MOHAN BABU UNIVERSITY

Sree Sainath Nagar, Tirupati – 517 102

MBU
MOHAN BABU
UNIVERSITY
DREAM. BELIEVE. ACHIEVE

SCHOOL OF ENGINEERING

B.Tech. Electronics and Communication Engineering

CURRICULUM AND SYLLABUS

(From 2022-23 Admitted Batches)

FULLY FLEXIBLE CHOICE BASED CREDIT SYSTEM
(FFCBCS)

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 COMMUNICATION ENGINEERING

Vision

To be a center of excellence in the fields of Electronics, Communications and Instrumentation through teaching and research producing high quality engineering professionals and Entrepreneurs with values andethics 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 industryto meet societal needs.
- Inculcating ethics and values in students for effective engineering practice.

B.Tech. Electronics and Communication Engineering

PROGRAM EDUCATIONAL OBJECTIVES

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

PEO1. Pursue higher education in the core or allied areas of Electronics and Communication Engineering or Management.

PEO2. Develop into a productive and valued professional in industry /research by addressing the challenges in the core or allied areas of Electronics and Communication 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. ECE Programwill 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. ECE programwill be able to:

PSO1. Design and develop customized electronic circuits for domestic and industrialapplications.

PSO2. Analyze, synthesize and design wired and wireless communication systems for desired specifications and applications.

PSO3. Apply suitable methods and algorithms to process and extract information from signals and images in Radar, Satellite, Fiber optic and Mobile communication systems.

B.Tech. Electronics and Communication Engineering

(Regular - 4 Years Program)

Basket Wise - Credit Distribution

S. No.	Basket	Credits (Min. - Max.)
1	SCHOOL CORE	50-54
2	PROGRAM CORE	45-61
3	PROGRAM ELECTIVE	24-36
4	SPECIALIZATION ELECTIVE	12-18
5	UNIVERSITY ELECTIVE	9-12
	TOTAL CREDITS	**Min. 160**

B.Tech. Electronics and Communication Engineering

(Lateral Entry - 3 Years Program)

Basket Wise - Credit Distribution

S. No.	Basket	Credits (Min. - Max.)
1	SCHOOL CORE	20-34
2	PROGRAM CORE	45-61
3	PROGRAM ELECTIVE	24-36
4	SPECIALIZATION ELECTIVE	12-18
5	UNIVERSITY ELECTIVE	9-12
	TOTAL CREDITS	**Min. 120**

School Core (50-54 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	-
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. 4 Credits to be earned)							
22LG102401	English for Professionals	2	-	2	-	3	-
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	-
22MM101406	Special Functions and Complex Analysis	3	-	-	-	3	-
22MM101405	Numerical Methods, Probability and Statistics	3	-	-	-	3	-

Course Code.	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
Physics Basket (Min. 4 Credits to be earned)							
22MM102452	Engineering Physics	3	-	2	-	4	-
22MM102451	Applied Physics	3	-	2	-	4	-
Management Basket (Min. 5 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	-
22LG107602	Essential Life Skills for Holistic Development	2	-	-	-	2	-
22AB107601	NCC/NSS Activities	-	-	-	-	2	-
22MG107601	Innovation, Incubation and Entrepreneurship	2	-	-	-	2	-
22EE107601	Intellectual Property Rights	2	-	-	-	2	-
22EE107602	Fundamentals of Research Methodology	2	-	-	-	2	-
22AB107602	Yoga	-	-	-	-	2	-

* Compulsory Course

School Core (20-34 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	-

Course Code.	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
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	-
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	-
22LG107602	Essential Life Skills for Holistic Development	2	-	-	-	2	-
22AB107601	NCC/NSS Activities	-	-	-	-	2	-
22MG107601	Innovation, Incubation and Entrepreneurship	2	-	-	-	2	-
22EE107601	Intellectual Property Rights	2	-	-	-	2	-
22EE107602	Fundamentals of Research Methodology	2	-	-	-	2	-
22AB107602	Yoga	-	-	-	-	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	
22EE102403	Network Analysis	3	-	2	-	4	Fundamentals of Electrical Engineering
22EC102001	Semiconductor Devices and Circuits	3	-	2	-	4	-
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
22EC101135	Sensors and measuring instruments	3	-	-	-	3	-
22EC101004	Electromagnetic Fields and Transmission Lines	3	-	-	-	3	Engineering Physics
22EC101005	Signals and Systems	3	-	-	-	3	Transformation Techniques and LinearAlgebra
22EC101006	Probability and Stochastic Processes	3	-	-	-	3	Multivariable Calculus and DifferentialEquations
22EC102007	Analog Communications	3	-	2	-	4	Signals and Systems
22EC102008	Digital Communications	3	-	2	-	4	Analog Communications
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	-
22EC102014	Antennas and Propagation	3	-	2	-	4	Electromagnetic Fields and TransmissionLines

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	
22EC101105	Electronics	Biomedical Instrumentation and Measurements	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	VLSI	FPGA Architectures and Applications	3	-	-	-	3	VLSI System Design
22EC101020		Digital IC Design	3	-	-	-	3	VLSI System Design
22EC101021	Communications	Fiber Optic Communications	3	-	-	-	3	-
22EC101022		Radar Engineering	3	-	-	-	3	-
22EC101023		Cellular and Mobile communications	3	-	-	-	3	-
22CB102002		Computer Networks	3	-	2	-	4	-
22EC102024		Microwave Engineering	3	-	2	-	4	Electromagnetic Fields andTransmission Lines
22EC101025		Error Control coding	3	-	-	-	3	Digital Communications
22EC102119		Software Defined Radio Architecture	3	-	2	-	4	Wireless Communication, Digital Signal Processing and Antennas
22EE101406	Signal Processing	Linear Control Systems	3	-	-	-	3	Signals and Systems
22EC104026		Image Processing	3	-	2	4	5	-
22EC104027		Advanced Digital Signal Processing	3	-	2	4	5	Digital Signal Processing
22EC102028	IoT	Internet of Things and Applications	3	-	2	-	4	-
22AI101402		Introduction to Soft Computing	3	-	-	-	3	
22AI104002		Object Oriented Programming Through	3	-	2	4	5	Programming for ProblemSolving

	Interdisciplinary	Java						
22CB101001		Cryptography and Network Security	3	-	-	-	3	Computer Networks
22CS102002		Python programming	3	-	2	-	4	Programming for Problem Solving
22AI102001		Operating Systems	3	-	2	-	4	-
22CS102005		Database Management Systems	3	-	2	-	4	Data Structures and Algorithms
22AI102002		Artificial Intelligence	3	-	2	-	4	Python Programming
22EC102029		Fundamentals of Machine Learning	3	-	2	-	4	-
22EC102120		Generative AI and Professional Practices	3	-	2	-	4	-
22EC101182		Deep Learning for Visual Computing	3	-	-	-	3	Introduction to Machine learning
22EC101139		Multimedia Communication	3	-	-	-	3	Computer Communications and Networks
22EC101140		Advanced Robotics	3	-	-	-	3	-
22EC101141		Quantum Computing and Information	3	-	-	-	3	Electronic Devices and Circuits, Semiconductor Devices and Circuits
22EC101142		Machine Learning for Future Wireless Communication	3	-	-	-	3	Machine Learning and Wireless Communications
22EC101143		Machine Learning Models	3	-	-	-	3	-
22EC102121		AI in Natural Language Processing	3	-	2	-	4	-

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	
22EC101030	VLSI	Low Power CMOS VLSI Design	3	-	-	-	3	VLSI System Design
22EC101031		Analog IC Design	3	-	-	-	3	VLSI System Design
22EC101032		Testing and Testability	3	-	-	-	3	VLSI System Design
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	
22EC101036	Communications	Satellite Communications	3	-	-	-	3	Digital Communications
22EC101037		Broadband Communications Systems	3	-	-	-	3	-
22EC101038		Electromagnetic Interference and Compatibility	3	-	-	-	3	-
22EC101039		Wireless Sensor Networks	3	-	-	-	3	Computer Networks
22EC101136		Advanced Computational Electromagnetics	3	-	-	-	3	Electromagnetic Waves and Transmission Lines
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 (9-12 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	-
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 toopt 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 theabove 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 experienceon 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 safetyissues related to quality of water.

CO2. Acquire basic knowledge on industrial polymers, composites, and Nano materials usedin engineering applications.

CO3. Apply and demonstrate competency in the basic concepts of electrochemical cells andsensors.

CO4. Acquire basic knowledge of instrumental methods and their applications in theanalysis 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, H_2–O_2 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 P^H 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, 16^{th} edition, 2013.
2. K.N. Jayaveera, G.V. Subba Reddy and C. Ramachandriah, *Engineering Chemistry,* Mc.GrawHill Publishers, New Delhi.
3. Engineering Chemistry lab Manual

REFERENCE BOOKS:

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

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=Iy_FS3LZXEY
2. https://www.youtube.com/watch?v=0_ZcCqqpS2o
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_(Ana lytical_Chemistry)/Analytical_Sciences_Digital_Library/Active_Learning/Shorter_Activities /El ectrochemical_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_lube_par tner/

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 reductiontechniques, mesh and nodal analysis.

CO2. Analyze the single phase AC electrical circuits to investigate the response anddetermine various electrical quantities.

CO3. Analyze the operational aspects of Single Phase Induction Motors and realize theirapplications.

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 theperformance 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 testson 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 TOPROBLEM 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, Filesof 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 necessaryvalues from the keyboard.
      i. $(ax + b)/(ax - b)$ ii. $2.5 \log x + \text{Cos } 32^0 + | x^2 + y^2|$
      iii. $ax^5 + bx^3 + c$ iv. ae^{kt}

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/sec^2). WriteC program to find the distance travelled at regular intervals of time given the valuesof *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 ageand lives in a city, and is a male then the premium is Rs.4 per thousand and thepolicy 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 thepolicy 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: $1+x+x^2+x^3+\ldots\ +x^n$. 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<=Rs.5000 then increase it by 15%.

   If Basic-pay> Rs.5000 and <=Rs.25000 then it increase by10%.

   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 ofservice 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. YashavantKanetkar, *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 ProgrammingApproach 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
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 oftrees, 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	-	-	-	-	-	-	-
Course Correlation Mapping	-	-	-	-	-	-	-	-	3	3	-	-
	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 inrandom 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 a 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_mobileno. 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, 5thEdition, 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 geometricentities (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 truelengths, 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	Course Title	L	T	P	S	C
22AI105001	**DESIGN THINKING**	-	1	2	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

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, Phasesof Design Thinking, Canva Tool.

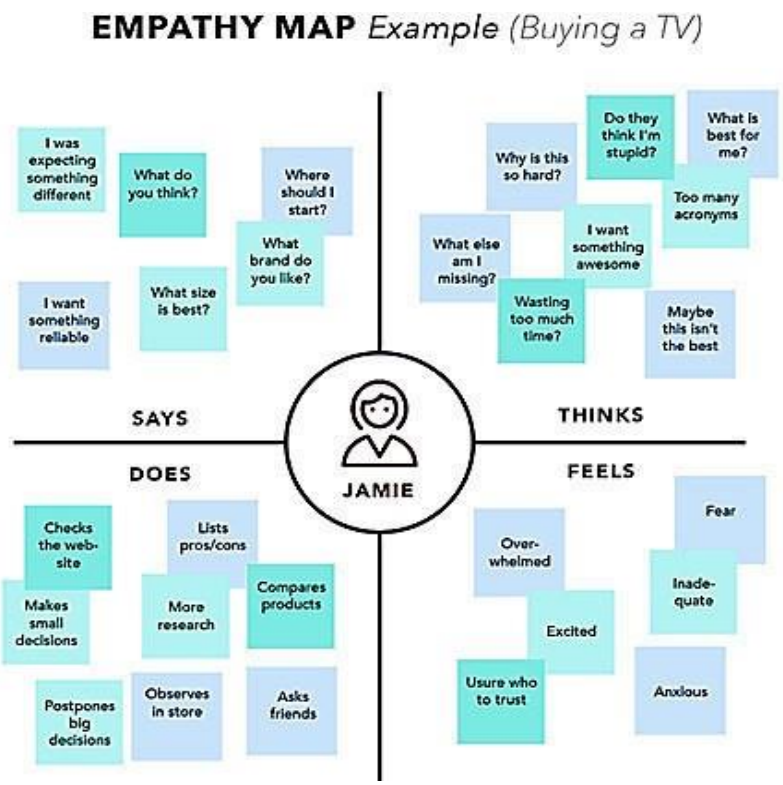
1. Conduct survey and identify the problem by either individual or group and frame a problem statement using AEIOU (Activities, Environment, Interactions, Objects,Users) framework.

