emergent properties of LLMs, Learning with few examples Is emergence an illusion, What's in the training data?, Encoding bias, Sensitive information.

Module 3 Data privacy and safety with LLMs

(09 Periods)

Safety-focused improvements for LLM generations, Post-processing detection algorithms Content filtering or conditional pre-training, Reinforcement learning from human feedback Reinforcement learning from AI feedback, Navigating user privacy and commercial risks, Inadvertent data leakage, Best practices when interacting with chatbots

Module 4 Making social connections with chatbots

(09 Periods)

Chatbots for social interaction, The loneliness epidemic, Emotional attachment theory and chatbots, Attachment Theory, The good and bad of human-chatbot relationships, Social Penetration Theory, Charting a path for beneficial chatbot interaction.

Module 5 ChatGPT and AI Chatbots

(09 Periods)

Introduction, The 'Big Three' AI Chatbots, ChatGPT, Microsoft Copilot, Google Bard, How AI Chatbots Work, Security and privacy, Simple Prompts, Reasoning and Summarising, Truthiness and Chatbots.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Use the OpenAI API to interact with ChatGPT, Bard, Bing AI, LLaMa, and Alpaca. Create simple applications that leverage these models for various tasks (e.g., customer support, content generation).
2. Collect and preprocess a dataset from the web for training a simple language model.
3. Implement content filtering and post-processing detection algorithms on LLM outputs.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

- 3 Numa Dhamani and Maggie Engler, "Introduction to Generative AI ", Manning Publications Co.,2024
- 4 Mark Pesce, "Getting Started with ChatGPT and AI Chatbots: An Introduction to Generative AI Tools", O'Reilly Media, 2024

REFERENCE BOOKS:

- 3 Ian Goodfellow, Yoshua Bengio, and Aaron Courville, " Deep Learning", MIT Press,2016
- 4 Kai-Fu Lee, "AI Superpowers: China, Silicon Valley, and the New World Order", Houghton Mifflin Harcourt,2018.

VIDEO LECTURES:

- 3 <https://www.coursera.org/learn/nlp-sequence-models>
- 4 <https://www.youtube.com/watch?v=K47kS1deTE4>

WEB RESOURCES:

- 3 <https://news.microsoft.com/source/topics/ai/>
- 4 <https://platform.openai.com/docs/overview>
- 5 <https://www.affectiva.com/product/in-cabin-sensing-ai/>

SPECIALIZATION ELECTIVE

Course Code

Course Title

L T P S C

22AI101015

AI FOR ROBOTICS

3 - - - 3

Pre-Requisite Artificial Intelligence

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed Introduction to AI and Intelligent Robot; Intelligent Robots; Advanced robotics and AI; Object recognition using AI; Image Recognition process; Perception and behaviour; Deliberation; Navigation; Localization; Mapping and Exploration.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate the usage of Intelligent Robots and the role of Artificial Intelligence in robotic control
- CO2** Conduct behavioral analysis and Objects recognition using AI based techniques
- CO3** Design the Robot deliberation, navigation and exploration methods using AI techniques
- CO4** Apply Machine Learning approaches and train Robot Arms for interactive functionality in socio-interactive applications

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	2	-	1	1	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	3	2	2	-	1	1	-	-	-	-	-	-	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module1 INTRODUCTION TO AI AND INTELLIGENT ROBOTS (09 Periods)

Intelligent Robots: Definition, Components of a Robot, Three Modalities:Kinds of Robots,Seven Areas of AI:Intelligence.

Foundation of Advanced Robotics and AI: The basic principle of robotics and AI, Artificial intelligence and advanced robotics techniques, Introducing the robot and the development environment, Software components (ROS,Python,and Linux),Robot control systems and a decision-making frame work, Soft real-time control,Control loops,The robot control system -a control loop with soft real-time control, Reading serial port sinareal-time manner.

Module2 BAYESIAN CONCEPT LEARNING (07 Periods)

Introduction, Importance, Bayes' theorem, Bayes optimal classifier, Naïve Bayes classifier,Applications of Bayes classifier.

Module3 SUPERVISED LEARNING (10 Periods)

Classification: Classification model, Classification learning steps, K-Nearest Neighbor, Decision Tree, Support vectormachines.

Regression: Introduction, Simple linear regression, Improving accuracy of the linear regression model, Multiple linear regression, Assumptions and problemsin regression analysis.

Module4 UNSUPERVISED LEARNING (09 Periods)

Introduction, Unsupervised vs supervised learning, Applications of unsupervised learning,Clustering as a machine learning task,Types of clustering techniques,Partitioning methods,K-Medoids,Hierarchical clustering,DBSCAN.

Module5 ARTIFICIAL NEURAL NETWORKS (09 Periods)

Artificial neuron, Types of activation functions, Early implementations of ANN, Architectures of neural network, Learning processin ANN,Back propagation.

Total Periods:45

EXPERIENTIAL LEARNING

1. Use NaïveBayes classifier to solve the credit card fraud detection problem.
2. Build a neural network that will read the image of a digit and correctly identify the number.
(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Francis XGovers, "Artificial Intelligence for Robotics: Build Intelligent Robots that perform Human tasks using AI Techniques",Packt Publishing Ltd,2018.
2. RobinR.Murphy,"Introduction to AI Robotics",2nd Edition,TheMITPress,2019.

REFERENCE BOOKS:

1. Stuart_{th}Russell,PeterNorvig,*Artificial Intelligence:A Modern Approach*,Prentice Hall,4 Edition,2020.
2. Rabindra Nath Shaw, Ankush Ghosh, Valentina E. Balas, Monica Bianchini,Artificial Intelligence for Future Generation Robotics,2021.

VIDEOLECTURES:

1. <https://www.youtube.com/watch?v=3O2vX2cBZDs>
2. <https://www.udacity.com/course/artificial-intelligence-for-robotics--cs373>

WEB RESOURCES:

1. <https://medium.com/vsinghbisen/ai-in-robotics-use-of-artificial-intelligence-in-robotics-726a4e9ade18>
2. <https://towardsdatascience.com/how-does-ai-detect-objects-technical-d8d63fc12881>
3. <https://robotics.mit.edu/object-recognition-robots>

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS104001	DATA ANALYTICS	3	-	2	4	5
Pre-Requisite	Data Mining					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: The course provides Introduction to Data Analytics and its Life Cycle, Review of Basic Data Analytic Methods Using R, Advanced Analytical Theory and Methods, Advanced Analytics-Technology and Tools: In-Database Analytics and Communicating and Operationalizing an Analytics Project.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Use Analytical Architecture and its life cycle in Data Analytics
- CO2.** Analyze and Visualize the Data Analytics Methods using R.
- CO3.** Apply Advanced Analytical Methods for Text Analysis and Time –Series Analysis.
- CO4.** Develop Analytical Report for given Analytical problems.
- CO5.** Analyze and Design Data Analytics Application on Societal Issues.
- CO6.** Work independently or in team to solve data analytics related problems with effective communication

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	-	2	-	-	-	-	-	-	-	3	3	3	-
CO2	2	3	-	-	2	2	-	-	-	-	-	-	3	3	3	-
CO3	1	2	3	-	2	-	-	-	-	-	-	-	3	3	3	-
CO4	2	3	3	2	2	-	-	-	-	-	-	-	3	3	3	-
CO5	2	2	3	2	2	3	-	-	-	-	-	-	3	3	3	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	2	3	3	2	3	2	-	-	3	3	-	-	3	3	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO DATA ANALYTICS and R (09 Periods)

Practice in Analytics: BI versus Data Science, Current Analytical Architecture, Emerging Big Data Ecosystem and a New Approach to Analytics. **Data Analytics Life Cycle:** Key Roles for a Successful Analytics Project Background and Overview of Data Analytics Lifecycle Phases - Discovery Phase, Data Preparation Phase, Model Planning, Model Building, Communicate Results, Operationalize. **Introduction to R:** R Graphical User Interfaces, Data Import and Export, Attribute and Data Types, Descriptive Statistics.

Module 2: BASIC DATA ANALYTICAL METHODS (09 Periods)

Exploratory Data Analysis: Visualization Before Analysis, Dirty Data, Visualizing a Single Variable, Examining Multiple Variables, Data Exploration Versus Presentation. **Statistical Methods for Evaluation:** Hypothesis Testing, Difference of Means, Wilcoxon Rank-Sum Test, Type I and Type II Errors, Power and Sample Size, ANOVA, Decision Trees in R, Naïve Bayes in R.

Module 3: ADVANCED ANALYTICAL TECHNOLOGY AND METHODS (09 Periods)

Time Series Analysis: Overview of Time Series Analysis, Box-Jenkins Methodology, ARIMA Model, Autocorrelation Function (ACF), Autoregressive Models, Moving Average Models, ARMA and ARIMA Models, Building and Evaluating an ARIMA Model, Reasons to Choose and Cautions.

Text Analysis: Text Analysis Steps, A Text Analysis Example, Collecting Raw Text, Representing Text, Term Frequency—Inverse Document Frequency (TFIDF), Categorizing Documents by Topics, Determining Sentiments, Gaining Insights.

Module 4: ANALYTICAL DATA REPORT AND VISUALIZATION (09 Periods)

Communicating and Operationalizing an Analytics Project, Creating the Final Deliverables: Developing Core Material for Multiple Audiences, Project Goals, Main Findings, Approach, Model Description, Key Points Supported with Data, Model Details Recommendations, Additional Tips on Final Presentation, Providing Technical Specifications and Code, Data Visualization.

Module 5: DATA ANALYTICS APPLICATIONS (09 Periods)

Text and Web: Data Acquisition, Feature Extraction, Tokenization, Stemming, Conversion to Structured Data, Sentiment Analysis, Web Mining.

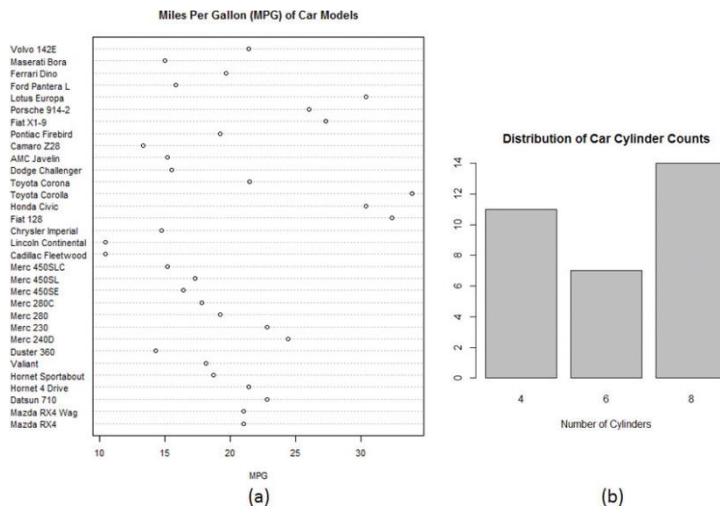
Recommender Systems: Feedback, Recommendation Tasks, Recommendation Techniques, Final Remarks.

Social Network Analysis: Representing Social Networks, Basic Properties of Nodes, Basic and Structural Properties of Networks.

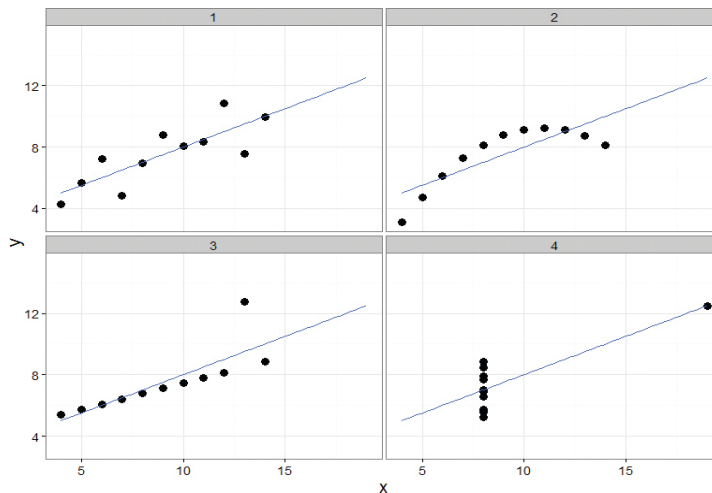
Total Periods: 45

EXPERIENTIAL LEARNING

1. Introduction to R Studio, Basic operations and import and export of data using R Tool.
2. Implement Data Exploration and Visualization on different Datasets to explore multiple and Individual Variables.
3. Draw the scatter plots using ggplot2 package for Anscombe's quartet four datasets.

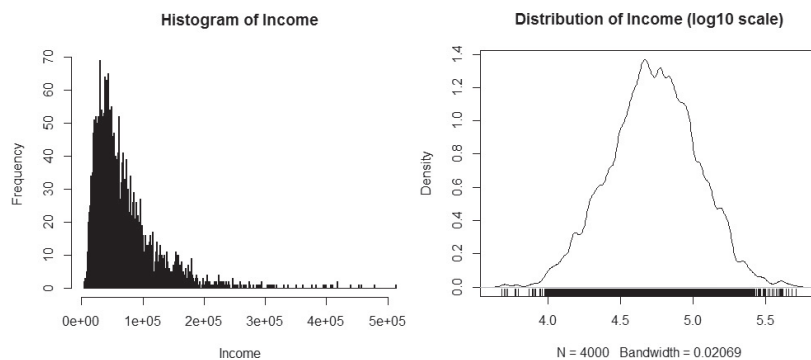
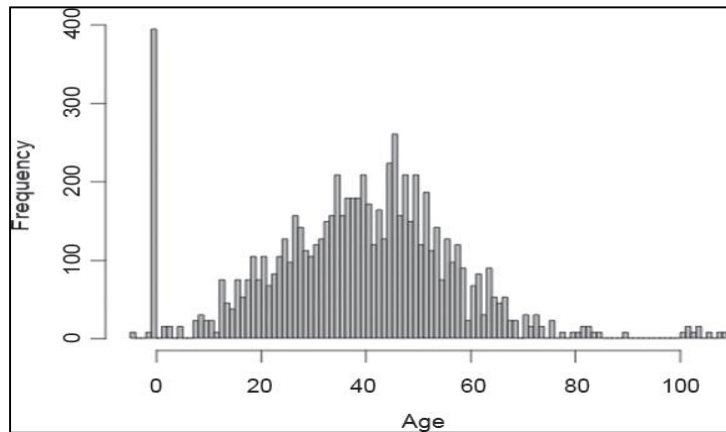
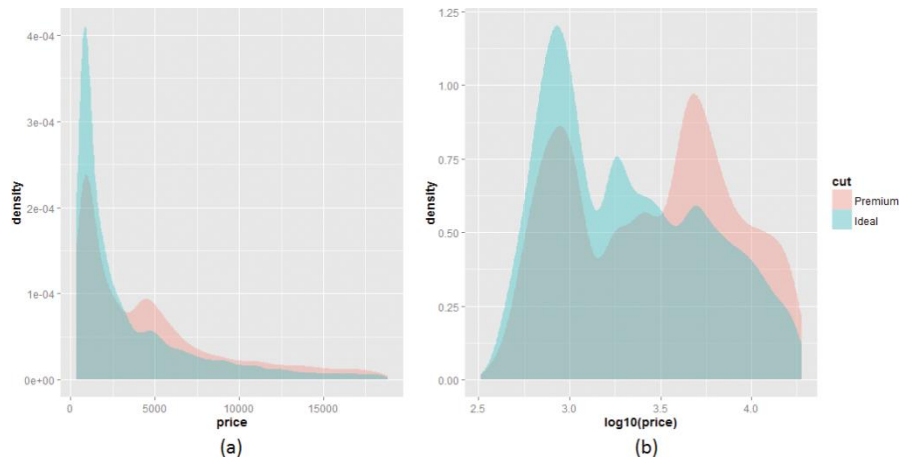


4. Build a Decision Tree using party and rpart packages.
5. Consider a scenario in which a bank is conducting data analyses of its account holders to gauge customer retention. Draw the histogram for age distribution of the account holders.

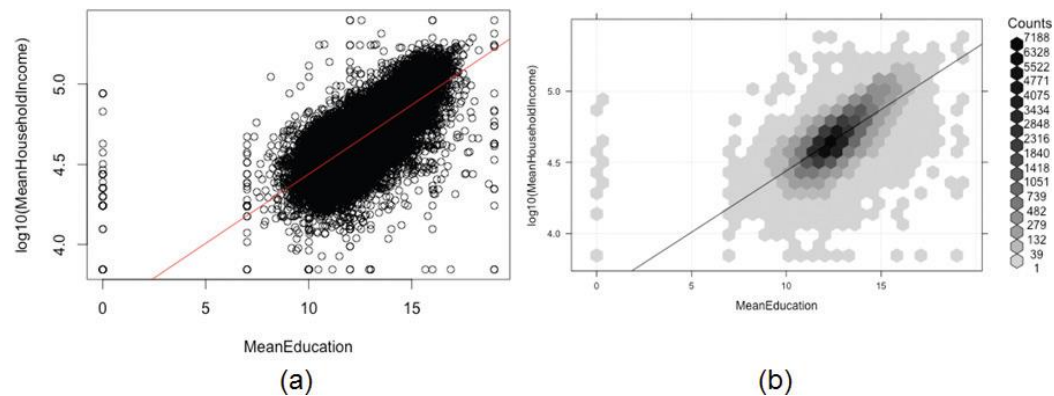


6. Build a predictive model using Random Forest Package.
7. Implement Linear and logistic Regression on Datasets to predict the probability.
8. Draw a dotchart and a barplot based on the mtcars dataset, which includes the fuel consumption and 10 aspects of automobile design and performance of 32 automobiles.

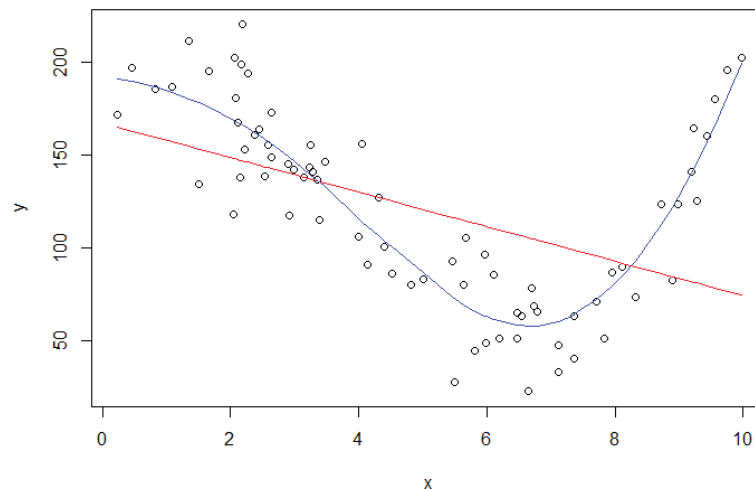
9. Draw a histogram of household income. The histogram shows a clear concentration of low household incomes on the left and the long tail of the higher incomes on the right and also draws a density plot of the logarithm of household income values, which emphasizes the distribution. The income distribution is concentrated in the center portion of the graph.



10. Consider a density plot of diamond prices (in USD). It contains two density plots for premium and ideal cuts of diamonds. Draw density plot of diamond prices and also density plot of the log10 of diamond prices.



11. Draw the following scatterplot by considering a vector of vector of uniform distribution, use the runif() function.



12. Consider a case to compare the logarithm of household income against the years of education, as shown in Figure (a). The cluster in the scatterplot on the left (a) suggests a somewhat linear relationship of the two variables. In Figure (b), the same data is plotted using a hexbinplot. Draw the same.
13. Implement Apriori Algorithm in Association Rule Mining.
14. Implement Text Mining on Twitter data using twitterR package.

15. Implement K-Means, K-Medoids, Hierarchical and Density-based Clustering techniques.
16. Implement Time Series Analysis using Classification and clustering Techniques.

TEXT BOOKS:

1. EMC Education Services, *Data Science and Big Data Analytics – Discovering, Analyzing, Visualizing and Presenting Data*, John Wiley and Sons, 2015.
2. Joao Moreira, Andre Carvalho, Andre Carlos Ponce de Leon Ferreira Carvalho, Tomas Horvath, *A General Introduction to Data Analytics*, John Wiley and Sons, 1stEdition, 2019.

REFERENCE BOOKS:

1. Anil Maheshwari, *Data Analytics Made Accessible*, Lake Union Publishing, 1stEdition, 2017.
2. Richard Dorsey, *Data Analytics: Become a Master in Data Analytics*, Create Space Independent Publishing Platform, 2017.
3. Yanchang Zhao, *R and Data Mining: Examples and Case Studies*, Elsevier, 1stEdition, 2015, (PDF URL: <http://www.RDataMining.com>).

SOFTWARE/TOOLS:

- R and Python 3.8

VIDEO LECTURES:

<https://nptel.ac.in/courses/106107220>

Web Resources:

1. <https://www.simplilearn.com/tutorials/data-analytics-tutorial>
 2. https://www.tutorialspoint.com/excel_data_analysis/data_analysis_overview.htm
 3. <https://intellipaat.com/blog/tutorial/data-analytics-tutorial/>
- <https://www.educba.com/data-science/data-science-tutorials/data-analytics-basics/>

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS101004	PREDICTIVE ANALYTICS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This Course provides a detailed discussion on Overview of Predictive analytics, Predictive Modeling, Data understanding, Data preparation, Item sets and Association Rules, Descriptive modeling, Assessing Predictive Models.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge on the basics of Predictive Analytics and Modelling.
- CO2.** Analyze the insights of data using data visualization and preparation methods for improved decision making.
- CO3.** Apply data pre-processing techniques to prepare data for predictive analytics.
- CO4.** Identify patterns in categorical data and build descriptive models using Association rules, Principal Component Analysis and Clustering algorithms.
- CO5.** Identify and deploy appropriate predictive models using batch approach, Regression and Ensemble Models to improve corporate operations.

CO-PO-PSO Mapping Table

Course Outcome	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3	-
CO2	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3	-
CO3	3	3	2	2	3	-	-	-	-	-	-	-	3	3	3	-
CO4	3	3	2	2	3	-	-	-	-	-	-	-	3	3	3	-
CO5	3	3	2	2	3											
Course Correlation Level	3	2	2	2	3		-	-	-	-	-	-	3	3	3	-
Correlation Level: 3-High 2-Medium 1-Low																

COURSE CONTENT:

Module-1: INTRODUCTION

(09 periods)

Overview of Predictive Analytics: Analytics, Predictive Analytics, Business Intelligence, Predictive Analytics vs. Statistics, Predictive Analytics vs. Data Mining, Challenges in Using Predictive Analytics, Educational Background. Setting up the Problem: Predictive Analytics Processing Steps, Defining Data for Predictive Modelling, Defining the Target Variable, Defining Measures of Success for Predictive Models, Doing Predictive Modelling Out of Order, and Case Study: Recovering Lapsed Donors and Fraud Detection.

Module-2: DATA UNDERSTANDING

(08 periods)

What the Data Looks Like, Single Variable Summaries, Data Visualization in One Dimension, Histograms, Multiple Variable Summaries, Data Visualization, Two or Higher Dimensions, The Value of Statistical Significance, Pulling It All Together into a Data Audit.

Module-3: DATA PREPARATION

(08 periods)

Variable Cleaning: Incorrect Values, Consistency in Data Formats, Outliers, Multi-dimensional Outliers, Missing Values, Fixing Missing Data. Feature Creation: Simple Variable Transformations, Fixing Skew, Binning Continuous Variables, Numeric Variable Scaling, Nominal Variable Transformation, Ordinal Variable Transformations, Date and Time Variable Features, ZIP Code Features, Multidimensional Features, Variable Selection Prior to Modelling, Sampling.

Module-4: ASSOCIATION RULES AND DESCRIPTIVE MODELING

(10 periods)

Item sets and Association Rules: Terminology, Condition, Left-Hand-Side, Antecedent, Right-Hand-Side, Consequent, Output, Conclusion, Rule (Item Set), Support, Antecedent Support, Confidence, Accuracy, Lift. Parameter Settings, How the Data Is Organized, Measures of Interesting Rules, Deploying Association Rules, Problems with Association Rules, Building Classification Rules from Association Rules.

Descriptive Modeling: Data Preparation Issues with Descriptive Modeling, Principal Component Analysis, Clustering Algorithms.

Module-V: PREDICTIVE MODELING

(10 periods)

Predictive Modeling and Assessing Predictive Models: Batch Approach to Model Assessment, Assessing Regression Models. Model Ensembles: Motivation for Ensembles, Bagging, Boosting, Improvements to Bagging and Boosting, Model Ensembles and Occam's razor, Interpreting Model Ensembles. Model Deployment, HelpDesk Case Study.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Develop a case study on Healthcare prediction using Predictive Analytics
2. How predictive analytics will enable Customer Churn Prediction.
3. Prepare a Report on Challenges that Organizations need to face with Predictive analytics.
4. Demonstrate how Privacy and Security can be ensured in Predictive Analytics.

RESOURCES:

TEXT BOOK:

1. DeanAbbott-Applied Predictive Analytics_Principles and Techniques for the Professional Data Analyst-Wiley,2014.

REFERENCE BOOKS:

1. Siegel, Eric, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Wiley, 2016.
2. Theobald, Oliver, Data Analytics for Absolute Beginners Cengage Learning, 2nd Edition,2019.
3. Bari, A., Chaouchi, M., Jung, T. Analytics for Dummies, 2nd Edition, 2016.

VIDEO LECTURES

- https://onlinecourses.nptel.ac.in/noc21_mg86
- <http://www.nitttrc.edu.in/nptel/courses/video/110104086/L08.html>
- <https://www.coursera.org/articles/predictive-analytics>
- https://onlinecourses.swayam2.ac.in/imb20_mg19
- <https://nptel.ac.in/courses/110105089>

WEB RESOURCES:

- <https://www.investopedia.com/terms/p/predictive-analytics.asp>
- www.ibm.com/topics/predictive-analytics
- <https://cloud.google.com/learn/what-is-predictive-analytics>

<https://www.mathworks.com/discovery/predictive-analytics>

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS102008	BUSINESS INTELLIGENCE TOOLS	3	-	2	-	4
Pre-Requisite	Data Mining					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course is emphasize on the fundamentals of business intelligence and tools including introduction of business intelligence and analytics, market research and operational intelligence, Agile Methodologies for BI Projects Data Modeling for BI Solutions business intelligence reporting interface and practical mastery of experiments using business intelligence open source tools.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Use different business intelligences and analyze them.
- CO2.** Apply market research and operational intelligence on different data sets.
- CO3.** Design and develop Agile Methodologies for BI Projects
- CO4.** Create Data Modeling for BI Solutions
- CO5.** Develop The BI Reporting Interface by choosing suitable BI Tool.
- CO6.** Work independently or in team to solve BI related problems with effective communication

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3	2
CO2	3	3	3	2	2	-	2	-	-	-	-	-	3	-	3	2
CO3	3	3	3	3	3	-	-	-	-	-	2	-	3	-	3	2
CO4	2	3	3	3	3	-	-	2	-	-	-	-	3	-	3	2
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	-	3	2
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	-	-	-	2	2	3	3	2	-	3	-	3	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Introduction to Business Intelligence and Analytics (10 Periods)

Introduction: Business Intelligence, Mobile Business Intelligence, Real-time Business Intelligence;

Analytics: Business Analytics, Software Analytics, Embedded Analytics, Learning Analytics, Predictive Analytics, Prescriptive Analytics, Social Media Analytics and Behavior Analytics.

Essential Aspects of Business Intelligence: Context Analysis, Business Performance Management, Business Process Discovery, Information System, Organizational Intelligence, Data Visualization, Data Profiling, Data Cleansing, Process Mining and Competitive Intelligence.

Module 2: Market Research and Operational Intelligence (08 Periods)

Market Research: Introduction, Market Segmentation, Market Trend, SWOT Analysis, Marketing Research;

Operational Intelligence: Introduction, Business Activity Monitoring, Complex Event Processing, Business Process Management, Root Cause Analysis;

Module 3 Agile Methodologies for BI Projects (9 Periods)

Introduction to Agile Methodologies, Agile Approaches : Our Recommended Mix between Scrum and Kanban, Developing Projects with Scrum, Maintenance with Kanban , Mix of Both Methodologies, Scrumban; Peculiarities of Scrum for BI, Agile Management Tools.

Data Modeling for BI Solutions:

Modeling Steps, Defining our Model, Exploring Data Modeling Possibilities: View Layer, Data Split, Fact Normalization and Denormalization , Time Transformations , Fact Phases , Real vs. Potential , Historical Hierarchies ; Multiple Views Using a Table, Entity Isolation , Modifying Existing Structures, Adding More Sales Document Status , Data Modeling Tools : Erwin DataModeler, MySQL Workbench , Preparing the ETL.

Module 4 ETL Basics (9 Periods)

Need of ETL Process, Details of the solution, Open Source ETL suites, Understanding ETL concepts. Performance Improvements: Database Optimizations, ETL Optimizations.

Module 5 The BI Reporting Interface (09 Periods)

How to Choose the BI Tool, Best Practices in Dashboarding: Starting from Top Left , Joining Related Information , Focus on Relevant Data , Formatting Recommendations, Graphic Usages; BI Tools: Microstrategy Desktop , Microsoft Power BI, Qlik Sense.

BI Process Scheduling: Finishing the ETL, PDI Command-Line Tools, Scheduling Jobs in the Task Scheduler, Running Database Maintenance Tasks.

Moving to a Production Environment: Multienvironment Scenario, Maintaining the Environment, Security, Auditing.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Power BI Desktop installation and familiarizing an Interface of Power BI. (*Study on features, architecture, building blocks, and components of Power BI*).
2. Import the data from different sources such as Excel, MySQL, SQLServer, Oracle etc. to load into Power BI and creating tables manually. (*Demonstration on getting data into Power BI Desktop, Data sources and modeling in Power BI*).
3. Implement Extraction, Transformation and Loading (ETL) process to create a database into MySQL/SQLServer/Power BI and then perform renaming, splitting, removing and reordering of columns; managing query groups, merge queries, SQL joins and union. (*Demonstration on data transformation*)
4. Create employee, department, and location tables using Power BI and then establish relationships between tables to display employee details such as employee name, employee no., department, date-of-join, gross salary and location. (*Demonstration on relationships*).
5. Design a dashboard to show units in stock by product and a total sale by year. (*Demonstration on List of Power BI chart types for visualization*).
6. Design a dashboard to check the total amount of sales made in each month and find out which month had the highest and lowest sales. Use a simple clustered column chart. Drag the date column on the axis and the sales on to the values then change the color of the bars by going to the format option and selecting data colors. (*Demonstration on format options of charts*).
7. Design a dashboard using a pie chart to analyze the sales made by each segment and find out which segment made the highest and lowest number of sales. Click on the pie chart option, select segment on to the legend, and sales on to the values. Create a map that depicts the sales made in each country and show the Donut chart to illustrate the profit made in each Segment. Positioning, Aligning, Sorting Visuals.
8. Design a dashboard to show sales, profits, regional cash inflows and the customers product-specific churn (stop using a product)of products over a period of time using necessary charts include Combo Charts, Bar Charts, Tables, Line Charts, Column Charts, and Point Maps. Interaction between Visuals.
9. Publish (Share or Embed) Power BI dashboards or reports that are designed on the Web (e-mail or social media).
10. Create a report that shows an employee detail such as employee name, employee no., designation, salary. In addition, create a custom column to show the stipend. If an employee designation is a manager, then the stipend should be 35% of his/her basic salary.
11. salary. If an employee is a senior consultant, then the stipend should be 25% of his/her basic, otherwise it should be 15% of the basic for remaining employees (*Study on DAX - Data Analysis Expressions functions include aggregate, counting, logical and date functions for creating calculated columns and measures*).

RESOURCES

TEXT BOOKS:

1. Drew Bentley, "Business Intelligence and Analytics", 1st edition, Library Press, 2017.
2. Albert Nogues, Juan Valladares, "Business Intelligence Tools for small companies, 1st edition, APress, 2017.

REFERENCE BOOKS:

1. Swain Scheps, "Business Intelligence for Dummies", 1st edition, Wiley publishing, 2008
2. Wilfried Grossmann, Stefanie Rinderle-Ma, "Fundamentals of Business Intelligence", 1st edition, Springer Press, 2015.
3. Teo Lachev, "Applied Microsoft Power BI," Prologika, Seventh Edition, 2022.
4. Alberto Ferrari and Marco Russo, "Introducing Microsoft Power BI," Microsoft Press, 2016.
5. Brett Powel, "Mastering Microsoft Power BI," Packt Publishing, First Edition, 2018

SOFTWARE/TOOLS:

Microsoft Power BI Desktop (<https://powerbi.microsoft.com/en-us/downloads/>)

WEB RESOURCES:

1. <https://docs.microsoft.com/en-us/power-bi/fundamentals/power-bi-overview>.
2. <https://www.edureka.co/blog/power-bi-tutorial/>
3. <https://mindmajix.com/power-bi-visualization-types>
4. <https://intellipaat.com/blog/tutorial/power-bi-tutorial/>
5. <https://docs.microsoft.com/en-us/powerapps/maker/canvas-apps/sharepoint-scenario-build-report>.
6. <https://www.projectpro.io/article/power-bi-microsoft-projects-examples-and-ideas-for-practice/533>

DATASET LINKS:

1. Customer segmentation (e-commerce) data - For dataset visit <https://www.kaggle.com/fabiendaniel/customer-segmentation/data>.
2. Financial Sample Excel workbook for Power BI - <https://docs.microsoft.com/en-us/power-bi/create-reports/sample-financial-download>.

Marketing Analytics dataset - <https://www.kaggle.com/jackdaoud/marketing-data>.

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS102002	BIG DATA TECHNOLOGIES	3	-	2	-	4

Pre-Requisite Database Management Systems

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Hadoop Basics, Hadoop Distributed File system, MapReduce, Hive, Pig and HBase, Zookeeper, Sqoop and Big data Case Studies.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge on Big Data characteristics, storage, processing, querying and reporting
- CO2.** Analyze large dataset issues and solve using data analytic techniques.
- CO3.** Design and Develop classification and clustering models for dataset analysis.
- CO4.** Solve large data analysis problems using Big data techniques.
- CO5.** Apply Big Data Tools: Sqoop, HBase, Hive, Pig, MapReduce and Zookeeper for large
- CO6.** Work independently and in teams to solve Big Data problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcome s	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	0
CO2	2	2	3	-	-	1	-	-	-	-	-	-	3	-	-	2
CO3	2	2	2	3	-	-	2	-	-	-	-	-	3	-	-	2
CO4	2	3	-	-	2	-	-	-	-	-	-	-	3	-	-	2
CO5	-	-	-	-	-	-	-	2	3	-	-	-	3	-	-	0
CO6	-	-	-	-	-	-	-	-	-	3	-	2	3	-	-	0
Level of correlation of the course	3	3	3	3	2	1	2	2	3	3	-	2	3	-	-	2
Correlation Levels: 3: High 2: Medium 1: Low																

COURSE CONTENT:

Module 1 - INTRODUCTION TO BIG DATA AND HADOOP (9 periods)

Introduction to Big Data: Evolution and Definition of Big Data, Structure of Big Data, Characteristics, Advantages, Applications and Tools.

Hadoop: Data storage and analysis, Comparison with other systems, History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases.

Module 2 – HADOOP DISTRIBUTED FILE SYSTEM AND HADOOP I/O (9 periods)

Hadoop Distributed File system: HDFS concepts, Command-Line Interface, Hadoop file systems, Java Interface, Data Flow, Hadoop Archives.

Hadoop I/O: Data Integrity, Compression, Serialization, File-Based Data Structures.

Module 3 – MAPREDUCE, TYPES& FORMATS AND FEATURES (9 periods)

MapReduce: Analyzing the data with Hadoop, Scaling Out, Hadoop Streaming, Hadoop Pipes.

Types and Formats: MapReduce Types, Input Formats, Output Formats.

Features: Counters, Sorting, Joins, Side Data Distribution and MapReduce Library Classes.

Module 4– HIVE, PIG AND HBASE (9 periods)

Hive: Comparison with Traditional Databases, HiveQL, Tables, Querying Data, and User-Defined Functions.

Pig: Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators.

HBase: Basics, Concepts, Clients, HBase vs. RDBMS, Praxis.

Module 5– ZOOKEEPER, SQOOP AND CASE STUDIES (9 periods)

Zookeeper: Zookeeper Service, Building applications with Zookeeper, Zookeeper in production.

Sqoop: Database Imports, working with Imported Data, Importing Large Objects, Performing an Export.

Case Studies: WhatsApp, Facebook and Twitter.

Total periods: 45

EXPERIENTIAL LEARNING:

1. Practice on Hadoop:

i. Hadoop installation and Cluster Configuration.

ii. Create Name node, Secondary Name node in Safe mode.

iii. **Create Hadoop File system Shell and Read and write Data.**

2. **Practice on MapReduce:**

i. **Create file to count the number of words and display the same.**

ii. Create zip file of weather report and fetch the max temperature value from the report

3. Install and Run Hive and Hbase, then use Hive to create, alter, and drop databases,

tables, and perform views, functions, indexes and Joins.

4. Perform Data Processing Operators using **Pig**.

5. **Import and Export data from RDBMS database using Sqoop tool.**

6. **Perform data storage and management using Zookeeper tool.**

7. **Install Spark and Pyspark in Windows and Ubuntu.**

8. Practice on Spark

i) Spark Transformations i.e. map(), filter(), flatmap(), groupBy(), groupByKey(), sample(), union (), join(), distinct(), keyBy(), partitionBy and zip().

ii) Spark Actions i.e. getNumPartitions(), collect(), reduce(), aggregate (), max(), sum(), mean(), stdev(), countByKey().

9. Write a Scala program for Linear Search, Binary Search, Bubble Sort, Quick Sort, and

Stack operations.

10. Practice on PySpark

i) Actions and Transformation commands.

ii) Program for implementation of bubble sort and Selection Sort

iii) Program for implementation of stack and Queue

11. **Case study 1: Insurance Domain**

i) **Perform Hive operations on Insurance Dataset**

ii) **Perform Pig Data Processing Operators on Insurance Dataset**

12. Case study 2: Healthcare Domain

i) Perform Hive operations on Insurance Dataset

ii) Perform Pig Data Processing Operators on Insurance Dataset

RESOURCES

TEXT BOOKS:

1. Tom White, *Hadoop: The Definitive Guide*, O'REILLY Publications, Third Edition, 2012.
2. Anil Maheswari, *Big Data*, Tata McGraw Hill, First Edition, 2017.

REFERENCE BOOKS:

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications," Wiley Publications, 2014.
2. Paul Zikopoulos, IBM, Chris Eaton and Paul Zikopoulos "Understanding Big Data: Analytics for Enterprise Class Hadoop and streaming Data," The McGraw-Hill Companies, 2012.
3. Chuck Lam "Hadoop in action," Manning Publications, 2011.

SOFTWARE/Tools Used:

1. An Intel-compatible platform running Windows 10 /8.1/8 /7 /Vista /XP /2000 Windows server 2019 /2016 /2012 /2008 /2003
2. At least 256 MB of RAM, a mouse, and enough disk space for recovered files, image files, etc.
3. The administrative privileges are required to install and run Big Data utilities.
4. A network connection for data recovering over network.

VIDEO LECTURES:

1. <https://www.youtube.com/live/KCEPoPJ8sWw?feature=share>
2. <https://youtu.be/bAyrObI7TYE>

WEBRESOURCES:

1. <https://www.simplilearn.com/introduction-to-big-data-and-hadoop-tutorial>
2. https://hadoop.apache.org/docs/r1.2.1/hdfs_design.html
3. <https://www.developer.com/java/understanding-mapreduce-types-and-formats.html>
4. https://prismoskills.appspot.com/lessons/System_Design_and_Big_Data/Chapter_01_-_Hadoop.jsp
5. <https://www.simplilearn.com/introduction-to-zookeeper-tutorial>
6. <https://data-flair.training/blogs/top-hadoop-hdfs-commands-tutorial/>
7. <https://www.edureka.co/blog/hive-commands-with-examples>
8. https://www.tutorialspoint.com/apache_pig/apache_pig_grunt_shell.htm
9. Transformations and Actions (databricks.com)

SPECIALIZATION ELECTIVE

Course Code
22CB102005

Course Title
ETHICAL HACKING

L	T	P	S	C
3	-	2	-	4

Pre-Requisite 22CB102002 - Computer Networks

Anti-Requisite

Co-Requisite

COURSE DESCRIPTION:

The aim of the course is to introduce the methodologies and framework of ethical hacking for enhancing the security. The course includes-Impacts of Hacking; Types of Hackers; Information Security Models; Information Security Program; Business Perspective; Planning a Controlled Attack; Framework of Steps (Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Deliverable and Integration).

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate knowledge on ethical hacking, framework, information security models and information security program.
- CO2** Demonstrate the knowledge on interpreting the results of a controlled attack in business perspectives.
- CO3** Apply techniques for Preparing for a Hack and Reconnaissance.
- CO4** Apply Enumeration Techniques to identify penetration categories.
- CO5** Apply security policies for incident management.
- CO6** Work independently and in teams to solve hacking issues with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	3	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	3	3	-
CO3	3	3	2	2	2	-	-	-	-	-	-	-	3	3	3	-
CO4	3	3	2	2	2	-	-	-	-	-	-	-	3	3	3	-
CO5	3	3	2	2	2	-	-	-	-	-	-	-	3	3	3	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	2	2	-	-	-	3	3	-	-	3	3	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION

(09 Periods)

Introduction: Hacking Impacts, The Hacker

Framework: Planning the test, Sound Operations, Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Final Analysis, Deliverable, Integration

Information Security Models: Computer Security, Network Security, Service Security, Application Security, Security Architecture

Information Security Program: The Process of Information Security, Component Parts of Information Security Program, Risk Analysis and Ethical Hacking

Module 2: THE BUSINESS PERSPECTIVE AND PLANNING FOR A CONTROLLED ATTACK

(09 Periods)

Business Objectives, Security Policy, Previous Test Results, Business Challenges Inherent Limitations, Imposed Limitations, timing is Everything, Attack Type, Source Point, Required Knowledge, Multi-Phased Attacks, Teaming and Attack Structure, Engagement Planner, The Right Security Consultant, The Tester, Logistics, Intermediates, Law Enforcement

Module 3 PREPARING FOR A HACK AND RECONNAISSANCE

(08 Periods)

Technical Preparation, Managing the Engagement, Social Engineering, Physical Security, Internet Reconnaissance

Module 4 ENUMERATION AND EXPLOITATION

(11 Periods)

Enumeration Techniques, Soft Objective, Looking Around or Attack, Elements of Enumeration, Preparing for the Next Phase Intuitive Testing, Evasion, Threads and Groups, Operating Systems, Password Crackers, RootKits, applications, Wardialing, Network, Services and Areas of Concern

Module 5 DELIVERABLE AND INTEGRATION

(08 Periods)

The Deliverable, The Document, Overall Structure, Aligning Findings, Presentation Integrating the Results, Integration Summary, Mitigation, Defense Planning, Incident Management, Security Policy, Conclusion

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Practice the following Linux commands:
ls,cat,cd,mkdir,nano,vim,rm,rmdir,nslookup,chmod,ping,netstat,Kill..etc.
2. Design and develop file systems and privileges in Linux Distribution.
3. Set-up Linux distribution (Kali Linux, Parrot OS or Ubuntu) in the windows
 - a) Vmware/VirtualBox
 - b) Dual Boot
 - c) Subsystems
4. Use the following tools for identifying attacks:
 - a) Nmap/Zenmap
 - b)Google Hacking(Dorking)
5. Perform the following in Web and Mobile Applications:
 - a) Web Application
Subdomain Finding, Live URL's Finding, Hacking History (Waybackurl's),GAU(Get All URL's).
 - b)Android/IOS
Source code Analysis (Java/Kotlin) tool (jadx-GUI)
6. Using Burp suite perform penetration testing of web applications. (Installation of Burp suite, Configuration and setup Burp suite with Firefox in kali Linux and Windows)
7. Perform password brute force attack through Burp suite (Dictionary Attacks).
8. Perform DoS attacks with the help of Burp suite and its techniques
 - i) Long Password/String DoS attack.
 - 2) JqL Injection.
9. Perform SQL Injection, CSRF, SSTI, XSS(Java Script Injection), IDOR, Open Redirection. Identify the impact if a web application affected with these types of vulnerabilities.
10. Hack Windows XP using nmap and metasploit.
(These attack will be done in the virtual Box/VMware there will be two machines running in the windows one will be Attacker Machine(Kali Linux) other one is Windows XP(with Antivirus & Windows Protection "OFF").Using Nmap you have to find the IP of the Windows XP and further you need to proceed extracting the OS, Version, and The Older version is affected with Some CVE based vulnerabilities and by using Metasploit you need to exploit and takeover complete Windows Machine and perform Log-out command through Kali Linux.)
11. Perform Linux Distribution Deletion:
 - a) Deleting in VMware/Virtual Box
 - b) Deleting in Dual Boot.
 - c) Deleting in Subsystem.

SOFTWARE/TOOLS:/HARDWARE TOOLS

1. Virtual Box/VMware , Kali Linux ISO file, Burpsuite.
2. The Particular Computer must have Virtualization Technology Enabled for sure.

RESOURCES

TEXT BOOKS:

1. James S. Tiller, "The Ethical Hack: A Framework for Business Value Penetration Testing",Auerbach Publications, CRC Press
1. Web Application Hackers Handbook, Michael T. Simpson, Kent Backman, James E. "Corley, Hands-On Ethical Hacking and Network Defense", Second Edition, CENGAGE Learning, 2010.

REFERENCE BOOKS:

1. Web Application hackers Hand Book(Dafydd Stuttard and Marcus Pinto), EC-Council, "Ethical Hacking and Countermeasures Attack Phases", Cengage Learning
2. Michael Simpson, Kent Backman, James Corley, "Hands-On Ethical Hacking and NetworkDefense", Cengage Learning
3. Steven DeFino, Barry Kaufman, Nick Valenteen, "Official Certified Ethical Hacker Review Guide", CENGAGE Learning.
4. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", Syngress Basics Series – Elsevier, August 4, 2011.
5. Whitaker & Newman, " Penetration Testing and Network Defense" , Cisco Press, Indianapolis, IN, 2006.

WEB REFERENCES:

1. <https://portswigger.net/web-security>
2. <https://www.elsevier.com/books/cyber-security-awareness-forlawyers>
3. <https://books.google.co.in/books>

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc22_cs13/preview
2. <https://portswigger.net/web-security> (Practical Labs will also present with Video Lectues)

SPECIALIZATION ELECTIVE

Course Code
22CB101011

Course Title
CLOUD SECURITY

L	T	P	S	C
3	-	-	-	3

Pre-Requisite Cloud Computing

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course emphasizes on the security issues of cloud at the application and network level. It covers Threats and Vulnerabilities in Virtual Platforms and different strategies to maintain the security in the cloud. By the end of this course students will acquire basic knowledge on privacy issues and the impact of Cloud Computing on Corporate IT.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Analyze the security challenges associated with deployment and delivery models for securing cloud-based systems
- CO2.** Interpret the Virtualization Security over hypervisors and VM with understanding of Virtualization Management Servers.
- CO3.** Analyze security policies and processes by employing security management models, which can be utilized to protect the integrity of cloud-based systems.
- CO4.** Analyze identity and access management (IAM) practice for authentication, authorization, and auditing of the users accessing cloud services.
- CO5.** Develop solutions to detect, mitigate and prevent evolving legal, compliance and privacy issues arising from cloud-based systems.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	3	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	3	3	-
CO3	3	2	2	3	2	-	-	-	-	-	-	-	3	3	3	-
CO4	3	2	2	2	2	-	-	-	-	-	-	-	3	3	3	-
CO5	3	2	2	2	2	-	-	-	-	-	-	-	3	3	3	-
Level of correlation of the course	3	2	2	3	2	-	-	-	-	-	-	-	3	3	3	-

Correlation Levels: **3: High** **2: Medium** **1: Low**

COURSE CONTENT

(9 Periods)

Module 1: SECURITY ISSUES IN THE CLOUD

Infrastructure Security: The Network Level: Ensuring Data Confidentiality and Integrity, Proper Access Control, Availability of Internet-Facing Resources, Replacing the Established Model of Network Zones and Tiers with Domains, Network-Level Mitigation.

The Application Level: Security Threats, DoS and EDoS, End User Security, Web Application Securities

Data Security and Storage: Aspects of Data Security Data Security Mitigation, Provider Data and Its Security

Module 2: VIRTUALIZATION SECURITY

(9 Periods)

Threats and Vulnerabilities in Virtual Platforms, Securing Hypervisors: ESXi, Hyper-V

Virtualization Management: Network Architecture, VMware vCenter, Virtual Machine Manager

Securing the VM: Stealing Guests, Cloud VM Reconnaissance, Virtual Disk Manipulation, Virtual Machine Encryption, Locking down VMware VMs.

Module 3: SECURITY MANAGEMENT IN THE CLOUD

(9 Periods)

Identity and Access Management: Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management

Security Management in the Cloud: Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS, Security Vulnerability, patch and Configuration Management

Module 4 PRIVACY ISSUES

(9 Periods)

Privacy Issues: Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations

Module 5 AUDIT AND COMPLIANCE

(9 Periods)

Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Control Objectives, Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance

Security-as-a-[Cloud] Service: Email filtering, Web Content filtering, Vulnerability Management, Identity Management as a Service

Impact of Cloud Computing on Corporate IT: Potential Threats of using CSP's, **Case Study:** Potential Changes in the IT Profession Caused by Cloud Computing

Total Periods: 45

RESOURCES

TEXT BOOKS:

1. Tim Mather, Subra Kumara swamy, Shahed Latif, *Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance*, O'Reilly Media,
2. Dave Shackleford, *Virtualization Security: Protecting Virtualized Environments*, Sybex , 2012

REFERENCE BOOKS:

1. Ronald L. Krutz, Russell Dean Vines, *Cloud Security*, Wiley
2. J.R. ("Vic") Winkler, *Securing the Cloud*, Syngress

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106/105/106105167/>
2. <https://nptel.ac.in/courses/106/106/106106129/>

WEB RESOURCES:

1. [https://www.iare.ac.in/sites/default/files/lecture_notes/CC%20LECTURE%20NOTE S.pdf](https://www.iare.ac.in/sites/default/files/lecture_notes/CC%20LECTURE%20NOTE%20S.pdf)
2. https://resources.sei.cmu.edu/asset_files/presentation/2012_017_001_52439.pdf
3. https://www.tutorialspoint.com/cloud_computing/cloud_computing_security.html

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB104001	CYBER FORENSICS AND INVESTIGATION	3	-	2	4	5
Pre-Requisite	Cyber Security Essentials					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Computer Forensics Evidence and Capture, Computer forensic analysis, Forensic Data Analysis, Mobile Device Security, Computer forensic cases and Computer Forensics Investigation Process.

COURSE OBJECTIVES:

- To impart knowledge on comprehensive understanding of digital forensic principles and the collection, preservation, and analysis of digital evidence.
- To enlighten the importance of forensic principles and procedures, legal considerations, digital evidence controls, and the documentation of forensic analysis.
- To develop an understanding of the different applications and methods for conducting network and digital forensic acquisition and analysis.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on computer forensics, collection and verification of digital evidence.

CO2. Perform computer forensic Analysis using digital evidence.

CO3. Perform Forensic Digital Analysis based on the legal issues.

CO4. Identify and analyze the potential Mobile forensic evidences.

CO5. Perform Computer Crime Investigation using Host and Network data.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	3	3	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	3	3	2
CO3	3	2	2	3	2	-	-	-	-	-	-	-	3	3	3	2
CO4	3	2	2	2	2	-	-	-	-	-	-	-	3	3	3	2
CO5	3	2	2	2	2	-	-	-	-	-	-	-	3	3	3	2
Level of correlation of the course	3	2	2	3	2	-	-	-	-	-	-	-	3	3	3	2

Correlation Levels: **3: High** **2: Medium** **1: Low**

COURSE CONTENT:

Module 1 - INTRODUCTION AND COMPUTER FORENSICS EVIDENCE AND CAPTURE

(9 periods)

Introduction: Computer Forensics Fundamentals – Types of Computer Forensics Technology – Types of Computer Forensics Systems – Vendor and Computer Forensics Services.

Computer forensics evidence and capture: Data Recovery – Evidence Collection and Data Seizure-Duplication and Preservation of Digital Evidence-Computer Image Verification and Authentication.

Module 2 – COMPUTER FORENSIC ANALYSIS

(9 periods)

Computer forensic analysis: Discover of Electronic evidence Identification of Data – Reconstructing Past Events – Fighting against Macro Threats – Information Warfare Arsenal – Tactics of the Military – Tactics of Terrorist and Rogues – Tactics of Private Companies

Module 3 – FORENSIC DATA ANALYSIS

(9 periods)

Information warfare: Arsenal – Surveillance Tools – Hackers and Theft of Components – Contemporary Computer Crime-Identity Theft and Identity Fraud – Organized Crime and Terrorism – Avenues Prosecution and Government Efforts – Applying the First Amendment to Computer Related Crime-The Fourth Amendment and other Legal Issues.

Module 4–MOBILE DEVICE SECURITY AND FORENSICS CASES(9 periods)

Computer forensic cases: Developing Forensic Capabilities – Searching and Seizing Computer Related Evidence –Processing Evidence and Report Preparation – Future Issues.

Introduction to Mobile Forensic -Android Device - Analysis- Android Mal ware- iOS Forensic Analysis - SIM Forensic Analysis - Case study.

Module 5–COMPUTER FORENSICS INVESTIGATION PROCESS(9 periods)

Introduction to Computer Crime Investigation: Initial Decision-Making Process, Assess the Situation: Notify Decision Makers and Acquire Authorization, Review Policies and Laws, Identify Investigation Team Members, conduct a Thorough Assessment, Prepare for Evidence Acquisition, Acquire the Data :Build Computer Investigation Toolkit, Preparing Your Organization for a Computer Investigation, Collect the Data, Store and Archive. Analyze the Data: Analyze Network Data, Analyze Host Data, Analyze Storage Media, Report the Investigation: Gather and Organize Information, Write the Report.

Total periods: 45

EXPERIENTIAL LEARNING:

1. Study of Computer Forensics and different tools used for forensic investigation.
2. **Perform Recovery of Deleted Files using Forensics Tools**
3. **Identify and list the steps for h22CBiding and extract any text file behind an image file/ Audio file using Command Prompt.**
4. Extract Exchangeable image file format (EXIF) Data from Image Files using Exifreader Software.
5. **Prepare the forensic image of the hard drive using EnCaseForensics.**
6. **perform the Evidence Image Restoring using EnCase Forensics.**
7. **Collect the Email Evidence in Victim PC.**
8. **Extracting Browser Artifacts.**
9. **View Last Activity of Your PC**
10. **Find Last Connected USB on your system (USB Forensics)**
11. **Case study 1: Comparison of two Files for forensics investigation by Compare IT software**
12. **Case study 2: Live Forensics Case Investigation using Autopsy.**

RESOURCES

RESOURCES

TEXT BOOKS:

- 1) John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Cengage Learning, 2nd Edition, 2005.
- 2) Marjie T Britz, "Computer Forensics and Cyber Crime: An Introduction", Pearson Education, 2nd Edition, 2008.
- 3) <https://www.cemca.org/ckfinder/userfiles/files/Module%2002%20Computer%20Forensics%20Investigation%20Process.pdf>

REFERENCE BOOKS:

- 1) MariE-Helen Maras, "Computer Forensics: Cybercriminals, Laws, and Evidence", Jones & Bartlett Learning; 2nd Edition, 2014.
- 2) Chad Steel, "Windows Forensics", Wiley, 1st Edition, 2006.
- 3) Majid Yar, "Cybercrime and Society", SAGE Publications Ltd, Hardcover, 2nd Edition, 2013.
- 4) Robert M Slade, "Software Forensics: Collecting Evidence from the Scene of a Digital Crime", Tata McGraw Hill, Paperback, 1st Edition, 2004

SOFTWARE/Tools Used:

1. An Intel-compatible platform running Windows 10 /8.1/8 /7 /Vista /XP /2000 Windows server 2019 /2016 /2012 /2008 /2003
2. Digital Forensic Tools:-The Sleuthkit Kit (TSK) , Helix ,Knoppix etc.
3. At least 256 MB of RAM, a mouse, and enough disk space for recovered files, image files, etc.
4. The administrative privileges are required to install and run Big Data utilities.
5. A network connection for data recovering over network.

VIDEO LECTURES:

1. <https://youtu.be/PEL37Z9gbRQ> <https://youtu.be/bAyrObl7TYE>
2. <https://youtu.be/dnidcOJA-ow>
3. <https://youtu.be/pM8yX-cr6S8>

WEB RESOURCES:

1. <https://www.noxcivis.com/forensics/>
2. <https://null-byte.wonderhowto.com/how-to/hack-like-pro-digital-forensics-for-aspiring-hacker-part-3-recovering-deleted-files-0149868/>
3. <https://cenexp.com/biblioteca/librerias/FOR/Bforense/LF20.pdf>
4. <https://www.cisa.gov/sites/default/files/publications/forensics.pdf>

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC102033	EMBEDDED PROGRAMMING	3	-	2	-	4
Pre-Requisite	Microcontroller and Interfacing					
Anti-Requisite	-					
Co-Requisite	Advanced Microcontrollers					

COURSE DESCRIPTION: This course is designed to provide a complete intermediate-level Skills necessary for microcontroller programming using the C programming language. It covers both the adaptations to C necessary for targeting an embedded environment, and the common components of a successful development project.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze the DC electrical circuits by applying the principles of network reduction techniques, mesh and nodal analysis.
- CO2** Analyze the single phase AC electrical circuits to investigate the response and determine various electrical quantities.
- CO3** Analyze the operational aspects of Single Phase Induction Motors and realize their applications.
- CO4** Understand the operational aspects of Special Machines used in industry and for domestic applications.
- CO5** Analyse the equivalent circuit of a single phase transformer, to determine the performance and assess its sustainability for various load conditions.
- CO6** Work independently or in teams to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	1	2	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	1	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	2	-	1	-	-	-	-	-	-	-	3	-
CO4	3	3	-	1	-	1	1	-	-	-	-	-	-	3	-
CO5	3	-	-	-	-	1	1	2	-	-	-	-	-	3	-
CO6									3	3				3	
Course Correlation Mapping	3	3		2	2	1			3	3	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO EMBEDDED PROGRAMMING (09 Periods)

Benefits of C in Embedded Systems, Problem Specification, Product Requirements, Hardware Engineering, Software Planning, Software Architecture, Psuedocode, Flowchart, State Diagram, Resource Management, Testing Regime,

Module 2: C FOR EMBEDDED SYSTEMS (09 Periods)

In line Assembly Language, Device Knowledge, Mechanical Knowledge, Libraries, Sample program.

Data types and variables, Identifier declaration, Function data types, Character data types, Integer data types, Bit data types, Real numbers, Complex data types, type def, Data type modifiers, Storage class modifiers

Module 3: C STATEMENTS, STRUCTURES & OPERATIONS (09 Periods)

Combining statements in a block, Functions, Control Structures, Decision Structures, Looping Structures, Operators and Expressions

Module 4: LIBRARIES (09 Periods)

Creating Libraries, Writing the Library, Libraries and linking

Module 5: OPTIMIZING AND TESTING EMBEDDED C PROGRAMS (09 Periods)

Optimization, Hand Optimization, Debugging Embedded C, Mixed C and Assembly, Exercising hardware, Dummy Loads, Emulators and Simulators, Packing Embedded Software, Sample Project.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Hello World through a relay
2. Toggling one of the heating/cooling unit relays
3. Keypad test program
4. Testing LCD display
5. Data transfer using ports
6. ADC Driver unit
7. Home automation sample project
8. PWM for speed control.
9. Ultrasonic distance measurement
10. Converting hours and minutes to a timestamp

RESOURCES

TEXT BOOKS:

1. Kirk Zurell, *C Programming for Embedded Systems* – Apply C to Microprocessors for Efficient Development, R&D Books Lawrence, CMP Media, Inc. Kansas 66046, USA, 2000

REFERENCE BOOKS:

1. Ted Van Sickle, *Programming Microcontrollers in C*, LLH Technology Publishing, Eagle Rock, Virginia, 2nd Edition, 2001.
2. Michael Barr, *Programming Embedded Systems in C and C++, O.' Reilly Publisher, First edition, 1999.*

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/108102169>
2. [https:// in.coursera.org/learn/introduction-embedded-systems](https://in.coursera.org/learn/introduction-embedded-systems)

Web Resources:

1. https://www.youtube.com/watch?v=VM7s1k0s7kk&list=PLzx1ARJOmyed-PYHMduhZDQ4eKXmWJj_T
2. <https://www.udemy.com/course/embedded-c-programming-for-embedded-systems/?referralCode=E5A03A84369AE1B6A199>
3. <https://www.youtube.com/watch?v=auyP0oDcW20&list=PLQptsE6qQy8NmtF89dFbfWfTY0yQfxWCK>
4. <https://www.youtube.com/playlist?list=PLQptsE6qQy8NmtF89dFbfWfTY0yQfxWCK>
5. <http://www.bytecra.com>
6. <https://www.mygreatlearning.com/blog/embedded-c/>

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101034	HARDWARE-SOFTWARE CO-DESIGN	3	-	-	-	3
Pre-Requisite	Embedded System					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Issues and Algorithms in CO- Design; Prototyping and its Emulation on Target Architectures; Compilation Techniques; Design Specification; Verification Tools for Embedded Processor Architectures; System- Level Languages with its Specification and Design.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze Co-Synthesis Algorithms for Co-Design Architectures.
- CO2** Analyze Prototyping and emulation for specialized target architectures to system design.
- CO3** Analyze target architectures in designing data-dominated and control-dominated embedded systems.
- CO4** Use compilation techniques and tools for embedded processor architectures and perform verification of co-design computational models.
- CO5** Apply language support for system level specification, co-simulation design and partitioning concepts in Cosyma and Lycos systems

CO-PO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	3	-	-	-	-	-	-	-	-	-			
Course Correlation Mapping	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CO-DESIGN ISSUES & CO-SYNTHESIS ALGORITHMS (11 Periods)

Co- Design Models, Architectures, Languages, a Generic Co-design Methodology. Hardware Software Synthesis Algorithms: Hardware- Software Partitioning, Distributed System Co-Synthesis.

Module 2: PROTOTYPING AND EMULATION FOR TARGET ARCHITECTURES (10 Periods)

Prototyping and Emulation Techniques, Prototyping and Emulation Environments, Future Developments in Emulation and Prototyping. Architecture Specialization Techniques, System Communication Infrastructure, Target Architecture and Application System Classes, Architecture for Control Dominated Systems (8051-Architectures for High Performance Control), Architecture for Data Dominated Systems (ADSP21060, TMS320C60), Mixed Systems.

Module 3: COMPILATION TECHNIQUES AND TOOLS FOR EMBEDDED PROCESSOR ARCHITECTURES (06 Periods)

Modern Embedded Architectures, Embedded Software Development Needs, Compilation Technologies, Practical Consideration in a Compiler Development Environment.

Module 4: DESIGN SPECIFICATION AND VERIFICATION (07 Periods)

Design, Co-Design, the Co-Design Computational Model, Concurrency Coordinating Concurrent Computations, Interfacing Components, Design Verification, Implementation Verification, Verification Tools and Interface Verification

Module 5: LANGUAGES FOR SYSTEM- LEVEL SPECIFICATION AND DESIGN (11 Periods)

System – Level Specification, Design Representation for System Level Synthesis, System Level Specification Languages .Heterogeneous Specifications and Multi Language Co-Simulation, the Cosyma System and Lycos System.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Case study on requirement and specification phases in design
2. Investigation on codesign tools – commercial vs open source
3. Case study on Cosyma and Lycos systems

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Jorgen Staunstrup, Wayne Wolf, "Hardware / Software Co- Design Principles and Practice", Springer, 2009.
2. Kluwer, "Hardware / Software Co- Design Principles and Practice", Academic Publishers, 2002.

REFERENCE BOOKS:

1. Patrick R. Schaumont, "A Practical Introduction to Hardware/Software Co-design", Springer, 2010.
2. Giovanni, Wayne Wolf, "Readings in Hardware Software Co - design", Academic Press, 2002.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/108102045/30>
2. <https://nptel.ac.in/courses/106/105/106105165/>
3. <https://www.coursera.org/learn/introduction-embedded-systems>

Web Resources:

1. <https://www.tec.ee.ethz.ch/education/lectures/hardware-software-codesign.html>
2. <https://ieeexplore.ieee.org/document/7525779>
3. http://ptolemy.eecs.berkeley.edu/ptolemyII/ptII10.0/ptII10.0.1_20141217/ptolemy/domains/continuous/doc/index.html

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101035	REAL TIME SYSTEMS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course is designed to provide an overview on the fundamentals of Real Time Systems Modeling. The course provides a deep insight about the various concepts such as Scheduling Approaches; Multiprocessor and Distributed Scheduling Algorithms; Fault Tolerant Systems; Real Time Operating Systems.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyse Real Time System Characterization, Workload and Resource management algorithms and apply suitable techniques to model hard and soft real time systems.
- CO2** Solve scheduling problems and apply suitable techniques in constrained RT systems by Surveying various Real Time scheduling approaches for uniprocessor, Multiprocessor and distributed environments.
- CO3** Evaluate appropriate Fault tolerant techniques and apply them to design fail safe RT systems.
- CO4** Implement Efficient Real Time Systems porting suitable operating system on to hardware by Investigating POSIX standard Kernel structure, services and Kernel objects.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	1	2	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	1	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	2	-	1	-	-	-	-	-	-	-	3	-
CO4	3	3	-	1	-	1	1	-	-	-	-	-	-	3	-
Course Correlation Mapping	3	3	-	1	2	-	-	-	-	-	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: MODELING OF REAL TIME SYSTEMS

(09 Periods)

Hard Vs Soft Real Time Systems, A Reference Model of Real Time Systems- Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency. Functional Parameters, Resource Parameters of Jobs and Parameters of Resources, Scheduling hierarchy.

Module 2: APPROACHES TO REAL TIME SCHEDULING

(09 Periods)

Clock Driven, Weighted Round Robin, Priority Driven, Dynamic Vs Static Systems, Effective Release Times and Dead Lines, Optimality and Non-optimality of EDF and LST algorithms, Challenges in Validating Timing Constraints in Priority Driven Systems, Offline Vs Online Scheduling.

Module 3: SCHEDULING REAL TIME TASKS IN MULTIPROCESSOR AND DISTRIBUTED SYSTEMS

(09 Periods)

Multiprocessor task allocation, Dynamic allocation of tasks, Fault tolerant scheduling of tasks, Clocks in distributed Real Time Systems, Centralized clock distribution, Distributed clock synchronization.

Module 4: FAULT TOLERANCE TECHNIQUES

(09 Periods)

Introduction, Failures- Causes, Types, Detection. Fault and Error Containment, Redundancy- Hardware, Software, Time, Integrated Failure Handling.

Module 5: OPERATING SYSTEMS

(09 Periods)

Overview- Threads and Tasks, the Kernel. Time Services and Scheduling Mechanisms, Basic Operating System Functions- Communication and Synchronization, Event Notification and Software Interrupt Memory Management, I/O and Networking. Processor Reserves and Resource Kernel, Capabilities of Commercial Real Time Operating Systems.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Graphical Task Model Creation
2. Simulation of Pre-emption and non-pre-emption Workload Models
3. Real Time CPU Utilization calculation
4. Scheduling Tools Overview: TORSCH, TIMES, CHEDDAR
5. Modeling Scheduling Problem: Define Set of Tasks, Define Scheduling Problem, Run Scheduling Algorithm
6. Simulation of Workload (Periodic Task): Modeling Graphical Representation of Task Parameters
7. Simulation of List Scheduling

8. Simulation of static scheduling algorithm: RMS/ Cyclic Scheduling
9. Simulation of EDF Scheduling algorithm
10. Real Time Scheduling: Fixed Priority Scheduling and its response time analysis

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Jane W.S. Liu, "*Real Time Systems*", Pearson Education, 1st Edition, 2006.
2. Rajib Mall, "*Real Time Systems-Theory and Practice*", Pearson Education India, 1st Edition, Nov. 2012.
3. C. M. Krishna, Kang G Shin, "*Real Time Systems*", McGraw-Hill Series, Dec. 1996.

REFERENCE BOOKS:

1. Phillip A. Laplante and Seppo J. Ovaska, "*Real-Time Systems Design and Analysis: Tools for the Practitioner*", Wiley-IEEE Press, 4th edition, Nov. 2011.
2. Hermann Kopetz, "*Real-Time Systems: Design Principles for Distributed Embedded Applications*", Springer; 2nd Edition, 2011.

VIDEO LECTURES:

1. [https:// onlinecourses.nptel.ac.in/noc21_cs98/](https://onlinecourses.nptel.ac.in/noc21_cs98/)
2. [https:// onlinecourses.nptel.ac.in/noc20_cs16/](https://onlinecourses.nptel.ac.in/noc20_cs16/)

Web Resources:

1. <http://rttime.felk.cvut.cz/scheduling-toolbox/manual/>
2. <https://www.it.uu.se/research/group/darts/times>
3. beru.univ-brest.fr/cheddar
4. www.cyphy.ece.mcgill.ca/Benchmark/Tools.html

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101036	SATELLITE COMMUNICATIONS	3	-	-	-	3
Pre-Requisite	Digital Communications					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Orbital Aspects of satellites, Satellite Subsystems, Satellite Link Design, Earth Station Technology. Multiple Access, Orbit Considerations, Global Positioning System and Navigation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Solve problems on satellite's orbital mechanics by analyzing various satellite orbits, launches, launch Vehicles, kepler's laws of planetary motion.
- CO2** Design efficient satellite uplink-downlink budgets for the given parameters by analyzing various subsystems of satellite such as Telemetry, Tracking and Command, Power, Altitude and Orbit control system.
- CO3** Apply appropriate multiple accessing techniques to enhance the performance of satellite systems such as FDMA, TDMA and CDMA techniques.
- CO4** Analyze various LEO, GEO & NGSO constellation satellites and their design aspects for various satellite applications.
- CO5** Analyze the principles of global positioning systems, GPS Receiver Operation and satellite based Navigation Services in India such as GAGAN (GPS Aided Geo Augmented Navigation) and IRNSS (Indian Regional Navigation Satellite System).

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	3	-	-	-	-	2	-	-	-	-	-	-	3
CO3	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3
CO4	3	3	1	-	-	2	-	-	-	-	-	-	-	-	3
CO5	3	3		-	-	2	2	-	-	-	-	-	-	-	3
Course Correlation Mapping	3	3	2	3	3	2	2	2	-	-	-	-	-	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION, ORBITAL MECHANICS AND LAUNCHERS (10 Periods)

Origin of Satellite Communications, Historical Background, Basic Concepts of Satellite Communications, Frequency Allocations for Satellite Services, Applications, Future Trends of Satellite. Orbital Mechanics, Kepler's Laws of planetary motion, Look Angle Determination, Orbital Perturbations, Orbit Determination, Launches and Launch Vehicles, Orbital Effects in Communication Systems Performance.

Module 2: SATELLITE SUBSYSTEMS AND SATELLITE LINK DESIGN (10 Periods)

Satellite Subsystems - Attitude and Orbital Control System, Telemetry, Tracking, Command and Monitoring, Power Systems, Communication Subsystems, Satellite Antennas, Equipment Reliability and Space Qualification. Basic Transmission Theory, System Noise Temperature and G/T ratio, Design of Uplink and Down Links, Design of Satellite Links for specified C/N.

Module 3: EARTH STATION TECHNOLOGY AND MULTIPLE ACCESS (09 Periods)

EARTH STATION: Introduction, Transmitters, Receivers, Antennas, Tracking Systems,

MULTIPLE ACCESS: Frequency Division Multiple Access (FDMA), Intermodulation, Calculation of C/N, Time Division Multiple Access (TDMA) Frame Structure, DAMA, Code Division Multiple Access (CDMA), Spread Spectrum Transmission and Reception

Module 4: LOW EARTH ORBIT AND NON-GEOSTATIONARY SATELLITE SYSTEMS (08 Periods)

Orbit Consideration, Coverage and Frequency Considerations, Delay and Throughput Considerations, System Considerations, Operational NGSO Constellation Designs and comparisons

Module 5: THE GLOBAL POSITIONING SYSTEM AND SATELLITE NAVIGATION (08 Periods)

THE GLOBAL POSITIONING SYSTEM: GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Navigation Message, GPS Signal Levels, Timing Accuracy, GPS Receiver Operation, GPS C/A Code Accuracy.

SATELLITE NAVIGATION: Introduction to Satellite based Navigation Services in India: GAGAN (GPS Aided Geo Augmented Navigation) and IRNSS (Indian Regional Navigation Satellite System)

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Determination of Orbital parameters for various satellite orbits.
2. Determination of look angles.
3. Design of uplink and downlink budget for specified C/N .
4. Estimation of BW, parameters for Multiple Access networks.
5. GPS position location and satellite Navigation services in India.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Timothy Pratt, Charles W Bostian and Jeremy E Allnutt, WSE, *Satellite Communications*, Wiley publications, 2nd Edition, 2003.
2. Dennis Roddy, *Satellite communications*, McGraw Hill, 4th Edition, 2009.

REFERENCE BOOKS:

1. Wilbur L. Pritchard, Henri G. Suyderhoud and Robert A. Nelson, *Satellite Communications Engineering*, Pearson Publications, 2nd Edition, 2008.
2. D.C. Agarwal, *Satellite communications*, Khanna Publications, 7th Edition, 2009.

VIDEO LECTURES:

1. <https://www.drishtiias.com/daily-updates/daily-news-analysis/isro-s-launch-vehicles>
2. <https://www.youtube.com/watch?v=qQYEL-gH7t4>
3. <https://www.youtube.com/watch?v=r-RxGQuZLio>
4. https://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navs services/gnss/gps/howitworks
5. <https://www.youtube.com/watch?v=1ga8Rjj8FcA>

Web Resources:

1. *Weblinks:* <https://www.isro.gov.in/applications/step-towards-initial-satellite-based-navigation-services-india-gagan-irnss>

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22EC101037	BROADBAND COMMUNICATIONS SYSTEMS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

Course Description: This course introduces cutting-edge technologies for broadband communication systems and allows to understand how various networking technologies will interoperate with existing protocols and systems to make robust, networked and fault-tolerant multimedia a reality.