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:

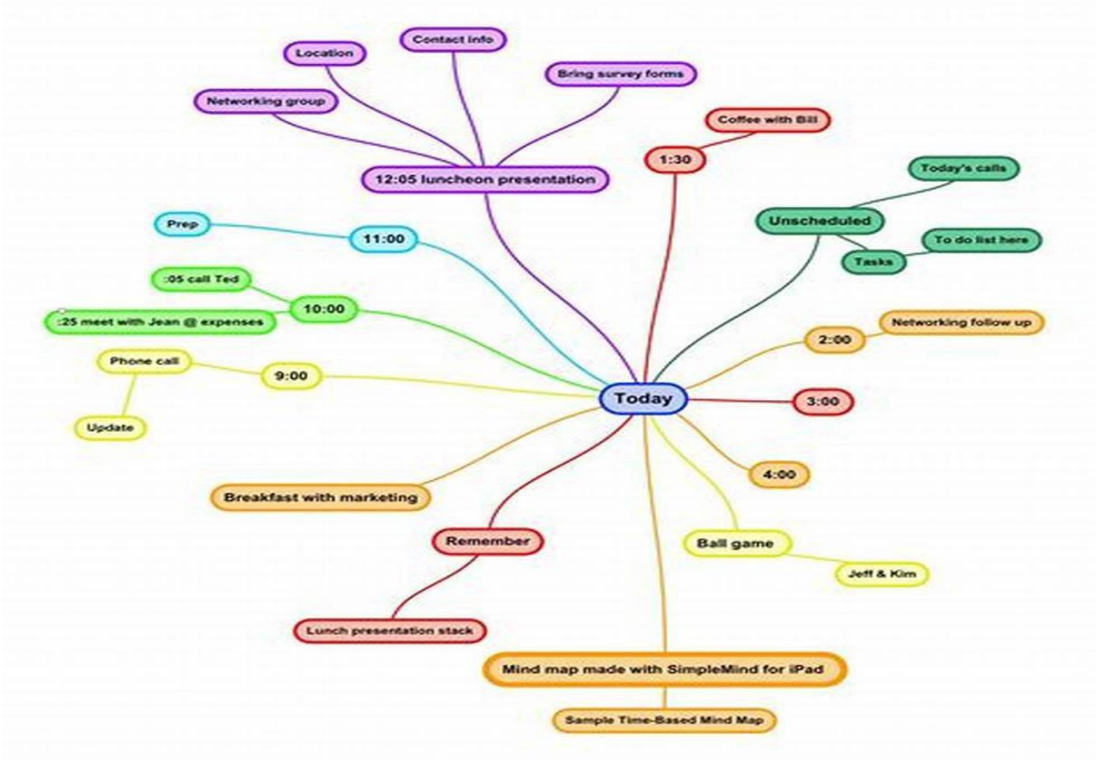


Ideation – Importance of visualizing and empathizing before ideating, Applying the method, Ideation Tools
– Story board, Brainstorming, Mind Map, SCAMPER.

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 fromPDMA*, Wiley, 2015.
2. Vijay Kumar, *101 Design Methods: A Structured Approach for Driving Innovation in YourOrganization*, 2012.
3. Kathryn Mc Elroy, *Prototyping for Designers: Developing the best Digital and PhysicalProducts*, 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/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 real world 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 thecourse.

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, Channelsof 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 Modesof technology-based communication.

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

Reading comprehension, Vocabulary, Listening, Grammar, Writing, and TechnicalCommunication

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. Preparea 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, politicaland 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 Webs 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 problemand 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 cakein 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, and 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 induvial 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	Course Title	L	T	P	S	C
22LG105402	**SOFT SKILLS**	-	-	2	-	1

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

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 formsin 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 IntuitiveThinking

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, andEmail 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	Course Title	L	T	P	S	C
22LG101403	**GERMAN LANGUAGE**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

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

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

CO1. Demonstrate basic knowledge of the German language and verb conjugation.

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

CO3. Apply the various sentence structures by examining the rules of grammar in speaking and writing.

CO4. Analyze the various verb structure of English and German languages effectively in professional writing

CO5. 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**
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 - 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	Course Title	L	T	P	S	C
22LG101404	**FRENCH LANGUAGE**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

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 ***(06Periods)***

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&qpvt=video+lecture+on+THE+ALPHABET+in+french&mid=D123409C16604E0FDE26D123409C16604E0FDE26&&FORM=VRDGAR
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 equalto its width. What is the largest volume bag of this shape that you can check on an AmericanAirlines flight?
2. An insulated rod of length l has its ends *A* and *B* maintained at $0^0\,C$ and $100^0\,C$ respectively until steady state conditions prevail. If *B* is suddenly reduced to 0^0 C and maintained at 0^0 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 $\rho = k x y z$.

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 definitionof 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 $(-\pi,\pi)$, 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. 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 magnitude2 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 Kirchoff Voltage law and then solve using Laplace transform. Analyze the result by using any technology**.**
3. Check that the complex numbers $C = \{x + iy / i^2 = -1, x, y \in \Re\}$, 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%20 Applications.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, 2l] using MATLAB.
3. Plot and visualize the first four terms of a Fourier series of a function f(x) in [-l, l] 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 ofintegrals 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 FUNTCIONS (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 $w = z^2, e^z$; 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 paperusing 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 ofEngineering Mathematics, Vol-III*, S. Chand & Company, 9th edition, 2013.
2. N. P. Bali and Manish Goyal, *A text book of Engineering Mathematics*, LaxmiPublications, 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 EQUATONS *(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^{rd} and 3/ 8^{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 ofmeans.

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 andSons 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 - Applicationsof 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 coefficientand 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-timecurve, 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 applicationsof 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 byusing 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 agiven 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 EngineeringPhysics* - 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*, DhanpatRai 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. CallisterJr., 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.economicsdiscussion.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, BadChoices 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 reflectedin 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, NewYork, 2006

REFERENCE BOOKS:

1. Conger J, *Inspiring others: Th e 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
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 purist 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 Practicesand 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 reflectedin 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 usingPPT
2. Select any company wherein you will get the details of activities and time and drawthe 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 successof 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 PrivateLimited.
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 appliedto an organization. Codes of professional ethics guide the stakeholders of an organization aboutthe 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, andcontroversy.

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, Conflictof 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., *EngineeringEthics*, 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 ServicesPvt 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=QFHOtH54oUc
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%20NAAGARAZAN.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 canbe 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 Tirupaticity.
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, RevisedEdition, 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_environmen t.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 techniquesand 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 & Mumbaiand

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*, Cengage Learning, 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 DEVLOPMENT ***(06 Periods)***

India - Technology and rural development, Pre and post-independence period, Rural India Life, 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, Needand 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 implantedand 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 ismore and prepare a document.

5. Develop a small IT application the village area which will be used for the growth ofthe 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. Virdi, 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, 1stEdition, 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/UCEZxAQu3ZBulN-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	Course Title	L	T	P	S	C
22LG107603	**SPOKEN ENGLISH**	-	1	2	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

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 conditionsin 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:

CO1 Understand different life skills required in personal and professional life.

CO2 Analyse well-defined techniques to cope with emotions and stress.

CO3 Apply appropriate thinking and problem-solving methods to solve problems.

CO4 Function effectively in a team and as an individual.

CO5 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**
CO1	3	-	-	-	-	-	-	-	-	2	-	2
CO2	2	3	-	-	2	-	-	-	-	2	-	2
CO3	2	3	-	-	2	-	-	-	-	2	-	2
CO4	2	2	-	-	2	-	-	-	3	2	-	2
CO5	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 Ethicslike 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 upwith 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*". Boolkboon.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.
3. Shalini Verma. "Development of Life Skills and Professional Practice"; First Edition; 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=xM0fajUl7Bg
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/
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 chooseto 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 Develop mentation.

(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. nhttps://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 filling intellectual property rights.

CO2 Understand the legislative practices and protocols for the acquisition of trademarksand the judicial consequences for violating laws of trademark protection.

CO3 Understand the legislative practices and protocols for the acquisition of copyrights andthe 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 protocolsfor 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 secrete 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:

CO1 Understands the underlying concepts of research methodology, types of research and the systematic research process.

CO2 Understand the philosophy of research design, types of research design and develop skills for a good research design.

CO3 Understand the philosophy of formulation of a research problem, methods of data collection, review of literature and formulation of working hypothesis.

CO4 Understand various data processing and analyzing techniques and their significance in the research.

CO5 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**
CO1	3	-	--	-	-	-	--	-	--	-	--	-
CO2	3	-	1	-	-	-	--	-	--	-	--	-
CO3	3	-	--	-	2	1	-	-	--	-	--	-
CO4	3	2	--	-	3	1	--	-	--	-	--	-
CO5	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
22EE102403	**NETWORK ANALYSIS**	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 various electrical 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, Shyammohan 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*, McGraw Hill, 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 Regulationin Half wave/Full wave rectifier with and without Capacitor filter.
3. Verify input and output characteristics of transistor in common base and commonemitter 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 squareinput.

8. Develop clipper circuit to clip positive and negative portions of the input waveformwith two reference voltages.

9. Develop clamping circuits to clamp different positive and negative dc levels of theinput 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
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 typesof 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 withrequired 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 givencut off frequency using Op-amp 741.
5. Design and Simulate D-A converter (R-2R ladder) using Op-amp 741 with requiredvoltage levels.
6. Design and simulate a comparator circuit and setup a zero crossing detector withOP 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 cycleand frequency.
9. Design and verify Monostable Multivibrator using 555 timer with a given duty cycleand frequency.
10. Design and verify D-A converter (R-2R ladder) using Op-Amp 741 with requiredvoltage 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, 4thEdition,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, 2ndEdition, 1997.

VIDEO LECTURES:

1. https://www.digimat.in/nptel/courses/video/108108114/L01.html
2. https://www.youtube.com/watch?v=clTA0pONnMs

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, 5thEdition, 2013.
2. Charles H. Roth, *Fundamentals of Logic Design,* Thomson Publications, 5thEdition, 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, 2ndEdition, 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 withperformance 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- pi (π) – Common Emitter transistor model, Hybrid-π conductance, Hybrid-π capacitances, validity of Hybrid-π 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 poweramplifier, 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
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:

CO1 Select the suitable measuring instruments to measure parameters like voltage, current, resistance by applying fundamental concepts of Measuring.

CO2 Identify the suitable transducers for the measurement of non-electrical parameters.

CO3 Design AC and DC bridges for measurement of resistance, capacitance, and Inductance.

CO4 Analyze the characteristics of the signal using suitable signal analyser.

CO5 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
CO1	3	3	-	-	3	-	-	-	-	-	-	-	2	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	2	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	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, DigitalStorage 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 differentialtransducer 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=e n&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 CORE

Course Code	Course Title	L	T	P	S	C
22EC101004	**ELECTROMAGNETIC FIELDS AND TRANSMISSION LINES**	3	-	-	-	3

Pre-Requisite Engineering Physics

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Static Electric & Magnetic Fields; Maxwell's Equations; Electromagnetic Wave Propagation; Transmission Lines.

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

CO1 Analyze time invariant electromagnetic field equations in different media.

CO2 Solve problems on time variant electromagnetic fields using Maxwell's Equations.

CO3 Understand the Transmission Lines concepts, Reflection and Refraction of Uniform Plane Waves for Electromagnetic Wave Propagation in various media.

CO4 Design impedance transformers by applying impedance matching techniques for maximum power transfer in transmission Lines.

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	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	-	**-**	-	-	**3**	**3**	-

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

COURSE CONTENT

MODULE 1: ELECTROSTATIC FIELDS ***(10 Periods)***

Review of calculus and vector algebra. Coulomb's Law, Electric Field Intensity – Fields due to point, Line Charge and Surface Charge distributions. Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations between E and V, Convection and Conduction Currents, Continuity Equation. Capacitance – Parallel Plate, Coaxial Capacitors, Illustrative Problems.

MODULE 2: MAGNETOSTATIC FIELDS ***(08 Periods)***

Biot-Savart's Law, Ampere's Circuital Law, Magnetic Flux Density. Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law, Illustrative Problems.

MODULE 3: MAXWELL'S EQUATIONS AND BOUNDARY CONDITIONS ***(09 Periods)***

Maxwell's Equations: Faraday's Law and Transformer EMF, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Final Forms and Word Statements(time variant and invariant).

Boundary Conditions: Conditions at a Boundary Surface: Dielectric-Dielectric and Dielectric- Conductor Interfaces, Illustrative Problems.

MODULE 4: ELECTROMAGNETIC WAVE PROPAGATION ***(09 Periods)***

Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, Sinusoidal Variations, Poynting Theorem. Wave Propagation in Lossless and Conducting Media. Conductors & Dielectrics – Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Polarization. Reflection and Refraction of plane waves – Normal and oblique Incidences, Brewster's Angle, Critical angle and Total Internal Reflection, Illustrative Problems.

MODUL 5: TRANSMISSION LINES ***(09 Periods)***

Types, Parameters, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Lossless line Characteristics, Condition for Distortionless Lines. Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR. λ/4, λ/2, λ/8 Lines – Impedance Transformations. Smith Chart – Configuration and Applications, Single stub matching, Illustrative Problems.

Total no. of Periods: 45

EXPERIENTIAL LEARNING

1. Plot and visualize Electromagnetic Fields due to point charge, line charge and volume chargeusing MATLAB.
2. Estimation of energy storage in Parallel-Plate Capacitor, cylindrical co-ordinates due the electric field using MATLAB
3. Understand Electric /Magnetic field characteristics across various boundary interfaces usingMATLAB
4. Analyse transmission lines parameters using smith chart using 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. Mathew O Sadiku, Principles of Electromagnetics, Oxford University press, 6th Edition, New York, 2011.
2. John D. Ryder, Networks, Lines and Fields, Pearson /PHI, 2nd Edition, 2015.

REFERENCE BOOKS:

1. E.C. Jordan and K.G. Balmain, Electromagnetic Waves and Radiating Systems, PHI, 2nd Edition, 2000.
2. G.Jagadeswar and T Jayachandra, Basics of Electromagnetics and Transmission Lines, CRC Press, Taylor & Francis group, 2020.

VIDEO LECTURES:

1. https://swayam.gov.in/nd1_noc20_ph08
2. https://nptel.ac.in/courses/117101056

Web Resources:

1. Review of Coordinate Systems https://www.youtube.com/watch?v=FDyenWWlPdU&t=142s
2. Coulombs Law https://www.youtube.com/watch?v=q7Js6LLIxLo
3. Capacitance-Parallel Plate, Co-axial, Spherical Capacitorshttps://www.youtube.com/watch?v=U4aeBVqj4ts
4. Ampere's Circuital Law and Applications https://www.youtube.com/watch?v=UtI1T721e5A
5. Maxwell's Equations in Different Final Forms and Word Statements https://www.youtube.com/watch?v=ibF0L6X53tg
6. https://1lib.in/book/5953989/ec7c84https://1lib.in/book/5953989/ec7c84

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:

CO1 Understand the basic operations on signals & sequences and determine the response of LTI systems using convolution.

CO2 Apply Fourier series and transform to analyse spectral characteristics of continuous-time periodic and aperiodic signals.