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

- CO1** Comprehend basic components and architectures of broadband communication.
- CO2** Analyse broadband over different technologies.
- CO3** Discuss broadband over xDSL.
- CO4** Analyse Testing and Fault Tolerance of Broadband Systems.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	2	2	2	-	-	-	-	-	-	-	-	-	3
CO3	3	3	2	2	2	-	-	-	-	-	-	-	-	-	3
CO4	3	3	2	2	2	-	-	3	-	-	-	-	-	-	3
Course Correlation Mapping	3	3	2	2	2	-	-	3	-	-	-	-	-	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO BROADBAND COMMUNICATION (10 Periods)

Components of Broadband Communication Systems, Cable Broadband Data Network Architecture, Importance of Broadband Network Architectures; Intranet and Extranet – Technologies, Applications and Design Issues.

Module 2: NETWORKING TECHNOLOGIES (10 Periods)

X.25 Technology – Devices, Protocol Suite; Frame Relay - Technology, Protocol Data Unit, Frame Relay versus X.25; Traditional SONET - Advantages and Disadvantages; Next Generation SONET (NGS) – Platform, Requirements, Standards and Advantages; VPN – Types, General Architecture, Security issues, Standards, Advantages and Disadvantages.

Module 3: ISDN, BISDN and ATM (10 Periods)

ISDN – Devices, Interfaces, Services, Architecture, Standards and Applications; BISDN – Interfaces, Terminals, Protocol Architecture and Applications; ATM - Technology, Cell, Layered Architecture, Network, Standards, Applications, Traffic Management, Advantages and Disadvantages.

Module 4: BROADBAND OVER XDSL (6 Periods)

DSL System Technology, DMT Line Code for ADSL, DMT Scheme – Benefits and Disadvantages, HDSL – Basic Characteristics and Applications, SDSL, SHDSL, RADSL, IDSL, CDSL, VDSL, Future of DSL Systems and Broadband Systems, xDSL Standards.

Module 5: BROADBAND NETWORK TESTING AND FAULT TOLERANCE (9 Periods)

Broadband Fixed Wireless Access Networks, Wireline Broadband Technology Testbed; Fault Tolerant Operations – Broadband LANs, Wireless Broadband Networks; Wireless Networks Fault Tolerance, Fault Tolerant Design for Broadband Systems.

Total Periods: 45

EXPERIENTIAL LEARNING

1. *Demonstrate an experiment to understand interconnection of various cables used in broadband communication.*
2. *Discuss a case study of broadband service regulations for maintaining QoS by telecom regulatory bodies such as TRAI.*

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Introduction to Broadband Communication systems, Cajetan M. Akujuobi, Matthew N.O. Sadiku, CRC press, 2007
2. Sumit Kaseria and Pankaj Sethi, "ATM Networks: Concepts and Protocols" Tata McGraw – Hill Publishing Company Limited, New Delhi (2001)

REFERENCE BOOKS:

1. Leon Gracia and Widjaja, "Communication Networks", Tata McGraw Hill, 2008.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/117/105/117105148/>

Web Resources:

1. <https://www.ee.iitb.ac.in/~sarva/courses/EE706/2012/EE706LecNotes.pdf>

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101038	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides theoretical, analytical and practical information required to understand EMI/C with respect to aspects viz. various sources of EMI, their characterizations and measurement procedures, tools and techniques for achieving electromagnetic compatibility.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze the concepts of EMI/C and non-ideal behaviour of components.
- CO2** Apply standards and regulations for measuring radiated and conducted interferences in open area test sites.
- CO3** Apply the practices of grounding, shielding and electrical bonding to avoid or reduce EMI/C.
- CO4** Analyze various EMC filters, connectors and components.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	2	2	2	-	-	3	-	-	-	-	-	-	3
CO3	3	3	2	2	2	-	-	-	-	-	-	-	-	-	3
CO4	3	3	2	2	2	-	-	-	-	-	-	-	-	-	3
Course Correlation Mapping	3	3	2	2	2	-	-	3	-	-	-	-	-	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO EMI/C AND COMPONENTS NON-IDEALITY (10 Periods)

Introduction to EMI/C: Concepts and Definition of EMI and EMC, Natural and nuclear EMI sources. Radiated and Conducted Emissions.

Components non-ideality: Wires, printed circuit board (PCB) lands, effect of component leads, resistors, capacitors, inductors.

Module 2: EMI/EMC STANDARDS AND OPEN AREA TEST SITES (08 Periods)

EMI/EMC Standards: Introduction, Standards for EMI/EMC, MIL STD - 461/462, IEEE/CIS Standards, FCC regulations.

Open Area Test Sites: open area test site measurements, Measurement precautions, open area test site, Terrain Roughness, Measurement of test site imperfections, Antenna factor measurement, Measurement errors.

Module 3: RADIATED INTERFERENCE AND CONDUCTED INTERFERENCE MEASUREMENTS (09 Periods)

Radiated Interference measurements: Anechoic chamber, Transverse Electromagnetic Cell, Reverberating chamber, Basic overview of GTEM Cell, Comparison of test facilities.

Conducted Interference measurements- Characterization of conduction currents/voltages, Conducted EM noise on power supply lines, Immunity to conducted EMI, Detectors and measurement.

Module 4: GROUNDING, SHIELDING AND BONDING (09 Periods)

Grounding - Principles and Practice of Earthing, Precautions in Earthing, Measurements of ground resistance, Cable shield Grounding.

Shielding- Shielding Theory, Shielding Materials, Shielding Integrity at discontinuities, Conductive coatings, Cable shielding.

Electrical Bonding.

Module 5: EMC FILTERS, CONNECTORS AND COMPONENTS (09 Periods)

Characteristics and Types of Filters - Impedance Mismatch Effects, Lumped Element Low Pass Filter, High Pass Filter, Band Pass Filter, Band Reject filter. Power Line filter Design - Common mode filter, Differential mode filter, Combined CM and DM filter.

EMC Connectors - Pigtail Effect.

EMC Components – EMC Gaskets, Isolation transformers. Opto Isolators.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Demonstrate an experiment to understand how an electrically conductive surface in physical contact with a charged dielectric can be inconspicuously charged to very high voltages.
2. Demonstrate an experiment to understand the concepts of self and mutual inductance and capacitance.
3. Demonstrate an experiment to understand the mechanism of crosstalk in cables.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Clayton R. Paul, "Introduction to Electromagnetic Compatibility", Wiley Student Edition, 2018.
2. V. Prasad Kodali, "Engineering Electromagnetic Compatibility", Wiley-IEEE Press, 2nd Edition, 2001.

REFERENCE BOOKS:

1. Christos Christopoulos, "Principles and Techniques of Electromagnetic Compatibility", CRC Press, 3rd edition, 2022.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/108106138>
2. <https://www.coursera.org/lecture/inputfilterdesign/introduction-to-electromagnetic-compatibility-emc-and-interference-emi-76203>

Web Resources:

1. <https://www.egr.msu.edu/emrg/electromagnetic-compatibility-emc-course-notes>
2. http://wireless.ictp.it/school_2004/lectures/struzak/Introd_to_EMC.pdf
3. <https://www.montana.edu/tjkaiser/ee335/notes/EE335-29-EMI.pdf>

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101039	WIRELESS SENSOR NETWORKS	3	-	-	-	3
Pre-Requisite	Computer Networks					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Overview of WSN, Network Architecture, WSN Infrastructure Establishment, Networking of Sensor nodes (MAC protocols, Routing Protocols, Congestion Control and Flow control).

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

- CO1** Understand the fundamentals of wireless sensor networks and their application to critical real-time scenarios, as well as the enabling technologies and network architecture for wireless sensor networks.
- CO2** Examine several Medium Access Control (MAC) protocols regulating the number of nodes accessing a shared communication medium.
- CO3** Analyse the algorithms used for Routing, flow control and congestion management.
- CO4** To understand how Time synchronization, localization and positioning, and topology control can improve the operational aspects of a network.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	-	-	-	-	2	-
CO2	3	3	3	2	2	-	1	-	-	-	-	-	-	3	-
CO3	3	3	2	2	2	-	2	-	-	-	-	-	-	3	-
CO4	3	2	3	3	-	-	1	-	-	-	-	-	-	2	-
Course Correlation Mapping	3	3	2	2	2		1						-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO WIRELESS SENSOR NETWORKS (10 Periods)

Advantages of sensor networks, Application examples, Challenges for WSNs, Enabling technologies for wireless sensor networks, Single-Node architecture-Hardware Components, Energy consumption of sensor nodes, Operating systems and execution environments Some examples of sensor nodes.

Module 2: NETWORK ARCHITECTURE (08 Periods)

Sensor network scenarios, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSN, Gateway concepts.

Module 3: MEDIUM ACCESS CONTROL (09 Periods)

Fundamentals of (wireless) MAC protocols, Low duty cycle protocols and wakeup concepts, Contention-based protocols, Schedule-based protocols, IEEE 802.15.4 MAC protocol.

Module 4: WSN INFRASTRUCTURE ESTABLISHMENT (08 Periods)

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

Module 5: ROUTING, CONGESTION CONTROL AND RATE CONTROL (10 Periods)

The many faces of forwarding and routing, Gossiping and agent-based unicast forwarding, Energy efficient routing, Geographic routing, Data-centric routing, Data aggregation, Congestion and flow control- Congestion situations in sensor networks, Mechanisms for congestion detection and handling, Protocols with rate control.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Design an application scenario where wireless sensor networks can be utilized to monitor environmental conditions in a forest. Identify the specific challenges that may arise in this scenario and propose suitable enabling technologies to overcome them.
2. Compare and contrast contention-based and schedule-based MAC protocols used in wireless sensor networks. Discuss their advantages, disadvantages, and specific use cases for each protocol type.
3. Implement a simple topology control algorithm for a wireless sensor network. Consider a scenario where nodes need to maintain connectivity while minimizing energy consumption. Evaluate the effectiveness of your algorithm in terms of network connectivity and energy efficiency.
4. Develop a routing protocol for data aggregation in a wireless sensor network. Consider a scenario where sensor nodes collect data from different locations and need to transmit aggregated data to a base station. Assess the performance of your routing protocol in terms of data delivery latency and energy consumption.
5. Investigate congestion detection and handling mechanisms in wireless sensor networks. Implement a congestion detection algorithm and evaluate its effectiveness in detecting and mitigating congestion situations. Compare the performance of different congestion

control mechanisms in terms of network throughput and packet loss.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, 2005.
2. Zhao and L. Guibas, "Wireless Sensor Networks", Morgan Kaufmann, San Francisco, 2004.

REFERENCE BOOKS:

1. C. S. Raghavendra, K.M. Shivalingam and T. Znati, "Wireless Sensor Networks", Springer, New York, 2004.
2. Anna Hac, "Wireless Sensor Network Designs", John Wiley & Sons, 2004.

VIDEO LECTURES:

1. https://youtu.be/GUSrkWJ_Z2g
2. <https://youtu.be/OaUE4otTsuc>

Web Resources:

1. <https://mrjacse.files.wordpress.com/2014/09/wireless-sensor-networks.pdf>
2. https://oms.bdu.ac.in/ec/admin/contents/1_P16CS42_2020052206181224.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101136	ADVANCED COMPUTATIONAL ELECTROMAGNETICS	3	-	-	-	3
Pre-Requisite	-Electromagnetic Waves and Transmission Lines					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course introduces the modern computational electromagnetics required to understand, develop, and design various engineering applications involving electromagnetic fields and to lay the foundations of electromagnetism and its practice in modern communications such as wireless, guided wave principles such as fiber optics and electronic electromagnetic structures.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** To understand the concept of electric and magnetic field in terms of mathematical descriptions.
- CO2.** To understand the phenomena of electromagnetic wave and its various parameters.
- CO3.** To apply the mathematical concepts for deriving the wave parameters and applications.
- CO4.** To apply and understand the electromagnetic concepts with numerical formulation.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	3	-	-	-	-	-	3	3	-	-	2	-	-
CO4	3	3	3	3	2	-	-	-	3	3	-	-	3	3	-
Course Correlation Mapping	3	3	2	-	-	-	-	-	-	-	-	2	2	-	-

Correlation Levels:

3: High;

2: Medium;

1: Low

COURSE CONTENT

Module 1: OVERVIEW OF ELECTROMAGNETIC SYSTEMS

(11 Periods)

Elements of vector calculus – scalar field – line and surface integrals – divergence and curl of vector fields – conservative field, stokes theorem- Laplacian – Electric field potential – Gauss's Law, potential – electric field and potential – potential energy- coefficients of potential and capacitance – Poisson and Laplace equations – solutions of Laplace equations – Dielectrics.

Module 2: MAGNETOSTATICS-I

(09 Periods)

Equation of continuity – energy density – pointing theorem- force between current loop – magnetic vector potential – boundary conditions – Time varying field – Faraday's law and induction.

Module 3: MAGNETOSTATICS-II

(10Periods)

Maxwell's equations and conservation of laws – angular momentum conservation – electromagnetic waves- – propagation of electromagnetic waves in different mediums- TE, TM and hybrid modes – introduction to waveguide structures.

Module 4: HISTORICAL DEVELOPMENT OF COMPUTATIONAL METHODS (08 Periods)

Introduction to numerical methods – boundary conditions – error computation – method of curvilinear squares – method of moments – finite element method – Monte Carlo method.

Module 5: VARIATION METHOD

(07 Periods)

Background, Calculus of Variations, Rayleigh-Ritz Method, Method of Weighted Residuals, Galerkin Method.

Total Periods: 45

RESOURCES

TEXT BOOKS:

1. Matthew N.O. Sadiku, "Numerical Techniques in Electromagnetics with MATLAB", CRC Press, 2009, eISBN: 978-1-4398-8304-4.
2. Davidson, D.B, Computational Electromagnetics for RF and Microwave Engineering, Cambridge University Press, 2005.

REFERENCE BOOKS:

1. Karl E. Lonngren, Sava V. Savov, Randy J. Jost, "Fundamentals of Electromagnetics with MATLAB", SciTech Publishing, Inc., 2007, Second Edition.
2. Jaan Kiusalaas, "Numerical Methods in Engineering with Python 3", Cambridge University Press, 2013, ISBN 978-1-107-0338.

Web Resources:

1. <https://www.ee.iitm.ac.in/~uday/2019a-EE6506/index.html>

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=Lc1kZwJXeNw>
2. https://www.youtube.com/watch?v=QnVN_LAPQc&list=PLHj96QRJ0kOhWO_7ji_sQHN_MwWRWS_9JV

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC103040	MACHINE LEARNING FOR SIGNAL PROCESSING	3	-	-	4	4

Pre-Requisite Digital Signal Processing

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course covers signal processing and statistical machine learning based on mathematical foundations, discrete signals (sampling, quantization, and coding), linear Gaussian systems, nonlinear and non-Gaussian signal processing, and statistical machine learning algorithms

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Implement efficient algorithms for data compression, information theory, and statistical machine learning by applying mathematical foundations
- CO2** Apply signal processing techniques to analyze and manipulate discrete signals.
- CO3** Apply linear and non-linear Gaussian systems and signal processing techniques to solve complex engineering problems
- CO4** Analyze and interpret the results of statistical machine learning algorithms for signal processing applications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	2	3	-	-	-	-	-	-	-	-	-	3
CO2	1	2	-	3	3	-	-	-	-	-	-	-	-	-	3
CO3	1	-	2	2	3	-	-	-	-	-	-	-	-	-	3
CO4	-	2	-	-	3	1	-	-	-	-	-	-	-	-	3
Course Correlation Mapping	1	1	1	2	3	1	-	-	-	-	-	-	-	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: MATHEMATICAL FOUNDATIONS (09 Periods)

Vector Spaces, Probability and stochastic process, Data compression and information, computational complexity

Module 2: DISCRETE SIGNALS: SAMPLING, QUANTIZATION AND CODING (09 Periods)

Discrete-time sampling, Bandlimited sampling, Uniform bandlimited sampling, Generalized uniform sampling, Quantization, Rate distortion theory, Lloyd-Max and entropy-constrained quantizer design, Statistical quantization and dithering, Vector quantization.

Module 3: LINEAR GAUSSIAN SYSTEMS AND SIGNAL PROCESSING (09 Periods)

LTI systems, LTI signal processing, Kalman filter, Time-varying Linear systems.

Module 4: NONLINEAR AND NON-GAUSSIAN SIGNAL PROCESSING (09 Periods)

Running windows filters, Recursive filtering, Global nonlinear filtering, Hidden Markov Models

Module 5: PULSE MODULATION & DEMODULATION (09 Periods)

QDA, LDA, SVM, Regression, PCA

Total Periods: 45

EXPERIENTIAL LEARNING

1. Explore real-world applications of vector spaces, such as image or audio processing. Use vector space operations to manipulate and analyze images or audio signals. Investigate the impact of different vector space transformations on the processed data.
2. Conduct probability experiments using physical or virtual dice, coins, or cards. Compare the experimental probabilities with theoretical probabilities and analyze the relationship between the number of trials and the convergence of the experimental results.
3. Explore the concept of entropy in information theory. Calculate the entropy of different data sources and analyze its relationship with the compression potential of the data. Experiment with various compression techniques and compare their performance in terms of compression ratio and fidelity of the reconstructed data.
4. Analyze the time complexity of sorting algorithms (e.g., bubble sort, quicksort) by measuring their execution times on different input sizes. Compare and contrast the efficiency of different algorithms and discuss their best and worst-case scenarios.
5. Compare the performance of vector quantization with other compression techniques, such as transform-based compression (e.g., JPEG for images) or perceptual coding (e.g., MP3 for audio). Analyze their trade-offs in terms of compression efficiency and computational complexity.

PROJECT BASED LEARNING

1. Design and implement a vector quantization algorithm for image compression.
2. Develop a Kalman filtering algorithm for object tracking in a video sequence.
3. Build a hidden Markov model for speech recognition.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Little, Max A. Machine learning for signal processing: data science, algorithms, and computational statistics. Oxford University Press, 2019

REFERENCE BOOKS:

1. Vetterli M, Kovačević J, Goyal VK. Foundations of signal processing. Cambridge University Press; 2014

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=mexN6d8QF9o>
2. https://onlinecourses.nptel.ac.in/noc21_ee33/preview
3. <https://archive.nptel.ac.in/courses/108/108/108108148/>

Web Resources:

1. <https://towardsdatascience.com/machine-learning-and-signal-processing-103281d27c4b>
2. http://home.iitk.ac.in/~vipular/stuff/2019_MLSP.html

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101041	ADAPTIVE SIGNAL PROCESSING	3	-	-	-	3
Pre-Requisite	Digital Signal Processing					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Development of adaptive filter theory; Method of steepest descent; Least-Mean-Square Algorithm and recursive least square algorithm; Kalman filtering algorithm; order-recursive adaptive filters.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

- CO1** Analyze Error- Performance Surface of linear optimum and adaptive filters.
- CO2** Analyze Steepest-Descent Algorithm to assess the error performance of the Wiener filters.
- CO3** Apply LMS and RLS Algorithms for error minimization in noise cancellation.
- CO4** Apply kalman and non Linear adaptive filters in the fields of signal processing, communications, Bio-Medical, Instrumentation and control engineering for error optimization.
- CO5** Analyze order recursive adaptive filters to estimate mean square error.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	2	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	-	2	-	-	-	-	-	-	-	-	-	-	3
CO3	3	2	-	2	3	1	1	-	-	-	-	-	-	-	3
CO4	3	2	-	2	3	1	1	-	-	-	-	-	-	-	3
CO5	3	3	-	2	-	-	-	-	-	-	-	-	-	-	3
Course Correlation Mapping	3	3	-	2	3	1	1	-	3	3	-	-	-	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ADAPTIVE SYSTEMS & (10 Periods) DEVELOPMENT OF ADAPTIVE FILTER THEORY

Eigen Value Problem, Properties of eigen values and eigen vectors (proof is not required), Eigen Filters, eigen Value computations. The Filtering problem, Linear Optimum Filters, Adaptive Filters, Linear Filter structures, Approaches to the development of linear adaptive filters. Linear Optimum Filtering: Statement of the problem, Principle of Orthogonality, Minimum Mean Square Error, Wiener-Hopf equations, Error-Performance Surface

Module 2: METHOD OF STEEPEST DESCENT (07 Periods)

Basic Idea of Steepest-Descent Algorithm, Steepest-Descent Algorithm applied to the Wiener Filter, Stability of the Steepest-Descent Algorithm, Examination of the transient behavior of the Steepest-Descent Algorithm, the Steepest-Descent Algorithm as a deterministic search method, Virtue and limitation of the Steepest-Descent Algorithm.

Module 3: LEAST-MEAN-SQUARE ADAPTIVE FILTERS (10 Periods) AND RECURSIVE LEAST-SQUARES ADAPTIVE FILTERS

Overview of the structure and operation of the Least-Mean-Square Algorithm, Least-Mean-Square adaptation Algorithm, Applications-Adaptive Noise cancelling Applied to a Sinusoidal Interference and Adaptive Beam forming, Comparison of the LMS Algorithm with Steepest-Descent Algorithm.

Matrix Inversion lemma, exponentially weighted recursive least square algorithm, update recursion for the sum of weighted error squares, Single-Weight Adaptive Noise Canceller convergence analysis of RLS Algorithm

Module 4: KALMAN FILTERING & NON LINEAR ADAPTIVE (10 Periods) FILTERING

Recursive Minimum Mean-Square Estimation for Scalar Random variables, Statement of Kalman filtering problem, The Innovations Process, estimation of the state using the Innovations Process, Filtering, Initial conditions, Extended Kalman filter.

An overview of the Blind Deconvolution problem, Bussgang Algorithm for blind Equalization.

Module 5: ORDER-RECURSIVE ADAPTIVE FILTERS (08 Periods)

Gradient-Adaptive Lattice Filter, order-recursive adaptive filters using least square estimation, adaptive forward linear prediction, adaptive backward linear prediction, conversion factor, least-square lattice predictor, angle-normalized estimation errors, first order state space models for lattice filtering.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Implement the Wiener filter algorithm for a given signal and noise scenario. Evaluate the performance of the filter by calculating the mean square error between the filtered output and the desired signal.
2. Compare the stability and convergence characteristics of the steepest descent algorithm and the least-mean-square (LMS) algorithm. Apply both algorithms to a specific adaptive filtering problem and analyze their performance.
3. Design an adaptive noise cancellation system using the LMS algorithm to remove sinusoidal interference from a corrupted signal. Validate the effectiveness of the algorithm by measuring the signal-to-noise ratio improvement after cancellation.
4. Implement the recursive least squares (RLS) algorithm for adaptive filtering. Apply the RLS algorithm to a system identification problem and analyze its convergence behavior and estimation accuracy.
5. Develop an extended Kalman filter for tracking the state of a dynamic system given noisy measurements. Implement the filter and evaluate its performance in terms of state estimation accuracy and robustness to measurement noise.

RESOURCES

TEXT BOOKS:

1. Simon Haykin, *"Adaptive Filter Theory"*, Pearson Education, 5th edition, 2014

REFERENCE BOOKS:

1. Bernard Widrow, Samuel D. Stearns, *"Adaptive Signal Processing"*, Pearson Education, 1st edition, 2002.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/117/105/117105075/>
2. <http://engineeringvideolectures.com/course/518>

Web Resources:

1. <https://www.ee.iitm.ac.in/~skrishna/ee6110/>

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC102118	BIOMEDICAL SIGNAL PROCESSING	3	-	2	-	4
Pre-Requisite	Digital Signal processing					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course covers biomedical signal processing methodologies. Bioelectric signals characteristics are studied their clinical significance is reviewed. Methods for processing and interpreting biological signals are often derived from a modelling viewpoint that is based on statistical signal descriptions. The objectives of signal processing technologies range from noise and artefact reduction to the extraction of clinically relevant characteristics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze the nature of biomedical signals and related concepts.
- CO2** Design various time domain filtering techniques for the removal of artefact from biomedical signal.
- CO3** Apply signal compression techniques on biomedical signals.
- CO4** Elucidate the fundamental principles in the analysis and design of filters, power spectral densities and estimation of ECG.
- CO5** Identify event detection and analyse EEG signals by suitable estimation methods.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	2	2	3	2	-	-	-	-	-	-	-	-	-	-	3
CO3	1	2	-	2	3	-	-	-	-	-	-	-	-	-	3
CO4	1	2	-	2	3	-	-	-	-	-	-	-	-	-	3
CO5	1	2	2	2	3	-	-	-	-	-	-	-	-	-	3
Course Correlation Mapping	3	3	3	2	3	-	-	-	-	-	-	-	-	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO BIOMEDICAL SIGNALS

(08 Periods)

Computers in medicine, Human anatomy and physiology, Cell structure, Origin of bioelectric potential, Biomedical signals, The Brain and its potentials. Electrophysiological origin of brain waves. EEG signal and its characteristic- ECG signal origin and characteristics.

Module 2: ADAPTIVE INTERFERENCE / NOISE CANCELLATION

(09 Periods)

Types of noise in bio signals, Digital filters – IIR and FIR – Notch filters – Optimal and adaptive filters. Wiener filters – steepest descent algorithm – LMS adaptive algorithm – Adaptive noise canceller – cancellation of 50 Hz signal in ECG – Cancellation of maternal ECG in fetal electrocardiography.

Module 3: DATA COMPRESSION TECHNIQUES

(09 Periods)

Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding, data reduction algorithms– Fourier transform, correlation, convolution, power spectrum estimation.

Module 4: CARDIOLOGICAL SIGNAL PROCESSING

(09 Periods)

Cardiological signal processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), analog filters, ECG amplifier, and QRS detector, power spectrum of the ECG, QRS detection algorithm.

Module 5: NEUROLOGICAL SIGNAL PROCESSING

(09 Periods)

Brain and its potentials, Electrophysiological origin of Brain waves, EEG signal and its characteristics, EEG analysis, Autoregressive (AR) method, Recursive Estimation of AR parameters.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Detection of QRS complex in ECG
2. Spectral analysis of EEG signals
3. Manipulations on images (addition, subtraction, division, logical).
4. Computation of Mean, Standard Deviation, Correlation coefficient of the given Image.
5. Image enhancement techniques on 8-bit image:
 - A) Brightness improvement
 - B) Brightness reduction
 - C) Thresholding
 - D) Negative of an image
 - E) Log transformation
 - F) Power Law transformation
6. Read an image, plot its histogram then do histogram equalization. Comment about the result.
7. Read an image and apply

- 1) Gaussian 3x3 mask for blurring
 - 2) High pass filter mask with different masks
 - 3) Laplacian operator with centre value positive and negative
 - 4) High boost filtering.
8. FFTs, Image filtering: smoothing and sharpening
 9. Implement inverse filter and wiener filter over image and comment on them.
 10. Determination of edge detection using operators.
 11. Write a program for erosion and dilation, opening & closing using inbuilt and without inbuilt function.

RESOURCES

TEXT BOOKS:

1. D. C Reddy, "Biomedical Signal Processing, Principles and Techniques", Tata McGraw Hill Publishing Company Limited, First Edition, 2005.
2. Willis J Tompkins, "Biomedical Digital Signal Processing", Prentice Hall India Private Limited, First Edition, 2006.

REFERENCE BOOKS:

1. Rangayyan, R.M., 2015. Biomedical signal analysis (Vol. 33). John Wiley & Sons.
2. John G Proakis, Dimitris and G. Manolakis, "Digital Signal Processing Principles algorithms, applications" PHI Third Edition. 2006

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=ezfPI8kUdbg&list=PLVDPthxoc3INzu07X-CbQWPZNMboPXKtb>
2. https://www.youtube.com/watch?v=s17ypoDJ1y8&list=PLeefXVKiX48qqPwldtml_rzjCqKBK oRFa
3. <https://www.youtube.com/watch?v=XKoGk99ktf8>

Web Resources:

1. https://www.google.com/search?q=biomedical+signal+processing+course+ppt&rlz=1C1C HWL_enIN841IN841&sxsrf=AJOqlzW5PdoX89QTpFdhXz5gLiCEX6_JbQ:1677303758555&e =zp_5Y_zFIb6G4-EPsM-tkAo&start=10&sa=N&ved=2ahUKEwj85NW1-6_9AhU-wzgGHbBnC6IQ8tMDegQIAxAE&biw=1366&bih=625&dpr=1#fpstate=ive&vld=cid:3e261a 52,vid:I9GBf0sTk4s
2. <https://www.mathworks.com/matlabcentral/fileexchange/55112-eeg-analysis-and-classification>

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101042	IoT SYSTEM ARCHITECTURE AND PROTOCOLS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course deals with An Architectural Overview of M2M and IoT Technology fundamentals, IoT Reference Architecture and Real-World Design Constraints, IoT Data Link Layer & Network Layer Protocols, Session Layer Protocols and Application Layer Protocols, Security in IoT Protocols and Case studies.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Demonstrate knowledge on architecture and technology of M2M to IoT.
- C02** Demonstrate knowledge on IoT architectures and identify design constraints of IoT.
- C03** Select suitable protocols of data link and network layer protocols for different applications of IoT.
- C04** Identify appropriate protocols of session and application layer protocols for different applications of IoT.
- C05** Evaluate security issues and challenges during implementation of real world models.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	2	3	-	-	-	-	-	-	-	-	-	-	-	-	3
C02	2	2	3	2	-	-	-	-	-	-	-	-	-	-	3
C03	2	2	3	2	2	2	-	-	-	-	-	-	-	-	3
C04	2	2	3	2	-	2	-	-	-	-	-	-	-	-	3
C05	2	2	3	2	2	2	1	1	-	-	-	-	-	-	3
Course Correlation Mapping	2	2	3	2	2	2	1	1	-	-	-	-	-	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: M2M TO IOT - AN ARCHITECTURAL OVERVIEW AND M2M AND IOT TECHNOLOGY FUNDAMENTALS **(09 Periods)**

M2M to IoT an Architectural Overview: Building architecture, Main design principles and needed capabilities, An IoT architecture outline, Standards considerations.

M2M and IoT Technology Fundamentals: Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a service (XaaS), M2M and IoT analytics, Knowledge management.

Module 2: IOT ARCHITECTURE STATE OF THE ART, IOT REFERENCE ARCHITECTURE AND REAL-WORLD DESIGN CONSTRAINTS **(09 Periods)**

IoT Architecture State of the Art: Introduction, State of the art, Architecture Reference Model- Reference model and architecture, IoT reference model.

IoT Reference Architecture: Functional view, Information View, Deployment and operational view, Other relevant architectural views.

Real-World Design Constraints: Technical design constraints hardware is popular again, Data representation and visualization, Interaction and remote control.

Module 3: IOT DATA LINK LAYER & NETWORK LAYER PROTOCOLS **(09 Periods)**

IoT Data Link Layer: IEEE 802.15.4, IEEE 802.11ah, LoRaWAN, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy.

Network Layer Encapsulation Protocols: 6LoWPAN, 6TiSCH, 6Lo.

Network Layer Routing Protocols: RPL, CORPL, CARP.

Module 4: SESSION LAYER PROTOCOLS AND APPLICATION LAYER PROTOCOLS **(09 Periods)**

Session Layer Protocols: MQTT, AMQP, CoAP, XMPP, DDS. Application Layer Protocols: SCADA, Generic Web-Based Protocol.

Module 5: SECURITY IN IOT PROTOCOLS AND CASE STUDIES **(09 Periods)**

Security in IoT protocols: MAC 802.15.4, 6LoWPAN, RPL, IoT Challenges.

Case Studies: Smart Metering, Smart House, Smart Cities.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Discuss in detail about IoT Standard for Interoperable and Scalable Systems
2. Identify the programming and embedded intelligence required while developing Realworld applications by identifying the real world design constraints.
3. What are the advantages of LoRaWAN? Identify one real-time application which is based on LoRaWAN that is been deployed and discuss in detail.
4. Develop a program using MQTT communication protocol with the ESP32 to publish messages and subscribe to topics.
5. Compare Smart energy meter with conventional meter by drawing the architectural block diagrams. Identify the pros and cons of the both the systems and suggest solutions to

overcome the drawbacks.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Jan Holler and Vlasios Tsiatsis, From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence, Elsevier Ltd., 2014.
2. David Hanes and Gonzalo Salgueiro, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, 2017.

REFERENCE BOOKS:

1. Peter Waher, Learning Internet of Things, PACKT publishing, BIRMINGHAM –MUMBAI.
2. Olivier Hersent and David Boswarthick, The Internet of Things Key Applications and Protocols, John Wiley & Sons Ltd Publication, 2012.
3. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=gl7Jfhy3J0U>
2. https://www.youtube.com/watch?v=39pE_SVUD04&list=PLgMDNELGJ1CaBrefq-0eYatfOnoncW0y-&index=4
3. <https://www.youtube.com/watch?v=8Eso5VnT35E>
4. <https://www.youtube.com/watch?v=WCfc-itJvSI>

Web Resources:

1. <https://iotnotesbyparita.wordpress.com/iot-architecture-state-of-the-art/>
2. <https://www.ibm.com/cloud/architecture/architectures/iotArchitecture/reference-architecture/>
3. <https://developer.ibm.com/articles/iot-lp101-connectivity-network-protocols/>
4. https://www.cisco.com/en/US/docs/net_mgmt/wan_access_performance_management_system/2.0/client/user/guide/ecap-app.html#:~:text=Encapsula%E2%84%A2on%20protocols%20connect%20the%20layer,set%20the%20ASE's%20encapsula%E2%84%A2on%20protocol.
5. <https://onomondo.com/resource-hub/iot-networking-protocols-overview-and-advantages/>
6. <https://techvidvan.com/tutorials/iot-session-layer-protocols/>
7. <https://www.dhitechnologies.org/top-5-security-protocols-for-the-internet-of-things/>

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101043	SMART IoT APPLICATIONS	3	-	-	-	3
Pre-Requisite	IoT SYSTEM ARCHITECTURE AND PROTOCOLS					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course deals with the concepts of IoT and its applications, market perspective of IoT, its vision from a global context, development of smart applications based on the requirements of the users and industry.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyse various IoT applications based on the users requirements, security, energy usage and standards.
- CO2** Develop IoT architectures for M2M to IoT by considering the standards.
- CO3** Design and develop IoT based applications for domestic and commercial purpose that create value addition to the products developed or produced by the industries.
- CO4** Analyse various security threats and develop smart, secure platforms for deployment in smart cities and smart healthcare

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	-	1	2	2	-	-	1	1	-	-	-	-	3
CO2	1	2	3	2	2	2	1	1	1	1	-	-	-	-	3
CO3	1	-	3	2	2	2	2	1	1	1	-	-	-	-	3
CO4	1	3	2	2	2	2	1	2	1	-	-	-	-	-	3
CO5	1	3	3	2	2	2	1	1	1	1	-	-	-	-	3
Course Correlation Mapping	1	3	-	1	2	2	-	-	1	1	-	-	-	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: IoT & WEB TECHNOLOGY

(09 Periods)

The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

Module 2: M2M to IoT

(10 Periods)

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module 3: IoT ARCHITECTURE

(10 Periods)

IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, **IoT Reference Architecture**- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module 4: IoT APPLICATIONS FOR VALUE CREATIONS

(08 Periods)

Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, ValueCreation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and GasIndustry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Module 5: INTERNET OF THINGS PRIVACY, SECURITY AND GOVERNANCE

(08 Periods)

Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.

Total Periods: 45

EXPERIENTIAL LEARNING

1. List and summarize few Eclipse IoT Projects. Develop one IoT project.
2. Sketch the architecture of IoT Toolkit and explain each entity in brief.
3. Demonstrate a smart object API gateway service reference implementation in IoTtoolkit.
4. Write and explain working of an HTTP- to-CoAP semantic mapping proxy in IoTtoolkit.
5. Describe gateway-as-a-service deployment in IoT toolkit.
6. Explain application framework and embedded software agents for IoT toolkit.
7. Demonstrate the working of python program using Raspberry Pi.

8. Connect Raspberry Pi with your existing system components.
9. How do you connect and display your Raspberry Pi on a Monitor Or TV?
10. Create any circuitry project using Arduino.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. A. Bahga, V. Madiseti; Internet of Things: A Hands-on Approach, 1st Edition, Universities Press (India) Pvt. Ltd., 2015.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
3. Cuno Pfister, Getting Started with the Internet of Things, O'Reilly Media, 2011, ISBN: 978-1-4493-9357-1

REFERENCE BOOKS:

1. D. Hanes, G. Salgueiro, P. Grossetete, R. Barton, J. Henry; IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 1st Edition, Pearson India Pvt. Ltd., 2018.
2. Y. Kanetkar, S. Korde; 21 Internet of Things (IOT) Experiments: Learn IoT, the programmer's way, 1st Edition, BPB Publications, 2018.

VIDEO LECTURES:

1. <https://in.coursera.org/learn/iot-architecture>
2. <https://www.iitg.ac.in/cse/course-list.php?id=CS578>
3. <https://nptel.ac.in/courses/108108123>

Web Resources:

1. <https://github.com/connectIOT/iottoolkit>
2. <https://www.arduino.cc/>
3. <http://www.zettajs.org/>
4. Contiki (Open source IoT operating system)
5. Arduino (open source IoT project)
6. IoT Toolkit (smart object API gateway service reference implementation)
7. Zetta (Based on Node.js, Zetta can create IoT servers that link to various devices and sensors)
8. <https://www.mendix.com/building-iot-applications/>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101701	AI IN HEALTHCARE	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of Artificial Intelligence (AI) in Healthcare; The Present State and Future of AI in Healthcare Specialties; The Role of Major Corporations in AI in Healthcare; Applications of AI in Healthcare.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand the fundamental concepts of AI in Healthcare sector.
- CO2** Analyse the present state and future of AI in Healthcare specialties for different scenarios.
- CO3** Apply design concepts and metrics for AI in Healthcare.
- CO4** Demonstrate basic concepts and terminologies of future applications of Healthcare in AI.
- CO5** Develop AI applications through AI techniques for healthcare

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	-	-	-	-	-	-	-
CO2	2	3	-	2	-	2	2	-	-	-	-	-
CO3	2	-	2	2	-	-	-	-	-	-	-	-
CO4	2	-	-	-	2	2	-	-	-	-	-	-
CO5			3									
Course Correlation Mapping	2	-	3	2	2	2	2	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ARTIFICIAL INTELLIGENCE IN HEALTHCARE **(08 Periods)**

Introduction to AI in Healthcare, Benefits & Risks, AI in the health sector, AI versus human intelligence, The future of AI in health sector, AI & Neural networks.

Module 2: THE PRESENT STATE & FUTURE OF AI IN HEALTHCARE SPECIALTIES **(10 Periods)**

Artificial Intelligence in: preventive healthcare, Radiology, Pathology, Surgery, Anesthesiology, Psychiatry, Cardiology, Pharmacy, Dermatology, Dentistry, Orthopedics, Ophthalmology.

Module 3: THE ROLE OF MAJOR CORPORATIONS IN AI IN HEALTHCARE **(08 Periods)**

IBM Watson, The role of Google & Deep mind in AI in Healthcare, Baidu, Facebook & AI in Healthcare, Microsoft & AI in Healthcare.

Module 4: FUTURE OF HEALTHCARE IN AI (10 Periods)

Evidence-based medicine, personalized medicine, Connected medicine, Virtual Assistants, Remote Monitoring, Medication Adherence, Accessible Diagnostic Tests, Smart Implantables, Digital Health and Therapeutics, Incentivized Wellness, Block chain, Robots, Robot-Assisted Surgery, Exoskeletons, Inpatient Care, Companions, Drones, Smart Places, Smart Homes, Smart Hospitals.

Module 5: APPLICATIONS OF AI IN HEALTHCARE (09 Periods)

Case Study 1: AI for Imaging of Diabetic Foot Concerns and Prioritization of Referral for Improvements in Morbidity and Mortality.

Case Study 2: Outcomes of a Digitally Delivered, Low-Carbohydrate, Type 2 Diabetes Self-Management.

Case Study 3: Delivering A Scalable and Engaging Digital Therapy.

Case Study 4: Improving Course Outcomes for Junior Doctors through the Novel Use of Augmented and Virtual Reality for Epilepsy.

Case Study 5: Big Data, Big Impact, Big Ethics: Diagnosing Disease Risk from Patient Data.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Analyze how the artificial intelligence is used to predict the disease result and Prognosis Assessment of a patient.
2. How does drug discovery happen and how does AI is helping in drug discovery and Labs.
3. Justify that artificial intelligence provide engineering solutions for early detection and Diagnosis of diseases.
4. Demonstrate the prediction of bladder volume of a patient.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Dr. Parag Mahajan, *Artificial Intelligence in Healthcare*, MedManthra Publications, First Edition 2019.
2. Arjun Panesar, *Machine Learning and AI for Healthcare Big Data for Improved Health*, Apress Publications, 2019.

REFERENCE BOOKS:

1. Michael Matheny, Sonoo Thadaney Israni, Mahnoor Ahmed, and Danielle Whicher, *Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril*, National Academy of Medicine Publication, First Edition 2019.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=-aHBwTQQyNU>
2. <https://intellipaat.com/blog/artificial-intelligence-in-healthcare/>

Web Resources:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/>
2. <https://www.ibm.com/topics/artificial-intelligence-healthcare>
3. <https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CM101701	BANKING AND INSURANCE	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Introduction to Banking; Bank-Customer Relationship; Electronic Payment System and Business Models; Introduction to Risk and Insurance; Insurance Overview.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate the importance of Banking and functions of the Reserve Bank of India and its role in the country's sustainable development.
- CO2** Demonstrate the role, relationships, and operations between Banker and Customer.
- CO3** Demonstrate the Online Banking system, various types of Electronic Payments, and Business models.
- CO4** Demonstrate the concept of risk and principles, functions, and, types of Insurance companies.
- CO5** Understand the principles of insurance and its functions.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3							2				1
CO2	3							2				1
CO3	3							2				1
CO4	3							2			1	1
CO5	3							2			1	1
Course Correlation Mapping	3							2			1	1

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO BANKING

(09 Periods)

Meaning - Importance of banking- Functions of banking - Reserve Bank of India: Functions – Role of RBI in sustainable development.

Module 2: BANK-CUSTOMER RELATIONSHIP

(09 Periods)

Debtor-creditor relationship, deposit products or services, payment, and collection of cheques. Accounts – Types of accounts, the procedure for opening and closing an account - Loans and Advances- principles of lending.

Module 3 ELECTRONIC PAYMENT SYSTEM&BUSINESS MODELS

(09 Periods)

Introduction to Online Banking - types of e-payment system, e-cash, NEFT, RTGS, Creditcards, Electronic Wallet and Debit cards. **Business models-** B2B, B2C, C2C, and B2G.

Module 4 INTRODUCTION TO RISK AND INSURANCE

(09 Periods)

Insurance: Definition, Insurance as risk mitigation mechanism, elements of insurance. Concept of risk, risk Vs uncertainty.

Module 5 INSURANCE OVERVIEW

(09 Periods)

Principles of insurance - insurance types - LIC & GIC – insurance functions, IRDA - Insurance Players in India.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Make a PowerPoint presentation on the banking system in India.
2. Submit a report on the working of insurance companies.
3. Prepare a report on the functions of RBI & IRDA in India.
4. Submit a report on electronic banking facilities provided by Indian banks.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. RanganadhaChary, A.V. and Paul, R.R., *Banking and Financial system*, KalyaniPublisher, New Delhi, 3rd edition, 2016.
2. Sharma, R.K., Shashi K. Gupta and Jagwant Singh, *Banking and Insurance*, Kalyani Publishers, New Delhi, 17th edition, 2014

REFERENCE BOOKS:

1. *Indian Institute of Banking & Finance, Digital Banking*, Taxman Publications Pvt.Ltd., 2016 edition, 2016.
2. Jyotsna Sethi and Nishwan Bhatia, *Elements of Banking and Insurance*, PHI Learning Pvt. Ltd., 2nd edition, 2012.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=a1_p8zhbAfE
2. https://www.youtube.com/watch?v=bxNw9VB5Y_0

Web Resources:

1. https://unacademy.com/content/railway-exam/study_material/economics/importance-of-banking-sector-in-the-country/
2. <https://www.geeksforgeeks.org/life-insurance-meaning-elements-and-types-of-life-insurance-policies/>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS101701	BIOINFORMATICS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course focus on Biological Data Acquisition, Databases, Data Processing, Methods of Analysis, Applications of Bio-informatics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand basic biological data acquisition in bioinformatics.
- CO2** Identify the proper databases for the information search by choosing the biological databases and also submission and retrieval of data from databases.
- CO3** Analyze the results of bioinformatics data using text and sequence-based searching techniques.
- CO4** Analyze the secondary and tertiary structures of proteins by applying differential alignment programs
- CO5** Design biological databases by using contextual knowledge on bioinformatics.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	3	3	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BIOLOGICAL DATA ACQUISITION

(09 Periods)

Biological information, Retrieval methods for DNA sequence, protein sequence and protein structure information

Module 2: DATABASES

(09 Periods)

Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases - primary and secondary sequence databases, protein sequence and structure databases.

Module 3: DATA PROCESSING

(09 Periods)

Data – Access, Retrieval and Submission: Standard search engines; Data retrieval tools – Entrez, DBGET and SRS; Submission of (new and revised) data; Sequence Similarity Searches: Local and global. Distance metrics. Similarity and homology. Scoring matrices, PAM and BLOSUM

Module 4: METHODS OF ANALYSIS

(09 Periods)

Dynamic programming algorithms, Needleman-Wunsch and Smith-waterman. Heuristic Methods of sequence alignment, FASTA and BLAST; Multiple Sequence Alignment and software tools for pair wise and multiple sequence alignment, CLUSTAL program, Prediction of Tertiary structure of proteins.

Module 5: APPLICATIONS

(09 Periods)

Genome Annotation and Gene Prediction; ORF finding; Phylogenetic Analysis, Genomics, Proteomics, Genome analysis – Genome annotation, DNA Microarray, computer aided drug design (CADD).

Total Periods: 45

EXPERIENTIAL LEARNING

1. Calculate the dynamic programming matrix and one or more optimal alignment(s) for the sequences GAATTC and GATTA, scoring +2 for a match, – 1 for a mismatch and with a linear gap penalty of $d = 2$.
2. Determine whether the RNA string GGACCACCAGG should be folded into two substructures.
3. Discuss how to carry out the multiple sequence alignment of the following three sequences: TTTTAAAA, AAAACCCC, CCCCTTTT.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Lesk, A. K., *Introduction to Bioinformatics*, Oxford University Press, 4th Edition, 2013
2. Dan Gusfield, *Algorithms on Strings, Trees and Sequences: Computer Science and Computational Biology*, Cambridge University Press, 1997.

REFERENCE BOOKS:

1. Baldi, P. and Brunak, S., *Bioinformatics: The Machine Learning Approach*, MIT Press, 2nd Edition, 2001.
2. Mount, D.W., *Bioinformatics Sequence and Genome Analysis*, Cold Spring Harbor Laboratory Press, 2nd Edition, 2004.
3. Tindall, J., *Beginning Perl for Bioinformatics: An introduction to Perl for Biologists*, O'Reilly Media, 1st Edition, 2001.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=liNblw4x50E>
2. <https://www.youtube.com/watch?v=eZfyWdHnzR0>

Web Resources:

1. <https://www.britannica.com/science/bioinformatics>
2. <https://www.ebi.ac.uk/training/online/courses/bioinformatics-terrified/what-bioinformatics/>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS101701	BIOLOGY FOR ENGINEERS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to living organisms, Proteins, Nucleic acids and enzymes, Genetics and Molecular biology, Recombinant DNA technology, Human physiology and applied biology.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Identify difference between cells, Cellular components and their functions.
- CO2** Understand Proteins, Nucleic acids structure and function and also Mechanism of enzyme action.
- CO3** Identify Central dogma of Molecular biology and processes of Molecular Biology.
- CO4** Understand Recombinant DNA technology and its importance in creating new Animalsand Plants.
- CO5** Understand basics and Mechanism of different Physiological process including nerve function and applications of biological sciences.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	3	2	-	-	-	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: LIVING ORGANISMS

(09 Periods)

Comparison of biological organisms with manmade systems, Classification of living organisms, Cellular basis of life, differences between prokaryotes and eukaryotes, classification on the basis of carbon and energy sources, molecular taxonomy

Module 2: PROTEINS, NUCLEIC ACIDS AND ENZYMES

(10 periods)

Biomolecules, structure, function and Classification of proteins, structure, function and Classification of and Nucleic acids, Enzymes, Enzyme nomenclature, Classification of Enzymes and Mechanism of Enzyme action, Industrial applications of enzymes, Fermentation and its industrial applications

Module 3 GENETICS AND MOLECULAR BIOLOGY

(11 Periods)

Mendel's laws, single gene disorders in humans, Genetic code, DNA replication, Transcription, Translation.

Module 4 RECOMBINANT DNA TECHNOLOGY

(08 Periods)

Recombinant DNA Technology: recombinant vaccines, transgenic microbes, plants and animals, animal cloning, biosensors, biochips.

Module 5 HUMAN PHYSIOLOGY AND APPLIED BIOLOGY

(07 Periods)

Fundamentals of Human physiology, neurons, synaptic and neuromuscular junctions, Introduction to EEG, DNA fingerprinting, DNA Micro array and Genomics.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Identify the Cell and Cellular organelle spotters and write the functions of spotters identified
2. Prepare a table of Enzymes and their importance.
3. Assignments on Central dogma of Molecular biology
4. Identify different organs in the organ system diagrams.
5. Assignments on photosynthesis.
6. Quiz related to organ system and functions.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Rajiv Singal, Gaurav Agarwal, *Biology for Engineers*, CBS, 2019.
2. S. Sing and T. Allen, *Biology for Engineers*, Vayu Education of India, 2014.

REFERENCE BOOKS:

1. B. Alberts, A. Johnson et al., *The molecular biology of the cell*, Garland Science, 6th edition, 2014.
2. A. T. Johnson, *Biology for Engineers*, CRC press, 2011.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=N0Y386SVGN8>
2. <https://www.youtube.com/watch?v=1Pzk-UqilW4>
3. <https://www.youtube.com/watch?v=208pMhKoQeo>

Web Resources:

1. Structure and function of Proteins: <https://nptel.ac.in/courses/104102016/16>
2. Enzyme catalysis: <https://nptel.ac.in/courses/103103026/module3/lec35/4.html>
3. Biochips: <https://nptel.ac.in/courses/112104029/3>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22LG101701	BUSINESS COMMUNICATION AND CAREER SKILLS	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Nature and Scope of Communication, Corporate Communication, Writing Business Messages & Documents, Careers & Résumés, and Interviews.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate knowledge of professional communication by analyzing and applying the styles and strategies of business communication in Communication Networks, Interpersonal, and Informal communication.
- CO2** Analyze the limitations of communication by applying and demonstrating corporate and cross-cultural communication strategies effectively in a business context and Crisis Management situations.
- CO3** Apply appropriate strategies and techniques in writing business messages, business letters, and résumé for effective professional communication and career building.
- CO4** Demonstrate appropriate communication techniques and answering strategies by analyzing the expectations during presentations and interviews.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	2	-	-	-	-	3	-	-
CO2	1	2	-	-	2	-	-	-	-	3	1	-
CO3	1	-	-	-	2	-	-	-	-	3	-	-
CO4	1	2	-	-	2	-	-	-	-	3	-	-
Course Correlation Mapping	2	2	-	-	2	-	-	-	-	3	1	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: NATURE AND SCOPE OF COMMUNICATION

(9 Periods)

Introduction – Communication Basics – Functions of Communication – Communication Networks – Interpersonal Communication – Informal Communication – Communication Barriers – Roles of a Manager.

Module 2: CORPORATE COMMUNICATION

(9 Periods)

Introduction – Corporate Communication – Cross-Cultural Communication; Concept & Styles – Corporate Communication Strategy – Corporate Citizenship – Crisis Communication: Case Study.

Module 3: WRITING BUSINESS MESSAGES & DOCUMENTS

(9 Periods)

Introduction – Importance of Written Business Communication – Types of Business Messages – Five Main Stages of Writing Business Messages – Business Letter Writing – Kinds of Business Letters – Common Components of Business Letters – Strategies for Writing the Body of a Letter.

Module 4: CAREERS AND RÉSUMÉS

(9 Periods)

Introduction – Career Building – Résumé Formats: Traditional, Electronic and Video Résumé – Sending Résumés – Follow-up Letters – Business Presentations and Speeches: Planning – Structuring – Organizing – Delivery.

Module 5: INTERVIEWS

(9 Periods)

Introduction – General Preparation for an Interview – Success in an Interview – Important Non-verbal Aspects – Types of Interviews – Styles of Interviewing – Types of Interviewing – Online Recruitment Process.

Total Periods: 45

EXPERIENTIAL LEARNING

1. People often get confused in identifying or using English vocabulary on most occasions. Prepare a list of confusing words and find methods to overcome the difficulties in using those words to uplift the career of professionals.
2. Organizations and institutions use modern technology in communicating with their colleagues, clients, and stakeholders. Make a PowerPoint presentation on the modern communication system of any organization and its role in the success of the organization and its career.
3. As a student in the modern technological world, organizing or attending webinars is inevitable. Analyze the pros and cons of video conferencing by organizing webinars and preparing a report.
4. Form a team and act as a team leader. Prepare a performance appraisal report of the team using visual aids to support the presentation.
5. Make a detailed study on social networking and its impact on modern business and Career.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be

reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Meenakshi Raman, Prakash Singh, *Business Communication*, Oxford University Press, NewDelhi, 2nd edition, 2012.
2. Neera Jain, Sharma Mukherji, *Effective Business Communication*, Tata Mc Graw–Hill

REFERENCE BOOKS:

1. Courtland L. Bovee et al., *Business Communication Today*, Pearson, New Delhi, 2011.
2. Krizan, *Effective Business Communication*, Cengage Learning, New Delhi, 2010.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/110105052>
2. https://edurev.in/courses/14522_Business-Communication-The-Ultimate-Guide

Web Resources:

1. <http://www.career.vt.edu/interviewing/TelephoneInterviews.html>
2. http://job-search-search.com/interviewing/behavioral_interviews
3. <https://goo.gl/laEHOY> (dealing with complaints)
4. <http://www.adm.uwaterloo.ca/infocacs/CRC/manual/resumes.html>
5. <https://goo.gl/FEMGXS>
6. <http://www.resumania.com/arcindex.html>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22LG101702	QUANTITATIVE APTITUDE AND VERBAL ABILITY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course explores essential quantitative, verbal, and analytical reasoning skills for competitive exams and placements. It covers arithmetic, algebra, geometry, data interpretation, probability, and logical problem-solving. Verbal modules focus on grammar, vocabulary, reading comprehension, and critical reasoning techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1. Demonstrate knowledge of number systems, percentages, ratios, and averages to solve real-time quantitative problems.**
- CO2. Apply algebraic techniques, progressions, and geometric concepts to compute and analyze mathematical scenarios.**
- CO3. Utilize combinatorics, probability, and data interpretation for decision-making under constraints.**
- CO4. Apply core grammar rules, sentence structures, reading comprehension, and critical reasoning techniques to communicate effectively.**

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	-	-	-	-	-	-	-
CO2	3	2	-	-	2	-	-	-	-	-	-	-
CO3	3	3	2	3	2	-	-	-	-	-	-	-
CO4	3	2	2	2	2	-	-	-	-	3	-	-
Course Correlation Mapping	3	2	2	3	2	-	-	-	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: NUMBER SYSTEMS, PERCENTAGES, RATIOS & AVERAGES (9 Periods)

Number system, power cycle, remainder cycle, factors, multiples, HCF, LCM, Percentages, fraction-to-decimal conversions, increase/decrease calculations, simple and compound interest, Ratio, proportion, variation, problems on ages, profit and loss vocabulary, partnership, cost/selling price, Averages, weighted averages, mixtures and alligations.

Module 2: ALGEBRA, PROGRESSIONS, GEOMETRY (9 Periods)

Logarithms, rules and simplifications, solving quadratic equations, Arithmetic and geometric progressions, nth term, sum formulas, Geometry and mensuration, triangles, circles, area, perimeter, volume, surface area, Time and work, efficiencies, pipes and cisterns, division of wages, Speed, distance, relative motion, trains, boats and streams, races.

Module 3: COMBINATORICS, PROBABILITY, AND DATA INTERPRETATION (9 Periods)

Permutation and combination, counting principles, factorials, arrangements, selections, Probability concepts, events, rules of probability, real-life applications, Data interpretation from tables, pie charts, bar graphs, Data sufficiency techniques, evaluating adequacy of given data, Basic logical reasoning within quantitative problem-solving.

Module 4: CORE VERBAL GRAMMAR AND SENTENCE STRUCTURE (9 Periods)

Sentence correction, subject-verb agreement, modifiers, parallelism, tenses, comparisons, Articles and prepositions, omission rules, compound structures, interrogatives, Active and passive voice, direct and indirect speech rules, Sentence completion, para-jumbles, context clues, logical connectors, Vocabulary building, synonyms, antonyms, word usage, analogies.

Module 5: READING COMPREHENSION AND CRITICAL REASONING (9 Periods)

Reading comprehension types, speed reading, tone/inference-based questions, Critical reasoning – arguments, assumptions, conclusions, strengthen/weaken/inference, Word roots, prefixes, suffixes, sentence structure clues, Logical structuring of arguments, spotting fallacies, Application of reasoning in RCs, data-based questions, verbal puzzles.

Total Periods: 45

EXPERIENTIAL LEARNING

33. NUMBER SYSTEMS, PERCENTAGES, RATIOS & AVERAGES

A trader has 3 varieties of rice 13529 kg, 9617 kg, 7987 kg by weights. Find the minimum number of bags of equal size in which he can store the rice without mixing.

- a) 163
- b) 191
- c) 246
- d) 212

34. NUMBER SYSTEMS, PERCENTAGES, RATIOS & AVERAGES

The ratio of the ages of A and B is 3:4. After 5 years, the ratio becomes 4:5. What are their present ages?

- a) 15 and 20
- b) 18 and 24
- c) 30 and 40
- d) 20 and 25

35. ALGEBRA, PROGRESSIONS, GEOMETRY

Solve for x:

If $2x + 3 = 7$, then what is the value of x?

- a) 1
- b) 2
- c) 3
- d) 4

36. ALGEBRA, PROGRESSIONS, GEOMETRY

The perimeter of a rectangle is 36 cm. If the length is 10 cm, what is the width?

- a) 8 cm
- b) 9 cm
- c) 6 cm
- d) 7 cm

37. COMBINATORICS, PROBABILITY, AND DATA INTERPRETATION

A card is drawn at random from a standard deck of 52 playing cards. What is the probability that it is a red king?

- a) 1/13
- b) 1/26
- c) 1/52
- d) 2/13

38. COMBINATORICS, PROBABILITY, AND DATA INTERPRETATION

The number of students in five different classes is as follows:

Class A – 40, Class B – 35, Class C – 50, Class D – 45, Class E – 30.

What is the average number of students per class?

- a) 38
- b) 40
- c) 42
- d) 45

39. CORE VERBAL GRAMMAR AND SENTENCE STRUCTURE

Identify the grammatically correct sentence:

- a) He go to the gym every morning.
- b) He goes to the gym every morning.
- c) He going to the gym every morning.
- d) He gone to the gym every morning.

40. CORE VERBAL GRAMMAR AND SENTENCE STRUCTURE

Despite the heavy rain, the match _____.

- a) has cancel
- b) was cancelled
- c) will be cancelled
- d) continued as scheduled

41. READING COMPREHENSION AND CRITICAL REASONING

Passage:

The Earth's climate has changed throughout history. However, the current trend of global warming is particularly alarming because it is occurring at an unprecedented rate. Scientists overwhelmingly agree that human activities, especially the burning of fossil fuels, are the primary cause of this rapid change.

According to the passage, what is the main cause of current global warming?

- a) Natural changes in the climate
- b) Increase in solar activity
- c) Volcanic eruptions
- d) Human activities like burning fossil fuels

42. READING COMPREHENSION AND CRITICAL REASONING

A new study shows that students who take handwritten notes retain more information than those who type notes. Therefore, schools should ban laptops during lectures to improve student learning.

Which of the following, if true, most seriously weakens the argument?

- a) Many students find typing faster than writing by hand.
- b) Some students need laptops to access course materials.
- c) The study did not account for the difficulty level of the lectures.
- d) The students who typed their notes reviewed them more often than those who wrote by hand.

RESOURCES

TEXT BOOKS:

1. "R.S. Aggarwal", *Quantitative Aptitude for Competitive Examinations*, S. Chand Publishing, 2025.
2. "Abhijit Guha", *Quantitative Aptitude for Competitive Examinations*, 7th edition, Tata McGraw Hill Education, 2021.

REFERENCE BOOKS:

1. "Arun Sharma", *How to Prepare for Quantitative Aptitude for CAT*, 11th Edition, McGraw Hill Education, 2024.
2. "Nishit Sinha", *Quantitative Aptitude for CAT*, 5th edition, Pearson Education, 2020.

SOFTWARE/TOOLS:

1. Microsoft Excel or Google Sheets (for solving DI sets)
2. Any Scientific Calculator (if permitted)
3. Online Aptitude Test Platforms like:
 - o Indiabix (<https://www.indiabix.com>)
 - o Lofoya (<https://www.lofoya.com>)
 - o Testbook (<https://testbook.com>)

VIDEO LECTURES:

1. NPTEL: Aptitude Learning (Verbal & Quant)
2. [Unacademy: Quantitative Aptitude by Arun Sharma](#)
3. [YouTube: TalentSprint Aptitude Classes](#)
4. [YouTube: Study Smart – Full Aptitude Playlist](#)
5. Udemy: Quantitative Aptitude for Competitive Exams

WEB RESOURCES:

1. <https://www.indiabix.com/aptitude/questions-and-answers/>
2. <https://www.geeksforgeeks.org/aptitude/>
3. <https://www.lofoya.com>
4. <https://www.placementseason.com/aptitude-questions>
5. <https://www.campusgate.co.in/p/quantitative-aptitude.html>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22LG101703	LOGICAL REASONING AND RECRUITMENT ESSENTIALS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course develops essential logical reasoning, analytical skills, and practical communication for competitive exams and placements. It covers data arrangements, coding-decoding, pattern recognition, counting principles, probability, and data interpretation. Learners also acquire skills in logical connectives, syllogisms, time and direction sense, along with group discussions, resume writing, and interview preparation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Apply concepts of data arrangements, blood relations, ranking, and direction sense to solve spatial and logical reasoning problems.
- CO2.** Analyze patterns in coding-decoding, series, analogies, odd-one-out, and visual reasoning to improve abstraction and recognition skills.
- CO3.** Apply principles of combinatorics, probability, data interpretation, logical connectives, syllogistic reasoning, and time-space analysis to construct effective solutions and derive valid conclusions.
- CO4.** Demonstrate effective communication skills in group discussions, resume writing, and personal interviews through structured activities.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	-	-	-	-	-	-	-
CO2	3	2	3	2	2	-	-	-	-	-	-	-
CO3	3	3	2	3	2	-	-	-	-	-	-	-
CO4	3	2	-	-	2	-	-	-	-	3	-	-
Course Correlation Mapping	3	2	2	3	2	-	-	-	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DATA ARRANGEMENTS AND BLOOD RELATIONS (8 Periods)

Linear arrangement, circular arrangement, multi-dimensional arrangement, coded and descriptive blood relations, family trees, ranking, and ordering problems. Focus on directional logic, positional comparisons, and attribute-based placement. Enhances spatial reasoning and logical deduction skills.

Module 2: CODING-DECODING, SERIES, ANALOGY, ODD ONE OUT & VISUAL REASONING (8 Periods)

Letter coding, number coding, substitution patterns, alphanumeric series, analogy-based reasoning, identifying odd one out in sequences, visual reasoning including mirror images, paper folding, figure sequences. Builds pattern recognition and abstraction abilities.

Module 3: COUNTING PRINCIPLES, P&C, PROBABILITY, DATA INTERPRETATION & SUFFICIENCY (9 Periods)

Fundamental counting principle, permutation and combination, probability theory and applications, interpreting pie charts, tables, and bar graphs, data sufficiency problems requiring logical assessment of given facts. Develops analytical thinking and quantitative aptitude.

Module 4: LOGICAL CONNECTIVES, SYLLOGISMS, VENN DIAGRAMS, CLOCKS, CALENDARS & DIRECTION (8 Periods)

IF-THEN logic, syllogistic reasoning with Venn diagrams, calendar-based date/day calculations, clock-angle problems, direction sense and cube-based spatial puzzles. Trains logical sequencing and time-space orientation.

Module 5: RECRUITMENT ESSENTIALS – GD, RESUME & INTERVIEW SKILLS (12 Periods)

Basics of group discussion, resume writing guidelines, and key sections, personal interview structure, HR and technical questions, body language tips, mock GD and interview sessions for real-time practice and evaluation. Equips students with communication and interview readiness.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

43. DATA ARRANGEMENTS AND BLOOD RELATIONS

Six people – A, B, C, D, E, and F – are sitting in a row, facing north.

- B is sitting to the immediate right of D.
- C is at one of the ends.
- A is sitting between E and F.
- D is not at either end.
- E is sitting to the left of A.

Who is sitting in the middle?

Options:

- A) A
- B) B
- C) D
- D) F

44. DATA ARRANGEMENTS AND BLOOD RELATIONS

Pointing to a man, Mira says, "He is the son of my mother's only daughter."
How is the man related to Mira?

Options:

- A) Son
- B) Nephew
- C) Cousin
- D) Brother

45. **CODING-DECODING, SERIES, ANALOGY, ODD ONE OUT & VISUAL REASONING**

In a certain code language, **GAMES** is written as **HZNFT**.
How is **PLANE** written in that code?

Options:

- A) QMBOF
- B) QMBOD
- C) QNCOD
- D) OKZMD

46. **CODING-DECODING, SERIES, ANALOGY, ODD ONE OUT & VISUAL REASONING**

Which word does **not** belong to the group?

Options:

- A) Apple
- B) Mango
- C) Banana
- D) Carrot

47. **COUNTING PRINCIPLES, P&C, PROBABILITY, DATA INTERPRETATION & SUFFICIENCY**

If the sales of Company A in 2021 were 80 units and in 2022 were 120 units, what was the percentage increase?

Options:

- A) 33.3%
- B) 50%
- C) 40%
- D) 60%

48. **COUNTING PRINCIPLES, P&C, PROBABILITY, DATA INTERPRETATION & SUFFICIENCY**

The number of students in five different classes is as follows:

Class A – 40, Class B – 35, Class C – 50, Class D – 45, Class E – 30.

What What is the value of x?

Statement I: $x^2 = 49$

Statement II: x is a negative number

- A) Only I is sufficient
- B) Only II is sufficient
- C) Both I and II together are sufficient
- D) Each alone is sufficient

49. **LOGICAL CONNECTIVES, SYLLOGISMS, VENN DIAGRAMS, CLOCKS, CALENDARS & DIRECTION**

Statements:

1. All engineers are logical.
2. Some logical people are creative.
3. No creative person is careless.

Conclusion:

- I. Some engineers are creative.
- II. No engineer is careless.

Choose the correct option:

- A) Only I follows
- B) Only II follows
- C) Neither I nor II follows
- D) Both I and II follow

50. **LOGICAL CONNECTIVES, SYLLOGISMS, VENN DIAGRAMS, CLOCKS, CALENDARS & DIRECTION**

Ravi starts from his home at 3:00 PM and walks 4 km East, then turns left and walks 3 km. He then turns left again and walks 4 km. What direction is he facing, and what time will it be if each km takes him 15 minutes?

- A) Facing North, 3:45 PM
- B) Facing West, 4:00 PM
- C) Facing South, 4:00 PM
- D) Facing West, 3:45 PM

51. RECRUITMENT ESSENTIALS – GD, RESUME & INTERVIEW SKILLS

Improves Communication Skills – Students learn to express their thoughts clearly and confidently in a group setting.

Builds Critical Thinking – It enhances analytical skills by encouraging students to think on their feet, structure arguments, and respond to different viewpoints.

Boosts Teamwork & Listening Skills – GD teaches the importance of active listening, respecting others' opinions, and working collaboratively, which are essential in professional environments.

52. RECRUITMENT ESSENTIALS – GD, RESUME & INTERVIEW SKILLS

Boosts Confidence – Simulated interviews reduce anxiety and prepare students to face real interviews with ease.

Improves Self-Presentation – Students learn how to present their strengths, goals, and experiences effectively.

Provides Constructive Feedback – Personalized feedback helps identify areas for improvement in communication, attitude, and body language.

RESOURCES

TEXT BOOKS:

3. "R.S. Aggarwal", *Quantitative Aptitude for Competitive Examinations*, S. Chand Publishing, 2025.
4. "Abhijit Guha", *Quantitative Aptitude for Competitive Examinations*, 7th edition, Tata McGraw Hill Education, 2021.

REFERENCE BOOKS:

3. "Arun Sharma", *How to Prepare for Quantitative Aptitude for CAT*, 11th Edition, McGraw Hill Education, 2024.
4. "Nishit Sinha", *Quantitative Aptitude for CAT*, 5th edition, Pearson Education, 2020.

SOFTWARE/TOOLS:

4. Microsoft Excel or Google Sheets (for solving DI sets)
5. Any Scientific Calculator (if permitted)
6. Online Aptitude Test Platforms like:
 - o Indiabix (<https://www.indiabix.com>)
 - o Lofoya (<https://www.lofoya.com>)
 - o Testbook (<https://testbook.com>)

VIDEO LECTURES:

6. NPTEL: Aptitude Learning (Verbal & Quant)
7. [Unacademy: Quantitative Aptitude by Arun Sharma](#)
8. [YouTube: TalentSprint Aptitude Classes](#)
9. [YouTube: Study Smart – Full Aptitude Playlist](#)
10. Udemy: Quantitative Aptitude for Competitive Exams

WEB RESOURCES:

6. <https://www.indiabix.com/aptitude/questions-and-answers/>
7. <https://www.geeksforgeeks.org/aptitude/>
8. <https://www.lofoya.com>
9. <https://www.placementseason.com/aptitude-questions>
10. <https://www.campusgate.co.in/p/quantitative-aptitude.html>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101701	CIVIL ENGINEERING AND THE SOCIETY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on introduction to civil engineering, aesthetics of historic and modern civil engineering structures, unpredictable nature and the civil engineering; civil engineering solutions for the problems of traffic, pollution, water and waste management; building sustainable smart cities.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Analyze principles of civil engineering to basic civil engineering problems following ethics and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO2 Analyze aesthetics of historic and modern civil engineering structures to solve complex civil engineering problems using tools and techniques by following ethics and latest trends considering society, environment and sustainability besides communicating effectively in graphical form.

CO3 Analyze unpredictable nature and the role of civil engineering to solve complex civil engineering problems using tools and techniques by following ethics and considering society, environment and sustainability besides communicating effectively in graphical form.

CO4 Analyze civil engineering solutions for the problems of traffic, pollution, water and waste management to solve complex problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO5 Analyze the building principles of sustainable smart cities to solve complex problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	2	3	2	-	1	-	1
CO2	3	3	-	1	2	2	2	2	-	1	-	1
CO3	3	3	-	1	2	2	2	2	-	1	-	-
CO4	3	3	-	1	2	2	2	2	-	1	2	-
CO5	3	3	-	1	2	2	2	2	-	1	2	-
Course Correlation Mapping	3	3	-	1	2	2	2	2	-	1	2	1

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO CIVIL ENGINEERING (07 Periods)

Philosophy of civil engineering, Disciplines of civil engineering, Evolution of construction and civil engineering in the world; Civil engineer - Duties and responsibilities, Role of Civil engineer in the society; Civil engineering materials and their applications, Latest advancements in civil engineering.

Module 2: AESTHETICS OF HISTORIC AND MODERN CIVIL ENGINEERING STRUCTURES (09 Periods)

Aesthetics in civil engineering structures; Aesthetic principles and techniques - Analysis of materials, textures and colors in aesthetic design, Integration of aesthetics with structural engineering principles; Historic civil engineering structures - Case studies of iconic historic structures (e.g. Colosseum, Taj Mahal, Eiffel Tower); Modern civil engineering structures - Exploration of contemporary iconic structures (e.g. Burj Khalifa, Sydney Opera House, Golden Gate Bridge); Integration of aesthetics and functionality - Ethical considerations in balancing aesthetics, functionality and sustainability; Future trends in aesthetic engineering.

Module 3 UNPREDICTABLE NATURE AND THE CIVIL ENGINEERING (09 Periods)

Unpredictable nature, Examples of unpredictable natural disasters - Earthquakes, Floods, Landslides, Hurricanes, Tsunamis, Impacts of unpredictable natural events on infrastructure; Role of civil engineering; Resilience in civil engineering - Strategies for building resilient structures, Risk assessment and analysis, Incorporating safety factors, Using robust construction materials, Implementing redundancy and backup systems, Sustainable design practices; Case studies of successful resilient designs.

Module 4 CIVIL ENGINEERING SOLUTIONS FOR THE PROBLEMS OF TRAFFIC, POLLUTION, WATER AND WASTE MANAGEMENT (11 Periods)

Introduction to urban challenges and sustainable development; Traffic management solutions - Causes and impacts of traffic congestion, Intelligent transportation systems; Pollution control and environmental engineering, Sources and types of urban pollution, Air quality monitoring and control strategies, Water pollution control, Noise pollution management, Sustainable construction practices to reduce pollution; Water resource management, Water demand and supply management in urban areas, Rainwater harvesting techniques, Water conservation and wastewater treatment technologies; Waste management strategies, Solid waste generation and disposal challenges, Waste-to-energy conversion technologies, Case studies of successful waste management initiatives; Integration and synergies among Solutions, Multi-disciplinary approach for holistic solutions.