CO3 Analyse the properties of correlation and convolution to extract signals from noisy signalin various applications.

CO4 Analyse sampling & it‟s effects and reconstruct signals using interpolation.

CO5 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
CO1	3	2	-	-	-	-	-	-	-	-	-	-	**-**	**-**	3
CO2	3	2	-	2	3	-	-	-	-	-	-	-	**-**	**-**	3
CO3	3	3	-	2	-	2	-	-	-	-	-	-	**-**	**-**	3
CO4	3	3	-	2	-	-	-	-	-	-	-	-	**-**	**-**	3
CO5	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*, PearsonHigher 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
22EC101006	**PROBABILITY AND STOCHASTIC PROCESSES**	3	-	-	-	3

Pre-Requisite Multivariable Calculus and Differential Equations.

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Probability theory; The Random Variable; Operations on Single and Multiple Random Variables; Temporal and spectral Characteristics of Stochastic Processes; Noise analysis.

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

CO1 Analyze the probability of occurrence of events in an experiment through axiomatic definitions, conditional, total probability and Bernoulli's trials.

CO2 Evaluate Moments by performing various operations on single and multiple random Variables.

CO3 Solve problems on stochastic process by analyzing the temporal and spectral characteristics.

CO4 Estimate various noises in communications to improve signal to noise ratio.

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	-	-	-	-	-	-	-	-	-	3	
CO2	3	3	-	3	-	-	-	-	-	-	-	-	-	3	
CO3	3	2	-	3	-	-	-	-	-	-	-	-	-	3	
CO4	3	3	-	2	-	-	-	-	-	-	-	-	-	3	
CO5	-	-	-	-	-	-	-	-	3	3	-	-	-	3	
Course Correlation Mapping	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**3**	**-**

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

COURSE CONTENT

Module 1: PROBABILITY ***(08 Periods)***

Probability introduced through Sets and Relative Frequency, Experiments and Sample Spaces - Discrete and Continuous Sample Spaces; Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Baye's Theorem, Independent Events, Bernoulli Trials.

Module 2: THE RANDOM VARIABLE ***(10 Periods)***

Introduction, Random Variable Concept - Definition of Random variable, Condition for a function to be a Random Variable, Discrete and Continuous Random Variable; Distribution Function, Density Function Properties, The Gaussian Random Variable, Other distribution and density examples - Binomial, Poisson, Uniform, Exponential, Rayleigh; Conditional Distribution and Density Functions, Properties.

Operations on One Random Variable: Introduction, Expectation, Moments - Moments about Origin, Central Moments, Variance and Skew; Chebyshev's Inequality, Functions that give moments - Characteristic Function, Moment Generating Function; Transformations of a random Variable.

Module 3: MULTIPLE RANDOM VARIABLES ***(10 Periods)***

Multiple Random Variables: Vector Random Variables, Joint Distribution and its Properties, Joint density and its Properties, Marginal Distribution and Density, Conditional Distribution and Density, Statistical Independence, Distribution and density of a sum of random variables, Central Limit Theorem.

Operations on Multiple Random Variables: Expected Value of a Function of Random Variables - Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables; Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

Module 4: STOCHASTIC PROCESSES–TEMPORAL AND SPECTRAL CHARACTERISTICS ***(10 Periods)***

Concept of Stochastic process, Stationary and Statistical Independence.

TEMPORAL CHARACTERISTICS: Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Correlation Functions- Auto correlation function and its properties, Cross correlation function and its properties, Covariance Functions; Gaussian Random Processes, Poisson Random Process.

SPECTRAL CHARACTERISTICS

Power density spectrum, properties of power density spectrum, relationship between power spectrum and auto correlation function, cross power density function, properties of cross power density function

Module 5: NOISE ANALYSIS ***(07 Periods)***

Noise classification - Uncorrelated Noise, External Noise, Atmospheric Noise, Extraterrestrial Noise, Manmade Noise, Internal Noise, Shot Noise, Transit-Time Noise, Thermalnoise, Noise power, Noise voltage, Correlated Noise, Impulse Noise; Interference, Signal-to-Noise Power Ratio, Noise Factor and Noise Figure, Equivalent Noise Temperature.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Suppose you are conducting an experiment where you toss a fair coin three times. What is the sample space for this experiment? Calculate the probability of obtaining at least two heads.
2. A random variable X represents the number of defective items in a batch of 100. The probability distribution of X is given by P(X = k) = (0.1)^k * (0.9)^(100-k) *C(100, k), where C(n, r) denotes the binomial coefficient. Calculate the mean and variance of X.
3. Let X be a continuous random variable with the probability density function (PDF) f(x) = 2x, 0 <= x <= 1. Calculate the cumulative distribution function (CDF) F(x) and find P(0.25 <= X <= 0.5).
4. Two dice are rolled simultaneously. Let X be the sum of the numbers that appear on the dice. Find the joint probability mass function (PMF) of X and determine the probability that the sum is greater than 8, given that the first die shows a 5.
5. Consider two independent Gaussian random variables, X and Y, with mean μX = 2, μY = 3, standard deviation σX = 1, and σY = 2. Find the joint probability density function (PDF) of X and Y and calculate the probability that X + Y > 5.

(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. Peyton Z. Peebles, *Probability, Random Variables & Random Signal Principles,* TMH, 4th Edition, 2017
2. Wayne Tomasi, *Electronic communications systems*, Pearson Education, 5th Edition, 2004

REFERENCE BOOKS:

1. George R. Cooper and Clare D. McGillem, *Probabilistic Methods of Signal and SystemAnalysis,* Oxford, 3rd Edition, 2015
2. Athanasios Papoulis and S. Unnikrishna Pillai, *Probability, Random Variables and StochasticProcesses,* PHI, 4th Edition, 2002.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/111102111
2. https://archive.nptel.ac.in/courses/111/102/111102014/

Web Resources:

1. https://www.tutorialspoint.com/statistics/probability.htm

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22EC102007	**ANALOG COMMUNICATIONS**	3	-	2	-	4

Pre-Requisite Signals and Systems

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Continuous wave modulations; Modulators and De-Modulators; Transmitters; Receivers; Noise performance; Pulse modulations; Multiplexing.

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

CO1 Evaluate total power, Bandwidth, and efficiency of Various Analog Modulation Schemes.

CO2 Analyze the performance of different modulation systems by evaluating Signal to Noise Ratio.

CO3 Analyze various Transmitter & Receiver circuits and receiver parameters.

CO4 Analyze various pulse modulations and demodulations Schemes.

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	-	3	-	-	-	-	-	-	-	-	3	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	3	-
CO3	3	3	2	3	-	-	-	-	-	-	-	-	3	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	3	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-	3	3	-
Course Correlation Mapping	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**3**	**-**

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

COURSE CONTENT

Module 1: AMPLITUDE MODULATION & DEMODULATION ***(12 Periods)***

Modulation (AM), Generation of AM waves - Square law modulator, switching modulators. Demodulation of AM waves – Square law detector, Envelope detector. Double sideband suppressed carrier (DSBSC), Generation of DSBSC waves - Balanced modulator, Ring modulator, Coherent detection of DSBSC waves - Costas receiver, squaring loop. Single sideband modulation (SSB), Generation of SSB waves - Frequency Discrimination Method, Phase Discrimination Method. Demodulation of SSB waves, Vestigial sideband (VSB) modulation & demodulation.

Module 2: ANGLE MODULATION & DEMODULATION ***(09 Periods)***

Basic Definitions Phase Modulation (PM) and Frequency Modulation (FM), Single-Tone FM, Bandwidth of angle modulated waves - Narrow band frequency modulation (NBFM) and Wide band frequency modulation (WBFM). Transmission Bandwidth of FM Waves, Generation of FM waves – Indirect FM, Direct FM. Demodulation of FM Waves- Frequency Discrimination, PLL Demodulator.

Module 3: NOISE IN ANALOG COMMUNICATION SYSTEMS ***(09 Periods)***

Noise in Analog communication System, Signal to Noise ratio in AM, DSB & SSB System, Signal to Noise ratio in Angle Modulation System, Threshold effect in Angle Modulation System, Pre-emphasis & De-emphasis, FM Capture Effect.

Module 4: RADIO RECEIVERS & TRANSMITTERS ***(10 Periods)***

Radio Receiver measurements - Sensitivity, Selectivity, and fidelity. Radio Receivers - Receiver Types, Tuned radio frequency receiver, Super heterodyne receiver, Intermediate frequency, AGC, FM Receiver, Amplitude limiting. Comparison of FM with AM Receiver, Radio Transmitter - Classification of Transmitters, AM Transmitter, FM Transmitter.

Module 5: PULSE MODULATION & DEMODULATION ***(05 Periods)***

Analog pulse modulation schemes, Pulse Amplitude Modulation (PAM) & demodulation, Pulse Time Modulation – Pulse Duration and Pulse Position modulations. Demodulation schemes, Time Division Multiplexing, Frequency Division Multiplexing.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Generation and Detection of Amplitude Modulation.
2. Generation and Detection of DSB-SC & SSB.
3. Generation and Detection of Frequency modulation.
4. Spectral analysis of AM signals using spectrum analyzer.

5. Study the characteristic of Pre-emphasis & De-emphasis Circuits.
6. Study the Characteristics of a frequency mixer.
7. Pulse Analog Modulations and Demodulations (PAM, PWM, PPM).
8. Simulation of Generation of AM, DSB-SC,SSB using MATLAB.
9. Simulation of Generation of FM and Demodulation FM using MATLAB.
10. Simulation of Pulse Analog Modulations and Demodulations (PAM,PWM,PPM) using MATLAB.

RESOURCES

TEXT BOOKS:

1. Simon Haykin, *"Communication Systems",* Wiley-India edition, 3rd edition, 2010.
2. R.P Singh and S.D Sapre, *Communication Systems Analog and Digital*, *McGraw Hill Education*,3rd Edition, 2017.

REFERENCE BOOKS:

1. K. Sam Shanmugam, *Digital and Analog Communication Systems*, Wiley, 2019.
2. Herbert Taub. Donald L Schiling, Goutam Sana, *Principles of Communication Systems*,McGraw-Hill, 4th Edition, 2012.
3. John G. Proakis Masoud salehi, *Contemporary communication systems using MATLAB*, PWSPublishsing Company, 1998.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_ee74/preview
2. https://archive.nptel.ac.in/courses/117/105/117105143/

Web Resources:

1. https://www.tutorialspoint.com/analog_communication/analog_communication_introduction.htm
2. https://www.physics-and-radio-electronics.com/blog/analog-communication-introduction/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22EC102008	**DIGITAL COMMUNICATIONS**	3	-	2	-	4

Pre-Requisite Analog Communications

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Digitization techniques - Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta modulation (DM) and Adaptive Delta Modulation (ADM). Baseband and Pass band signal transmission; Detection of Baseband and Pass band signals and error probability; Information Theory ; Source and channel coding techniques.

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

CO1 Analyze the Signal to Noise Ratio in Pulse Code Modulation and Delta modulation systems.

CO2 Analyze Baseband, bandPass Data Transmission schemes and derive Probability of errors.

CO3 Evaluate Channel capacity and analyze various source encoding techniques.

CO4 Analyze various error detection and correction codes to enable reliable data transmission.

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	-	-	-	-	-	-	-	-	-	-	3	3	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO3	3	3	-	1	-	-	-	-	-	-	-	-	3	3	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	3	3	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-	3	3	-
Course Correlation Mapping	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**3**	**-**

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

COURSE CONTENT

Module 1: PULSE DIGITAL MODULATION ***(11 Periods)***

Pulse Code Modulation (PCM)- PCM Generation and Reconstruction, Quantization noise. Non-uniform Quantization, Companding, Differential Pulse Code Modulation (DPCM), Delta modulation (DM), Adaptive Delta Modulation.

Noise in PCM System: Calculation of Quantization noise, Output Signal Power, Effect of thermal noise in PCM, Output Signal to Noise Ratio (SNR) in PCM.

Noise in DM System: Calculation of Quantization Noise in DM, Output signal power, Effect of thermal noise in DM, Output Signal to Noise Ratio in DM.

Module 2: BASE BAND DATA TRANSMISSION ***(07 Periods)***

Elements of Base band Binary PAM Systems, Inter symbol Interference, Eye Pattern, Baseband Shaping, Correlative coding.

Module 3: BAND PASS DATA TRANSMISSION ***(10 Periods)***

Introduction, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Quadrature PSK, Differential Phase Shift Keying (DPSK), Probability of error, Optimum filter, Matched filter, Calculation of error Probability of ASK, PSK, FSK.

Module 4: INFORMATION THEORY ***(09 Periods)***

Information Theory: Information and entropy, conditional entropy and redundancy, Information rate, Mutual information and its properties, Error Free Communication over Noisy Channel, Channel Capacity of Discrete Memory less Channel, Channel Capacity of Continuous Channel, Hartley Shannon's theorem, bandwidth –S/N trade off.

Source Coding: Shannon Fano Coding, Huffman Coding.

Module 5: ERROR CONTROL CODES ***(08 Periods)***

Linear Block Codes - Matrix description of Linear Block Codes, Error detection and error Correction capabilities of linear block codes. Cyclic Codes.

Convolution Codes - Introduction, encoding of convolution codes, time domain approach, transform domain approach, Graphical approach-State, Tree and Trellis diagram. Decoding using Viterbi algorithm.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Verification of Sampling Theorem.
2. Pulse code modulation Generation and demodulation.
3. Delta modulation Generation and demodulation.
4. Perform ASK, FSK & PSK Modulation Generation and demodulations.

5. Perform DPSK Modulation Generation and demodulation.
6. Perform QPSK Modulation Generation and demodulation.
7. Generation and Detection of PCM signals using MATLAB.
9. Generation and Detection of FSK signal using MATLAB.
10. Generation and Detection of PSK signal using MATLAB.
11. Generation and Detection of QPSK signal using MATLAB.