Module 5 BUILDING SUSTAINABLE SMART CITIES (09 Periods)

Smart city; Elements of smart city infrastructure - Buildings, Mobility, Energy, Water, Waste management, Health and digital layers; Need for an integrated approach; Role of science, technology and innovation in the implementation of smart infrastructure; Smart infrastructure design principles and policies; Case studies: Gujarat International Finance Tech-City in India.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Group discussion on compatibility of modern construction materials compared to that of traditional civil engineering materials
2. Poster presentation on historic and modern civil engineering structures.
3. Submit a case study report on Life Cycle Analysis (LCA) of any one of the historic civil engineering structure.
4. Submit a case study report on the theme of severity of the natural disasters on the Civil engineering structures.
5. Debate on challenges, limitations and solutions for design and implementation of smart city.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. David Muir Wood., *Civil Engineering: A Very Short Introduction*, Oxford University Press, 1st Edition, 2012.
2. Roger Scruton, *The Aesthetics of Architecture*, Princeton University Press, 2nd Edition, 2013.

REFERENCE BOOKS:

1. Anubha Kaushik and C. P. Kaushik, *Perspectives in Environmental Studies*, New Age International (P) Ltd Publications, 6th Edition, 2018.
2. Sang Lee (Editor), *Aesthetics of Sustainable Architecture*, 010 publishers, 1st Edition, 2013.
3. Marc Kushner, *The Future of Architecture in 100 Buildings*, Simon and Schuster, 1st Edition, 2015.
4. Nicholas J. Garber and Lester A. Hoel, *Traffic and Highway Engineering*, Nelson Engineering, 1st Edition, 2008.
5. Stephen M. Wheeler and Timothy Beatley, *Sustainable Urban Development*, Reader Routledge Urban Reader Series, 3rd Edition, 2014.
6. Larry W. Mays, *Water Resources Engineering*, Wiley India Private Limited, 3rd Edition, 2011.
7. Hans Straub, *A History of Civil Engineering: An Outline from Ancient to Modern Times*, The MIT Press, 4th Edition, 1964.
8. Brian Vanden Brink, *Iconic: Perspectives on the Man-Made World*, Down East Books, Illustrated Edition, 2012.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/123/105/123105001/>
2. https://onlinecourses.nptel.ac.in/noc22_ce42/preview
3. https://onlinecourses.nptel.ac.in/noc19_ce31/preview

4. https://onlinecourses.nptel.ac.in/noc20_ce07/preview

Web Resources:

1. <https://bregroup.com/insights/aesthetics-in-architecture-how-beauty-and-design-are-inspiring-each-other/>
2. <https://keckwood.com/news-updates/how-civil-engineers-help-during-disaster-recovery/#:~:text=Civil%20engineers%20provide%20humanitarian%20and,shortages%20to%20hard%2Dhit%20communities>
3. <https://smartcities.gov.in/>
4. <https://www.twi-global.com/technical-knowledge/faqs/what-is-civil-engineering>
5. <https://www.ice.org.uk/engineering-resources/knowledge-resources/water-and-waste-water-management>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101701	CONSTITUTION OF INDIA	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides and in-depth knowledge about Constitution of India's Preamble and its Philosophy; Union Legislature; Federalism in India; Judiciary and Public Services; Nation Building. The students can gain first-hand information and knowledge about these dynamics and accordingly act based on these sources in their professional and routine activities.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

CO1 Demonstrate knowledge in the Parliamentary proceedings, Election Commission, Public Services and Foreign Policy of India.

CO2 Apply the reasoning informed by the various aspects of the Constitution and its provisions to assess societal issues and the consequent responsibilities relevant to the professional engineering practice.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	3	2	-	-	-	-	-
CO2	2	-	-	-	-	3	-	3	-	-	-	-
Course Correlation Mapping	2	-	-	-	-	3	2	3	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: PREAMBLE AND ITS PHILOSOPHY

(9 Periods)

Introduction to Indian Constitution; Evolution of Indian Constitution; preamble and its philosophy

Module 2: UNION LEGISLATURE

(9 Periods)

The Parliament, Parliamentary Structure, Process of Legislation; President of India – Powers and Functions; Prime Minister and Council of Ministers; Constitution Amendment Procedure.

Module 3: FEDERALISM IN INDIA

(9 Periods)

Centre-State Administrative Relationship; Governors – Powers and Functions; State Legislature - Composition and powers; Chief Ministers - Powers and Functions; The Election Commission – Powers and Functions.

Module 4: JUDICIARY AND PUBLIC SERVICES

(9 Periods)

The Union Judiciary - Supreme Court and High Court; Fundamental Rights and Duties All India Services - Central Civil Services - State Services - Local Services.

Module 5: INTERNATIONAL PARTICIPATION

(9 Periods)

Foreign Policy of India; International Institutions Influence: UNO, WTO, WHO, SAARC, International Summits: BRICS, NSS, UNEP – India's Role in International Negotiations; Environmentalism in India.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Review newspapers and submit a report on critical analysis of Indian Civil Servants exercise of powers, in the wake of constitutionally assigned authority.
2. Visit your village Panchayat office or Municipality office and generate a report on your observations about maintained Constitutional symbolism.
3. Watch few videos on recent Indian Independence Day and Republic Day celebrations as marked in New Delhi and present a detailed report, by considering the following aspects:
 - A) Comparatively analyze the speeches of the President of India and Prime Minister of India as delivered on these two occasions.
 - B) Compare these two events relevance in terms of Indian Armed Forces presence.
 - C) Observe, compare and analyse 'flag code' relevance as marked in these two events.
4. Watch a few videos on recent 'proceedings' of any state Legislative Assembly session and submit a detailed report.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Brij Kishore Sharma, *Introduction to the Constitution of India*, Prentice Hall of India, 2005

REFERENCE BOOKS:

1. Mahendra Pal Singh, V. N. Shukla's, *Constitution of India*, Eastern Book Company, 2011.
2. Pandey J. N., *Constitutional Law of India*, Central Law Agency, 1998

VIDEO LECTURES:

1. Doctrine of Basic Structure: <https://www.youtube.com/watch?v=cvUf9ZeEe8Y>
2. Significance of the Constitution: https://www.youtube.com/watch?v=vr1Dc_-ZKbQ

Web Resources:

1. The Constitution of India: <https://www.youtube.com/watch?v=of2SoO8i8mM>
2. Protection of Constitutional Democracy: <https://www.youtube.com/watch?v=smJ99cdPrns>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CM101702	COST ACCOUNTING AND FINANCIAL MANAGEMENT	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Cost accounting; cost sheet & preparation of cost sheet; standard costing & variance analysis; financial management & ratio analysis; introduction to investment.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate the concepts of Cost Accounting and Management Accounting and the elements of costing.
- CO2** Determine the Cost of Production for pricing decisions.
- CO3** Apply the Standard Costing and Variance techniques for the control of the cost of production
- CO4** Analyze the Profitability and financial condition of an organization using Ratios.
- CO5** Apply Capital Budgeting techniques for making investment decisions in an organization.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3				2			1				
CO2	3				2			1			1	
CO3	3				2			1			1	
CO4	3				2			1			1	
CO5	3				2			1				
Course Correlation Mapping	3				2			1			1	

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: COST ACCOUNTING

(09 Periods)

Meaning of Cost and Cost Accounting, Objectives, Scope, Advantages, and Disadvantages – Cost Accounting Vs Management Accounting – Elements of Costing – Installation of costing system – Material Control, Labor Control, Overhead Control.

Module 2: COST SHEET & PREPARATION OF COST SHEET

(09 Periods)

Analysis of Cost – Preparation of cost sheet, estimate, tender, and quotation (Simple problems) – Importance of Costing while pricing the products

Module 3 STANDARD COSTING & VARIANCE ANALYSIS

(09 Periods)

Introduction to Standard Costing & Variances – Variance Analysis: Material variances, Labor variances (Simple Problems).

Module 4 FINANCIAL MANAGEMENT & RATIO ANALYSIS

(09 Periods)

Meaning, Objectives - Nature and Scope, Importance of FM – Ratio Analysis: Types of Ratios: Solvency Ratios, Liquidity Ratios, Turnover Ratios, and Profitability Ratios - Financial Statement Analysis through Ratios (Simple Problems).

Module 5 INTRODUCTION TO INVESTMENT

(09 Periods)

Investment - Meaning and Definition- concept of risk and returns - Capital budgeting techniques – Security Analysis and Portfolio Management (Basic concepts).

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a report on the role of cost accountants in the growth of a company.
2. To visit the manufacturing unit to observe how they used various techniques for analyzing the financial health of a company.
3. Prepare a report on factors influencing the form of business organization.
4. Prepare the cost sheet with practical examples of any two manufacturing companies.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. S.P. Jain and K.L. Narang: *Cost Accounting*, Kalyani Publishers, Ludhiana, 10th edition, 2016.
2. I.M. Pandey, *Financial Management*, Vikas Publishing House Pvt. Ltd., 14th edition, 2016.

REFERENCE BOOKS:

1. The Institute of Company Secretaries of India, *Cost and Management Study Material*, New Delhi.
2. CA Saravana Prasath, *Cost Accounting and Financial management*, Wolters Kluwer India Pvt. Ltd., New Delhi, 2018.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=ESqO8sFgQa0&list=PLLhSIFdZcUVE2kzOhEubO9rkvUOAgZbz>
2. <https://www.youtube.com/watch?v=tzasFmP1CpA>
<https://www.youtube.com/watch?v=tzasFmP1CpA>

Web Resources:

1. https://www.tutorialspoint.com/accounting_basics/management_versus_cost_accounting.htm
2. <https://www.netsuite.com/portal/resource/articles/financial-management/financial-management.shtml>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101701	CYBER LAWS AND SECURITY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Cyber Crimes and Indian IT Act; Cyber Offenses; Tools and Methods used in Cyber Crime; Phishing and Identity Theft; Indian and Global Perspective on Cyber Crimes and Cyber Security; Organizational Implications on Cyber Security; IPR Issues; Cyber Crime and Terrorism; Cyber Crime Illustrations

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate knowledge in Cyber security, Cybercrimes and its related laws in Indian and Global Act.
- CO2** Analyze the legal perspectives and laws related to cybercrimes in Indian context.
- CO3** Apply security and privacy methods in development of modern applications and in organizations to protect people and to prevent cybercrimes.
- CO4** Solve Cyber security issues using privacy policies and Use antivirus tools to minimize the impact of cyber threats.
- CO5** Apply security standards for the implementation of Cyber Security and laws.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	3	2										
CO3	3	2	3									
CO4	3	2	3									
CO5	3	2	2									
Course Correlation Mapping	3	2	3									

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO CYBER CRIMES AND OFFENSES (09 Periods)

Cyber Crimes: Introduction, Definition, Origin, Cybercrime and information security, Cyber criminals, Classifications of cybercrimes, The legal perspectives and Indian perspective, Cybercrime and Indian ITA 2000, Global perspective on cybercrimes.

Cyber Offenses: Introduction, Criminals planning on attacks, Social engineering, Cyber stalking, Cyber cafe and crimes, Botnets.

Module 2: TOOLS AND METHODS USED IN CYBER CRIME AND PHISHING AND IDENTITY THEFT (09 Periods)

Introduction, Proxy servers and Anonymizers, Phishing, Password cracking, Key loggers and Spywares, Virus, Worms and Ransomware, Trojan horses and Backdoors, Steganography, DoS and DDoS attacks.

Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).

Module 3 CYBER CRIMES AND CYBER SECURITY-LEGAL PERSPECTIVES (08 Periods)

Introduction, Cyber laws in Indian context, The Indian IT act, Challenges to Indian law and Cybercrime scenario in India, Consequences of not addressing the weakness in IT act, Digital signatures and the Indian IT Act, Cyber Crime and Punishment, Cyber law, Technology and Students in India scenario.

Module 4 CYBER SECURITY-ORGANIZATIONAL IMPLICATIONS (10 Periods)

Introduction, Web threats for organizations – evils and perils, Security and privacy implications from cloud computing, Social Media Marketing-Security risks and Perils for organizations, Social computing and associated challenges for organizations, Protecting people's privacy in organization, Organizational guidelines for internet usage, Safe computing and Usage policy, Incident handling and Best practices.

Module 5 CYBER CRIME AND TERRORISM AND ILLUSTRATIONS (09 Periods)

Cyber Crime & Terrorism: Introduction, Intellectual property in the cyber space, The ethical dimension of cybercrimes, The psychology, Mindset and skills of hackers and cyber criminals, Sociology of cyber criminals, Information warfare.

Cyber Crime Illustrations: Indian banks lose millions of rupees, Justice vs. Justice, Parliament attack, The Indian case of online gambling, Bank and credit card related frauds, Purchasing goods and services scam, Nigerian 419 scam.

Total Periods: 45

EXPERIENTIAL LEARNING

1. The Cyber Security Risks on Social Media – Learn from Case Studies:
<https://www.rswebsols.com/tutorials/internet/cyber-security-risks-social-media>
2. SIX automates key cybersecurity tasks to actively protect itself against social media threats: <https://www.hootsuite.com/resources/six-group-case-study>
3. Important Cyber Law Case Studies : <https://www.cyberralegalservices.com/detail-casestudies.php>

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Nina Gobole, Sunit Belapure, *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Wiley India, 2011.

REFERENCE BOOKS:

1. Prashant Mali, *Cyber Law and Cyber Crimes*, Snow White Publications Pvt. Ltd., 2013.
2. Alfred Basta and et al, *Cyber Security and Cyber Laws*, Cengage Learning India 2018

VIDEO LECTURES:

1. Learn Cyber Security | Cyber Security Training:
<https://www.youtube.com/watch?v=PIHnamdwGmw>
2. Cyber Security For Beginners: <https://www.youtube.com/watch?v=4RE4d23tDFw>

Web Resources:

1. <https://study.com/academy/course/computer-science-110-introduction-to-cybersecurity.html>
2. <https://www.pandasecurity.com/en/mediacenter/panda-security/types-of-cybercrime/>
3. <https://mediasmarts.ca/digital-media-literacy/digital-issues/cyber-security/cyber-security-spam-scams-frauds-identity-theft>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EE101701	ELECTRICAL SAFETY AND SAFETY MANAGEMENT	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: The course deals with the various aspects of potential risk due to electrical shock; safety precautions to be followed while working in hazardous zones; safe practices while handling various electrical equipment and during maintenance; and relevant electrical safety standards and Indian rules and acts.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand the Indian electricity rules, regulations and various standards to be maintained for the safety of life and equipment.
- CO2** Understand the potential effects of electrical shock and safety measures to protect against such risk.
- CO3** Understand the safety aspects and safe practices to be followed while installing residential, commercial, and agricultural appliances.
- CO4** Identify various hazardous working zones and take necessary precautionary measures while working in such areas.
- CO5** Follow safety measures during installation, testing and commissioning, and maintenance of electrical equipment/plant.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	--	--	--	1	3	1	3	--	--	--	1
CO2	3	--	--	--	1	2	2	--	--	--	--	1
CO3	3	--	--	--	1	2	2	--	--	--	-	1
CO4	3	--	--	--	2	3	2	2	--	--	--	1
CO5	3	--	--	--	--	3	2	2	--	--	--	1
Course Correlation Mapping	3	--	--	--	1	3	2	3	--	--	--	1

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INDIAN ELECTRICITY RULES AND ACTS, AND THEIR SIGNIFICANCE (10 Periods)

OSHA standards of electrical safety, Basic electrical safety rules as per OSHA; Objectives and scope of IE acts and IE rules, Ground clearance and Section Clearances, Clearance in transmission and distribution lines, Significance of Equipment Earthing, Earthing of equipment bodies, structures and non-current carrying metallic parts, Earthing of system neutral; Rules regarding first aid and firefighting facility, Electrical safety general requirements as per IE rules.

Module 2: INTRODUCTION TO ELECTRICAL SAFETY AND SAFETY MANAGEMENT (10 Periods)

Electric Safety: Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, Protection against electrical hazards and types, Effect of current on the human body, Principles of electrical safety and approach to prevent accidents.

Electric shocks and its prevention: Primary and secondary electrical shocks, possibilities of getting an electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, Safety precautions in LV installations and electric plant.

Module 3: ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL, AND AGRICULTURAL INSTALLATIONS (08 Periods)

Introduction—Wiring and fitting; Domestic appliances—water tap giving a shock, shock from wet wall, fan firing shock; Multi-storied building, Temporary installations, Agricultural pump installation; Do's and Don'ts for safety in the use of domestic electrical appliances; Principles of safety management in electrical plants, safety auditing, and economic aspects.

Module 4: ELECTRICAL SAFETY IN HAZARDOUS AREAS (07 Periods)

Hazardous zones—class 0, 1 and 2; Sparks, flashovers and corona discharge in electrical plants; equipment for hazardous locations; scope for live line work, principles of live line maintenance, special tools for live line maintenance, safety instructions for working on HV lines/apparatus.

Module 5: SAFETY DURING INSTALLATION TESTING AND MAINTENANCE (10 Periods)

Safety during installations: Preliminary preparations, preconditions for the start of installation work and safe sequence, safety aspects during installations of Transformers and Rotating machines.

Safety during testing: Purpose of commissioning checks and tests, equipment tests, high voltage energization tests, performance and acceptance tests, and safety aspects during commissioning.

Safety during maintenance: Operators' safety, Types of safety maintenance, Safety procedures, safety precautions during maintenance, and planning of maintenance.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Study and submit a report on various electrical safety standards followed in abroad countries.
2. Visit a nearby industry and submit a report on various safety measures followed in the industry.
3. Study and submit a report on standard practices followed during the maintenance/commissioning of the electrical apparatus in any industry.
4. Collect information about various safety/alert sign boards and the relative measures for a particular situation.
5. Should practice preliminary first aid assistance such as Cardiopulmonary resuscitation (CPR) and shall demonstrate.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Rao, Prof. H.L. Saluja, *Electrical Safety, Fire Safety Engineering and Safety Management*, Khanna Publishers. New Delhi, 2nd Edition, 2018 Reprint.

REFERENCE BOOKS:

1. Cadick, John, Mary Capelli-Schellpfeffer, and Dennis K. Neitzel, *Electrical safety Handbook*, McGraw-Hill Education, 2012.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=g-ofq7i_u48

Web Resources:

1. <https://cercind.gov.in/Act-with-amendment.pdf>
2. <https://www.edapp.com/blog/electrical-safety-training-topics/>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22MG101701	ENTREPRENEURSHIP FOR MICRO, SMALL AND MEDIUM ENTERPRISES	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: To understand the setting up and management of MSMEs and initiatives of Government and other institutions support for growth and development of MSMEs

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand the basic of SME and challenges of MSMEs
- CO2** Explain the opportunities to Set-Up SSI/SME Units and role of rural & women entrepreneurship.
- CO3** Illustrate roles of various institutions supporting MSMEs.
- CO4** Understand Management of MSME, NPA & sickness units
- CO5** Evaluate role of Government in Promoting Entrepreneurship

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	-	-	-	-	-	-	-
CO2	1	1	2	-	-		2		1			-
CO3	2	2	1	-	-	-	-	1	-	-	2	
CO4	3	1	2	-	-	-	-	-	-	-	-	2
CO5	2	2	1	-	-	1	-	-	-	-	-	1
Course Correlation Mapping	2	2	2	2	1	1	2	1	1	-	2	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Introduction2

(07 Periods)

Concept & Definition, Role of Business in the modern Indian Economy SMEs in India, Employment and export opportunities in MSMEs. Issues and challenges of MSMEs

Module 2: MSME Setting

(09 Periods)

Identifying the Business opportunity, Business opportunities in various sectors, formalities for setting up an enterprise - Location of Enterprise - steps in setting up an enterprise - Environmental aspects in setting up, Incentives and subsidies.

Module 3: MSMEs Supporting Institutions

(09 Periods)

Forms of Financial support, Long term and Short term financial support, Sources of Financial support, Development Financial Institutions, Investment Institutions, Central level institutions, State level institutions, Other agencies, Commercial Bank - Appraisal of Bank for loans

Module 4: Management of MSME

(10 Periods)

Management of Product Line; Communication with clients - Credit Monitoring System - Management of NPAs - Restructuring, Revival and Rehabilitation of MSME, Problems of entrepreneurs - sickness in SMI - Reasons and remedies -- Evaluating entrepreneurial performance

Module 5: Entrepreneurship Promotion

(10 Periods)

MSME policy in India, Agencies for Policy Formulation and Implementation: District Industries Centers (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship & Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB)

Total Periods: 45

EXPERIENTIAL LEARNING

1. Present a case study on MSMEs Business Strategies.
2. Collect the data about nearby MSMEs and Present their structures in a PPT
3. Discuss in the group MSMEs opportunities in terms of Orientation and Development.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Vasant Desai, *Small Scale Industries and Entrepreneurship*, Himalaya Publishing House, 2003..
2. Poornima M Charanthimath, *Entrepreneurship Development Small Business Enterprises*, Pearson, 2006.

REFERENCE BOOKS:

1. Suman Kalyan Chaudhury, *Micro Small and Medium Enterprises in India Hardcover*, Raj Publications, 2013.
2. Aneet Monika Agarwal, *Small and medium enterprises in transitional economies, challenges and opportunities*, DEEP and DEEP Publications
3. Paul Burns & Jim Dew Hunt, *Small Business Entrepreneurship*, Palgrave Macmillan publishers, 2010.

VIDEO LECTURES:

1. <https://sdgs.un.org/topics/capacity-development/msmes>
2. <https://blog.tatanexarc.com/msme/msme-schemes-in-india-for-new-entrepreneurs-and-start-ups/>

Web Resources:

1. ncert.nic.in/textbook/pdf/kebs109.pdf
2. <https://www.jetir.org/papers/JETIR1805251.pdf>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101702	ENVIRONMENTAL POLLUTION AND CONTROL	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on fundamentals of air pollution, dispersion of pollutants, effects and control of air pollution, water pollution, soil pollution and control, and municipal solid waste management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze air and noise pollution using appropriate tools and techniques to solve complex environmental issues following relevant standards considering society, environment and sustainability besides communicating effectively in graphical form.
- CO2** Analyze air and noise pollution control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.
- CO3** Analyze water pollution and its control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.
- CO4** Analyze soil pollution and its control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.
- CO5** Analyze solid waste and its management measures using appropriate tools and techniques to solve solid waste disposal issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	2	2	3	3	2	-	1	-	-
CO2	2	3	-	2	2	3	3	2	-	1	-	1
CO3	2	3	-	2	2	3	3	2	-	1	-	1
CO4	2	3	-	2	2	3	3	2	-	1	-	1
CO5	2	3	-	2	2	3	3	2	-	1	1	1
Course Correlation Mapping	2	3	2	2	2	3	3	2	-	1	1	1

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: AIR AND NOISE POLLUTION

(08 Periods)

Air Pollution: Scope, Significance, Classification, Sources – Line, Area, Stationary, Mobile; Effects of air pollutants on man, material and vegetation; Global effects of air pollution; Air pollution meteorology - Lapse rate, Inversion, Plume pattern; Dispersion of air pollutants - Dispersion models and applications; Ambient air quality standards.

Noise Pollution: Sound pressure, Power and intensity, Impacts of noise, permissible limits of noise pollution, measurement of noise, Noise standards.

Module 2: AIR AND NOISE POLLUTION CONTROL

(10 Periods)

Self-cleansing properties of the environment, Dilution method, Control at source, Process changes and equipment modifications, Control of particulates – Types of equipment, Design and operation - Settling chambers, Centrifugal separators, Bag house filters, Wet scrubbers, Electrostatic precipitators; Control of gaseous pollutants – Adsorption, Absorption, Condensation, Combustion; Control of air pollution from automobiles, Control of noise pollution, Case studies, Latest developments in the air and noise pollution control.

Module 3: WATER POLLUTION AND CONTROL

(10 Periods)

Water pollution – Sources, Causes, Effects; Surface and groundwater quality – Physical, Chemical, Biological; Drinking water quality standards, Water purification – Processes, Engineered systems – Aeration, Solids separation, Settling operations, Coagulation, Softening, Filtration, Disinfection; Wastewater – Sources, Causes, Effects, Treatment process and disposal – Primary, Secondary, Tertiary; Case studies, Latest developments in the water pollution control.

Module 4: SOIL POLLUTION AND CONTROL

(08 Periods)

Soil pollutants, Sources of soil pollution, Causes, Effects and control of soil pollution, Diseases caused by soil pollution, Methods to minimize soil pollution, Effective measures to control soil pollution, Soil quality standards, Case studies, Latest developments in the soil pollution control.

Module 5: MUNICIPAL SOLID WASTE MANAGEMENT

(09 Periods)

Municipal solid waste – Types, Composition and characteristics; Methods of collection and transportation; Methods of disposal – Open dumping, Sanitary landfill, Composting and Incineration; Utilization - 6R Concept, Recovery and recycling and Energy Recovery; Latest developments in solid waste management.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Explain plume patterns due to air pollution and meteorology effects and draw a neat sketch of plume pattern from any chimney that you have observed in recent times.
2. Compare the different air pollution control equipment used in India and draw a neat sketch line diagram of equipment you have seen in any of your industrial visit.
3. Submit a study report on Coagulation, Flocculation, Sedimentation, Filtration and Disinfection in your own words after watching a YouTube video on water treatment.
4. Enumerate the effective measures to control soil pollution with any two case studies.

5. Submit a report on case studies on the use of 6Rs concept of Municipal Solid Waste Management.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Peavy, H. S, Rowe, D. R., and Tchobanoglous, G., *Environmental Engineering*, McGrawHill Inc., 1985.
2. C. S. Rao, *Environmental Pollution Control Engineering*, New Age International Pvt.Ltd., 2nd Edition, 2007.
3. Ibrahim A. Mirsa, *Soil Pollution: Origin, Monitoring & Remediation*, Springer, UK, 2nd Edition, 2008.

REFERENCE BOOKS:

1. M. N. Rao and H. V. N. Rao, *Air Pollution*, Tata McGraw–Hill Education Pvt. Ltd., 19th Edition, 2010.
2. Daniel Vallero, *Fundamentals of Air Pollution*, Academic Press (Elsevier), 5th Edition, 2014.
3. S. M. Khopkar, *Environmental Pollution Monitoring and Control*, New Age International Pvt. Ltd., 2nd Edition, 2007.
4. V. M. Domkundwar, *Environmental Engineering*, Dhanpat Rai & Co. Pvt. Ltd., New Delhi, 2014.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/123/105/123105001/>
2. <https://archive.nptel.ac.in/courses/105/107/105107213/>
3. <https://archive.nptel.ac.in/courses/103/107/103107084/>

Web Resources:

1. <https://www.lkouniv.ac.in/site/writereaddata/siteContent/202005012116016435Ranvijay-Pratap-Singh-Environmental-Pollution.pdf>
2. [https://www.deshbandhucollege.ac.in/pdf/resources/1585622878_HIST_\(HONS.\)_II_Env-Pollution.pdf](https://www.deshbandhucollege.ac.in/pdf/resources/1585622878_HIST_(HONS.)_II_Env-Pollution.pdf)
3. https://www.jica.go.jp/jica-ri/IFIC_and_JBICI-Studies/english/publications/reports/study/topical/health/pdf/health_08.pdf
4. https://www.iitr.ac.in/wfw/web_ua_water_for_welfare/education/proceeding_of_short-term_training/diploma/Environmental_Sciences_May_24-28_2007/Lecture_notes/Env_Pollution-rb.pdf
5. https://anits.edu.in/online_tutorials/es/Unit%203.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101702	ESSENTIALS OF VLSI	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course contains the topics that make student realize the need for Testing. The various types of testing along with Fault Modeling. Test methods for evaluation and test generation algorithms, Delay Tests, IDDQ Tests for testing the circuits , Ad-Hoc DFT Methods, Scan Based Designs, Built-In Self Test.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand the importance of Testing, fault models and related theorems.
- CO2** Analyze various test methods as applicable to digital circuits.
- CO3** Appraise the various combinational and sequential circuit test generation algorithms for functional verification of digital circuits
- CO4** Assess delay test algorithms and IDDQ test algorithms for at-speed testing of CMOS Integrated Circuits.
- CO5** Recognize the concepts and architectures for Built-In Self Test to satisfy industry specifications.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					-	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	
CO3	3	3	2	2	2	-	-	-	-	-		-
CO4	3	3	2	2	2	-	2	3	-	-	-	-
CO5	3	-	-	-	-	-	-	3	-	-	-	-
Course Correlation Mapping	3	3	2	2	2	-	2	3	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO VLSI

(09 Periods)

Levels of Abstraction, VLSI Design Flow, MOS Transistor - Characteristics, $I_{DS} - V_{DS}$ Relation, NMOS and CMOS Logic – Logic Gates Design, NMOS and CMOS Fabrication Process.

Module 2: CMOS CIRCUIT DESIGN PROCESS

(10 Periods)

MOS Layers, Stick Diagrams, NMOS and CMOS Design Styles, Lambda based Design Rules, NMOS and CMOS Layouts for Inverter and Universal Gates, Sheet Resistance, Capacitance and Delay Calculations, Effects of Scaling.

Module 3: SUBSYSTEM DESIGN

(11 Periods)

Adders – Manchester Carry Chain Adder, Carry Look Ahead Adder, Carry Select Adder, Carry Skip adder, Barrel Shifter, Multiplier – Array Multiplier, Booth Multiplier.

Module 4: PROGRAMMABLE HARDWARE

(06 Periods)

Design Styles, Programmable Interconnects, Field Programmable Gate Arrays, Complex Programmable Logic Devices, Cell based Design Methodology.

Module 5: DESIGN FOR TESTABILITY

(09 Periods)

Ad-Hoc DFT Methods, Full Scan Design, Partial Scan Design, Random Logic BIST – Test-per-Clock and Test-per-Scan BIST Systems; Boundary Scan Standard – TAP Controller and Port.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Develop and Illustrate D – algorithm for Sequential Circuits.
2. Illustrate the applicability of existing testing algorithms for circuits with multiple stuck-at-faults.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Michael L. Bushnell, Vishwani D. Agrawal, *Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits*, Kluwer Academic Publishers, Springer US, New York, 2006.

REFERENCE BOOKS:

1. Miron Abramovici, Melvin A. Breur, Arthur D. Friedman, *Digital Systems Testing and Testable Design*, Wiley, Jaico Publishing House, 1st Edition, 2001.
2. Alfred L. Crouch, *Design for Test for Digital ICs & Embedded Core Systems*, Pearson Education, 1st Reprint Edition, 2007.
3. Robert J. Feugate, Jr., Steven M. McIntyre, *Introduction to VLSI Testing*, Prentice Hall, 1st Illustrated Edition, 1998.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/117105137>
2. <https://nptel.ac.in/courses/117103125>
3. <https://nptel.ac.in/courses/106103016>

Web Resources:

1. <https://www.electronics-tutorial.net/vlsi-design-for-testability/IC-Testing.html>
2. <https://alexromanov.github.io/2022/08/14/what-is-testability/>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101702	INTRODUCTION TO ETHICAL HACKING	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on ethical hacking overview, role of security and penetration testers, foot printing, reconnaissance and scanning networks, enumeration and vulnerability analysis, system hacking, network protection systems.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand and recognize role of security and penetration testers to protect the system from malware attacks.
- CO2** Apply the foot printing tools to find the vulnerabilities in the system.
- CO3** Analyze vulnerabilities to find the system security loopholes or flaws in networked systems within a given range of IP
- CO4** Apply the web attackers tools to assess the website's security
- CO5** Identify the possible incidents and threats, alert administrators, and prevent potential attacks using IDS

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-
CO5	3	2	3	2								
Average	3	3	3	2								
Course Correlation Mapping	3	3	3	2								

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION

(10 Periods)

Ethical Hacking Overview, Role of Security and Penetration Testers .Penetration, Testing Methodologies, Laws of the Land, Overview of TCP/IP, The Application Layer, The Transport Layer, The Internet Layer, IP Addressing, Network and Computer Attacks, Malware, Protecting Against Malware Attacks, Intruder Attacks, Addressing Physical Security.

Module 2: FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS

(09 Periods)

Foot printing Concepts, Foot printing through Search Engines, Web Services, Social Networking Sites, Website, Email, Competitive Intelligence, Foot printing through Social Engineering, Foot printing Tools, Network Scanning Concepts, Port-Scanning Tools, Scanning Techniques, Scanning Beyond IDS and Firewall

Module 3: ENUMERATION AND VULNERABILITY ANALYSIS

(09 Periods)

Enumeration Concepts, NetBIOS Enumeration, SNMP, LDAP, NTP, SMTP and DNS Enumeration, Vulnerability Assessment Concepts, Desktop and Server OS Vulnerabilities, Windows OS Vulnerabilities, Tools for Identifying Vulnerabilities in Windows, Linux OS Vulnerabilities, Vulnerabilities of Embedded Oss.

Module 4: SYSTEM HACKING

(10 Periods)

Hacking Web Servers, Web Application Components, Vulnerabilities, Tools for Web Attackers and Security Testers Hacking Wireless Networks, Components of a Wireless Network, Wardriving, Wireless Hacking, Tools of the Trade.

Module 5: NETWORK PROTECTION SYSTEMS

(07 Periods)

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

Total Periods: 45

EXPERIENTIAL LEARNING

1. List out various ways used to Protect Yourself from Hackers.
2. Demonstrate how do White Hackers work?
3. Demonstrate The bug bounty program.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Michael T. Simpson, Kent Backman, and James E. Corley, *Hands-On Ethical Hacking and Network Defense, Course Technology*, Delmar Cengage Learning, 2010.
2. Patrick Engebretson, *The Basics of Hacking and Penetration Testing*, SYNGRESS, Elsevier, 2013.

REFERENCE BOOKS:

1. Dafydd Stuttard and Marcus Pinto, *The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws*, Wiley, 2nd Edition, 2011.
2. Justin Seitz, *Black Hat Python: Python Programming for Hackers and Pentesters*, 2nd Edition, 2014.

VIDEO LECTURES:

1. <https://www.coursera.org/learn/ethical-hacking-essentials-ehe>
2. <https://www.udacity.com/course/ethical-hacker-nanodegree--nd350>

Web Resources:

1. <https://github.com/PacktPublishing/Python-Ethical-Hacking>
2. <https://www.youtube.com/watch?v=x3IwvPvDpKE>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101703	FORENSIC SCIENCE	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of Forensic Science, Tools and Techniques in Forensic Science, Forensic Photography, Crime Scene Management, Crime Scene Management Laws and Forensic Science.

COURSE OUTCOMES: *After successful completion of the course, students will be able to:*

- CO1** Understand the basic concepts of Forensic science.
- CO2** Apply various tools and techniques in forensic science for crime investigation.
- CO3** Understand Forensic Photography fundamentals.
- CO4** Perform Crime scene investigation, scene reconstruction and prepare reports.
- CO5** Understand Legal aspects of Forensic Science.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3	3	2	2	2							
CO3	3	3										
CO4	3	3	2	2	2							
CO5	3	3	2	2	2							
Course Correlation Mapping	3	3	2	2	2							

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION

(09 Periods)

Introduction, Need, Scope, Concepts and Significance of Forensic Science, History and Development of Forensic Science, Laws and Basic principles of Forensic Science, Branches of forensic science, Organizational set-up of a Forensic Science Laboratory. Investigative strategies. Expert testimony and eye-witness report.

Module 2: TOOLS AND TECHNIQUES IN FORENSIC SCIENCE

(09 Periods)

Basic principles of microscopy, spectroscopy, chromatography, Electrophoresis, Enzyme_Linked Immunosorbent Assay (ELISA), Radio Immuno Assay (RIA). Measuring and optical instruments. Research methodologies; Formation of research design on a specific problem. Central tendency and Dispersion. Test of significance. Analysis of variance, Correlation and Regression.

Module 3: FORENSIC PHOTOGRAPHY

(8 Periods)

Basic principles of Photography, Techniques of black & white and color photography, cameras, lenses, shutters, depth of field, film; exposing, development and printing techniques; Different kinds of developers and fixers; UV, IR, fluorescence illumination guided photography; Modern development in photography- digital photography, working and basic principles of digital photography; Surveillance photography. Videography and Crime Scene & laboratory photography.

Module 4: CRIME SCENE MANAGEMENT

(11 Periods)

Crime scene investigations, protecting and isolating the crime scene; Documentation, sketching, field notes and photography. Searching, handling and collection, preservation and transportation of physical evidences, Chain of custody and Reconstruction of scene of crime. Report writing.

Module 5: LAW AND FORENSIC SCIENCE

(8 Periods)

Legal aspects of Forensic Science: Forensic Science in the Criminal Justice System, The Criminal Investigation Process, Production of Evidence: The Subpoena, The Rules of Evidence, Authentication of Evidence: The Chain of Custody, The Admissibility of Evidence, Laboratory Reports, Examples of Analysis and Reports, Expert Testimony, Getting into Court, Testifying, Being a Witness and an Expert, Considerations for Testimony.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Study of Computer Forensics and different tools used for forensic investigation
2. Identify and list the steps for hiding and extract any text file behind an imagefile/ Audio file using Command Prompt

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Houck M.M and Siegel J.A, *Fundamentals of Forensic Science*, Elsevier, 2nd edition, 2010.
2. Sharma B.R, *Forensic Science in Criminal Investigation and Trials*, Universal PublishingCo., New Delhi, 2003.