RESOURCES

TEXT BOOKS:

1. Herbert Taub. Donald L Schiling, Goutam Sana, *Principles of Communication Systems*,McGraw-Hill, 4th Edition, 2012.
2. B.P.Lathi, Zhi Ding, *Modern Digital and Analog Communication Systems*, Oxford, 4th Edition,2012.

REFERENCE BOOKS:

1. Simon Haykin, *Digital Communications Systems*, Wiley, 2013.
2. K. Sam Shanmugam, *Digital and Analog Communication Systems*, Wiley, 2019.
3. R.P Singh and S.D Sapre, *Communication Systems Analog and Digital*, *McGraw Hill Education*,3rd Edition, 2017.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/108/101/108101113/
2. https://online.stanford.edu/courses/ee279-introduction-digital-communication

Web Resources:

1. https://www.javatpoint.com/digital-communication
2. https://ocw.mit.edu/courses/6-450-principles-of-digital-communications-i-fall-2006/pages/lecture-notes/

SCHOOL 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 andalso 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 usingMATLAB.
5. Verify N-point FFT algorithm using CCS on DSP processors and also verify usingMATLAB.
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 transformationtechniques 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 andApplications,*" Prentice Hall, Fourth Edition, 2007.
2. B.Venkataramani, M. Bhaskar, "*Digital Signal Processors – Architecture, Programming andApplications,*" 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 atthe beginning.

1. FPGA Implementation of Matrix Vector Multiplication Using Xilinx Systemgeneration.
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 thesame shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Kamran Eshraghian, Douglas A. Pucknell and sholeh Eshraghian, Essentials of VLSI Circuitsand 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=9SnR3M3CIm4
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/

SCHOOL 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:

CO1 Analyze computer arithmetic algorithms for fixed-point and floating-point binary operations.

CO2 Analyze the architecture, organization and functions of the components of a digital computer.

CO3 Design digital circuits for the given functional description of micro-operations and memory elements.

CO4 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
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	1	2	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	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 transmissionassociated 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 anexample.
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. CarlHamacher, ZvonkoVranesic, SafwatZaky,Naraig Manjikian, *Computer Organization and Embedded Systems*, 6th Edition, McGraw Hill, 2012.

REFERENCE BOOKS:

1. William Stallings, *Computer Organization and Architecture: Designing for Performance*, 11thEdition, 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 controlapplications.

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 andPeripherals 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 forconsidering 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
22EC102014	**ANTENNAS AND PROPAGATION**	3	-	2	-	4

Pre-Requisite Electromagnetic Fields and Transmission Lines

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a complete discussion about the parameters used to characterize and test antennas. The detailed analysis of various antennas Wire antennas; Antenna Arrays; VHF, UHF and Microwave antennas that include Helical, Horn, Microstrip Patch, Reflector Antennas, etc is provided. The various Antenna Measurement techniques are suggested. Also the various modes of electromagnetic wave propagation are described.

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

CO1 Apply the basic concepts of Antenna Radiation and analyze the various parameters as applicable to wire antennas with various lengths.

CO2 Design of high gain antenna arrays for real time applications with required radiation levels for communication needs, meeting the public health and safety conditions.

CO3 Analyze antenna parameters such as radiation pattern, directivity and gain by various measurement methods.

CO4 Analyze different modes of wave propagation through various layers of atmosphere.

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	2	3	2	-	1	1	1	-	-	-	-	-	3	-
CO3	3	3	-	-	2	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**2.6**	**3**	**2**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

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

COURSE CONTENT

MODULE 1: ANTENNA BASICS AND THIN LINEAR WIRE ANTENNAS ***(10 Periods)***

Introduction, Radiation mechanism, Antenna parameters patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective height; Antenna Field Zones, Friis transmission equation, Retarded potentials, Radiation from small electric dipole, Quarter wave monopole and half wave dipole Current distributions, Field components, Radiated power, Radiation resistance, Beam width, Directivity, Effective area and Effective height.

Module 2: ANTENNA ARRAYS ***(09 Periods)***

Point sources - Definition, Patterns, arrays of 2 isotropic sources different cases; Principle of pattern multiplication, Uniform linear arrays - Broadside arrays, End fire arrays, EFA with increased directivity, Derivation of their characteristics and comparison, BSA with non-uniform amplitude distribution - General considerations and Binomial arrays, Yagi-Uda arrays, Folded dipoles & their characteristics.

Module 3: VHF, UHF AND MICROWAVE ANTENNAS ***(10 Periods)***

Helical Antennas - Helical geometry, Helix modes, Practical design considerations for monofilar helical antenna in axial and normal modes, Horn antenna, Rectangular Microstrip antennas - Introduction, Geometrical Features, Characteristics Advantages and limitations, Reflector types-paraboloidal, cassegrain, feed methods for parabolic reflectors; RF radiation hazards and solutions, Illustrative problems.

Module 4: ANTENNA MEASUREMENTS ***(07 Periods)***

Introduction, Concepts- Reciprocity, Near and far fields, Coordinate system, Sources oferrors, Pattern measurement arrangement, Measurement of Directivity, Gain(by comparison, Absolute and 3-Antenna Methods), Radiation pattern.

Module 5: WAVE PROPAGATION ***(09 Periods)***

Introduction, Modes of wave propagation, Ground wave propagation, Space wave propagation- Introduction, field strength variation with distance and height, effect of earth's curvature, absorption; Super refraction, M-curves and duct propagation, troposphere propagation. Sky wave propagation - Introduction, structure of Ionosphere, refraction and reflection of sky waves by Ionosphere, Ray path, Critical frequency, MUF, LUF, OF, Virtual height and Skip distance, Relation between MUF and Skip distance.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Design Monopole Antenna to operate at 1GHz and verify its associated parameters.
2. Design Half Wave Dipole Antenna to operate at 1GHz and verify its associated parameters.

3. Design a Broadside and End-Fire Antenna Array with atleast 4 Elements to operate at 1 GHz and verify its associated parameters.
4. Design Folded Dipole Antenna to operate at 500MHz and verify its associated parameters.
5. Design Yagi-Uda Array Antenna with minimum of five elements to operate at 500MHz and verify its associated parameters.
6. Design Helical Antenna in Normal Mode to operate at 10GHz and verify its associated parameters.
7. Design Helical Antenna in Axial Mode to operate at 10GHz and verify its associated parameters.
8. Design Pyramidal Horn Antenna to operate at 10GHz and verify its associated parameters
9. Design Microstrip Patch Antenna with strip feeding to operate at 2.4 GHz and verify its associated parameters.
10. Design Microstrip Patch Antenna with probe feeding to operate at 2.4 GHz and verify its associated parameters

RESOURCES

TEXT BOOKS:

1. John D. Kraus and Ronald J. Marhefka and Ahmad S.Khan, Antennas and Wave Propagation,TMH, 4th Edition, 2017.

REFERENCE BOOKS:

1. C.A. Balanis, Antenna Theory, John Wiley & Sons, 2nd Edition, 2007.
2. G.S.N.Raju, Antennas and Wave Propagation, Pearson Education India, 1st Edition, 2006.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/108101092
2. https://nptel.ac.in/courses/108105114

Web Resources:

1. https://www.electronics–notes.com/articles/antennas–propagation/
2. https://www.tutorialspoint.com/antenna_theory/antenna_theory_types_of_propagation.htm

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101105	**BIOMEDICAL INSTRUMENTATION AND MEASUREMENTS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite Biomedical Instrumentation

Co-Requisite -

COURSE DESCRIPTION: This course deals with the concepts of Physiology of Cardiovascular, Nervous and Respiratory System; Generation and propagation of bioelectrical signals; Therapeutic and Imaging equipment.

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

CO1 Demonstrate knowledge on Bioelectric Potentials and various electrodes for measuring Potentials.

CO2 Analyze ECG signals and measure various cardiovascular parameters.

CO3 Analyze EEG and EMG signals and measure various parameters in neuro muscularand respiratory systems.

CO4 Demonstrate the working of various therapeutic instruments.

CO5 Demonstrate the working of imaging instruments used for diagnosis by following ethical values.

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	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	3	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**3**	**2**	**-**

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

COURSE CONTENT

Module 1: BIO- POTENTIAL SIGNALS AND ELECTRODES ***(09 Periods)***

Bio-signals and their characteristics, Organization of cell, Nernst equation of membrane, Resting and Action potentials. Bio-amplifiers, characteristics of medical instruments, problems encountered with measurements from living systems. Bio-potential electrodes

– Body surface recording electrodes, Internal electrodes, micro electrodes. Bio-chemical transducers – reference electrode, the pH electrodes, Blood gas electrodes

Module 2: CARDIOVASCULAR INSTRUMENTATION ***(09 Periods)***

Heart and cardiovascular system Heart electrical activity, blood pressure and heart sounds. Cardiovascular measurements electro cardiography – electrocardiogram, ECG Amplifier, Electrodes and leads, ECG recorder principles. Types of ECG recorders. Principles of blood pressure and blood flow measurement.

Module 3: NEUROLOGICAL INSTRUMENTATION ***(09 Periods)***

Neuronal communication, electro encephalogram (EEG), EEG Measurements EEG electrode-placement system, interpretation of EEG, EEG system Block diagram, preamplifiers and amplifiers. EMG block diagram and Stimulators.

Module 4: EQUIPMENT FOR CRITICAL CARE ***(09 Periods)***

Therapeutic equipment – Pacemaker, Defibrillator, Shortwave diathermy, Hemodialysis machine. Respiratory Instrumentation – Mechanism of respiration, Spirometry, Pneumotachograph, Ventilators.

Module 5: MEDICAL IMAGING SYSTEM ***(09 Periods)***

Ultrasonic Imaging: Doppler principle, Modes of Display: A-Mode, B-Mode and Echocardiography. Computed Tomography: Block diagram of CT scanner, Applications of Computed Tomography. MRI Imaging System, Cine angiogram, Endoscope.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Using AI Algorithm discuss the Quality of Bio-Medical Images.
2. Extract the region of interest(nodules) from Lung CT Images.
3. Discuss the recent advancements in Biomedical equipments.

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

RESOURCES

TEXT BOOKS:

1. Leslie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, *Biomedical Instrumentation andMeasurements*, 2nd Edition, PHI, 2003.
2. R.S. Khandpur, *Hand Book of Biomedical Instrumentation*, Tata McGraw Hill, 2nd Edition, 2002.

REFERENCE BOOKS:

1. John G.Webster, *Medical Instrumentation Application and Design*, 3rd Edition, Wiley IndiaPvt. Ltd., 2004.
2. M. Arumugam, *Biomedical Instrumentation*, Anuradha Publications.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc22_bt56/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee105/preview

Web Resources:

1. https://www.nibib.nih.gov›science-education›students-resource
2. https://www.who.int›medical_devices›support
3. http://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering
4. https://www.labster.com/simulations?institution=university-college

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC102015	**NANOSTRUCTURES ANDNANOTECHNOLOGY**	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 beable 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 engineering‖ 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 PROPERTIES *(11 Periods)*

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, Opticalproperties Electrical conductivity.

MODULE 3: FABRICATION OF NANOSTRUCTURES BY PHYSICAL TECHNIQUES *(09 Periods)*

Introduction, Lithography, Nanomanipulation and Nanolithography, Soft Lithography, Assembly of Nanoparticles and Nanowires, Other Methods for Microfabrication.

MODULE 4: CARBON NANOTUBES (CNT) – PROPERTIES AND SYNTHESIS ***(08 Periods)***

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 ofNanoparticles, 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, 2010Education (India) Pvt. Ltd., 2002.

REFERENCE BOOKS:

1. Tai-Ran Hsu, *MEMS & Microsystems, Design and Manufacture*, McGraw Hil
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:

CO1 Acquire an overview of automotive components, subsystems and basics of automotive systems and design electronics

CO2 Use and apply available automotive sensors and actuators in various electronic control system while designing automotive system design.

CO3 Understand the networking of various modules in automotive systems, communication protocols and Infotainment systems

CO4 Recognize different control systems in today's automotive industry

CO5 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
CO1	3	3	-	3	-	-	-	-	-	-	-	-	3	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	3	-
CO3	3	3	2	3	-	-	-	-	-	-	-	-	3	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	3	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	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 Coolent 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: "Automative 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 Guage 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 thesame shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. John H. Davies, MSP430 Microcontroller Basics, Newnes Publications, 1stEdition, 2008.
2. Santanu Chattopadyay, Embedded System Design, PHI, 2010.
3. Frank Vahid, Tony D. Givargis, Embedded System Design – A Unified Hardware/ SoftwareIntroduction, John Wiley, January 2006

REFERENCE BOOKS:

1. Chris Nagy, Embedded Systems Design using the TI MSP30 Series, Newness 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 thesame 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 LogicArrays, 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, DedicatedSpecialized 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 InternationalEdition,Eighth Indian Reprint 2015.
   Robert Lafore, Data Structures & Algorithms in Java, 2nd Edition, Pearson, 2007.
2. Charles H. Roth Jr, LizyKurian 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/SamihaMourad , Wayne Wolf, Digital Design Using Field Programmable GateArrays, 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
22EC101020	**DIGITAL IC DESIGN**	3	-	-	-	3

Pre-Requisite VLSI System Design

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on introduction to MOS transistors; Characteristics of CMOS digital circuits; Transistor Sizing; memory design; Design strategies; Design of subsystems.

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

CO1 Design combinational and Sequential logic circuits using various design styles.

CO2 Analyze timing issues to improve the performance of sequential logic circuits.

CO3 Develop sub systems using CMOS logic for high speed networks.

CO4 Analyze design methodologies and tools at various levels of abstraction.

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	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	2	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	2	-	3	-	-
CO4	2	3	3	-	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	-	**-**	**2**	**2**	**3**	-	-

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

COURSE CONTENT

Module 1: CMOS INVERTER CHARACTERISTICS AND DESIGN STYLES ***(10 Periods)***

MOS Inverters: Introduction, The Static CMOS Inverter - An Intuitive Perspective, Evaluating the Robustness of the CMOS Inverter - The Static Behavior, Performance ofCMOS Inverter —The Dynamic Behavior.