REFERENCE BOOKS:

1. Nanda B.B and Tewari, R.K, *Forensic Science in India- A vision for the Twenty First Century*, Select Publisher, New Delhi, 2001.
2. James, S.H and Nordby, J.J, *Forensic Science- An Introduction to Scientific and Investigative Techniques*, CRC Press, USA, 2003.
3. Saferstein, Criminalistics, *An Introduction of Forensic Science*, Prentice Hall Inc, USA, 2007.
4. Barry, A.J. Fisher, *Techniques of Crime Scene Investigation*, CRC Press, NewYork, 7th edition, 2003.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106106178>
2. <https://www.youtube.com/watch?v=X5fo1H7bc0g>

Web Resources:

1. <https://www.nist.gov/forensic-science>
2. <https://www.coursera.org/learn/forensic-science>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101702	GENDER AND ENVIRONMENT	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Gender and the environment relationship, Gendered Roles in the Family & Community, Gender and sustainable development, Gender in environmental justice, Gender & Environmental Security.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Apply the knowledge of gender & environmental connections by analyzing key issues and topics within global environmental politics in environmental decision-making.
- CO2** Demonstrate knowledge of the concepts of gender and sustainable development through debates and policy documents.
- CO3** Analyze the concept of environmental security and justice by identifying the sources of insecurity.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	3	3	-	-	-	-	-
CO2	3	-	-	-	-	2	3	1	-	2	-	-
CO3	3	1	-	-	-	3	3	-	-	-	-	2
Course Correlation Mapping	3	1	-	-	-	3	3	1	-	2	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: GENDER AND ENVIRONMENT RELATIONSHIP (09 Periods)

Introduction – Gender and Environment – Development of gender roles – Society, gender & environment – Understanding environmental politics – Gender-environment connections– Eco-feminism – Cultural eco-feminism – Social eco-feminism – Feminist political ecology

Module 2: GENDERED ROLES IN THE FAMILY & COMMUNITY (09 Periods)

Organization of the household – Domestic division of labour – Food: growing, harvesting, shopping, preparing, and cooking

Gender & Power – Planning – Politics – NGO – Gendering of environmental protest – Environmental decision-making

Module 3: GENDER AND SUSTAINABLE DEVELOPMENT (09 Periods)

Concept of sustainability & its achievement – Concept of sustainable development – Ecological Modernization – Gender & sustainability debates – Gender & sustainable development debates – Gender in policy documents – Gender, poverty & equity in sustainable development

Module 4: GENDER IN ENVIRONMENTAL JUSTICE (09 Periods)

Normative Concerns (Fairness, Inequality & Justice) –Making sense of Environmental justice – Ecological debt, Transnational harm, & human rights – Ecological justice – Gender &Environmental Justice – Gender, Vulnerability & risk – Women in environmental justice movements – Knowledge & participation – Gender, sustainability & justice as guiding concepts.

Module 5: GENDER AND ENVIRONMENTAL SECURITY (09 Periods)

Connections between security & the environment – **Gender, environment & security:** Sustainability as security – poverty & insecurity – Insecurity as injustice – Competing waysof thinking security – Reflecting on sources of insecurity – **Case Study** – Food Security - **Case Study** – The impacts of natural disasters

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a poster presentation on the impact of globalization on family structure and society.
2. Prepare a presentation on the family setup of different countries and their peculiar customs.
3. Prepare poster presentation on "Ancient hominin walked like a human but climbed like an ape."
4. Find out the problems of present society and being part of future generations how you may help to strengthen environmental security.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Nicole Detraz, *Gender and the Environment*, Polity Press, Cambridge, UK. 2017
2. Susan Buckingham- Hatfield, *Gender and Environment*, Routledge, London. 2000

REFERENCE BOOKS:

1. Promillakapur ed., *Empowering Indian Women*, Publication Division, Government of India, New Delhi. 2000.
2. Ronnie Vernooy, Ed., *Social and Gender Analysis Natural Resource Management: Learning Studies and Lessons from Asia*, Sage, New Delhi. 2006
3. Swarup Hemlata and Rajput, Pam, *Gender Dimensions of Environmental and Development Debate: The Indian Experience*, In Sturat S. Nagel, (ed). *India's Development and Public Policy*. Ashgate, Burlington. 2000

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101701	GLOBAL STRATEGY AND TECHNOLOGY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Introduction to strategic management; Strategic management process; Principles of good strategy; Globalization strategies; Research and Development strategies; Technology Management and Transfer; Elements of Transfer Process; Corporate Governance in the Indian scenario.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate the knowledge on strategic management, its approaches, and tools through ethical decision making.
- CO2** Analyse the globalization challenges for scrupulous selection of globalization strategies.
- CO3** Apply the R&D strategies and trends to enhance the technological breakthroughs for new products and applications.
- CO4** Demonstrate the knowledge on technology management and transfer that strengthen the economy and accelerate the application of technology and resources.
- CO5** Analyze the challenges of corporate governance in Indian scenario for the effective development of value-oriented organizations.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	1	1	-	1	-	-	1	-
CO2	3	2	1	-	1	1	-	-	-	-	1	-
CO3	3	2	1	-	1	1	-	-	-	-	1	-
CO4	3	2	1	-	1	1	-	-	-	-	1	-
CO5	3	2	1	-	1	1	-	1	-	-	1	-
Course Correlation Mapping	3	2	1	-	1	1	-	1	-	-	1	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: STRATEGIC MANAGEMENT

(09 Periods)

Introduction, Classes of decisions, Levels of strategy, Core competence, Strategic intent and stretch, Approaches to strategy making, Roles of different strategists, Strategic Management-Process, Benefits, Limitations; Ethics in strategic decision making, Principles of good strategy, Strategic Management in India; Common managerial strategy formulation tools.

Module 2: GLOBALIZATION

(09 Periods)

Definition, Stages, Essential conditions for globalization, Globalization strategies, Competitive advantage of Nations and regions, Factors affecting Globalization, Globalization of Indian business.

Module 3: RESEARCH & DEVELOPMENT STRATEGIES

(09 Periods)

Concept, Evolution of R and D Management, R and D as a business, R and D as competitive advantage, Elements of R and D strategies, Integration of R and D, Selection and implementation of R and D strategies, R and D trends and challenges.

Module 4: TECHNOLOGY MANAGEMENT AND TRANSFER

(09 Periods)

Technology Management: Introduction, Technology-Definition, Components, Classification Features; Technology Management-Concept, Nature; Drivers of Management of Technology-Significance, Scope, Responding to technology challenges.

Technology Transfer: Introduction, Definition, Classification, Significance, Elements of process, Types of Technology Transfer, Package, Modes of Transfer, Routes, Channels and Effectiveness of Technology Transfer.

Module 5: CORPORATE GOVERNANCE: THE INDIAN SCENARIO

(09 Periods)

Emergence of corporate governance in India-Landmarks, Models, Codes and status in India, Role and Responsibilities of Regulators, The Board of Directors; Corporate Governance- Specific issues in India, Family-owned Business, Corporate Governance and the Indian ethos.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Case studies: Using real-world examples of global businesses and their technological strategies, students can examine the challenges and opportunities presented by different markets and technologies. This can involve analyzing data, conducting market research, and making decisions based on their findings.
2. Simulation games: Students can participate in simulation games that allow them to make decisions about global strategy and technology in a virtual environment. This can help them understand the complexities of international business, such as navigating different cultures, regulations, and economic systems.
3. Industry partnerships: Partnerships with technology companies and global businesses can provide students with hands-on experience in global strategy and technology. This can include internships, shadowing, or working on real projects with industry professionals.
4. Project-based learning: Students can work on real-world projects that require them to apply their knowledge of global strategy and technology. This can include developing a business plan for a new product or service, designing a marketing campaign for a global audience, or analyzing the impact of a new technology on a specific industry.
5. Field trips: Visiting international businesses or attending technology conferences can provide students with a first-hand look at global strategy and technology in action. This can help them understand the challenges and opportunities of different markets and technologies, as well as connect with industry professionals.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

CASE STUDIES:

1. Tesla: Can Elon Musk's electric car company succeed globally?
2. Uber: How the ride-sharing giant is expanding its global footprint.
3. Alibaba: How China's e-commerce giant is competing on the global stage.
4. Airbnb: How the home-sharing platform is disrupting the global hotel industry.
5. Netflix: How the streaming service is expanding globally and adapting to local markets.

ARTICLES:

1. "Digital Transformation: Why it Matters for Global Business" by Forbes
2. "How AI is Changing Global Business Strategy" by Harvard Business Review
3. "The Future of Globalization: Exploring the Role of Technology" by World Economic Forum
4. "Globalization 4.0: What it Means for Technology and Strategy" by McKinsey & Company
5. "How Technology is Transforming Global Supply Chains" by MIT Sloan Management Review

RESOURCES

TEXT BOOKS:

1. Francis Cherunilam, *Strategic Management*, Himalaya Publishing House, 3rd Edition, 2002.
2. C. S. G. Krishnamacharyulu and Lalitha Ramakrishnan, *Management of Technology*, Himalaya Publishing House, Second Edition, 2012.

REFERENCE BOOKS:

1. White and Bruton, *The Management of Technology and Innovation: A Strategic Approach*, Cengage Learning, 1st Edition, 2007.
2. S.K.Mandak, *Ethics in Business and Corporate Governance*, TMH, 2nd Edition, 2012.

VIDEO LECTURES:

1. <https://www.digimat.in/nptel/courses/video/110106157/L01.html>
2. <https://www.digimat.in/nptel/courses/video/110106157/L43.html>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EE101704	GREEN TECHNOLOGIES	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on green technology concepts, the role of industry and government in establishing green energy footprints and cleaner development mechanisms. It also presents energy-efficient and sustainable green production systems, concepts of energy ecosystems, and concepts of green buildings.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Understand the green technology concepts and the consequences of greenhouse gas emissions.
- C02** Acquire basic knowledge on cleaner development mechanism, the importance of re-use of materials, and the oxidation technology for wastewater.
- C03** Go beyond energy-efficient machinery, biofuels, and environmentally friendly materials.
- C04** Acquire basic knowledge on man-made ecosystems, sources, and control of pollution.
- C05** Understand the concepts and requirements for green buildings.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	3	-	-	-	-	1
C02	3	-	-	-	-	-	3	-	-	-	-	1
C03	3	-	-	-	-	-	3	-	-	-	-	1
C04	3	-	-	-	-	-	3	-	-	-	-	1
C05	3	-	-	-	-	-	3	-	-	-	-	1
Course Correlation Mapping	3	-	-	-	-	-	3	-	-	-	-	1

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO GREEN TECHNOLOGY (09 Periods)

Green technology-definition, importance, factors affecting green technology. Global atmosphere- green house gases, global warming, acid rain, ozone depletion and photochemical smog. Role of industry, government and institutions; industrial ecology, role of industrial ecology in green technology.

Module 2: CLEANER DEVELOPMENT TECHNOLOGIES (08 Periods)

Cleaner development mechanisms, role of industry; reuse, reduce and recycle, raw material substitution; wealth from waste; carbon credits, carbon trading, carbon sequestration, eco labeling. Oxidation technology for wastewater treatment - cavitation, fenton chemistry, photocatalysis and hybrid processes.

Module 3: ENERGY EFFICIENT SYSTEMS AND PROCESSES (09 Periods)

Energy efficient motors, energy efficient lighting, control and selection of luminaries; bio-fuels, fuel cells- working, selection of fuels, Green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of sustainable green production systems.

Module 4: ENERGY ECOLOGY AND ENVIRONMENT (08 Periods)

Concept and theories of ecosystems - energy flow in major manmade ecosystems- agricultural, industrial and urban ecosystems - sources of pollution from energy technologies and its impact on atmosphere - air, water, soil, and environment - environmental laws on pollution control - innovation and sustainability: - eco-restoration / phyto-remediation, renewable energy technologies, industrial ecology and agro ecology.

Module 5: GREEN BUILDINGS (10 Periods)

Definition- Features and benefits, Fundamental planning decisions for energy efficient building- site selection, buildings forms and orientations, building fabrics and insulation, ventilation, passive solar features. Eco-friendly and cost effective materials, energy management. Rooftop solar photovoltaic system and solar tracking system, alternating roofing systems.

Total Periods: 45

EXPERIENTIAL LEARNING

1. The student shall prepare a report on the causes of global warming and should suggest possible remedies for reducing the global warming
2. The student shall prepare a report on the wastewater management system.
3. The student shall prepare a report on controlling pollution in the environment.
4. The student shall observe the various considerations in a greenhouse building and should prepare the report on the observations made and should suggest possible avenues for improvement.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

RESOURCES

TEXT BOOKS:

1. Khan B.H, *Non conventional energy resources*, Tata McGraw-Hill, New Delhi 2006.
2. Paul L. Bishop, *Pollution prevention –Fundamentals and Practices*, McGraw-Hill-international 2000.

REFERENCE BOOKS:

1. P. Aarne Vesilind, *Introduction to environmental engineering*, Cenage Learning 2010.
2. Joseph A. Salvato, *Environmental engineering*, Wiley
3. Tom D Reynolds, *Unit operations and processes in environmental engineering*, PWS Publishing.
4. D. Y. Goswami, F. Kreith and J. F. Kreider, *Principles of Solar Engineering*, Taylor and Francis.
5. C. S. Solanki, *Solar Photovoltaics: Fundamental Applications and Technologies*, Prentice Hall.

Web Resources:

1. N. Vinutha bai, R. Ravindra, Energy efficient and green technology concepts, International Journal of Research in Engineering and Technology p 253-258, Volume: 03 Special Issue: 06, 2014, eISSN: 2319-1163 pISSN: 2321-7308.

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101702	HUMAN RESOURCE MANAGEMENT	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Concepts of HRM; Environmental Scanning; Human Resource Planning; Job analysis; Job design; Job evaluation; Recruitment; Selection; Placement; Orientation; Training and Development; Performance appraisal; Merit rating; Compensation; Industrial relations; Trade unions; Industrial disputes; Ethical issues; Employee safety.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate the knowledge on the principles, processes and practices of human resource management.
- CO2** Analyze the key issues related to administering the human elements such as motivation, recruitment, training and development, compensation, appraisal, and career development.
- CO3** Provide solutions to plan and manage human resource functions effectively within organization.
- CO4** Apply HRM concepts and techniques in strategic planning to improve organizational effectiveness.
- CO5** Evaluate HRM related social, cultural and safe responsibilities and issues in a global context.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	1	-	-	-	-	-	-
CO2	3	3	1	1	-	1	-	-	-	-	-	-
CO3	3	2	3	1	-	-	-	-	-	-	-	-
CO4	2	1	1	1	3	1	-	-	-	-	-	-
CO5	3	1	1	1	1	1	2	3	-	-	-	-
Course Correlation Mapping	3	2	1	1	2	2	2	3				

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO HRM & HRP

(09 Periods)

Introduction to Human Resource Management (HRM): Objectives, Scope and significance of HRM, Functions of HRM, Prospects in HRM, Environmental scanning.

Human Resource Planning (HRP): Introduction, Nature and importance of HRP, Factors affecting HRP, The planning process, Human resource planning and the Government, Requisites for successful HRP, Barriers to HRP.

Module 2: RECRUITMENT AND PLACEMENT

(09 Periods)

Job Analysis – Nature and process of job analysis, Methods of collecting job data, Potential problems with job analysis, Requisites for job analysis; Job Design - Factors, Job design approaches, Contemporary issues; Job evaluation - Process, Methods; Recruitment - Nature, Purposes and importance, Factors governing recruitment, Recruitment process, Evaluation and control; Selection – Nature, Process, Barriers to effective selection, Evaluation of selection process, Placement; Separation.

Module 3: HUMAN RESOURCE DEVELOPMENT AND COMPENSATION

(09 Periods)

Orientation - Orientation programme, Requisites of an effective programme, Evaluation of orientation programme, Problems of orientation; Training and development – Nature, Inputs, Training process, Methods, Impediments to effective training, Management development, Career development, Talent management; Performance Appraisal - Nature, Appraisal process, Challenges of performance appraisal; Merit rating; Compensation - Philosophy, Components, Theories, Factors influencing employee compensation, Challenges, Wage and salary administration.

Module 4: INDUSTRIAL RELATIONS AND TRADE UNIONS

(09 Periods)

Industrial Relations (IR): Nature of IR, Importance of Peaceful IR; Approaches to IR - Unitary Approach, Pluralistic approach, Marxist approach; Parties to IR; IR strategy; Industrial Disputes - Nature, Causes, and Settlement.

Trade unions: Nature of trade unions, Strategic choices before unions, Union tactics, Trade union movement in India, Trends in trade union movement, Managing unions; Indian Factories Act; Employee's compensation Act; Industrial disputes Act.

Module 5: ETHICAL ISSUES AND SAFETY ADMINISTRATION

(09 Periods)

Managing Ethical Issues in HRM: Nature of ethics, Sources of business ethics, Myths about ethics, Ethical dilemmas, HR ethical issues, Managing ethics, Improving ethical decision making.

Employee Safety: Safety, Need for safety, Types of accidents, Safety programme, ISO safety standards.

Total Periods: 45

EXPERIENTIAL LEARNING

1. What are the challenges that are faced by HR in effective performance management including performance appraisal in MNCs? Discuss in detail in the contemporary of HRM.
2. Evaluate employee relations in a comparative perspective across few countries of your choice. Describe in brief by taking a case study.
3. Visit an organization or industry and Evaluate HRM related social, cultural, ethical and environmental responsibilities and issues in a global context.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

RESOURCES

TEXT BOOKS:

1. Aswathappa K, *Human Resource Management*, Tata McGraw Hill Private Limited, 8th edition, 2017.
2. Garry Dessler and Biju Varkkey, *Human Resource Management*, Pearson India, 16th Edition, 2020.

REFERENCE BOOKS:

1. Raymond A. Noe, John R. Hollenbeck, *HRM: Gaining a Competitive Advantage*, TMH, 7th edition, 2010.
2. Bohlander George W, Snell Scott, *Principles of Human Resource Management*, Cengage Learning, 16th edition, 2016.
3. Edwin B. Flippo, *Personnel Management*, McGraw-Hill International editions, 6th edition, 1984.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/122105020>
2. https://onlinecourses.nptel.ac.in/noc20_mg15/preview
3. <https://www.digimat.in/nptel/courses/video/122105020/L01.html>

UNIVERSITY ELECTIVE

Course Code

22SS101703

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

Course Title

INDIAN ECONOMY

L T P S C

3 - - - 3

COURSE DESCRIPTION: Introduction; Elementary Economic Analysis; Economic Planning; Time Value of Money; Value Analysis/Value Engineering.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand the basic concepts of economics, economic analysis, economic planning and strata.
- CO2** Demonstrate knowledge in capital budgeting, evaluation of engineering projects, depreciation policy and familiarize with the concepts of value analysis vs value engineering.
- CO3** Analyze and apply financial information for the evaluation of finance.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	2	-	-	-	-	-	-
CO2	3	-	-	-	-	2	-	-	-	-	-	2
CO3	3	-	-	-	-	2	-	-	-	-	-	2
Course Correlation Mapping	3	-	-	-	-	2	-	-	-	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION

(09 Periods)

Economics-Flow in an Economy, Law of Supply and Demand; Micro and Macro Economics; Relationship between Science, Engineering, Technology and Economic Development; Concept of Engineering Economics-Types of Efficiency, Definition and Scope of Engineering Economics.

Module 2: ELEMENTARY ECONOMIC ANALYSIS

(09 Periods)

Economic Analysis – Meaning, Significance, Simple Economic Analysis; Material Selection for a Product, Substitution of Raw Material; Design Selection for a Product; Material Selection-Process Planning, Process Modification.

Module 3: ECONOMIC PLANNING

(09 Periods)

Introduction - Need For Planning in India, Five-year plans(1951-2012), NITI Aayog (from 2014 onwards); Inclusive Growth-Meaning, Significance, Need for inclusive growth in India, Strategy for more inclusive growth, Challenges and Prospects; Employment and Inclusive Growth in India, Role of engineers in sustaining inclusive growth.

Module 4: TIME VALUE OF MONEY

(12 Periods)

Concepts and Application; Capital Budgeting-Traditional and Modern Methods; Simple and Compound Interest, Cash Flow Diagram, Principle of Economic Equivalence; Evaluation of Engineering Projects - Present Worth Method, Future Worth Method, Annual Worth Method, Internal Rate of Return Method, Cost-benefit Analysis in Public Projects; Depreciation Policy-Depreciation of Capital Assets, Causes of Depreciation, Straight Line Method and Declining Balance Method.

Module 5: VALUE ANALYSIS/VALUE ENGINEERING

(06 Periods)

Introduction-Value Analysis, Value Engineering, Functions, Aims; Value Analysis vs Value Engineering; Value Engineering Procedure- Advantages, Application Areas.

EXPERIENTIAL LEARNING

1. Prepare a poster presentation on the impact of globalization on family structure and society.
2. Prepare a presentation on family setups of different countries and their peculiar customs if any.
3. Prepare a poster presentation on "Ancient hominin walked like a human but climbed like an ape."
4. Find out the problems of present society and being part of future generations and how you may help to strengthen environmental security.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Panneerselvam. R., *Engineering Economics*, PHI Learning Private Limited, New Delhi, 2nd edition, 2013.
2. Jain. T. R., V. K. Ohri, O. P. Khanna., *Economics for Engineers*, VK Publication, 1st edition, 2015.

REFERENCE BOOKS:

1. DuttRudar & Sundhram K. P. M., *Indian Economy*, S. Chand, New Delhi, 62nd revised edition, 2010.
2. Misra, S. K. & V. K. Puri., *Indian Economy: Its Development Experience*, Himalaya Publishing House, Mumbai, 32nd edition, 2010.

UNIVERSITY ELECTIVE

Course Code

22SS101704

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

Course Title

INDIAN HISTORY

L T P S C

3 - - - 3

COURSE DESCRIPTION: Introduction; Ancient India; Classical and Medieval era; Modern India; India after independence.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate contextual knowledge in the evolution of ancient and medieval Indian History and acquire an awareness of societal and cultural transformation.
- CO2** Analyze the situations before and after Independence and assess the societal reforms implemented in India after Independence.
- CO3** Practice culture transformations and appreciate its influence to adapt themselves in global scenarios.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	1	-	-	-	-	-	-
CO2	1	2	-	-	-	1	-	-	-	-	-	-
CO3	1	1	-	-	-	2	-	-	-	-	-	-
Course Correlation Mapping	2	1	-	-	-	2	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO INDIAN HISTORY (08 Periods)

Elements of Indian History; History Sources: Archaeology, Numismatics, Epigraphy & Archival research; Methods used in History; History & historiography; Sociological concepts-structure, system, organization, social institutions, Culture and social stratification (caste, class, gender, power), State & Civil Society.

Module 2: ANCIENT INDIA (09 Periods)

Mohenjo-Daro civilization; Harappa civilization; Mauryan Empire.

Module 3: CLASSICAL & MEDIEVAL ERA (12 Periods)

Classic Era (200 BC - 1200 AD); Hindu - Islamic Era (1200 - 1800 AD).

Module 4: MODERN INDIA (06 Periods)

Age of Colonialism (17th - 19th centuries); First war of Indian Independence; Freedom Struggle (1857-1947)

Module 5: INDIA AFTER INDEPENDENCE (1947 -) (10 Periods)

The Evolution of the Constitution and Main Provisions; Consolidation of India as a Nation; Politics in the States; Indian economy; Modernization and globalization, Secularism and communalism, Nature of development, Processes of social exclusion and Inclusion, Changing Nature of Work and Organization.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a write-up on how to safeguard ancient monuments.
2. Analyze the most famous historically important place you visited.
3. Prepare a presentation on the ancient Seven Wonders of the World with their significance and how they are destroyed.
4. Prepare a presentation on "Wars of the past not only destroyed people and their livelihood but also the people's tradition and culture."
5. Prepare a poster on "Continents that No Longer Exist" with causes

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. K. Krishna Reddy, *Indian History*, Tata McGraw-Hill, 21st reprint, 2017.

REFERENCE BOOKS:

1. Guha, Ramachandra, *India after Gandhi*, Pan Macmillan, 2007.
2. Romila Thapar, *Early India*, Penguin India, New Delhi 2002.

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101705	INDIAN TRADITION AND CULTURE	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Basic traits of Indian Culture; Humanistic Reforms under Jainism and Buddhism; Culture in the medieval period; Socio Religious reforms in Indian Culture; Reform movements for harmonious relations.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate knowledge of Vedic and Upanishadic culture and society to consider human aspirations, values and theories.
- CO2** Understand the contributions of Buddhism and Jainism to Indian culture.
- CO3** Examine the cultural conditions and achievements of India under Mouryas and Guptas.
- CO4** Analyze social religious reforms and reform movements.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	1	-	-	-	-	-	-
CO2	3	-	-	-	-	1	-	-	-	-	-	2
CO3	2	-	-	-	-	3	-	-	-	-	-	-
CO4	2	-	-	-	-	3	-	-	-	-	-	2
Course Correlation Mapping	3	-	-	-	-	2	-	-	-	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BASIC TRAITS OF INDIAN CULTURE

(08 Periods)

Meaning and definition and various interpretations of culture - Culture and its features - The Vedic and Upanishad culture and society - Human aspirations and values in these societies - Chaturvidha purushardhas, Chaturashrma and Chaturvarna theory.

Module 2: HUMANISTIC REFORMS UNDER JAINISM AND BUDDHISM

(09 Periods)

Salient features of Jainism - contributions of Jainism to Indian culture - Contributions of Achaarya and Mahaapragya - Buddhism as a humanistic culture - The four noble truths of Buddhism - Contributions of Buddhism to Indian culture.

Module 3: CULTURE IN THE MEDIEVAL PERIOD

(09 Periods)

Unifications of India under Mouryas and Guptas and their cultural achievements - Cultural conditions under satavahanas - Contributions to Pallavas and Cholas to art and cultural achievements of Vijayanagara rulers

Module 4: SOCIO RELIGIOUS REFORMS IN INDIAN CULTURE

(09 Periods)

Western impact on India - Introduction of Western education - social and cultural awakening and social reform movements of Rajaramohan Roy - Dayanandha Saraswathi - Anne Besant (Theosophical Society).

Module 5: REFORM MOVEMENTS FOR HARMONIOUS RELATIONS

(09 Periods)

Vivekananda, Eswarchandraravidyasagar and Veeresalingam - emancipation of women and struggle against caste - Rise of Indian nationalism - Mahatma Gandhi - Non-violence and satyagraha and eradication of untouchability.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Identify different cultural festivals of Indian States and prepare a write-up on their uniqueness.
2. India has a rich history with numerous architectural wonders. Prepare a report on any three famous architectural wonders in India.
3. Explore the diverse flavors of Indian cuisine and prepare a poster on the different dishes and their distinctiveness.
4. India is a country of Unity in Diversity. Make a PowerPoint presentation on different traditional dresses of various cultural people.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Valluru Prabhakaraiah, *Indian Heritage and Culture*, Neelkamal Publications Pvt. Ltd. Delhi, 1/e, reprint 2015.

REFERENCE BOOKS:

1. L. P. Sharma, *History of Ancient India*, Konark Publishers, Pvt. Ltd. New Delhi, 2010.
2. L. P. Sharma, *History of Medieval India*, Konark Publishers, Pvt. Ltd. New Delhi, 2010.
3. The Cultural Heritage of India Vol-I, II, III, IV, V, The Ramakrishna Mission Institute of Culture, Calcutta

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101703	INSTRUMENTATION IN INDUSTRIES	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on measurement of various parameters like displacement, force, torque, acceleration, velocity, density, viscometer, hygrometers, temperature, pressure, level and flow.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Select appropriate displacement, force and torque measuring devices for specific measurement application.
- CO2** Identify suitable acceleration, velocity and density measuring devices for specific measurement application.
- CO3** Apply suitable viscometer and hygrometer for measurement of viscosity, humidity and moisture for a specific application.
- CO4** Select appropriate temperature and pressure transducer for an industrial requirement.
- CO5** Identify appropriate level and flow transducer for measurement of level and flow for a specific application.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	3	-	-	-	-	-	-	-	-
CO2	3	2	-	3	-	-	-	-	-	-	-	-
CO3	3	2	-	3	-	-	-	-	-	-	-	-
CO4	3	2	-	3	-	-	-	-	-	-	-	-
CO5	3	2	-	3	-	-	-	-	-	-	-	-
Course Correlation Mapping	3	2	-	3	-	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DISPLACEMENT, FORCE & TORQUE MEASUREMENT (08 Periods)

Displacement Measurement: Introduction, Strain gauge, LVDT, Capacitive Gauges and applications.

Force Measurement: Introduction, Analytical Balance, Spring Balance, Load cells.

Torque Measurement: Introduction, Strain gauge, Relative angular twist and applications.

Module 2: ACCELERATION, VELOCITY & DENSITY MEASUREMENT (08 Periods)

Acceleration Measurement: Introduction, LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers and applications.

Velocity Measurement: Introduction, Revolution Counter, Capacitive Tacho, Drag-cup Type, Tacho and Stroboscope and applications.

Density Measurement: Introduction, Pressure type densitometers, Float type densitometers, Ultrasonic densitometer and gas densitometer.

Module 3: VISOCITY, HUMIDITY & MOISTURE MEASUREMENT (09 Periods)

Viscosity Measurement: Introduction, friction tube viscometer, say bolt's viscometer, rotameter viscometer, Searle's rotating cylinder, cone and plate viscometer.

Humidity Measurement: Introduction, Dry and wet bulb psychrometers, Resistive and capacitive type hygrometers

Moisture Measurement: Introduction, Thermal Conductivity and Capacitive sensors, Applications of moisture measurement, Moisture measurement in solids.

Module 4: TEMPERATURE & PRESSURE MEASUREMENT (10 Periods)

Temperature Measurement: Definitions and standards, RTD, Thermistor, Thermocouples: Laws of thermocouple, Reference junctions compensation, Radiation fundamentals, Radiation methods of temperature measurement, Total radiation pyrometers, Optical pyrometers, Applications.

Pressure Measurement: Introduction, manometer and its types, elastic transducers Bourdon tube, diaphragm, bellows, electrical types, resistive, inductive and capacitive, Thermal conductivity gage, Ionization gage, Sound level meter, Microphone, Applications.

Module 5: LEVEL & FLOW MEASUREMENT (10 Periods)

Level Measurement: Introduction, Gauge Glass technique, Float Types – Float-and-tape method, Float-and-shaft method, Magnetic float types. Electrical types – Resistance switch type, Inductive and Capacitance type. Ultrasonic methods. Applications

Flow Measurement: Introduction, Head types – Orifice, Venturi, Flow Nozzle. Rotameter & types. Coriolis flow meter, Gyroscopic flow meter, Liquid bridge mass flowmeter, Calorimetric flow meter. Electromagnetic flow meter, Ultrasonic flow meter, Hotwire anemometer type. Applications.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Record temperature from RTD and convert temperature in to voltage.
2. Measure the speed of rotating shaft using stroboscope.
3. Record level of the tank using suitable device.
4. Measure the flow rate of water in boiler plant.
5. Measure the displacement using LVDT.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. K. Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and Sons, New Delhi, 19th Revised Edition, 2013
2. D. Patranabis, *Principles of Industrial Instrumentation*, TMH, 3rd Edition, 2010.

REFERENCE BOOKS:

1. Ernest Doebelin & Dhanesh Manik, *Measurement Systems*, McGraw Hill International, 6th Edition, 2011.

VIDEO LECTURES:

1. <https://www.vlab.co.in/>
2. <https://archive.nptel.ac.in/courses/103/103/103103135/>
3. <https://nptel.ac.in/courses/103103135>

Web Resources:

1. https://www.tutorialspoint.com/electronic_measuring_instruments/index.htm
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/108105064/lec1.pdf
3. <https://www.ibiblio.org/kuphaldt/socratic/sinst/book/liii.pdf>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101704	INTRODUCTION TO NANOTECHNOLOGY	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: The fundamental principles of nanoelectronics and the utilization of nanostructures as nano electronic devices.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate the basic knowledge in nanoelectronics, crystal structure of emiconducting material various techniques for fabrication and measurement of nanostructure, semiconducting nano electronic devices.
- CO2** Analyze Crystal structure of nanomaterials Nanostructure based device
- CO3** Design and develop new nano devices for advanced technological applications.
- CO4** Capable of solving problems in the field of nanoelectronics.
- CO5** Involve and resolve the future research challenges in the fields related to nanoelectronics.
- CO6** Apply the environmental context with ethical principle in developing new nanodevices.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	2	3	-	-	-	-	-	-	-	-	-
CO4	2	2	2	3	-	-	-	-	-	-	-	-
CO5	3	3	-	-	3	-	-	-	-	-	-	-
CO6	3	-	-	-	-	3	3	2	-	-	-	-
Course Correlation Mapping	3	3	3	3	3	3	3	2	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

MODULE 1: INTRODUCTION TO NANOELECTRONICS

(08 Periods)

The "Top-Down" Approach, Lithography, The "Bottom-Up" Approach; Why Nanoelectronics? Nanotechnology Potential. The Schrödinger wave equation, Wave mechanics of particles, Atoms and atomic orbitals

MODULE 2: MATERIALS FOR NANOELECTRONICS

(09 Periods)

Semiconductors, Crystal lattices: bonding in crystals, Electron energy bands, Semiconductor heterostructures, Lattice-matched and pseudomorphic heterostructures; Organic semiconductors, Carbon nanomaterials: nanotubes and fullerenes.

MODULE 3: FABRICATION AND MEASUREMENT TECHNIQUES FOR NANOSTRUCTURES

(10 Periods)

Bulk crystal and heterostructure growth: Nanolithography, etching, and other means for fabrication of nanostructures and nanodevices; Techniques for characterization of nanostructures, Spontaneous formation and ordering of nanostructures; Clusters and nanocrystals, Methods of nanotube growth, Chemical and biological methods for nanoscale fabrication, Fabrication of nanoelectromechanical systems.

MODULE 4: SEMICONDUCTING NANO STRUCTURES

(09 Periods)

Time and length scales of the electrons in solids, Statistics of the electrons in solids and nanostructures; The density of states of electrons in nanostructures, Electron transport in nanostructures, Electrons in Quantum well, Quantum wire and Quantum dots.

MODULE 5: NANOELECTRONIC DEVICES

(09 Periods)

Resonant tunneling diodes, Field effect transistors, Single electron transfer devices, Potential effect transistors, Light emitting diodes and lasers; Nanoelectromechanical system devices, Quantum dot cellular automata.

Total No. of Periods: 45

EXPERIENTIAL LEARNING

1. Submission of report on specifications of Clean room.
2. Submission of report on specifications of Clean bench.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, *Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications*, Cambridge University Press, 2012.
2. George W. Hanson, *Fundamentals of Nanoelectronics*, Prentice Hall, 2007

REFERENCE BOOKS:

1. Mitin.V, Kochelap.V and Stroscio.M, *Introduction to Nanoelectronics*, Cambridge University Press, 2008
2. Karl Goser et.al, *Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum devices*, Springer, 2005.

VIDEO LECTURES:

1. Introduction to Nanotechnology, nanohub.org
2. <https://nptel.ac.in/courses/103103033>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101702	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Introduction to Artificial Intelligence, Designing intelligent agents, Solving general purpose problems, Search in complex environments, Represent knowledge, Robotics, Ethics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze and Architect intelligent agents using Artificial Intelligence Techniques and principles
- CO2** Analyze the usage of Knowledge representation techniques in Artificial Intelligence
- CO3** Analyze and interpret the problem, identify suitable solutions using heuristic functions and search algorithms
- CO4** Investigate robot hardware and frameworks for intelligent robotic perception.
- CO5** Demonstrate knowledge on ethical implications of intelligent machines for providing privacy, trust, security and safety.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	1	-	-	-	-	-	-
CO5	-	-	-	-	-	1	-	2	-	-	-	-
Course Correlation Mapping	3	3	2	-	-	1	-	2	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 INTRODUCTION TO ARTIFICIAL INTELLIGENCE (09 Periods)

Foundations of artificial intelligence, History of artificial intelligence, State of the art, Risks and benefits of AI, Intelligent agents – Agents and environments, The concept of rationality, Structure of agents.

Module 2 KNOWLEDGE & REASONING (09 Periods)

Logic, Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses.

First-Order Logic - Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution.

Module 3 PROBLEM SOLVING BY SEARCHING (09 Periods)

Problem solving agents, Search algorithms, Uninformed search strategies, Informed search strategies – Greedy best-first search, A* search; Heuristic functions.

Module 4 SEARCH IN COMPLEX ENVIRONMENTS (09 Periods)

Local search algorithms and optimization problems – Hill-climbing search, Simulated annealing, Local beam search, Evolutionary algorithms; Optimal decisions in games – The minimax search algorithm, Optimal decisions in multiplayer games, Alpha-Beta pruning, Move ordering; Monte Carlo tree search.