Design of Combinational Logic Gates in CMOS: Static CMOS Design - Complementary CMOS, Ratioed Logic, Pass-Transistor Logic; Dynamic Logic- Basic Principles, Speed and Power Dissipation of Dynamic Logic, Issues in Dynamic Design, Dynamic CMOS Design, Cascading Dynamic Gates.

Module 2: DESIGN OF SEQUENTIAL LOGIC GATES IN CMOS ***(09 Periods)***

Introduction, Static Latches and Registers, Dynamic Latches and Registers, Alternative Register Styles, Pipelining: An approach to optimize sequential circuits, Non-Bistable Sequential Circuits, Perspective: Choosing a Clocking Strategy.

Module 3: TIMING ISSUES IN DIGITAL CIRCUITS ***(08 Periods)***

Introduction, Classification of Digital Systems, Synchronous Design — An In-depth Perspective, Synchronous Timing Basics, Static Timing analysis, Sources of Skew and Jitter, Clock-Distribution Techniques Latch-Based Clocking, Self-Timed Circuit Design, Synchronizers and Arbiters, Synchronous versus Asynchronous Design.

Module 4: SUBSYSTEM DESIGN PROCESS ***(11 Periods)***

General arrangement of 4-bit Arithmetic Processor, Design of 4-bit shifter, Design of ALUsub-system, Implementing ALU functions with an adder, Multipliers, modified Booth's algorithm.

Module 5: DESIGN METHODOLOGY AND TOOLS ***(07 Periods)***

Introduction, Structured Design Strategies, Design Methods, Design Flows, Design Economics, Data Sheets and Documentation.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Design of Schmitt trigger circuit for waveform generation.
2. Design of RISC-V processor.
3. Develop clock generation and distribution circuits

(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 M Rabaey, Digital Integrated Circuits, 2nd Edition, Pearson, 2016.
2. Kamran Eshranghian, Douglas A.Pucknell and Sholeh Eshranghian, Essential of VLSI Circuitsand Systems, 1st edition, PHI, 2005.

REFERENCE BOOKS:

1. Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits-I, McGraw Hill, 3rd edition, 2003.
2. Neil H. E. Weste, David Money Harris, CMOS VLSI Design-A Circuit and Systems Perspective, 4th Edition, Pearson Education, 2011.

VIDEO LECTURES:

1. (11) Introduc玲椀on - Digital IC Design Course - Lecture 1 – YouTube
2. (11) Lecture 2 Design Digital IC Design Course - YouTube

Web Resources:

1. Free Online Course: Digital IC Design from Swayam | Class Central
2. IC design, verification & manufacturing resources | Siemens Software
3. Digital Systems: From Logic Gates to Processors | Coursera
4. Design Tools & Simulation | Design Resources | TI.com

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101021	**FIBER OPTIC COMMUNICATIONS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course describes Single and Multimode fibers; Fiber materials; Fiber Joints; Optical sources and detectors; Power launching in to the fiber; Optical links; WDM; Introduction to optical networks.

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

CO1 Demonstrate knowledge on structure, properties, fabrication and advantages of optical fibers.

CO2 Analyze attenuation losses and signal distortion in optical fibers.

CO3 Analyze the performance Optical sources and Detectors

CO4 Demonstrate Power launching & coupling, splicing and fiber connectors.

CO5 Analyze Analog optical link to determine Carrier to Noise ratio and Digital optical link to determine Link budgets and power penalties.

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	-
CO2	3	2	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	2	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	-	-	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	3	2	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

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

COURSE CONTENT

Module 1: OVERVIEW OF FIBER OPTIC COMMUNICATION ***(08 Periods)***

The General system, Advantages of Optical Fiber Communication, Modes in a planar guide, Phase and group velocity, Goos-Haenchen shift.

Cylindrical Fiber-Modes, Mode Coupling, Step index fibers, Graded index fibers; Single mode fibers, Fiber materials, Fiber Fabrication, Mechanical properties of Fibers.

Module 2: FIBER LOSSES ***(07 Periods)***

Attenuation, Absorption, Scattering, Bending and Core & Cladding losses. Signal Distortion in Fibers - Pulse Broadening, Intermodal Delay, Intramodal or chromatic dispersion, Overall Fiber Dispersion in Multi Mode and Single Mode Fibers, Polarization-Mode Dispersion, Design optimization of Single-Mode Fibers.

Module 3: OPTICAL SOURCES AND DETECTORS ***(11 Periods)***

OPTICAL SOURCES: Light Emitting Diodes **-** LED Structures, Light Source Materials, Internal Quantum Efficiency, Modulation capability, Power-Bandwidth product, Laser Diodes**-** Modes and Threshold Conditions, Laser Diode Rate Equations, External Quantum Efficiencies, Resonant Frequencies.

OPTICAL DETECTORS: Physical Principles of Photo Diodes, Photo Detector Noise, Detector Response Time, Avalanche Multiplication Noise, Structures for InGaAs & APDs, Temperature Effect on Avalanche Gain, Comparisons of Photo Detectors.

Module 4: POWER LAUNCHING AND COUPLING ***(07 Periods)***

Source to Fiber Power Launching, Lensing Schemes for Coupling Improvement, Fiber- to-Fiber Joints, Fiber alignment and joint loss, LED coupling to single mode fibers, FiberSplices, Fiber Connectors.

Module 5: OPTICAL LINKS AND COMPONENTS ***(12 Periods)***

DIGITAL LINKS: Point-to-Point Links, budgets, Power penalties.

ANALOG LINKS: Overview, Carrier to Noise ratio, Multi-channel Transmission techniques, RF over Fiber, Radio over Fiber Links.

WDM concepts and Components: Overview of WDM, Components (Qualitative treatment only) - Passive Optical Couplers, Isolators and circulators, Fiber Grating Filters, Multiplexing and De-multiplexing, Introduction to Optical Networks.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Measurement of Numerical Aperture of a Fiber after preparing the fiber ends
2. Study of losses in optical fiber.
3. Preparation of splice joint and measurement of splice loss.
4. Measurement of fiber characteristics, fiber damage and splice loss/connector lossby OTDR.
5. Voltage vs. Current (V-I) characteristics of Laser Diode.
6. Characteristics of Photodiode and measure the responsivity

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

RESOURCES

TEXT BOOKS:

1. Gerd Keiser, *Optical Fiber Communications*, McGraw Hill International, 4th Edition, 2009.
2. John M. Senior, *Optical Fiber Communications principles and practice*, Pearson Edn, 3rdEdition, 2010.

REFERENCE BOOKS:

1. Max Ming-Kang Liu, *Principles and Applications of optical Communications,* TMH,2010.
2. 2. S.C.Gupta, *Optical Fiber Communication and its Applications*, PHI, 2011.

VIDEO LECTURES:

1. https://www.edx.org/course/fiber-optic-communications
2. https://alison.com/courses/an-introduction-to-optical-fiber/content#event=login

Web Resources:

1. https://www.coursera.org/projects/concepts-of-optic
2. https://onlinecourses.nptel.ac.in/noc21_ee114/preview

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101022	**RADAR ENGINEERING**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Radar equation; Targets; classification of radars; MTI and pulsed radar; Tracking with radar; radar receivers; Echo signal detection in the presence of noise; Navigational Aids.

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

CO1 Solve problems pertaining to prediction of radar parameters such as range, doppler frequency, signal strength by analyzing the principles of radar systems.

CO2 Apply appropriate techniques for signal detection, acquisition and tracking of various radar signals.

CO3 Analyze various types of radar displays, receivers, array antennas

CO4 Apply appropriate techniques for detection of radar signals in the presence of noise.

CO5 Analyze the features of navigational aids such as VOR (VHF Omni Directional Range),ILS (Instrument Landing 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	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO4	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3
CO5	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: RADAR EQUATION ***(10 Periods)***

Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, SNR, Envelope Detector, False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment),Illustrative Problems

Module 2: DOPPLER RADAR ***(11 Periods)***

Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, Illustrative Problems. FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar, MTI- Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range GatedDoppler Filters, MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler radar

Module 3: RADAR TRACKING ***(08 Periods)***

Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two- coordinates), Phase Comparison Monopulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

Module 4: RADAR RECEIVERS AND DETECTION CRITERIA ***(10 Periods)***

Radar display types, Duplexers – Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes.

Detection of Radar Signals in Noise–Detection criteria, Neyman-Pearson Observer, Likelihood-Ratio Receiver, Constant false Alarm Rate (CFAR), CFAR Receiver.

Module 5: FUNDAMENTALS OF NAVIGATIONAL AIDS ***(06 Periods)***

Introduction and Types of Navigational Aids, VHF Omni Directional Range (VOR) navigation system-salient features-principle of operation- advantages and limitations, ILS (Instrument Landing Systems), Principle of operation.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Determination of maximum unambiguous range and various parameters for Radar Applications.
2. Determination of minimum detectable signal for a radar receiver.
3. Apply appropriate techniques for signal detection, acquisition and tracking of variousradar signals.
4. Apply appropriate detection criteria such as Neyman Pearson Observer, CFAR fordetection of radar signals in the presence of noise.
5. Analyze the features of navigational aids such as VOR (VHF Omni Directional Range),ILS (Instrument Landing 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. Merrill I. Skolnik, *Introduction to Radar Systems*, TMH Special Indian Edition, 2nd Edition,Reprint 2017.
2. G S N Raju,*Radar Engineering and Fundamentals of Navigational Aids,* I.K. InternationalPvt. Ltd, 1stEdition, 2010.

REFERENCE BOOKS:

1. Merrill I. Skolnik, *Introduction to Radar Systems*, TMH, 3rd Edition, Reprint 2017.
2. Byron Edde, *Radar Principles, Technology, Applications*, Pearson Education, 2004.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=bXcY5Kjz8Hw
2. https://www.youtube.com/watch?v=NtyU6aKZ-cY
3. https://www.youtube.com/watch?v=wtxvwemEfWE
4. https://www.youtube.com/watch?v=hwX5oc9yv4M
5. https://www.youtube.com/watch?v=J8SUCip0GgI

Web Resources:

1. https://www.radartutorial.eu/01.basics/Radar%20Principle.en.html
2. https://www.tutorialspoint.com/radar_systems/radar_systems_tracking_radar.htm

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101023	**CELLULAR AND MOBILE COMMUNICATIONS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This Course provides a detailed discussion on concepts of frequency reuse cellular system designed with Reduced Co-channel interference. This course also covers the fundamentals 2G, 3G and 4G and their Interfaces.

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

CO1 Demonstrate the fundamentals of cellular systems and analyze cellular radio system design to determine the best frequency reuse pattern

CO2 Design and analyze various techniques used in frequency reuse Cellular systems to reduce cochannel interference.

CO3 Demonstrate various Handoff techniques followed in different scenarios to overcome call drop.

CO4 Demonstrate the working principles of 2G-GSM & its channel classification and fundamentals of 2.5G-GPRS & its interface.

CO5 Demonstrate the concepts of 3G and 4G cellular communication systems and its interfaces.

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	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	3	3	-	-	-	-	-	-	-	-	-	-	3
CO3	3	2	-	2		-	-	-	-	-	-	-	-	-	3
CO4	3	-	-	1	-	-	-		-	-	-	-	-	-	3
CO5	3	-	-	1	-								-	-	3
Course Correlation Mapping	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

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

COURSE CONTENT

Module 1: INTRODUCTION ***(09 Periods)***

INTRODUCTION TO CELLULAR MOBILE SYSTEMS

A basic cellular system, performance criteria, uniqueness of mobile radio environment, operation of cellular systems, Hexagonal shaped cells.

ELEMENTS OF CELLULAR RADIO SYSTEMS DESIGN

Concept of frequency reuse channels, co-channel interference reduction factor, Design of Antenna systems for worst case, cell splitting.

Module 2: INTERFERENCE, FREQUENCY MANAGEMENT& HANDOFFs ***(09 Periods)***

INTERFERENCE REDUCTION AND CELL COVERAGE FOR SIGNAL: Introduction to co-channel interference, Exploring co-channel interference areas in a system, Design of different antenna systems, Lee model.

FREQUENCY MANAGEMENT& CHANNEL ASSIGNMENT: Frequency Management, fixed channel assignment, non-fixed channel assignment.

HANDOFFs: Introduction to handoff, types of handoff and their characteristics.

Module 3: GLOBAL SYSTEM FOR MOBILE (2G SYSTEMS) ***(09 Periods)***

GLOBAL SYSTEM FOR MOBILE (2G SYSTEMS): GSM architecture, Radio specifications, Communication channels in GSM, Mapping Logical channels on to Physical Channels, signaling during a call.

GPRS (2.5G SYSTEMS)

Introduction to GPRS, GPRS support nodes, GPRS Interfaces

Module 4: THIRD GENERATION NETWORK (3G), UMTS ***(09 Periods)***

Introduction to 3G, WCDMA concept, Parameters of 3G WCDMA Air interface, Spectrum allocation for WCDMA, 3G services, UMTS Reference network architecture and Interfaces, Air-interface architecture and processing, Channels on the Air Interface, Introduction to High-Speed Packet Data Access (HSPA)

Module 5: 4G-LTE SYSTEMS ***(09 Periods)***

Introduction, Architecture of an evolved Packet system, LTE integration with 2G/3G network, E-UTRAN Interfaces, USER Equipment, LTE Mobility, LTE Radio interface, Introduction to 5G.

Total Periods:45

EXPERIENTIAL LEARNING

1. Download the app "Network Cell Info Lite" from android App store anddetermine the following parameters at various buildings in the MBU.
    a) Service cell and neighbour cell power in dB under Guage Tab
    b) Upload or download a file from you mobile and check the speed of thesame under speed tab.
    c) Draw a graph with room no. on X-axis and power on Y-axis
    d) Geographical location under map tab.

    All the above parameters are to be recorded and need to be submit a reportwith screen shorts.
2. Justify how VoLTE is better than LTE in terms of services.
3. Demonstrate the effect of Base station/Cell phone tower radiation on society and environment.
4. Justify why 5G mobile communications failed in mm wave frequency band.

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

RESOURCES

TEXT BOOKS:

1. William C. Y. Lee, *Mobile Cellular Telecommunications*, McGraw Hill, 2nd Edition, 1995.
2. Alexander Kukushkin, *Introduction to Mobile Network Engineering: GSM, 3G-WCDMA, LTEand the Road to 5G*, Wiley, First Edition, 2018.

REFERENCE BOOKS:

1. Theodore S Rappaport, *Wireless Communication Principles and Practice*, Pearson Education, 2nd Edition, 2002.
2. C. Y. Lee, *Wireless and Cellular Telecommunications*, McGraw Hill, 3rd Edition, 2006.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=iIjwzxnD-b0
2. https://www.digimat.in/nptel/courses/video/117104099/L01.html
3. https://www.youtube.com/watch?v=mo1lNRKnayA

Web Resources:

1. https://mrcet.com/downloads/digital_notes/ECE/IV%20Year/3.Cellular%20&%20Mobile%20Communi ca玲椀ons.pdf
2. https://www.uky.edu/~jclark/mas355/GSM.PDF
3. https://ndl.ethernet.edu.et/bitstream/123456789/87845/6/Lecture%20WCDMA.pdf

PROGRAM ELECTIVE

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.

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	3	2	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	2
CO4	3	2	2	2	2	-	-	-	-	-	-	-	-	3	-
CO5	3	2	2	-	-	-	-	3	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	-	**3**	**-**	-	-	3	-	-	-	-	-	3	2

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

COURSE CONTENT

MODULE 1: INTRODUCTION AND PHYSICAL LAYER ***(9 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 ***(9 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 ***(9 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 ***(9 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 ***(9 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

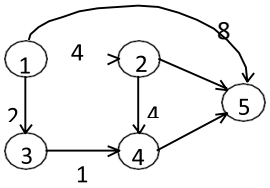
EXPERIENTIAL LEARNING

LIST OF EXERCISES:

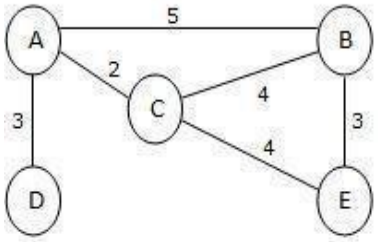
1. Implement the following data link layer framing methods.
   A) Character count
   B) Character stuffing
   C) Bit stuffing
2. Implement the frame sorting technique used in buffers.
3. Design and develop a program to compute checksum for the given frame 1101011011

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 controlalgorithm.

8. Using TCP/IP sockets, write a client-server program to open a file available in theserver.

9. Write a program for congestion control using leaky bucket algorithm.

10. Write a program for the Mail Client
    A) POP Client: Gives the server name, user name and password retrieve themails and allow manipulation of mail box using POP commands.
    B) 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.

RESOURCES

TEXT 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.

REFERENCE BOOKS:

1. Behrouz A. Forouzan, *Data Communications and Networking*, McGraw Hill, 5th Edition, 2013.
2. James F. Kurose and Keith W. Ross, *Computer Networking: A Top-Down Approach*, Pearson, 7th Edition, 2017.

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_OSIReferenceModelLayers.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.Compute r.C ommunications.8e.WilliamStallings.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC102024	**MICROWAVE ENGINEERING**	3	-	2	-	4

Pre-Requisite Electromagnetic Fields andTransmission Lines.

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course details about Microwave sources, components and various methods of microwave measurements. This course also deals with various modes of Wave Propagation at RF frequencies.

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

CO1 Analyze the Performance of Microwave Sources and amplifiers.

CO2 Analyze the functions and its properties of microwave components.

CO3 Select appropriate components of a microwave bench setup to measure relevant parameters.

CO4 Understand the applicability of various modes of propagation at RF frequencies.

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	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	2	2	2	3	-	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**2**	**3**	**2**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

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

COURSE CONTENT

Module 1: MICROWAVE SOURCES ***(11 Periods)***

Introduction, Microwave spectrum and bands, applications of Microwaves, Limitations and losses of conventional tubes at microwave frequencies. Classification of Microwavetubes. Two cavity klystron (Only Qualitative Treatment). Reflex Klystrons - structure, Velocity Modulation, Applegate diagram, mathematical theory of bunching, power output, efficiency, oscillating modes and O/P characteristics. Slow wave structures; structure of Helix TWT and amplification process. Magnetrons - different types, cylindrical travelling wave magnetron – Hull cutoff and Hartree conditions, Illustrative Problems.

Module 2: MICROWAVE SOLID STATE DEVICES ***(08 Periods)***

Introduction, classification, applications, Transfer Electronic Devices, Gunn diode- principles, RWH theory, characteristics, basic modes of operation – Gunn oscillation modes, LSA Mode; Transit-Time Devices – IMPATT, TRAPATT and BARITT.

Module 3: MICROWAVE COMPONENTS ***(10 Periods)***

Scattering Matrix- Significance, Formulation and properties. S Matrix calculations for 2-port junction, Waveguide multiport junctions-E plane and H plane Tees, Magic Tee, Directional coupler; Ferrites- composition and characteristics, Faraday rotation, ferrite components – Isolator and Circulator. Waveguide discontinuities – waveguide Windows, tuning screws and posts, matched loads; Coupling mechanisms- probe, loop. Waveguide attenuators- resistive card, rotary vane Attenuators, waveguide phase shifters - dielectric, rotary vane phase shifters; Illustrative problems.

Module 4: MICROWAVE MEASUREMENTS ***(07 Periods)***

Description of Microwave bench –different blocks and their features, errors and precaution; Microwave power measurement- Bolometer method, Measurement of attenuation, frequency, low and high VSWR, Q of the cavity and impedance measurements.

Module 5: WAVE PROPAGATION ***(09 Periods)***

Introduction, Modes of wave propagation, Ground wave propagation, Space wave propagation - Introduction, field strength variation with distance and height, effect of earth's curvature, absorption; Super refraction, M-curves and duct propagation, scattering phenomena, troposphere propagation, fading. Sky wave propagation- Introduction, structure of Ionosphere, refraction and reflection of sky waves by Ionosphere, Ray path, Critical frequency, MUF, LUF, OF, Virtual height and Skip distance,Relation between MUF and Skip distance, Multi-Hop propagation.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Obtain the Mode Characteristics of Reflex Klystron.
2. Obtain the Voltage Characteristics of Reflex Klystron.
3. Draw the V-I Characteristics and determine the Dynamic Resistance of GUNNDiode.
4. Determine the cutoff wavelength, free space wavelength and guide wavelengthfor the given Waveguide.
5. Find the VSWR of the given antennas.
6. Calculate the Attenuation of the given Waveguides.
7. Determine the Directivity and Coupling Factor of the given Direction Couplers.
8. Obtain the S-parameters for the given device.
9. Plot the radiation pattern for the given antennas
10. Obtain the S-Matrix for the given circulator.

RESOURCES

TEXT BOOKS:

1. Samuel Y. Liao, Microwave devices and circuits, Pearson Education, 3rd Edition,2003.
2. John D. Kraus and Ronald J. Marhefka and Ahmad S.Khan, Antennas and wave propagation, 4th Edition (special Indian Edition), TMH, New Delhi, 2010.
3. Matthew N.O.Sadiku, ”Elements of Electromagneticcs", Oxford University Press, 4th Edition, 2007.

REFERENCE BOOKS:

1. F.E. Terman, Electronic and Radio Engineering, McGraw-Hill, 4th Edition, 1955.
2. Annapurna Das and Sisir K Das, Microwave Engineering, McGraw-Hill, 2nd Edition,2009.
3. R.E.Collin, Foundations for Microwave Engineering, IEEE Press, john wiley,2nd Edition, 2002
4. Sushrut Das, Microwave Engineering, Oxford University Press, 2014.
5. Peter A. Rizzi, Microwave Engineering Passive Circuits, PHI, 1999.
6. M.Kulkarni, Microwave and Radar Engineering, Umesh Publications, 3rd Edition,2008.

VIDEO LECTURES:

1. https://www.coursera.org/learn/microwave-antenna
2. https://archive.nptel.ac.in/courses/108/103/108103141/
3. https://onlinecourses.nptel.ac.in/noc21_ee88/preview

Web Resources:

1. https://www.iare.ac.in/sites/default/files/mwe%20lecture%20notes.pdf
2. https://www.wiley.com/en-us/Microwave+Engineering%2C+4th+Edition-p-9780470631553
3. https://eng.libretexts.org/Bookshelves/Electrical_Engineering/Electronics/Book%3A_Fundamentals_of_Microwave_and_RF_Design_(Steer)/01%3A_Introduction_to_Microwave_Engineering/1.01%3A_RF_and_Microwave_Engineering
4. https://www.tutorialspoint.com/microwave_engineering/microwave_engineering_quick_guide.htm

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101025	**ERROR CONTROL CODING**	3	-	-	-	3

Pre-Requisite Digital Communications

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is designed to provide an overview on the fundamentals of Mathematical concepts related to coding, deep insight about the various Channel coding techniques such as Linear Block Codes, Cyclic Codes, Binary BCH Codes and Convolutional Codes

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

CO1 Understand mathematical concepts related to coding.

CO2 Analyze the concepts involved in formulation and computation of Linear Block Codes.

CO3 Analyze the concepts involved in formulation and computation of Cyclic Codes and Binary BCH Codes.

CO4 Analyze Convolutional Codes and evaluate different algorithms associated with Convolutional Coding.

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	-	-	-	-	-	-	-	-	-	-	**-**	**3**	-
CO2	3	3	-	2	-	-	-	-	-	-	-	-	**-**	**3**	-
CO3	3	3	-	2	-	-	-	-	-	-	-	-	**-**	**3**	-
CO4	3	3	-	2	-	-	-	-	-	-	-	-	**-**	**3**	-
Course Correlation Mapping	**3**	**3**	**-**	**2**	**-**	**-**	-	-	-	-	-	-	**-**	**3**	**-**

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

COURSE CONTENT

Module 1: INTRODUCTION ***(09 Periods)***

Coding for Reliable Digital Transmission and Storage – Types of codes, Modulation and coding, Maximum likelihood decoding, Types of errors, Error control strategies, Coded modulation. Introduction to Algebra- Groups & fields, Binary field arithmetic, Construction of Galois field and its basic properties, Computations, Vector spaces, matrices.

Module 2: LINEAR BLOCK CODES ***(09 Periods)***

Introduction linear block codes, Syndrome and Error detection, Error detection and Error correction capabilities of a Block code, Standard array and syndrome decoding, Probability of an undetected error for linear codes over a BSC, Single parity check codes, repetition codes, and self-dual codes, A class of single error correcting and double error detecting codes, Reed-Muller codes and other constructions, The squaring construction of codes, The Golay code, Interleaved codes, Illustrative Problems.

Module 3: CYCLIC CODES ***(09 Periods)***

Description of Cyclic codes, Generator and parity – check matrices of cyclic codes, Encoding of Cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes, Cyclic Hamming codes, The (23,12) Golay code, Shortened cyclic codes, Cyclic product codes.

Module 4: BINARY BCH CODES ***(09 Periods)***

Binary primitive BCH codes, Decoding of BCH codes, Iterative algorithm for finding the error location polynomial & its iterative algorithm, Finding the error location numbers and error correction, Correction of errors and erasures, Implementation of Galois Field arithmetic, Implementation of error correction, Weighted distribution & Error detection of binary BCH codes, Illustrative Problems.

Module 5: CONVOLUTIONAL CODES ***(09 Periods)***

Convolutional Codes: Encoding of Convolutional codes, Structural properties and distance properties of Convolutional codes, The Viterbi Algorithm, Performance bounds for Convolutional codes, Construction of good Convolutional codes, Implementation and performance of the Viterbi algorithm, The soft output of Viterbi algorithm (SOVA), The BCJR algorithm, Punctured and Tail-biting Convolutional codes, Illustrative problems.

Total Periods:45

EXPERIENTIAL LEARNING

1. Determination of Entropy of a given source
2. Determination of various Entropies and Mutual Information of a given channel(Noise Free Channel)
3. Determination of various Entropies and Mutual Information of a given channel (Binary

Symmetric Channel)

4. Generation and evaluation of variable length source coding using MATLAB (Huffman Coding and Decoding)
5. Coding & decoding of Linear Block Codes Coding & decoding of Cyclic codes
6. Coding & decoding of Cyclic codes
7. Coding and decoding of Convolutional codes
8. Coding and decoding of BCH codes.

(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. Shu Lin, Daniel J. Costello, Jr., *"Error Control Coding,"* Pearson Publications, Second Edition, 2011.
2. Bernard Sklar, Pabitra Kumar Ray, *"Digital Communications Fundamentals and Applications,"* Pearson Publications, Second Edition, 2009.

REFERENCE BOOKS:

1. Thomas M. Cover and Joy A. Thomas, *"Elements of Information Theory"*, John Wiley & Sons, 1st Edition, 1999.
2. John G. Proakis, "Digital Communications", Mc.GrawHill Publication, 5th Edition,2008.

VIDEO LECTURES:

1. https://www.digimat.in/nptel/courses/video/117104121/L01.html
2. https://www.youtube.com/watch?v=2_uC9stwBR4

Web Resources:

1. https://www.ee.iitm.ac.in/andrew/videolectures/EE512_2010/index.html
2. h琀琀ps://www.site.uo琀琀awa.ca/~yongacog/courses/elg3175/Lecture18-19-AY-Coding.pdf
3. https://www.vssut.ac.in/lecture_notes/lecture1528107793.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC102119	**SOFTWARE DEFINED RADIO ARCHITECTURE**	3	-	2	-	4

Pre-Requisite Wireless Communication, Digital Signal Processing and Antennas

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Principles and Architecture of Software Defined Radio; Flexible RF Receiver Design; Multi-band Coverage Systems; Flexible Transmitters and Power Amplifiers.