Module 5: ROBOTICS (09 Periods)

Robots, Robot hardware, Robotic perception, Alternative robotic frameworks, Application domains. Limits of AI, Ethics of AI – Surveillance, security and privacy, Fairness and bias, Trust and transparency, AI safety

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Design and implement agent programs for Table-driven agents using the agent function of vacuum-cleaner world. The agent cleans the current square if it is dirty, otherwise it moves to the other square.
2. Implement agent programs for Simple reflex agents and Model-based reflex agents using the agent function of vacuum-cleaner world.
3. Solve the travelling sales man problem using Hill Climbing search algorithm

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, *Artificial Intelligence: A Modern Approach*, Prentice Hall, 4th Edition, 2020.

REFERENCE BOOKS:

1. Stephen Lucci, Danny Kopec, *Artificial Intelligence in the 21st Century*, Mercury Learning and Information, 3rd Edition, 2018
2. Rich, Knight, Nair, *Artificial intelligence*, Tata McGraw Hill, Third Edition, 2009.
3. Deepak Khemani, *A First Course in Artificial Intelligence*, McGraw Hill Education, 2017.
4. Saroj Kaushik, *Artificial Intelligence*, Cengage Learning, 2011.

SOFTWARE/TOOLS:

1. Python
2. pandas, matplotlib

VIDEO LECTURES:

1. <https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence>
2. <http://aima.cs.berkeley.edu/>
3. <https://ai.google/education/>
4. <https://www.coursera.org/courses?query=artificial%20intelligence>
5. <https://www.edureka.co/blog/artificial-intelligence-with-python/>

Web Resources:

1. <http://www.airesources.org/>
2. <https://allthingsai.com/>
3. <https://designmodo.com/ai-tools-designers/>
4. <https://www.ulethbridge.ca/teachingcentre/chatgpt-ai-resources>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS101702	INTRODUCTION TO DATA SCIENCE	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Data Science; Data Collection and Data Pre-Processing, Exploratory Data Analytics, Model Development, and Model Evaluation.

COURSE OUTCOMES: *After successful completion of the course, students will be able to:*

- CO1** Demonstrate knowledge on Data science concepts.
- CO2** Perform data collection and pre-processing.
- CO3** Perform exploratory data analytics.
- CO4** Design and develop data visualization models.
- CO5** Evaluate performance of data models.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	3	2	2	-	-	-	-	-	-	-
CO3	2	2	2	3	2	-	-	-	-	-	-	-
CO4	2	3	2	2	2	-	-	-	-	-	-	-
CO5	3	2	2	2	2	-	-	-	-	-	-	-
Course Correlation Mapping	3	2	2	2	2	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module-1: INTRODUCTION

(09 periods)

Introduction to Data Science, Evolution of Data Science, Data Science Roles, Stages in a Data Science Project, Applications of Data Science in various fields, Data Security Issues.

Module-2: DATA COLLECTION AND DATA PRE-PROCESSING

(09 periods)

Data Collection Strategies, Data Pre-Processing- Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization.

Module-3: EXPLORATORY DATA ANALYTICS

(09 periods)

Descriptive Statistics, Mean, Standard Deviation, Skewness and Kurtosis, Box Plots, PivotTable, Heat Map, Correlation Statistics, ANOVA.

Module-4: MODEL DEVELOPMENT

(09 periods)

Simple and Multiple Regression, Model Evaluation using Visualization, Residual Plot, Distribution Plot, Polynomial Regression and Pipelines, Measures for In-sample Evaluation, Prediction and Decision Making.

Module-5: MODEL EVALUATION

(09 periods)

Generalization Error, Out-of-Sample Evaluation Metrics, Cross Validation, Overfitting, Under Fitting and Model Selection, Prediction by using Ridge Regression, Testing Multiple Parameters by using Grid Search.

Total periods: 45

EXPERIENTIAL LEARNING

- Use Case:** A human can express his emotions in any form, such as the face, gestures, speech and text. The detection of text emotions is a content-based classification problem. Detecting a person's emotions is a difficult task, but detecting the emotions using text written by a person is even more difficult as a human can express his emotions in any form. Recognizing this type of emotion from a text written by a person plays an important role in applications such as chatbots, customer support forum, customer reviews etc. So you have to train a machine learning model that can identify the emotion of a text by presenting the most relevant emoji according to the input text.
- Use Case:** Customer Personality Analysis is a detailed analysis of a company's ideal customers. It helps a business to better understand its customers and makes it easier for them to modify products according to the specific needs, behaviours and concerns of different types of customers. You have to do an analysis that should help a business to modify its product based on its target customers from different types of customer segments. For example, instead of spending money to market a new product to every customer in the company's database, a company can analyze which customer segment is most likely to buy the product and then market the product only on that particular segment.

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Cathy O'Neil and Rachel Schutt, *Doing Data Science*, O'Reilly, 2015

REFERENCE BOOKS:

1. David Dietrich, Barry Heller, Beibei Yang, *Data Science and Big Data Analytics*, EMC2013.
2. Davy cielen, *Introducing Data Science*, Manning Publications, 2022.
3. Chirag Shah, *A Hands-on Introduction to Data Science*, Cambridge University Press, 2020

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=JL_grPUnXzY&list=PLeo1K3hjS3us_ELKYSj_Fth2tIEkdKXvV
2. <https://www.youtube.com/watch?v=-ETQ97mXXF0>

Web Resources:

1. https://swayam.gov.in/nd1_noc19_cs60/preview
2. <https://towardsdatascience.com/>
3. <https://www.w3schools.com/datascience/>
4. <https://github.com/jakevdp/PythonDataScienceHandbook>
5. <https://www.kaggle.com>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101704	INTRODUCTION TO MACHINE LEARNING	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to machine learning, Bayesian concept learning, Supervised learning, Unsupervised learning, Artificial neural networks.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze the process of machine learning modeling and evaluation to automatically infer a general description for a given learning problem.
- CO2** Analyze the underlying mathematical models within machine learning algorithms and learning tasks.
- CO3** Design and implement machine learning solutions for classification, regression, and clustering problems.
- CO4** Design and implement efficient neural architectures to model patterns for a given learning problem.
- CO5** Develop intelligent solutions to solve societal problems related to computer vision, information security, healthcare and other areas.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	3	3	3	3	-	-	-	-	-	-	-
CO4	3	3	3	1	-	-	-	-	-	-	-	-
CO5	1	3	3	3	3	3	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	3	3	3	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO MACHINE LEARNING (10 Periods)

Machine Learning: Human learning, Types of human learning, Machine learning, Types of machine learning, Applications of machine learning, Issues in machine learning, Machine learning activities, Types of data, Selecting a model, Training a model, Model representation and interpretability, Evaluating performance of a model, Improving performance of a model.

Module 2: BAYESIAN CONCEPT LEARNING (07 Periods)

Introduction, Importance, Bayes' theorem, Bayes optimal classifier, Naïve Bayes classifier, Applications of Bayes classifier.

Module 3: SUPERVISED LEARNING (10 Periods)

Classification: Classification model, Classification learning steps, K-Nearest Neighbor, Decision Tree, Support vector machines.

Regression: Introduction, Simple linear regression, Improving accuracy of the linear regression model, Multiple linear regression, Assumptions and problems in regression analysis.

Module 4: UNSUPERVISED LEARNING (09 Periods)

Introduction, Unsupervised vs supervised learning, Applications of unsupervised learning, Clustering as a machine learning task, Types of clustering techniques, Partitioning methods, K-Medoids, Hierarchical clustering, DBSCAN.

Module 5: ARTIFICIAL NEURAL NETWORKS (09 Periods)

Artificial neuron, Types of activation functions, Early implementations of ANN, Architectures of neural network, Learning process in ANN, Backpropagation.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Use Naïve Bayes classifier to solve the credit card fraud detection problem.
2. Build a neural network that will read the image of a digit and correctly identify the number.

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Tom M. Mitchell, *Machine Learning*, McGraw Hill, 1997.
2. Saikat Dutt, Subramanian Chandramouli, Amit kumar das, *Machine Learning*, Pearson, 2019.

REFERENCE BOOKS:

1. Manaranjan Pradhan, U Dinesh Kumar, *Machine Learning Using Python*, Packt Publishing, 2019.
2. Aurelien Geron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems*, O'Reilly, 2nd Edition, 2019.
3. Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press, 4th Edition, 2020.
4. Shai Shalev Shwartz, Shai Ben David, *Understanding Machine Learning: From Theory to Algorithms*, Cambridge University Press, 2014.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106106202/>
2. <https://www.coursera.org/learn/machine-learning>
3. https://onlinecourses.nptel.ac.in/noc23_cs18/preview
4. https://onlinecourses.nptel.ac.in/noc23_cs87/preview
5. https://onlinecourses.nptel.ac.in/noc23_ee87/preview
6. <https://www.coursera.org/learn/ntumlone-algorithmicfoundations>
7. <https://www.coursera.org/specializations/machine-learning-introduction>
8. <http://ndl.iitkgp.ac.in/document/YkxIRXFvZXJrTDBkVzVVZi9ESjl6eXpRZkxRc2lhOWhlVXBhUVVWaXZINDNyZUVldU9LdUYvd20wbkQ4MC92UQ>
9. <https://www.coursera.org/learn/unsupervised-learning-recommenders-reinforcement-learning>

Web Resources:

1. <https://www.ibm.com/topics/machine-learning>
2. <https://www.simplilearn.com/tutorials/machine-learning-tutorial/what-is-machine-learning>
3. https://www.w3schools.com/python/python_ml_getting_started.asp
4. <https://developers.google.com/machine-learning/crash-course>
5. <https://www.greenteapress.com/thinkstats/>
6. <https://info.deeplearning.ai/machine-learning-yearning-book>
7. <https://www.kaggle.com/code/kanncaa1/machine-learning-tutorial-for-beginners>
8. <https://machinelearningmastery.com/machine-learning-in-python-step-by-step/>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS101701	INTRODUCTION TO PYTHON PROGRAMMING	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course is aimed at offering the fundamental concepts of Python scripting language to the students. It starts with the basics of Python programming and deals with lists, dictionaries, functions, exceptions and files. The objective of this course is to enable the students to develop the applications using the concepts of Python.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand the basic terminology used in computer programming to write, compile and debug programs in Python programming language.
- CO2** Use appropriate data type for handling user data and write optimized programs using the functions, and statements.
- CO3** Manage the exceptions raised during the program execution and avoid abrupt termination of the program execution.
- CO4** Process files and solve real world problems using classes and objects in the Python programming environment.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	2	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	2	-
CO4	2	3	3	-	-	-	-	2	-	-	-	-
Course Correlation Mapping	3	3	3	-	-	-	2	2	-	-	2	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DATA TYPES AND INPUT/OUTPUT

(09 Periods)

Internal working of Python, Python character set, Tokens, Python Core Data Types (list, set, tuple, and dictionary), The print () function, Assignment of values to variables, The input() function, The eval() function.

Module 2: OPERATORS AND CONTROL STATEMENTS

(09 Periods)

Operators- Arithmetic Operators, Operator precedence and Associativity, Bitwise operator, The compound assignment operator; Decision statements- Boolean operators, Boolean Expressions and Relational operators, Decision making statements; Loop Control Statements- while loop, range() function, for loop; break statement, continue statement.

Module 3: FUNCTIONS AND LISTS

(09 Periods)

Functions- Syntax and basics of a function, Use of a function, Parameters and arguments in a function, The local and global scope of a variable, The return statement, Recursive functions, The lambda function; Lists-Creating Lists, Accessing the elements of a List, List slicing, Python in-built functions for lists, List Comprehension, List Methods, Passing list to a function, Returning a list to function.

Module 4: TUPLES, SETS AND DICTIONARIES

(09 Periods)

Tuples - Creating tuples, tuple() function, Inbuilt functions for tuples, Indexing and Slicing, Operations on tuples, Passing variable length arguments to tuples, Sort tuples, Traverse tuples from a list, The zip() function, The Inverse zip(*) function; Sets - Creating sets, The set in and not in operator, The Python Set Class, Set operations; Dictionaries -Basics of Dictionaries, Creating a Dictionary, Adding and replacing values, Retrieving values, Formatting dictionaries, Deleting items, Comparing two dictionaries, Methods of dictionary class, Traversing dictionaries, Nested dictionaries, Traversing nested dictionaries.

Module 5: V FILES

(09 Periods)

File Handling-Opening a file, Writing Text, Closing files, Writing numbers to a file, Reading Text, Reading numbers from a file, Appending data, seek() function.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Calculator: Create a basic calculator program that can perform addition, subtraction, multiplication, and division operations. You can enhance it by adding more functionality, such as handling decimal numbers or including additional mathematical operations.
2. Develop recursive functions to solve problems that involve self-referential definitions.
3. Develop program to create dictionaries, add, retrieve and delete items from dictionaries.
4. Word Counter: Design a program that counts the number of words, characters, or lines in a given text file. You can also include additional features like finding the most common words or displaying statistics about the text.

5. Tic-Tac-Toe: Implement a two-player tic-tac-toe game where users take turns marking Xs and Os on a 3x3 grid. Determine the winner or detect a tie by checking the board after each move.
6. Dice Rolling Simulator: Create a program that simulates rolling dice. Allow the user to specify the number of dice to roll and display the results. You can also add features like keeping track of the roll history or calculating the probability of certain outcomes.

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Ashok Namdev kamthane and Amit Ashok Kamthane, *Programming and Problemsolving with PYTHON*, McGraw Hill Education, 1st Edition, 2016.

REFERENCE BOOKS:

1. Allen Downey, *Think Python*, Green Tea Press, 1st Edition, 2016.
2. W.J. Chun, *Core Python Programming*, Prentice Hall, 3rd Edition, 2013.
3. Kenneth A. Lambert, *Fundamentals of Python*, Cengage, 2nd Edition, 2015.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc19_cs41/preview
2. <https://www.coursera.org/specializations/python>
3. <https://www.coursera.org/learn/python-for-applied-data-science-ai>
4. <https://www.youtube.com/watch?v=WGJJIrtnfpk>
5. https://www.youtube.com/watch?v=_uQrJ0TkZlc
6. <https://www.udemy.com/topic/python/>
7. <https://freevideolectures.com/course/2512/python-programming>

Web Resources:

1. <https://www.w3schools.com/python/>
2. <https://www.programiz.com/python-programming>
3. <https://www.geeksforgeeks.org/python-programming-language/>
4. <https://www.javatpoint.com/python-lists>
5. <https://www.learnpython.org/>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101704	INTRODUCTION TO INTERNET OF THINGS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course is emphasize on the Architecture of IoT and Summarize the roles of various organizations for IoT, To Develop simple applications using Arduino and Rasberry, Test for errors in the application, Predict the market value, Experiment with embedded boards for creating IoT prototypes, To understand the domain specific IoTs and IoT system management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Understand the fundamental concepts of IoT and physical computing.
- C02** Demonstrate knowledge on variety of embedded boards and IoT Platforms
- C03** Understand the communication protocols in IoT communications.
- C04** Demonstrate knowledge on Domain specific IoT applications.
- C05** Understand the IoT System management and network management protocols.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	-	-	-	-	-	-
C02	3	3	3	-	-	-	-	-	-	-	-	-
C03	3	2	-	-	-	-	-	-	-	-	-	-
C04	3	3	3	-	-	-	-	-	-	-	-	-
C05	3	2	2				-	-	-	-	-	-
Course Correlation Mapping	3	3	3	-	-	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Overview of IoT

(09 Periods)

The Internet of Things: An Overview, The Flavour of the Internet of Things, The "Internet" of "Things", The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things?

Design Principles for Connected Devices: Calm and Ambient Technology, Privacy, Web Thinking for Connected Devices, Affordances.

Prototyping: Sketching, Familiarity, Costs Vs Ease of Prototyping, Prototypes and Production, Open source Vs Close source, Tapping into the community.

Module 2: Embedded Devices:

(09 Periods)

Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, Mobile phones and tablets, Plug Computing: Always-on Internet of Things

Module 3 Communication in the IoT:

(09 Periods)

Internet Communications: An Overview, IP Addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols

Prototyping Online Components: Getting Started with an API, Writing a New API, Real-Time Reactions, Other Protocols Protocol

Module 4 Domain specific IoTs

(09 Periods)

Introduction: Home automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle

Module 5 IoT and M2M

(09 Periods)

Introduction- M2M, Difference between IoT and M2M, SDN and NFV for IoT

IoT System Management with NETCONF-YANG: Need for IoT Systems Management, Simple network management protocol(SNMP), Network operator requirements, NETCONF, YANG

Total Periods: 45

EXPERIENTIAL LEARNING

1. A) Design and Simulate LED 7-Segment Display interfacing with Arduino.
 B) Design and Simulate Servo motor interfacing with Arduino.
2. A) Design and Simulate ultrasonic sensor and LCD interfacing with Arduino.
 B) Design and Simulate Flame Sensor interfacing with Arduino.

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Adrian McEwen, Hakim Cassimally, *Designing the Internet of Things*, Wiley Publications, 2012
2. Arshdeep Bahga, Vijay Madisetti, *Internet of Things: A Hands-On Approach*, Universities Press, 2014.

REFERENCE BOOKS:

1. Pethuru Raj, Anupama C. Raman, *The Internet of Things, Enabling technologies and use cases*, CRC Press.

VIDEO LECTURES:

1. <https://www.digimat.in/nptel/courses/video/106105166/L01.html>
2. <https://www.youtube.com/watch?v=oBZnySDgst8>

Web Resources:

1. <https://www.arduino>
2. <https://www.raspberrypi.org/>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101703	MANAGEMENT SCIENCE	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Concepts of Management; Concepts Related to ethics and social responsibility; Human Resource Management; Operations Management; Statistical Process Control; Inventory Management; Marketing; Project Management; Project Crashing.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate the concepts of management, its functions and processes used in optimum resource utilization within the context of ethics and social responsibility.
- CO2** Apply the concepts of HRM for selection and management of human resources.
- CO3** Analyze different operations management problems using quality management tools to produce effective, efficient and adoptable products/services
- CO4** Identify different marketing strategies to maximize enterprise profitability and customer satisfaction within the realistic constraints
- CO5** Develop network models in time-cost trade-off for effective project management.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1		1	1	1	1			1	
CO2	3	2	1		1						1	
CO3	3	3	1	1	1						1	
CO4	3	2	1		1	1					1	
CO5	3	3	3	1	1	1					2	
Course Correlation Mapping	3	2	1	1	1	1	1	1			1	

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: MANAGERIAL FUNCTION AND PROCESS

(10 Periods)

Concept and foundations of management, Evolution of management thought; Managerial functions – Planning, Organizing, Directing and Controlling; Decision-making; Role of manager, managerial skills; Managing in a global environment, Flexible systems management; Social responsibility and managerial ethics; Process and customer orientation; Managerial processes on direct and indirect value chain.

Module 2: HUMAN RESOURCE MANAGEMENT

(08 Periods)

Human Resource challenges; Human Resource Management functions; Human Resource Planning; Job analysis; Job evaluation, Recruitment and selection; Training and Development; Promotion and transfer; Performance management; Compensation management and benefits; Employee morale and productivity; Human Resource Information System.

Module 3: OPERATIONS MANAGEMENT

(10 Periods)

Fundamentals of Operations Management, Services as a part of operations management; Facilities location and layout; Line balancing; Quality management – Statistical Process Control, Total Quality Management, Six sigma; Role and importance of materials management, Value analysis, Make or Buy decision, Inventory control, Materials Requirement Planning, Enterprise Resource Planning, Supply Chain Management.

Module 4: MARKETING MANAGEMENT

(08 Periods)

Concept, evolution and scope; Marketing strategy formulation and components of marketing plan; Segmenting and targeting the market; Positioning and differentiating the market offering, Analyzing competition; Product strategy; Pricing strategies; Designing and managing marketing channels; Integrated marketing communications.

Module 5: PROJECT MANAGEMENT

(09 Periods)

Project management concepts; Project planning – Work Breakdown Structure, Gantt chart; Project scheduling – Critical Path Method, Program Evaluation and Review Technique, Crashing the project for time-cost trade off; Resource Levelling.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Find the social responsibilities in the context of management theoretically and practically in an organization? Explain them by taking a real case study in any organization (preferably in your organization).
2. Gaining market share should be one of management's primary goals because of its effect on operations and profitability. Comment. What Strategies Do Companies Employ to Increase Market Share?
3. A Gantt chart is a visualization that helps in scheduling, managing, and monitoring specific tasks and resources in a project. Prepare a gantt chart for Online food ordering system.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

RESOURCES

TEXT BOOKS:

1. Martand T. Telsang, *Industrial Engineering and Production Management*, S. Chand, 3rd Edition, 2018.
2. Koontz and Weihrich, *Essentials of Management*, TMH, New Delhi, 11th Edition, 2020.

REFERENCE BOOKS:

1. O.P. Khanna, *Industrial Engineering and Management*, Dhanpat Rai and Sons, 2018.
2. N.D. Vohra, *Quantitative Techniques in Management*, TMH, New Delhi, 5th Edition, 2014.
3. L.M. Prasad, *Principles and practice of Management*, S. Chand and Sons, 2019.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/122/106/122106032/>
2. <https://www.digimat.in/nptel/courses/video/122102007/L01.html>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101704	MANAGING INNOVATION AND ENTREPRENEURSHIP	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Evolution of entrepreneurship from economic theory Managerial and entrepreneurial competencies; Concepts of Shifting Composition of the Economy Purposeful Innovation & Sources of Innovative Opportunity; The Innovation Process; Innovative Strategies; Entrepreneurial Motivation; Entrepreneurs versus inventors; Ethics and International Entrepreneurship; Strategic Issues in International Entrepreneurship; Problem solving Innovation and Diversification

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate the principles of innovation process for establishing Industrial ventures.
- CO2** Identify and analyze the gaps in an organization for innovation in the context of developed economies
- CO3** Develop a comprehensive and well-planned business structure for a new venture.
- CO4** Demonstrate knowledge on intellectual property rights, patents, trademarks, copyrights, trade secrets and commercialization of intellectual property.
- CO5** Apply ethics in constructive innovation framework and problem solving.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1		1	1	1	1			1	
CO2	3	2	1		1						1	
CO3	3	3	1	1	1						1	
CO4	3	2	1	1	1	1					1	
CO5	3	3	3	1	1	1					2	
Course Correlation Mapping	3	2	1	1	1	1	1	1			1	

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CREATIVITY AND INNOVATION

(09 Periods)

Introduction, Levels of innovation, Purposeful innovation and the sources of innovative opportunity, The innovation process, Innovative strategies, Strategies that aim at introducing and innovation, Dynamics of ideation and creativity – Inbound, Outbound; Context and process of new product development, Theories of outsourcing.

Module 2: PARADIGMS OF INNOVATION

(09 Periods)

Systems approach to innovation, Innovation in the context of developed economies and Emerging economies, Examining reverse innovation and its application, Performance gap, Infrastructure gap, Sustainability gap, Regulatory gap, Preference gap, organizational factors effecting innovation at firm level.

Module 3: SOURCES OF FINANCE AND VENTURE CAPITAL

(09 Periods)

Importance of finance, Comparison of venture capital with conventional development capital, Strategies of venture funding, Investment phases, Investment process, Advantages and disadvantages of venture capital, Venture capital developments in India.

Module 4: INTELLECTUAL PROPERTY INNOVATION AND ENTREPRENEURSHIP

(09 Periods)

Introduction to Entrepreneurship, Evolution of entrepreneurship from economic theory, Managerial and entrepreneurial competencies, Entrepreneurial growth and development, Concepts, Ethics and Nature of International Entrepreneurship, Intellectual property – forms of IP, Patents, Trademarks, Design registration, Copy rights, Geographical indications, Patent process in India.

Module 5: OPEN INNOVATION FRAME WORK & PROBLEM SOLVING

(09 Periods)

Concept of open innovation approach, Difference between open innovations and Closed innovation approaches, Limitations and Opportunities of open innovation frame work, Global context of strategic alliance, Role of strategic alliance, Problem Identification and Problem Solving, Innovation and Diversification

Total Periods: 45

EXPERIENTIAL LEARNING

1. Identify the Innovative Marketing Strategies for Startups
2. Identify the Coca-cola Company Intellectual Property Rights

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

CASE STUDIES/ARTICLES:

Contemporary relevant case studies/ Articles will be provided by the course instructor at the beginning.

1. **Tesla Inc.: Disrupting the Automobile Industry**
This case study examines how Tesla Inc. disrupted the traditional automobile industry through its innovative electric vehicles and sustainable energy solutions. It discusses the sources of innovative opportunity that Tesla leverages, the ideation and creativity dynamics involved in new product development, and the strategies that the company uses to introduce and market its innovations.
2. **Google Inc.: Innovation in Developed Economies**
This case study explores how Google Inc. became a global leader in the technology industry through its innovative search engine, advertising, and cloud computing solutions. It highlights the performance gap that Google addressed, the regulatory and sustainability gaps that it leveraged, and the impact of its innovation strategies on the company's growth and profitability.
3. **Flipkart: From Startup to Unicorn**
This case study examines how Flipkart, an Indian e-commerce company, secured venture capital funding to become one of the largest online marketplaces in India. It discusses the importance of finance in entrepreneurship, the advantages and disadvantages of venture capital, and the strategies that Flipkart used to attract venture funding.
4. **Patanjali Ayurved: Building a Brand through Intellectual Property**
This case study explores how Patanjali Ayurved, an Indian consumer goods company, built a strong brand through its intellectual property strategies. It discusses the forms of IP that Patanjali leverages, the patent process in India, and the impact of IP on the company's growth and profitability.
5. **Procter & Gamble: Innovation through Open Innovation**
This case study analyzes how Procter & Gamble, a global consumer goods company, leveraged open innovation to achieve unprecedented success in product development and marketing. It discusses the difference between open and closed innovation approaches, the limitations and opportunities of open innovation, and the role of strategic alliances in global innovation.

RESOURCES

TEXT BOOKS:

1. Vinnie Jauhari, Sudhanshu Bhushan, *Innovation Management*, Oxford University Press, 1st Edition, 2014.
2. Drucker, P.F., *Innovation and Entrepreneurship*, Taylor & Francis, 2nd Edition, 2007.

REFERENCE BOOKS:

1. Robert D Hisrich, Claudine Kearney, *Managing Innovation and Entrepreneurship*, Sage Publications, 1st Edition, 2014.
2. V.K. Narayanan, *Managing Technology and Innovation for Competitive Advantage*, Pearson India, 1st Edition, 2002.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=wWsl48VLfVY>
2. <https://www.youtube.com/watch?v=dDpQ9ALKX0U>
3. https://www.youtube.com/watch?v=Eu_hkxkJGTg

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101705	MATERIAL SCIENCE	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Materials Structure and Constitution of Alloys; Heat treatment of steels; Properties of ferrous materials and its alloys; Properties of non-ferrous materials and its alloys; Properties and applications of Ceramics, Polymers and Composite materials.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Ability to understand and apply the principles of materials science to analyze and design materials for specific applications.
- CO2** Analyze the properties of materials and enhance the same through heat-treatment processes.
- CO3** Demonstrate the knowledge of ferrous and Non-ferrous materials and its alloys for engineering applications.
- CO4** Understand the relationship between materials properties and structure at the atomic and molecular level.
- CO5** Demonstrate the knowledge of Ceramics, Polymers, and Composite materials for suitable engineering applications.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1							1		
CO2	3	3	1							1		
CO3	3	1										
CO4	3	1										
CO5	3	1										
Course Correlation Mapping	3	2	1							1		

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: MATERIALS STRUCTURE AND CONSTITUTION OF ALLOYS (09 Periods)

Materials Structure: Space lattice, Unit cells and Metallic crystal structures (SC, BCC, FCC and HCP), Crystal defects: Point, Line, Interstitial and Volume, Primary and secondary bonding in materials.

Constitution of Alloys: Necessity of Alloying, Gibbs's phase and Hume Rothery rule, Iron-Iron-carbide diagram and its microstructural aspects.

Module 2: HEAT TREATMENT OF STEELS (09 Periods)

Annealing, Normalizing, Tempering, Carburization and Hardening- Austempering, Martempering, Carburizing, Nitriding, Cyaniding, Carbo-Nitriding, Flame and Induction Hardening, Vacuum and Plasma Hardening, Time-Temperature-Transformation Diagrams and Continuous Cooling Transformation Diagrams.

Module 3: FERROUS MATERIALS AND ALLOYS (09 Periods)

Steels: Structure, properties, classifications and applications of plain steels, Specifications of steels, Structure, properties, classifications and applications of low alloy steels, Hadfield manganese steels, Stainless steel and Tool steels.

Cast iron: Structure, properties and applications of Gray cast iron, White cast iron, Malleable cast iron, Nodular cast iron and Alloy cast iron.

Module 4: NON-FERROUS MATERIALS AND ALLOYS (09 Periods)

Structure, properties and applications of Copper and its alloys, Aluminium and its alloys, Titanium and its alloys, Nickel and its alloys, Magnesium and its alloys, Refractory and Precious metals.

Module 5: CERAMICS, POLYMERS AND COMPOSITES MATERIALS (09 Periods)

Ceramics: Classifications, Properties and Applications, Glass-ceramics, Polymers: Classification, Properties and Applications, Polymerization Reaction,

Composites: Classifications, Properties and Applications of Polymer matrix composites, Ceramic matrix composites, Metal matrix composites and Nanocomposites.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Laboratory experiments allow students to apply theoretical concepts and learn how to conduct experiments safely and effectively. Some examples of laboratory experiments include mechanical testing of materials, heat treatment of metals, and microscopy analysis of materials.
2. Materials characterization techniques such as X-ray diffraction, scanning electron microscopy, and transmission electron microscopy can provide valuable insights into the structure and properties of materials. Students can gain hands-on experience with these techniques by conducting experiments and analyzing the results.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

RESOURCES

TEXT BOOKS:

1. V. Raghavan, *Materials Science & Engineering*, Prentice Hall of India, 5th edition, 2004.
2. R. Balasubramaniam, Callister's, *Materials Science & Engineering*, John Wiley and sons, 2nd edition, 2014.

REFERENCE BOOKS:

1. Sidney H. Avner, *Introduction to Physical Metallurgy*, Tata McGraw Hill, 2nd edition, 1997.
2. George E Dieter, *Mechanical Metallurgy*, Tata McGraw Hill, 3rd edition, 2013.
3. Kodigre V D, *Material Science and Metallurgy*, Everest Publishing House, 31st edition, 2011.

VIDEO LECTURES:

1. <https://ocw.mit.edu/courses/materials-science-and-engineering/3-012-fundamentals-of-materials-science-fall-2005/lecture-notes/>
2. <https://nptel.ac.in/courses/116/104/116104045/>
3. https://www.youtube.com/watch?v=tsX-VYvkiJ8&list=PLJV_OG0NLkV8VRNFk-0AyDZz1pZym6V8j
4. <https://www.khanacademy.org/science/materials-science>

Web Resources:

1. <https://www.doitpoms.ac.uk/tlplib/teachers.php>
2. <https://www.springer.com/journal/10853>
3. <http://dmse.mit.edu/>
4. <http://dmse.mit.edu/>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22LG201701	PERSONALITY DEVELOPMENT	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course gives awareness to students about the various dynamics of personality development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate knowledge in Self-Management and Planning Career
- CO2** Analyze the functional knowledge in attitudes and thinking strategies
- CO3** Learn and apply soft skills for professional success.
- CO4** Function effectively as an individual and as a member in diverse teams
- CO5** Communicate effectively in public speaking in formal and informal situations.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	3	-	-	-	-	2	-	-
CO4	1	1	-	-	-	-	-	-	3	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	2	2	3	-	3	-	-	-	3	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: SELF-ESTEEM & SELF-IMPROVEMENT (09 Periods)

Know Yourself – Accept Yourself; Self-Improvement: Plan to Improve – Actively Working to Improve Yourself- Exercises- case studies

Module 2: DEVELOPING POSITIVE ATTITUDES (09 Periods)

How Attitudes Develop – Attitudes are Catching – Improve Your Attitudes – Exercises- case studies

Module 3 SELF-MOTIVATION & SELF-MANAGEMENT (09 Periods)

Show Initiative – Be Responsible Self-Management; Efficient Work Habits – Stress Management – Employers Want People Who can Think – Thinking Strategies- Exercises- case studies

Module 4 GETTING ALONG WITH THE SUPERVISOR (09 Periods)

Know your Supervisor – Communicating with your Supervisor – Special Communication with your Supervisor – What Should you Expect of Your Supervisor? – What your Supervisor expects of you – Moving Ahead Getting Along with your Supervisor- Exercises- case studies

Module 5 WORKPLACE SUCCESS (09 Periods)

First Day on the Job – Keeping Your Job – Planning Your Career – Moving Ahead- Exercises- case studies

Total Periods: 45

EXPERIENTIAL LEARNING

1. List out the self-improvements in you on the charts and explain in detail.
2. Discuss different famous personalities and their attitudes.
3. Describe different personalities with respect to self-motivation and self-management.
4. Imagine you are a supervisor and illustrate different special communications.
5. Assume and Interpret different experiences on the first day of your job.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

RESOURCES

TEXT BOOKS:

1. Harold R. Wallace and L. Ann Masters, *Personal Development for Life and Work*, Cengage Learning, Delhi, 10th edition Indian Reprint, 2011. (6th Indian Reprint 2015)
2. Barun K. Mitra, *Personality Development and Soft Skills*, Oxford University Press, 2011.

REFERENCE BOOKS:

1. K. Alex, *Soft Skills*, S. Chand & Company Ltd, New Delhi, 2nd Revised Edition, 2011.
2. Stephen P. Robbins and Timothy A. Judge, *Organizational Behaviour*, Prentice Hall, Delhi, 16th edition, 2014

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=6Y5VWBLi1es>
2. <https://www.youtube.com/watch?v=H9qA3inVMrA>

Web Resources:

1. <https://www.universalclass.com/.../the-process-of-perso...>
2. <https://www.ncbi.nlm.nih.gov/pubmed/25545842>
3. <https://www.youtube.com/watch?v=Tuw8hxrFBH8>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101703	PLANNING FOR SUSTAINABLE DEVELOPMENT	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on sustainable development, environmental impact, sustainable policies, governance, theories and strategies, media and education for sustainability.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Compare sustainable development theories in national and global context to protect the society and environment.
- CO2** Analyze the unforeseen environmental impacts on sustainable development to protect the society and environment.
- CO3** Analyze policies and governance for sustainable development considering ethics, economics, society and environment.
- CO4** Analyze systems and strategies for sustainable development using appropriate tools and techniques considering ethics, economics, society and environment.
- CO5** Analyze the role of media and education in sustainable development using appropriate tools and techniques considering ethics, society and environment besides communicating effectively.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	2	2	-	-	-	-	-
CO2	3	3	-	-	-	2	2	-	-	-	-	1
CO3	3	3	-	-	-	2	2	2	-	-	1	-
CO4	3	3	-	-	2	2	2	2	-	-	1	-
CO5	3	3	-	-	2	2	2	2	-	1	-	-
Course Correlation Mapping	3	3	-	-	2	2	2	2	-	1	1	1

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: SUSTAINABLE DEVELOPMENT

(09 Periods)

Definition and concepts of sustainable development, Capitalization of sustainability- National and global context; Sustainable development goals, Emergence and evolution of sustainability and sustainable development, Theories of sustainability, Case studies.

Module 2: ENVIRONMENTAL IMPACT

(09 Periods)

Climate change – Science, Knowledge and sustainability; Unforeseen environmental impacts on development, Challenges of sustainable development, Centrality of resources in sustainable development, Case studies.

Module 3: SUSTAINABLE POLICIES AND GOVERNANCE

(09 Periods)

Governance - Democracy and Eco-welfare; Global civil society and world civil politics, Civic environmentalism, Policy responses to sustainable development, Economics of sustainability, Social responsibility in sustainability, National action, ISO 14001: Environmental management system.

Module 4: SUSTAINABLE SYSTEMS AND STRATEGIES

(09 Periods)

Need for system innovation, Transition and co-evolution, Theories and methods for sustainable development, Strategies for eco-innovation, Ecological foot print analysis, Socio ecological indicators – Eco labels; Policy programmes for system innovation, Case studies.

Module 5: MEDIA AND EDUCATION FOR SUSTAINABILITY

(09 Periods)

Role of emerging media, Remarkable design and communication art, Activism and the public interest, Education for sustainability, Participation in decision making, Critical thinking and reflection, Case studies.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Submit a study report on the importance and implementation of United Nations sustainable goals 17 among all the ratified nations.
2. Submit a study report on any one case study that the challenges being faced during the sustainable development goals implementation.
3. Submit a study report on the social responsibility in implementation of sustainability concept.
4. Prepare and submit a report on any two case studies that how the eco labels put on their products shall make the consumers feel satisfaction over the sustainable development.
5. Submit a report on the communication art and activism through media which makes the public interest that helps to contribute towards sustainable development.

RESOURCES

TEXT BOOKS:

1. John Blewitt, *Understanding Sustainable Development*, Earth Scan Publications Ltd., 2nd Edition, 2008.
2. Jennifer A. Elliot, *An Introduction to Sustainable Development*, Earth Scan Publications Ltd., 4th Edition, 2006.