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

CO1. Understand requirements, benefits and different models for Software Defined Radio.

CO2. Understand in detail about Software Defined Radio Architecture for Performance Optimization.

CO3. Analyze the functioning of different blocks associated with Software Defined Radio.

CO4. Design flexible receivers for wide band coverage.

CO5. Analyze the circuits at different multirate signaling technique for frequency conversion and sampling issues.

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	-	3	3	-	-	-	2	-	-	-	-	3	-
CO3	3	3	-	3	-	2	-	-	2	-	-	-	-	3	-
CO4	3	3	3	3	-	-	-	-	2	-	-	-	-	3	-
CO5	3	3	-	3	-	-	-	-	2	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**2**	-	**-**	**-**	**-**	**3**	**-**

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

COURSE CONTENT

Module 1: INTRODUCTION TO SOFTWARE DEFINED RADIO ***(10 Periods)***

The requirement for Software Defined Radio, The Benefits of Multi-standard Terminals, Operational Requirements, Business Models for Software Defined Radio, New Base Station and Network Architectures, Smart Antenna Systems.

Module 2: BASIC ARCHITECTURE OF A SOFTWARE DEFINED RADIO ***(09 Periods)***

Software Defined Radio Architectures, Ideal Software Defined Radio Architectures, Required Hardware Specifications, Digital Aspects of a Software Defined Radio, Current Technology Limitations.

Module 3: FLEXIBLE RF RECEIVER ARCHITECTURES ***(10Periods)***

Receiver Architecture Options, Implementation of a Digital Receiver-Frequency Conversion Using Under Sampling, Achieving Processing Gain Using Oversampling, Noise figure, Receiver sensitivity, ADC Spurious Signals.

Module 4: MULTI-BAND AND GENERAL COVERAGE SYSTEMS ***(09 Periods)***

Multi-Band Flexible Receiver Design, The Problem of the Diplexer, Achieving Image Rejection, Dynamic Range Enhancement-Feedback Techniques, Feed Forward Techniques.

Module 5: FLEXIBLE TRANSMITTERS AND POWER AMPLIFIERS ***(07 Periods)***

Linear Up conversion Architectures - Analog quadrature up conversion, Quadrature Up Conversion With Interpolation, Interpolated band pass up conversion. Constant-Envelope Upconversion Architectures -PLL based transmitters: PLL-Based Reference Modulated Transmitter, PLL-Based Directly Modulated VCO Transmitter. Broadband Quadrature Techniques-Active All-pass filter, Use of high pass and low pass filters, Polyphase filtering.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Compare traditional radio systems with SDR systems through detailed case studies.
2. Implement basic DSP algorithms in a programming environment and test their performance in an SDR context.
3. Investigate current limitations in SDR technology through literature reviews and recent research papers.
4. Examine various receiver architectures used in current SDR systems, focusing on their strengths and weaknesses.
5. Implement a digital receiver using under sampling techniques in a software environment.
6. Analyze real-world applications of feed forward techniques in commercial SDR systems.

7. Use software tools to simulate various image rejection techniques and analyze their effectiveness.

8. Review and analyze case studies of PLL-based directly-modulated VCO transmitters in real-world applications.

(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. PKenington, "RF and Baseband Techniques for Software Defined Radio", Artec House,2005

REFERENCE BOOKS:

1. Jeffrey Hugh Reed, "*Software Radio: A Modern Approach to Radio Engineering*," Prentice Hall PTR, 2002.

2. Jouko Vanakka, "Digital Synthesizers and Transmitter for Software Radio", Springer,2005.

3. Wally H. W. Tuttlebee, "Software Defined Radio: Baseband Technologies for 3G Handsets and Base stations", John Wiley & sons, 2003.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/117/107/108107107/
2. https://onlinecourses.nptel.ac.in/noc21_ee95/preview

Web Resources:

1. https://www.ghs.com/products/SDR.html
2. https://www.everythingrf.com/community/what-is-a-software-defined-radio

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. BenjaminC.Kuo and FaridGolnaraghi, *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	Course Title	L	T	P	S	C
22EC104026	**IMAGE PROCESSING**	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 onimages.

CO2 Understanding of image enhancement in both spatial and frequency domains

CO3 Apply restoration techniques based on noise models and degradation function torestore 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 aboutthe result.

7. Read an image and apply
   1) Gaussian 3x3 mask for burring
   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 medica 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 McGraw Hill Education, Second Edition, 2020.

REFERENCE BOOKS:

1. Anil K. Jain, Fundamentals of Digital Image processing, Prentice Hall, 2007.
2. Pratt W.K, Digital Image Processing, 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
22EC104027	**ADVANCED DIGITAL SIGNALPROCESSING**	3	-	2	4	5

Pre-Requisite Digital Signal Processing

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Digital filter banks; Parametric and Non-Parametric Power Spectrum Estimation methods; Linear Prediction; Computationally efficient algorithms.

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

CO1 Design digital Filter Banks to improve performance characteristics of digital systemsin multidisciplinary environments like image processing, wireless communication, biomedical engineering, speech processing, video processing, etc

CO2 Realize, compare and estimate power spectrum using different Non-Parametric and Parametric Methods in the frequency analysis of systems.

CO3 Develop optimal Lattice Forward and Backward Predictors for Radar signal Processing and Remote sensing.

CO4 Analyze various DSP algorithms in Linear filtering.

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	2	3	-	-	1	-	-	**-**	**-**	**-**	**-**	**-**	-	3
CO2	3	3	-	-	-	-	-	-	**-**	**-**	**-**	**-**	**-**	**-**	3
CO3	3	2	3	-	-	-	-	-	**-**	**-**	**-**	**-**	**-**	**-**	3
CO4	3	3	-	-	2	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3
CO5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	3
Course Correlation Mapping	**3**	**3**	**3**	**-**	**2**	**1**	**-**	**-**	3	**3**	**-**	**-**	**-**	**-**	**3**

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

COURSE CONTENT

Module 1: MULTIRATE FILTER BANKS ***(10 Periods)***

Decimation, Interpolation, Sampling rate conversion by a rational factor I/D, Multistage Implementation of sampling rate conversion. Digital Filter Banks: Two-Channel Quadrature-Mirror Filter Bank, Elimination of aliasing, condition for Perfect Reconstruction, Polyphase form of QMF bank, Linear phase FIR QMF bank, IIR QMF bank, Acquisition of high quality data, Multirate narrow band digital filtering

Module 2: POWER SPECTRAL ESTIMATIONS ***(08 Periods)***

Estimation of spectra from finite duration observation of signals, Non Parametric Methods: Bartlett, Welch, Blackmann & Tukey methods. Performance Characteristics of Nonparametric Power Spectrum Estimators, Computational Requirements of Nonparametric Power Spectrum Estimates.

Module 3: PARAMETRIC METHODS OF POWER SPECTRAL ESTIMATION ***(08 Periods)***

Autocorrelation & Its Properties, Relation between auto correlation & model parameters, Yule-Walker & Burg Methods, MA & ARMA models for power spectrum estimation

Module 4: LINEAR PREDICTION ***(10 Periods)***

Forward and Backward Linear Prediction – Forward Linear Prediction, Backward Linear Prediction, Optimum reflection coefficients for the Lattice Forward and Backward Predictors. Solution of the Normal Equations: Levinson Durbin Algorithm, Schur Algorithm. Properties of Linear Prediction Filters

Module 5: DSP ALGORITHMS ***(09 Periods)***

Fast DFT algorithms based on Index mapping, Sliding Discrete Fourier Transform, DFT Computation Over a narrow Frequency Band, Split Radix FFT, Linear filtering approach to Computation of DFT using Chirp Z-Transform

Total Periods: 45

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 processorsand also verify using MATLAB.
3. Verify the circular convolution on Periodic sequences using CCS on DSPprocessors and also verify using MATLAB.
4. Verify N-point DFT & IDFT using CCS on DSP processors and also verify usingMATLAB.
5. Verify N-point FFT algorithm using CCS on DSP processors and also verify usingMATLAB.

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 withMATLAB
   A) Barlett window
   B) Blackman window

9. Design FIR filter (LP/HP/BP/BR) using following windowing technique withMATLAB
   A) Hamming window
   B) Hanning window

10. Design FIR filter (LP/HP/BP/BR) using Frequency sampling technique withMATLAB.

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. Adaptive removal of ocular artifact from human EEG

2. Speaker recognition system based on MFCC

(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 G. Proakis, Dimitris G. Manolakis, *Digital signal processing, principles, Algorithms andapplications,* Prentice Hall, 4th edition, 2007.
2. Sanjit K Mitra, "*Digital signal processing, A computer base approach",* McGraw-Hill HigherEducation, 4th edition, 2011.

REFERENCE BOOKS:

1. Emmanuel C Ifeacher Barrie. W. Jervis, "*DSP-A Practical Approach*", Pearson Education, 2ndedition, 2002.
2. A.V. Oppenheim and R.W. Schaffer, "*Discrete Time Signal Processing",* PHI, 2nd edition, 2006

VIDEO LECTURES:

1. https://nptel.ac.in/courses/117101001
2. https://freevideolectures.com/course/3042/advanced-digital-signal-processing

Web Resources:

1. https://ekeeda.com/degree-courses/electrical-engineering/advanced-digital-signal-processing

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 Raspbianon 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 Remote Desktop Server, Pi Camera, Face Recognition using Raspberry Pi, Installation of I2C driver on Raspberry Pi, SPI (serial peripheral interface) with Raspberry Pi, Programminga 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 inI2C 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 Arduinoand upload data to cloud using MQTT.
5. Design and Implementation of an IoT ECG (Electrocardiogram) System to recordhearts 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 Cameraand PIR Sensor with Email Notifications.
8. Design and Implement to upload Light sensor (TSL) data to cloud throughRaspberry 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:

CO1 Investigate soft computing techniques for solving computational problems.

CO2 Design efficient neural architectures to model patterns for a given learning problem.

CO3 Investigate and solve optimization problems using genetic algorithms.

CO4 Apply fuzzy logic and reasoning to handle uncertainty in engineering problems.

CO5 Develop intelligent solutions using hybrid soft computing techniques to solve problems ofmultidisciplinary domains.

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	3	1	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	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 geneticalgorithm, 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 andGenetic 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
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	**1**	**3**	**2**	**3**	**1**	**-**	**1**	**2**	**3**	**3**	**2**	**1**	**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 definedexception;

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, calculatethe 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 unit

If the type of the EB connection is commercial, calculate the amount to bepaid 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 totwo different values.

Inheritance

1. 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 thirdclass.

2. 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.

3. Develop a java application for generating pay slip on different category of employees using the concept of inheritance.

Exception Handling and Multithreading

1. 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.

2. 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

1. 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

1. 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 backgroundcolor
   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 andstations
   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
22CB101001	**CRYPTOGRAPHY AND NETWORK SECURITY**	3	-	-	-	3

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.

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
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: R_1
   A ->B: $E(PR_a, R_1)$
   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: IDA || $E(PU_B, R_A)$
   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?

(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. 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
22CS102002	**PYTHON PROGRAMMING**	3	-	2	-	4

Pre-Requisite Programming for Problem Solving

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 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, Classesand objects, Inheritance and polymorphism, Abstract Classes and interfaces.

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

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Design a python script to the perform the various computations for the amount payable by the customer for Challenger Computers Store. A customer buying twonumbers 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.

2. 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

3. 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 accepting numbers as long as the user wants to provide an input using an appropriate iterative statement and should display the final sum.

4. 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 getmore 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.

5. 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 positionof 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

6. 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.

7. 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 upto 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.

8. A) Design a function Learner_Age_Days with two formal parameters name, ageand it computes Learner's age in days, then displays learners name and age in days.

- Design a driver code to call the function using positional arguments, keyword arguments
- 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 numberslist.

9. A) Design a python script to create a new file Collect_Literals_Phython.txt, collectthe 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_Phython.txt file in read mode, read the entire contents of the file Collect_Literals_Phython.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

10. A) Construct a Python script to implement the below requirements. Create a baseclass 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 thefunction 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.

11. 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.
    - The variable num has the data 100, the value of num dividing by the value 0.
    - To importing a library file matheqn, this library file not available in Python.
    - A num_List has the values[10,20,30].To print the fifth value of num_List[5]
    - 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 IntelligenceCase Studies, Pearson, 2019.

REFERENCE BOOKS:

1. Charles Dierbach, *Introduction to Computer Science using Python: A Computational ProblemSolving Focus*, Wiley India, 2016.
2. Christian Hil, Learning Scientific Programming with Python, 2nd Edition, Cambridge UniversityPress, 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/

SCHOOL 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 & analyseservices of I/O subsystems and mechanisms of security & protection.

CO6 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	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	**3**	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**3**	**2**

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

COURSE CONTENT

Module 1 INTRODUCTION TO OPERATING SYSTEM ANDPROCESS MANAGEMENT ***(08 Periods)***

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: CriticalSection 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)? Defintion and Functions - javatpoint
4. Operating System Tutorial - GeeksforGeeks

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS102005	**DATABASE MANAGEMENT SYSTEMS**	3	-	2	-	4

Pre-Requisite Data Structures and Algorithms

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−modeling 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
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 ***(9 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 ***(8 Periods)***

Relational Model: Creating and modifying relations, Integrity constraints over relations, Enforcing integrity constraints, Querying relational data, Logical databasedesign, 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 ***(9 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 Schema Refinement And Transactions ***(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 Concurrency Control, Storage And Indexing ***(9 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:

1. 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 thebook.
   - Readers are registered with their user_id, email, name (first name, last name), Phone no (multiple entries allowed), communication address. The staff keeps trackof readers.