REFERENCE BOOKS:

1. Peter Rogers, Kazi F Jalal and John A Boyd, *An Introduction to Sustainable Development*, Earth Scan Publications Ltd., 2006.
2. Simon Dresner, *The Principles of Sustainability*, Earth Scan Publications Ltd., 2nd Edition, 2008.
3. Peter Bartelmus, *Environment Growth and Development: The Concepts and Strategies of Sustainability*, Routledge, 3rd Edition, 2003.
4. Gabriel Moser, Enric Pol, Yvonne Bernard, Mirilia Bonnes, Jose Antonio Corraliza and Maria Vittoria Giuliani, *People Places and Sustainability*, Hogrefe & Huber Publishers, 2nd Edition, 2003.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=a5i9RVyhBtc>
2. https://www.youtube.com/watch?v=fH_iIVPTujE
3. <https://www.youtube.com/watch?v=c2eNrFK5M8I>
4. <https://www.youtube.com/watch?v=qfOgdj4Okdw>
5. https://www.youtube.com/watch?v=_qLqLJq2954

Web Resources:

1. https://civil.gecgudlavalleru.ac.in/images/admin/pdf/1594706742_III-II-OE-Planning-for-Sustainable-Development.pdf
2. https://www.academia.edu/26950843/Sustainable_Development_in_Practice_Case_Studies_for_Engineers_and_Scientists
3. https://www.academia.edu/24286208/The_Role_of_the_Professional_Engineer_and_Scientist_in_Sustainable_Development
4. https://byjusexamprep.com/liveData/f/2022/8/sustainable_development_goals_upsc_notes_43.pdf
5. https://sdgs.un.org/sites/default/files/2020-10/course%201_Peter_Tarr%20%20-%20%20Compatibility%20Mode.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101705	PRINCIPLES OF COMMUNICATION ENGINEERING	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Fundamentals of Communications; Analog and digital - modulation and Demodulation Techniques; Information theory and coding.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyze different Analog and Digital Modulation Schemes to improve bandwidth and power efficiency.
- CO2** Analyze Pulse Analog modulation Schemes.
- CO3** Understand the concepts of Baseband & Passband Digital Transmission.
- CO4** Analyze various error detection and correction codes for reliable transmission.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	1	-	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	2	1	-	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: ANALOG MODULATION

(13 Periods)

Block diagram of Electrical Communication System, Types of Communications, Need for Modulation, Types of Amplitude Modulation- AM, DSBSC, SSBSC, Power and BW requirements, Generation of AM, DSBSC, SSBSC. Detection of AM - Diode detector, Product demodulation for DSBSC & SSBSC. Frequency & Phase Modulations.

Module 2: PULSE MODULATION

(07 Periods)

Elements & Advantages of Digital communication systems, PAM, Regeneration of Baseband Signal, PWM and PPM, Time Division Multiplexing, Frequency Division Multiplexing.

Module 3: BASE BAND DIGITAL TRANSMISSION

(07 Periods)

Pulse Code Modulation- Advantages, Block diagram of PCM, Quantization, effect of Quantization, Quantization error. DM, ADM and Comparison of PCM, DM & ADM.

Module 4: PASS BAND DIGITAL TRANSMISSION

(10 Periods)

Digital Binary Schemes-ASK, FSK, PSK, DPSK, QPSK, Modulation and Demodulation -Coherent and Non-coherent techniques.

Module 5: INFORMATION THEORY AND CODING

(08 Periods)

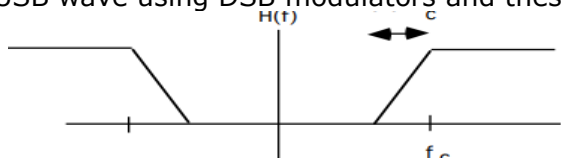
Concept of Information, Entropy and Rate of Information, Coding efficiency, Shannon-Fano and Huffman Coding.

Error Correction and Detection Codes- Linear Block Codes, Cyclic Codes, Convolution Codes.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Suppose that a non-linear device is available for which the output current i_0 and the input voltage v_i are related by: $i_0(t) = a_1 v_i(t) + a_3 v_i^3(t)$ where a_1 and a_3 are constants. Explain how this device may be used to provide (a) a product modulator (b) an amplitude modulator.
2. A voice signal occupying the frequency band 0.3 - 3.4 KHz is to be modulated onto a carrier wave of frequency 11.6 MHz. High pass filters such as the one shown below are available. Design a system to generate the USB wave using DSB modulators and these filters.



3. In a binary PCM system, the output signal to-quantizing noise ratio is to be held to a minimum of 40 dB. Determine the number of required levels, and find the corresponding output signal to quantizing-noise ratio.
4. A bipolar binary signal $S(t)$ is a +1V or -1V pulse during the interval (0, T). Additive white noise with power spectral density $\eta/2 = 10^{-5}$ W /kHz. W/Hz is added to the signal. Determine the maximum bit rate that can be sent with a bit error probability of $P_e \leq 10^{-7}$

5. A compact disc (CD) recording system samples each of two stereo signals with a 16-bit analog-to digital converter (ADC) at 44.1 kb/s.
- A) Determine the output signal-to-quantizing-noise ratio for a full-scale sinusoid.
 - B) The bit Stream of digitized data is augmented by the addition of error- correcting bits, clock extraction bits, and display and control bit fields. These additional bits represent 100 percent overhead. Determine the output bit rate of the CD recording system.
 - C) The CD can record an hour's worth of music. Determine the number of bits recorded on a CD. For a comparison, a high-grade collegiate dictionary may contain 1500 pages, 2 columns per page, 100 lines per column, 8 words per line, 6 letters per word, and 7 b per letter on average. Determine the number of bits required to describe the dictionary, and estimate the number of comparable books that can be stored on a CD.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. R.P. Singh and S D Sapre, *Communication Systems - Analog and Digital*, TMH, 2nd edition 2007.
2. Simon Haykin, *Communication Systems*, John Wiley, 2nd edition 2007.

REFERENCE BOOKS:

1. Herbert Taub & Donald L Schilling, *Principles of Communication Systems*, Tata McGraw-Hill, 3rd Edition, 2009.
2. Sham Shanmugam, *Digital and Analog Communication Systems*, Wiley-India edition, 2006.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/108/104/108104091/>
2. https://onlinecourses.nptel.ac.in/noc19_ee47/preview

Web Resources:

1. <https://studiousguy.com/basic-principles-of-communication/>
2. https://www.tutorialspoint.com/principles_of_communication/principles_of_communication_modulation.htm

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EE101702	RELIABILITY AND SAFETY ENGINEERING	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on the fundamentals of reliability and safety engineering. The course emphasizes on various reliability measures used in assessing the performance of the system, evaluating the critical parameters of the network, and the techniques to assess the reliability of the system. The course also deals with safety management and measures in industrial and other hazardous environments.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** apply the various probability and statistics fundamentals into engineering systems to evaluate performance.
- CO2** develop mathematical models for engineering networks/systems to evaluate the critical parameters for the reliability of a network/system.
- CO3** analyze the time-dependent/independent characteristics of a repairable system and frequency durations techniques to assess the reliability
- CO4** understand various safety management, policy, and planning strategies for personal and industrial safety.
- CO5** understand various safety and hazard identification techniques and follow appropriate safety measures in industry and society.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	1	1	1	-	-	-	-
CO2	3	3	-	-	2	1	1	-	-	-	-	-
CO3	3	2	-	2	1	1	1	-	-	-	-	3
CO4	3	2	-	-	2	1	1	1	-	-	-	-
CO5	3	2	-	-	2	1	1	1	-	-	-	-
Course Correlation Mapping	3	2	--	2	2	1	1	1	--	--	--	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FUNDAMENTALS OF RELIABILITY ENGINEERING (09 Periods)

Random variables, probability concepts, rules for probabilities of events. Probability density and distribution functions. Binomial distribution - Expected value and standard deviation for binomial distribution. Reliability functions, $f(t)$, $F(t)$, $h(t)$ - Relationship between these functions, Exponential density and distribution functions, expected value and standard deviation of exponential distribution. Measures of reliability - MTTF, MTTR, MTBF. Bathtub curve.

Module 2: NETWORK MODELING AND RELIABILITY EVALUATION (09 Periods)

Basic concepts - Evaluation of network reliability/unreliability, series systems, parallel systems, series - Parallel configuration systems. Redundant systems and its types. Evaluation of network reliability/unreliability using conditional probability method, tie-set and cut-set based approach, complete event tree and reduced event tree methods.

Module 3: MARKOV CHAIN AND MARKOV PROCESSES (09 Periods)

Basic concepts, stochastic transitional Probability matrix, time dependent probability evaluation, Limiting State Probability, Absorbing states. Modelling concepts - State space diagrams, time dependent reliability evaluation of single component repairable model, two component repairable model. Frequency and duration techniques.

Module 4: BASICS OF SAFETY CONCEPTS (08 Periods)

Introduction, goals, need for safety, history of safety movement - the evolution of modern safety concept, general concepts of safety management. Planning for safety- productivity, quality and safety, line and staff functions, budgeting for safety, safety policy.

Module 5: SAFETY TECHNIQUES AND APPLICATIONS (10 Periods)

Introduction to safety techniques, Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of the performance of supervisors on safety. Hazard identification techniques, components of safety audit, types of audit, audit methodology, and process of safety reporting. Applications of industrial Safety, environmental safety, health safety, electrical safety, fire safety.

Total Periods: 45

EXPERIENTIAL LEARNING

1. The students shall understand various IEEE reliability standards to be followed in the engineering systems for the evaluation of reliability and assess performance.
2. Should collect various engineering components assembled and their network models for evaluations of network reliability indices.
3. The students to visit a nearby power or process industry to know about various types of failures and repair performance of various engineering components and cause of replacements.
4. Should collect information about various safety/alert sign boards and the relative measures for a particular situation.

5. Should understand the standard practices followed during the maintenance/commissioning of the electrical apparatus in any industry following the various safety precautions.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Roy Billinton and Ronald N Allen, *Reliability Evaluation of Engineering Systems*, 2nd Edition, Springer, New York, 2013.
2. Frank R. Spellman, Nancy E. Whiting, *Safety Engineering: Principles and Practices*, 3rd Edition, Rowman & Littlefield, 2018.

REFERENCE BOOKS:

1. Charles E. Ebeling, *An introduction to reliability and maintainability engineering*, 2nd Edition Tata McGraw-Hill Education, 2010.
2. Dan Petersen, *Techniques of Safety Management: A Systems Approach*, 4th Edition American society of safety engineers, 2003.
3. Ajit Kumar Verma , Srividya Ajit , Durga Rao Karanki, *Reliability and Safety Engineering*, Springer London, 2016.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/105/108/105108128/>
2. <https://nptel.ac.in/courses/110/105/110105094/>
3. <https://www.youtube.com/watch?v=uutg8jKrL9w>
4. https://www.youtube.com/watch?v=_c-iZ2BAXPw
5. <https://www.youtube.com/watch?v=GeMCF3s5EDk>
6. <https://www.youtube.com/watch?v=xYWyyype7cxE>

Web Resources:

1. <https://ieeexplore.ieee.org/document/9353567>
2. <https://www.ualberta.ca/engineering/mechanical-engineering/research/reliability-and-safety.html>
3. <https://ieeexplore.ieee.org/document/9353567>
4. <https://www.taylorfrancis.com/books/edit/10.1201/9781003140092/industrial-liability-safety-engineering-dilbagh-panchal-mangey-ram-prasenjiti-chatterjee-anish-kumar-sachdeva>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101704	REMOTE SENSING, GIS AND GPS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on photogrammetry, remote sensing, geographic information system, GIS spatial analysis. This course also examines remote sensing and GIS applications, global positioning system and its real-time applications.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Analyze photogrammetry and remote sensing to solve complex surveying problem using appropriate tools and techniques following the relevant guidelines and latest developments considering society and environment besides communicating effectively in graphical form.
- C02** Analyze GIS to solve complex surveying problems using appropriate tools and techniques following latest developments besides communicating effectively in graphical form.
- C03** Analyze GIS spatial analysis to solve complex surveying problems using appropriate tools and techniques following latest developments besides communicating effectively in graphical form.
- C04** Analyze remote sensing and GIS applications to solve complex civil engineering problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society, environment, sustainability and management principles besides communicating effectively in graphical form.
- C05** Analyze global positioning system to solve complex surveying problems using appropriate tools and techniques considering society and environment besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	2	3	-	2	2	1	1	1	-	1	-	1
C02	2	3	-	-	2	1	1	-	-	1	-	1
C03	2	3	-	2	2	1	1	-	-	1	-	1
C04	2	3	-	-	2	1	1	1	-	1	1	1
C05	2	3	-	-	2	1	1	-	-	1	-	-
Course Correlation Mapping	3	3	-	2	2	1	1	1	-	1	1	1

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: PHOTOGRAMMETRY AND REMOTE SENSING (10 Periods)

Photogrammetry: Principle of photogrammetry, Types of aerial photographs, Planning and execution of photographic flights, Geometry of aerial photographs, Scale of aerial photographs and its determination, Stereoscopy, Ground control, Mosaics, Parallax measurements for height determinations, Latest developments in photogrammetry.

Remote Sensing: Elements of remote sensing, Electromagnetic spectrum, Energy resources, Physics of radiant energy, Energy interactions with earth surface features and atmosphere, Data acquisition platforms Spectral reflectance curves, Resolution; Spectral properties of water bodies, soil and vegetation; Sensors and platforms, Visual interpretation techniques.

Module 2: GEOGRAPHIC INFORMATION SYSTEM (09 Periods)

GIS categories, Components of GIS, Fundamental operations of GIS, Spatial and non spatial data, Raster data and vector data, File management, Layer based GIS, Feature based GIS, Map projections, Latest developments.

Module 3: GIS SPATIAL ANALYSIS (08 Periods)

Database models, Data storage, Vector data storage, Attribute data storage, Data manipulation and analysis, Integrated analysis of the spatial and attribute data - DTM/DEM, Softwares – Arc GIS, QGIS and Global mapper, Latest developments in GIS software.

Module 4: REMOTE SENSING AND GIS APPLICATIONS (09 Periods)

Land use/Land cover classification, Rainfall-runoff studies, Flood and drought impact assessment and monitoring, Drainage morphometry, Watershed management for sustainable development, GIS based precision farming, GIS based natural resources management, Inland water quality survey and management, Regional and urban planning and management, GIS based highway alignment, GIS based traffic congestion analysis, GIS for public health – Case Studies.

Module 5: GLOBAL POSITIONING SYSTEM (09 Periods)

Global Positioning System (GPS) – Fundamental concepts, Components of GPS – Space segment, Control segment, User segment, Reference systems, Satellite orbits; Classification of GPS receivers, GPS observations, GPS measurements and accuracy of GPS, Applications.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Sound composing project: In this assignment, Select area and collect the geometry of aerial photographs and analyze the views.
2. Visit any meteorological department and understand about rain gauges and collect, analyse the data
3. Visit Geographical Information Systems Laboratory and understand about GIS and GPS Systems

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Shivam, P. and Shashikanth, T., *A Text Book of Basic Concept of Remote Sensing, GPS and GIS*, Sankalp Publication, 2020.
2. Anji Reddi, M., *A Text Book of Remote Sensing and Geographical Information Systems*, B. S. Publications, 2nd Edition, 2012.

REFERENCE BOOKS:

1. Bhatta, B., *Remote Sensing and GIS*, Oxford University Press, 2nd Edition, 2011.
2. Lillesand, T. M., Kiefer, R. W. and Chipman, J. W., *Remote Sensing and Image Interpretation*, John Wiley and Sons (Asia) Pvt. Ltd., 7th Edition, 2014.
3. Chandra, A. M. and Ghosh, S. K., *Remote Sensing and Geographic Information System*, Narosa Publishing House, 2nd Edition, 2015.
4. Panigrahi, N., *Geographical Information Science*, University Press, 2nd Edition, 2013.
5. Peter A. Burrage and Rachael Mc Donnell, *Principles of Geographical Information Systems*, Oxford University Press, 2nd Edition, 2014.

VIDEO LECTURES:

1. <http://nptel.ac.in/courses/105/107/105107206/>
2. <https://syslab.ceu.edu/videos/geospatial-technologies>

Web Resources:

1. Digital Audio Signal Processing: <https://www.udemy.com/course/introduction-to-geospatial-technologies-and-arcgis-interface/>
2. Learn Audio Editing - for Beginners: https://www.youtube.com/watch?v=xGgaV9r_kH8
3. <https://storymaps.arcgis.com/stories/47e984aae614442cb80aa40d121b5fe>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101705	SMART CITIES	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a discussion on smart city and infrastructure, smart governance, smart mobility, smart economy, smart environment, smart buildings, smart energy, smart water, smart living, smart people and case studies.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand the concept of smart cities and its infrastructure for ensuring safety and sustainability using appropriate techniques and management principles in India besides lifelong learning.
- CO2** Analyse smart cities to solve problems associated with mobility and governance for the growing population by ensuring safety and sustainability, management using appropriate standards in India besides lifelong learning.
- CO3** Analyse smart cities to solve problems associated with economy and environment for ensuring safety and sustainability, management using appropriate techniques and standards in India besides lifelong learning.
- CO4** Analyse buildings, energy and water resource systems in smart cities to solve problems associated with the growing population for ensuring safety and sustainability, management using appropriate standards in India besides lifelong learning.
- CO5** Analyse the smart cities to solve complex problems associated with people and living systems for ensuring safety and sustainability, management using appropriate techniques in India besides lifelong learning.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	2	3	1	2	-	1	1	2
CO2	3	3	-	1	2	3	3	2	-	1	1	2
CO3	3	3	-	1	2	3	3	2	-	1	1	2
CO4	3	3	-	1	2	3	3	3	-	-	1	2
CO5	3	3	-	1	2	3	3	2	-	-	1	2
Course Correlation Mapping	3	3	-	3	2	2	2	2	-	1	1	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: SMART CITY AND INFRASTRUCTURE (09 Periods)

Smart city - Concept, Objectives, History, Need; Key trends in smart city development, Government of India – Policy for smart city.

Infrastructure: Smart city infrastructure – Components, Challenges; Managing - Principle stake holders, Infrastructure in India and World, Dimensions of smart cities, Global standards and performance benchmarks, Practice codes, Infrastructure development, Integrated infrastructure management systems for smart city, Infrastructure management system applications for existing smart city, Various types of infrastructure systems, Infrastructure assessment.

Module 2: SMART GOVERNANCE AND SMART MOBILITY (09 Periods)

Smart Governance: Definition, smart governance to citizens, Industries and commerce, Smart governance within government, Emerging trends in smart governance, Future of smart governance, Guidelines and standards for smart governance; IOT and ICT Application – Broadband city, Use of sensors, Intelligent city governance.

Smart Mobility: Intelligent transportation systems, Accessibility, Smart vehicles and fuels, GIS, GPS, Navigation system, Public transport, Traffic safety management, Logistics flows in cities, Mobility services, E-ticketing.

Module 3: SMART ECONOMY AND SMART ENVIRONMENT (09 Periods)

Smart Economy: City branding, Market places and crowd funding, Innovation, entrepreneurship – E-business, E-commerce, Online integrated business platforms and networks; Local and global interconnectedness, Productivity, Flexibility of labour market.

Smart Environment: Network and environmental monitoring, Energy efficiency, Urban planning and urban refurbishment, Smart buildings and building renovation, Resource management, Environmental protection.

Module 4: SMART BUILDINGS, SMART ENERGY AND SMART WATER (09 Periods)

Smart Buildings: Definition, Sustainable city – A green approach, Housing, Sustainable green building - Solar energy for smart city, Waste water management, solid waste management, 3Rs Policy, Green ratings.

Smart Energy: Current energy demand, Alternate energy sources, Renewable energy, Production, Solar energy, Wind energy, Energy from solid waste, Applications, Challenges in smart energy

Smart Water: Storage and conveyance system of water, Sustainable water and sanitation, Sewage systems, Flood management, Conservation system.

Module 5: SMART LIVING, SMART PEOPLE AND CASE STUDIES (09 Periods)

Smart Living: Definition, Cultural facilities, World-class education, Tourist attractions, World-class hospitals, Latest technologies, Quality housing, Community and urban life management, Social cohesion.

Smart People: Definition, Human development index, Level of qualification, Graduate enrolment ratio, Lifelong learning, ICT Skills, Quality of smart people – Flexibility, Creativity to contribute to education, Democratic nature; Personality dimensions – Extroversion, Agreeableness, Consciousness, Emotional Stability, Open to experience.

Case Studies: Helsinki – Finland; Zurich - Switzerland; Oslo - Norway; Amsterdam - The Netherlands; New York - United States; Seoul (World's first Smart City) - South Korea.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Prepare a report on smart city infrastructure for south Indian cities.
2. Prepare a review on need for changes in transportation and governing policies in India.
3. Write a report on energy conservation and economy stability in world's first smart city.
4. Write a report on need and technologies to be adopted for green buildings in a smart city.
5. Prepare a case study report on Hyderabad, Telangana.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Li Xian Yi, *Smart City on Future Life - Scientific Planning and Construction*, Posts and Telecom Press, 2012.
2. Arpan Kumar Kar, Manmohan Prasad Gupta, P. Vigneswara Ilavarasan and Yogesh K. Dwivedi, *Advances in Smart Cities*, CRC Press, Taylor & Francis Group, Boca Raton, 2017.

REFERENCE BOOKS:

1. Nicos Komninos, *The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities)*, Routledge Taylor & Francis Group, London, 2015.
2. Eleonora Riva Sanseverino, *Smart Rules for Smart Cities – Managing Efficient Cities in Euro-Mediterranean Countries*, Springer for innovation, Springer, Italy, 2014.
3. Smart Cities Mission: A Step Towards Smart India, National Portal of India
4. Anthony M. Townsend, *Smart Cities – Big Data, Civic Hackers and The Quest for a New Utopia*, W. W. Norton & Company, Inc., New York, 2013.
5. IoT Technician (Smart City) – MHRD, Govt. of India, 2nd Edition, 2022.

VIDEO LECTURES:

1. City of the Future: Singapore – Full Episode | National Geographic - YouTube
2. Integrated Waste Management for a Smart City - Course (nptel.ac.in)

Web Resources:

1. Smart Cities (nationalgeographic.org)
2. NPTEL :: Civil Engineering - NOC: Sustainable Materials and Green Buildings
3. Smart cities (europa.eu)
4. Top 7 Smart Cities in the World in 2023 (earth.org)

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101706	SMART SENSORS FOR ENGINEERING APPLICATIONS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides a detailed discussion on Basics of sensors, characteristics of sensors and their responses; Smart sensors for Engineering, Science and Health Monitoring Applications; Applications of smart sensors and advancements in sensing Techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Analyse the characteristics of transducers and estimate the response of sensors.
- CO2** Understanding the working of various sensors in the context of their specialised domains.
- CO3** Apply smart sensors for real time applications.
- CO4** Apply the advanced techniques to smart sensors to provide solution to real time applications.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	-	-	-	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CONCEPTS OF SENSORS

(08 Periods)

Introduction to sensors and transducers. Need for sensors in the modern world. Different fields of sensors based on the stimuli, various schematics for active and passive sensors. Static and dynamic characteristics of sensors. **zero, I and II order sensors:** Response to impulse, step, ramp and sinusoidal inputs. Environmental factors and reliability of sensors.

Module 2: SENSORS IN ENGINEERING

(07 Periods)

Physical principles of sensors, Electric Sensors: Resistive, Capacitive, Inductive. Piezoelectric sensor. Photo elastic sensors, Fluid Mechanic sensors.

Module 3: HUMAN AND BIOMIMETIC SENSORS

(10 Periods)

Human sensors: vision, Taste and smell, Hearing, Somatic, Biomimetic Sensors, Electrochemical, Thermoelectric sensors, Optic sensors.

Module 4: APPLICATIONS OF SMART SENSORS

(11 Periods)

WSN Based Physiological Parameters Monitoring System: Measurement of Human Body Temperature. Intelligent Sensing System for Emotion Recognition: Aim of the Emotion Recognition System, Development of Intelligent Sensing System for Emotion Recognition. WSN Based Smart Power Monitoring System.

Module 5: ADVANCEMENTS IN SENSING TECHNOLOGY

(09 Periods)

Ecological Monitoring Using Wireless Sensor Networks: Overview, Challenges, and Opportunities. Development of an Embedded System-Based Gateway for Environmental Monitoring in Wild Fields. Advancements in Structural Health Monitoring.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Build a wireless sensor system for Environmental pollution monitoring.
2. Design a smart temperature measurement system using required accessories.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Patrick F Dunn, *Fundamentals of sensors For engineering and science*, CRC Press, 2012.
2. Subhas C. Mukhopadhyay, Krishanthi P. Jayasundera, and Anton Fuchs, *Smart Sensors, Measurement and Instrumentation*, Springer, 2013.

REFERENCE BOOKS:

1. Subhas Chandra Mukhopadhyay, *Intelligent Sensing, Instrumentation and Measurements*, Springer, Kluwer Academic Publishers, 2013.
2. Henry Bolte, *Sensors – A Comprehensive Sensors*, John Wiley.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=oRydUfgMdgA>
2. https://onlinecourses.nptel.ac.in/noc22_ee36/

Web Resources:

1. <https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1199&context=nasapub#:~:text=The%20smart%20materials%20examined%20include,%2C%20magneto%2Doptical%20materials%2C%20and>
2. <https://www.youtube.com/watch?v=q8UuRkOQ9A0>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8433768/>
4. <https://www.mdpi.com/1424-8220/21/17/5890>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EE101703	SUSTAINABLE ENERGY SYSTEMS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course designed emphasizes the operating principle of a range of non-conventional energy resources, energy harvesting and conversion principles and key performance characteristics. The energy conversion technologies will include energy conversion from, Solar, Wind, Ocean, Biomass, Geothermal and Fuel cells. The course also emphasizes on various types of hybrid energy storage systems with their relative advantages and disadvantages.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand the fundamental concepts of renewable energy sources and their endurance for sustainability.
- CO2** Understand the various methods of harvesting solar energy, energy conversion principles, and operational aspects and environmental impacts of solar technologies.
- CO3** Understand the various methods of harvesting wind energy, conversion principles, operational aspects, and environmental impacts of wind energy systems.
- CO4** Understand the various methods of harvesting ocean energy, Biomass energy and geothermal energy, energy conversion technologies, operational aspects, and their impacts on the environment.
- CO5** Understand the principle of harvesting energy from fuel cells and the operational aspects of hybrid energy storage systems.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	--	--	--	--	2	2	--	--	--	--	1
CO2	3	--	--	--	2	2	2	--	--	--	--	1
CO3	3	--	--	--	2	2	2	--	--	--	--	1
CO4	3	--	--	--	2	2	2	--	--	--	--	1
CO5	3	--	--	--	2	2	2	--	--	--	--	1
Course Correlation Mapping	3				2	2	2					1

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO SUSTAINABLE ENERGY SOURCES (07 Periods)

Impact of conventional sources on Environment—acid rain, ozone layer depletion, Global warming, greenhouse effect and nuclear waste; Limitation of fossil fuels; Renewable energy sources; Renewable sources and their sustainable development.

Module 2: ENERGY FROM SOLAR (10 Periods)

Introduction, solar radiation, Measurement of solar radiation—Pyranometer; Solar energy collectors; Flat plate collectors— Liquid and air (non-porous) types; Focusing type— Parabolic and Point types; Solar photovoltaic system— PV cell and its types, Configuration of solar panel, PV system; Applications: Solar pump, Solar water heater

Module 3: ENERGY FROM WIND (08 Periods)

Introduction, power extraction from the wind, Wind turbines— Horizontal axis wind turbine— Propeller type and Vertical axis wind turbine— Darrieus rotor type; Basic components of wind energy conversion systems, Applications: Energy storage, Water pumping; Environmental impacts.

Module 4: ENERGY FROM OCEAN, BIOMASS AND GEOTHERMAL RESOURCES (12 Periods)

Energy from ocean: Introduction, ocean thermal energy conversion (OTEC): Open and closed cycle power plants; Tidal energy: Schematic diagram of tidal power plant; Advantages and disadvantages.

Energy from Biomass: Introduction, biomass conversion technologies-direct, Thermochemical and Biochemical conversions; Biogas generation—Anaerobic digestion process.

Geothermal energy: Introduction, Geothermal resources, Geothermal power plants—Vapour dominated and liquid dominated; Environmental issues.

Module 5: FUEL CELLS AND HYBRID ENERGY SYSTEMS (08 Periods)

Fuel Cells: Introduction, principle and operation of fuel cell, classification of fuel cells, advantages and disadvantages of fuel cells.

Hybrid energy systems: Need for hybrid systems, configuration and coordination, Block diagram approach of Stand-alone PV-wind system, PV-Diesel and Wind-diesel; energy storage systems — Ultra capacitors, SMES, Battery.

Total Periods: 45

EXPERIENTIAL LEARNING

1. The students shall visit a solar power plant, understand the operational aspects and should prepare a technical report on the plant visited.
2. The students shall visit a wind farm, understand the operational aspects, and should prepare a technical report on the plant visited.
3. The students shall visit a bio-mass energy conversion plant, understand the operational aspects and should prepare a technical report on the plant visited.
4. The students shall prepare a technical report on the need of a hybrid plant and find new avenues for a new hybrid system.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Rai, G.D., *Non-conventional Energy Sources*, Khanna Publishers, New Delhi, 2017.
2. G.N. Tiwari and M.K. Ghosal, *Renewable energy resources: Basic principles and applications*, Alpha Science International Ltd., 2005.

REFERENCE BOOKS:

1. Jhon Twidell and Tony Wier, *Renewable Energy Resources*, Taylor & Francis, 2nd edition, London and New York, 2006.
2. K.M. Mittal, *Non-conventional Energy Systems-Principles*, Progress and Prospects, Wheeler Publications, 1997.
3. S.Rao, Dr.B.B. Parulekar, *Energy Technology*, Third edition, Khanna Publications, 2013.
4. R. K. Rajput, *A textbook of power system engineering*, Laxmi publications (P) Ltd, 2016

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/103103206>
2. <https://nptel.ac.in/courses/121106014>
3. <https://youtu.be/mh51mAUexK4>
4. <https://youtu.be/UW4HYJ36q0Y>

Web Resources:

1. www.mnre.gov.in
2. www.ireda.in

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS101702	WEB DESIGN FUNDAMENTALS	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course is designed to introduce the student to the technologies and facilities of web design: CSS, javascript, and jquery. Students will understand the web design process and use these software technologies together to produce web design projects.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand the fundamentals of HTML 5 and the principles of web design.
- CO2** Construct basic websites using HTML and Cascading Style Sheets.
- CO3** Build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms.
- CO4** Learn how to use HTML5 and other Web technologies to develop interactive and responsive web pages.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	2	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	2	-
CO4	2	3	3	-	-	-	-	2	-	-	-	-
Course Correlation Mapping	3	3	3	-	-	-	2	2	-	-	2	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION

(09 Periods)

Elements – Data types - Working with Text - Arranging Text - Displaying Lists - VARElement - BDO Element - SPAN Element – DIV Element.

Module 2: LINKS AND URLS

(09 Periods)

Hyperlinks – URLs - Linking to a Mail System - Creating Tables - Inserting Images in aWeb Page – Colors – Form Elements - Multiple-Choice Elements – Multimedia

Module 3: DYNAMIC HTML

(09 Periods)

Features of JavaScript - Programming Fundamentals - JavaScript Functions, Events, Image Maps, and Animations – JS Objects - Document Object - Validation, Errors, Debugging, Exception Handling, and Security

Module 4: CASCADING STYLE SHEET

(09 Periods)

CSS Syntax - CSS Selectors - Backgrounds and Color Gradients - Fonts and Text Styles - Creating Boxes and Columns - Displaying, Positioning, and Floating an Element - TableLayouts - : Effects, Frames, and Controls in CSS

Module 5: ADVANCED FEATURES OF HTML5

(09 Periods)

Creating Editable Content - Checking Spelling Mistakes - Custom Data Attributes - Client-Side Storage - Drag and Drop Feature - Web Communication –**jQuery** - Fundamentals of jQuery - Callback Functions - jQuery Selectors - jQuery Methods to Access HTML Attributes.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Design a blog layout that includes header, navigation menu, content area, sidebar. Apply appropriate styling to each section.
2. Develop a java script based quiz that presents MCQs to the user and provides immediate feedback on their answers. Keep track of the score and display the final results at the end.
3. Build a web page that displays and image gallery. Each image should be a clickable link that opens the image in a larger view when clicked.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. DT Editorial Services, *HTML 5 Black Book*, Dreamtech Press, 2nd Edition, 2016.

REFERENCE BOOKS:

1. Jennifer Niederst Robbins, *HTML5 Pocket Reference*, O'Reilly, 5th Edition, 2018.
2. Ben Frain, *Responsive Web Design with HTML5 and CSS3*, Packt, 2nd Edition, 2020.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=h_RftxdJTzs
2. <https://www.youtube.com/watch?v=dlkWNdnO8ek>

Web Resources:

1. <https://www.w3schools.com/html/>
2. <https://www.w3schools.com/css/>
3. <https://www.geeksforgeeks.org/web-technology/>
4. <https://www.smashingmagazine.com/2021/03/complete-guide-accessible-front-components/> end-
5. <https://css-tricks.com/>
6. <https://davidwalsh.name/css-optional>

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101706	WOMEN EMPOWERMENT	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Concept & Framework, Status of Women, Women's Right to Work, International Women's Decade, and Women Entrepreneurship.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Demonstrate the knowledge of the characteristics and achievements of empowered women and women's empowerment techniques by analyzing women's legal and political status.
- CO2** Apply the knowledge of women's rights by analyzing various societal issues and obstacles in different fields, including science and technology.
- CO3** Demonstrate the knowledge of the significance of women's participation in policy debates, National conferences, and common forums for equality and development by identifying and analyzing issues.
- CO4** Analyze the concept of women's entrepreneurship, government schemes, and entrepreneurial challenges and opportunities.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	1	3	-	1	-	-	-	-
CO2	3	1	-	-	-	2	-	-	-	-	-	-
CO3	3	1	-	-	-	2	-	-	-	3	-	-
CO4	3	1	-	-	-	-	-	-	-	-	2	-
Course Correlation Mapping	3	1	-	-	1	3	-	1	-	3	2	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CONCEPT & FRAMEWORK

(09 Periods)

Introduction– Empowered Women’s Characteristics – Achievements of Women’s Empowerment **Concept of Empowerment:** Meaning & Concept – Generalizations about Empowerment – Empowerment Propositions – Choices women can make for empowerment – Women’s participation in decision making, development process & in Governance. **Framework for Empowerment** – Five levels of equality – Tenets of Empowerment– Elements – Phases and aspects – Techniques – Categories and Models
– Approaches.

Module 2: STATUS OF WOMEN

(09 Periods)

Legal Status: Present Scenario – Call for Social Change – Significant Trends – Legal & Schemes – Personal Law – Joint Family – Criminal Law – Shift towards Dowry – Deterrent Punishment – Criminal Law (II Amendment) – Discrimination in Employment.

Political Status: Present Scenario – Political Participation & its Nature Socio-economic Characteristics – Political Mobilization: Mass Media – Campaign Exposure – Group Orientation – Awareness of issues and participation – Progress & Future Thrust.

Module 3: WOMEN’S RIGHT TO WORK

(09 Periods)

Introduction – Present Scenario – Changes in Policy & Programme – National Plan of Action– Women’s Cells and Bureau – Increase in the work participation rate – Discrimination in the labour market – Women in unorganized sector – Issues and Obstacles– Women in Education – Women in Science & Technology – Case Study: Linking Education to Women’s Access to resources.

Module 4: WOMEN’S PARTICIPATORY DEVELOPMENT

(09 Periods)

Dynamics of social change – conscious participation – Information Explosion – Organized Articulation – National Conference – Common Forums – Participatory Development – New Issues Identified – Role of other Institutions.

Module 5: WOMEN ENTREPRENEURSHIP

(09 Periods)

Introduction – Definition – Concept – Traits of women Entrepreneurs – Role of Women Entrepreneurs in India – Reasons for Women Entrepreneurship – Government schemes & Financial Institutions to develop Women Entrepreneurs – Key policy recommendations
-Project Planning – Suggestions and measures to strengthen women entrepreneurship
-Growth & Future challenges – Training and Opportunities – Case Study: Training Women as Hand-pump Mechanics– Case Study: Literacy for Empowering Craftswomen

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare poster presentation on "impact of women's self-help groups on their empowerment and socio-economic development."
2. Prepare a comparative analysis chart on the status of women in various countries.
3. Prepare a presentation on women and cultural responsibilities in different societies.
4. Prepare a presentation on the women of the past, present and future in terms of responsibilities and duties.
5. Prepare a presentation on the great women entrepreneurs of India.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. SahaySushama, *Women and Empowerment*, Discovery Publishing House, New Delhi, 2013.
2. NayakSarojini, Jeevan Nair, *Women's Empowerment in India*, Pointer Publishers, Jaipur, 2017.

REFERENCE BOOKS:

1. Baluchamy. S, *Women's Empowerment of Women*, Pointer Publishers, Jaipur, 2010.
2. Khobragade Grishma, *Women's Empowerment: Challenges and Strategies Empowering Indian Women*, Booksclinic Publishing, Chhattisgarh, 2020.

Web Resources:

1. <https://www.economicdiscussion.net/entrepreneurship/women-entrepreneurs-in-india>
2. <https://www.businessmanagementideas.com/entrepreneurship-2/women-entrepreneurs>