   Choose appropriate Entities and attributes and relationships and draw the complete ER diagram.

2. 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.

3. Week 3:

   Implement various types of integrity constraints - NOT NULL constraint, DEFAULT constraint, UNIQUE constraint, PRIMARY key, FOREIGN key, CHECK constraint.

4. 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.

5. 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:

6. 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:

7. 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:

8. Week 8:
   A) Develop a PL/SQL program that displays the name and address of a studentwhose 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 itwith 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:

9. Week 9:
   A) Write a function that accepts two numbers A and B and performs thefollowing operations.
      - Addition
      - Subtraction
      - Multiplication
      - Division
   B) Write a PL/SQL block that reverses the given number.

Procedures:

10. 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:

11. Week 11:
    A) Write a block in PL/SQL to create a Cursor that displays the employee nameand 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 eachemployee in the EMPLOYEES table whose salary is less than that specified by a passed-in parameter value.

Triggers:

12. Week 12:
    Develop a suitable employee database application by considering appropriateattributes.
    A) Whenever the inserted or updated salary is more than 10 lacs permonth a trigger should be fired.
    B) Whenever, the inserted or updated salary is less than 5000 per month atrigger should be activated.

RESOURCES

TEXT BOOKS:

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw Hill, 3rdEdition, 2014.
2. Abraham Silberschatz, Henry. F. Korth, S. Sudarshan, Database System Concepts, McGrawHill, 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 LECTURES:

1. https://archive.nptel.ac.in/courses/106/105/106105175/
2. https://www.digimat.in/nptel/courses/video/106105175/L01.html
3. https://onlinecourses.nptel.ac.in/noc22_cs91/preview
4. https://www.youtube.com/watch?v=rbwXdTsCk2c
5. https://www.youtube.com/watch?v=64szTfLNu3o

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
22AI102002	**ARTIFICIAL INTELLIGENCE**	3	-	2	-	4

Pre-Requisite Python Programming

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:

CO1 Architect intelligent agents using artificial intelligence techniques and principles.

CO2 Analyze and interpret the problem, identify suitable solutions using heuristic functions, optimization algorithms and search algorithms.

CO3 Select and apply appropriate knowledge representation to build Bayesian networkmodels to reason under uncertainty.

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.

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	1		-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	1	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	1	-	2	-	-	-	-	-	3	-	-
CO6	-	-	-	-	-	-	-	-	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 agentfunction 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 yourfirst 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 MarkovModel.

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, MercuryLearning 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
22EC102029	**FUNDAMENTALS OF MACHINE LEARNING**	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: 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:

CO1 Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem.

CO2 Apply the appropriate linear models for any given problem.

CO3 Understand the foundation of probabilistic models and apply unsupervised learning algorithms for clustering.

CO4 Select the appropriate graphical models of machine learning

CO5 Apply deep learning algorithms to improve efficiency.

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	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	1	2	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

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

COURSE CONTENT

Module 1: CONCEPT LEARNING AND GENERAL-TO-SPECIFICORDERING ***(09 Periods)***

Well-posed learning problems, Designing a learning system, Perspectives andissues in machine learning, Concept learning task, Concept learning as search, FIND-S, Version spaces and candidate elimination algorithm, Inductive bias.

Module 2: DECISION TREE LEARNING AND KERNEL MACHINES ***(08 Periods)***

Decision Tree Learning: 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.

Kernel Machines: Support vector machines – SVMs for regression, SVMs forclassification, Choosing C, A probabilistic interpretation of SVMs.

Module 3: ARTIFICIAL NEURAL NETWORKS ***(10 Periods)***

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, An Example -Face Recognition.

Module 4: BAYESIAN LEARNING ***(09 Periods)***

Bayes theorem and concept learning, Maximum likelihood and least-squared error hypothesis, Maximum likelihood hypotheses for predicting probabilities, Minimum Description Length principle, Bayes optimal classifier, Gibbs algorithm, Naive Bayes classifier, An Example – Learning to classify text; Bayesian belief networks, EMAlgorithm.

Module 5: INSTANCEBASED LEARNING AND REINFORCEMENT LEARNING ***(09 Periods)***

Instance Based Learning: K-Nearest Neighbor learning, Locally weighted regression, Radial basis functions, Case-based reasoning.

Reinforcement Learning: The learning task, Q-learning, Nondeterministic rewards and actions, Temporal difference learning, Generalizing from examples, Relationship to dynamic programming.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Solve classification problem by constructing a feedforward neural network using Backpropagation algorithm. (Wheat Seed Data)
2. Implement ID3 (information gain) algorithm for decision tree learning fortransforming continuous variables into discrete variables.
3. Explore the problem of overfitting in decision tree and develop solution using pruning

technique.

4. Build a neural network that will read the image of a digit and correctly identify the number.
5. Implement k-NN algorithm to solve classification problem.
6. Use Naïve Bayes classifier to solve the credit card fraud detection problem over askewed dataset.
7. Train an SVM based classifier to predict whether the cancer is malignant or benign
8. Compare and analyze the performance of optimal Bayes classifier and Naïve Bayesusing simulated Gaussian Data.
9. Design and implement a radial basis function neural network to solve function approximation or regression problems.
10. Solve the stock price forecasting problem using statistical techniques – Maximum Likelihood estimation after understanding the distribution of the data.

RESOURCES

TEXT BOOKS:

1. Tom M. Mitchell, Machine Learning, McGraw Hill, 2013.
2. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.

REFERENCE BOOKS:

1. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 4th Edition, 2020.
2. Shai Shalev Shwartz, Shai Ben David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
3. Sebastian Raschka, Vahid Mirjalili, Python Machine Learning, Packt Publishing, 3rdEdition, 2019.
4. 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.

SOFTWARE/TOOLS:

1. Python
2. Scikit-learn/Keras/TensorFlow

VIDEO LECTURES:

1. https://www.coursera.org/learn/machine-learning
2. https://onlinecourses.nptel.ac.in/noc21_cs24/preview

Web Resources:

1. https://intellipaat.com/machine-learning-certification-training-course/
2. https://www.udemy.com/topic/machine-learning/free/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC102120	**GENERATIVE AI AND PROFESSIONAL PRACTICES**	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course introduces Engineering students to the foundational concepts, tools, and applications of Artificial Intelligence (AI) and Large Language Models (LLMs). It covers open-source LLMs, chatbot development, GenAI applications, and integration with external apps, focusing on hands-on experiments and projects to solve real-world problems.

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

CO1 Understand the basics of AI and LLMs, their evolution, and ethical considerations.

CO2 Work with open-source LLMs for fine-tuning and training.

CO3 Develop and integrate custom and multi-agent chatbots using no-code tools.

CO4 Explore and apply GenAI applications using open-source models and Google Colab.

CO5 Integrate AI applications with WhatsApp and other external apps for practical use cases.

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	2	2	1	-	-	-	-	-	2	-	-	-	-	-	3
CO2	2	2	1	-	-	-	-	-	2	-	-	-	-	-	3
CO3	2	2	1	-	-	-	-	-	2	-	-	-	-	-	3
CO4	2	2	1	-	-	-	-	-	2	-	-	-	-	-	3
CO5	2	2	1	-	-	-	-	-	2	-	-	-	-	-	3
Course Correlation Mapping	**2**	**2**	**1**	-	-	-	-	-	**2**	-	-	-	**-**	-	**3**

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

COURSE CONTENT

Module 1: INTRODUCTION To AI & LLMs ***(12 Periods)***

AI fundamentals, evolution, and impact on society; Introduction to LLMs, their workings, and applications; Ethical considerations in AI.

Module 2: OPEN-SOURCE LLMs AND MODEL TRAINING ***(09 Periods)***

Overview of LLAMA, Mistral, Gemma, and Grok, fine-tuning of models, case studies - training and fine-tuning .

Module 3: BUILDING CHATBOTS With NO-CODE TOOLS ***(09 Periods)***

No-code platforms for chatbot development; Building custom and multi-agent chatbots, Development of a functional chatbot for a specific application.

Module 4: GENAI APPLICATIONS ***(10 Periods)***

Text-to-image, video, image-to-video, and video-to-video applications; Hands-on experiments with open-source models in Google Colab, Developing a simple GenAI application.

Module 5: INTEGRATION WITH EXTERNAL APPS ***(05 Periods)***

Basics of APIs and integration with external applications; WhatsApp bot integration, case study of Integrating chatbot/GenAI application with WhatsApp or another app.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

Experiment 1 to 8 – without coding, Experiment 9 & 10 – With coding

9. Understanding AI Fundamentals
10. Exploring Large Language Models (LLMs)
11. Ethical Considerations in AI
12. Introduction to No-Code Platforms
13. Building Chatbots with No-Code Tools
14. Text-to-Image Applications
15. Video-to-Video Applications
16. AI in Daily Life
17. Training Open-source LLMs
18. Developing a GenAI Application

RESOURCES

TEXT BOOKS:

2. Artificial Intelligence & Generative AI for Beginners: The Complete Guide (Generative AI & Chat GPT Mastery Series Book 2) by David M. Patel
3. AutoGPT for Beginners: The Complete Guide: How To Set Up and Use Your Autonomous AI Agents (Generative AI & Chat GPT Mastery Series Book 3) by David M. Patel

REFERENCE BOOKS:

1. The Artificial Intelligence and Generative AI Bible: [5 in 1] The Most Updated and Complete Guide | From Understanding the Basics to Delving into GANs, NLP, Prompts, Deep Learning, and Ethics of AI Kindle Edition by Alger Fraley (Author)

Web Resources:

3. https://onlinecourses.swayam2.ac.in/imb24_mg116/preview

VIDEO LECTURES:

3. https://www.youtube.com/watch?v=ajWheP8ZD70&list=PLmQAMKHKeLZ-iTT-E2kK9uePrJ1Xua9VL
4. https://www.youtube.com/watch?v=J7afRW5XEb4

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101182	**DEEP LEARNING FOR VISUAL COMPUTING**	3	-		-	3

Pre-Requisite Introduction to Machine learning

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Visual representation and fundamentals of machine learning; Neural networks and backpropagation; Optimization techniques for neural networks; Modern convolutional neural networks; Unsupervised learning and generative models; Transfer learning.

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

CO1. Implement basic Image processing operations.

CO2. Understand the basic concept of deep learning.

CO3. Design and implement CNN and RNN and Deep generative model.

CO4. Understand the role of deep learning in computer vision applications.

CO5. Design and implement Deep generative model.

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	1	-	-	-	-	-	-	-	2	2	-	-	-	-
CO3	3	3	2	3	3	-	-	-	2	-	2	1	3	3	-
CO4	3	1	3	2	-	2	1	-	-	2	2	2	2	-	-
CO5	3	3	2	3	3	-	-	-	2	-	2	1	3	3	-
Course Correlation Mapping	**3**	**2.2**	**1.4**	**1.6**	**1.4**	**0.4**	**0.2**	**0**	**0.8**	**0.8**	**2**	**0.8**	**1.8**	**1.6**	**-**

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

COURSE CONTENT

Module 1: BASICS OF VISUAL COMPUTING ***(09 Periods)***

Introduction to Image Formation, Capture and Representation; Linear Filtering, Correlation, Convolution.
Visual Features and Representations: Edge, Blobs, Corner Detection; Visual Features extraction: Bag-of-words, VLAD; RANSAC, Hough transform.

Module 2: INTRODUCTION TO DEEP LEARNING ***(09 Periods)***

Deep Feed-Forward Neural Networks – Gradient Descent – Back-Propagation and Other Differentiation Algorithms – Vanishing Gradient Problem – Mitigation – Rectified Linear Unit (ReLU) – Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization for Deep Learning – Dropout – Adversarial Training – Optimization for Training Deep Models.

Module 3: VISUALIZATION AND UNDERSTANDING CNN ***(09 Periods)***

Convolutional Neural Networks (CNNs): Introduction to CNNs; Evolution of CNN Architectures: AlexNet, ZFNet, VGG.

Visualization of Kernels; Backprop-to-image/ Deconvolution Methods; Deep Dream, Hallucination, Neural Style Transfer; CAM, Grad-CAM.

Module 4: CNN and RNN FOR IMAGE AND VIDEO PROCESSING ***(09 Periods)***

CNNs for Recognition, Verification, Detection, Segmentation: CNNs for Recognition and Verification (Siamese Networks, Triplet Loss, Contrastive Loss, Ranking Loss); CNNs for Detection: Background of Object Detection, R-CNN, Fast R-CNN. CNNs for Segmentation: FCN, SegNet.

Recurrent Neural Networks (RNNs): Review of RNNs; CNN + RNN Models for Video Understanding: Spatio-temporal Models, Action/Activity Recognition

Module 5: DEEP GENERATIVE MODELS ***(09 Periods)***

Deep Generative Models: Review of (Popular) Deep Generative Models: GANs, VAEs
Variants and Applications of Generative Models in Vision: Applications: Image Editing, Inpainting, Super resolution, 3D Object Generation, Security; Recent Trends: Self-supervised Learning; Reinforcement Learning in Vision;

Total Periods: 45

RESOURCES

TEXT BOOKS:

1. Ian Goodfellow Yoshua Bengio Aaron Courville, "Deep Learning", MIT Press, 2017
2. Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, 2018.

REFERENCE BOOKS:

1. Rajalingappaa Shanmugamani, Deep Learning for Computer Vision, Packt Publishing, 2018
2. David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 2002.
3. Modern Computer Vision with PyTorch, V. Kishore Ayyadevara, Yeshwanth Reddy, 2020 Packt Publishing Ltd.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc20_ee74/preview
2. https://archive.nptel.ac.in/courses/117/105/117105143/

Web Resources:

1. https://www.tutorialspoint.com/python_deep_learning/index.htm
2. https://www.tutorialspoint.com/dip/index.htm

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101139	**MULTIMEDIA COMMUNICATION**	3	-	-	-	3

Pre-Requisite Computer Communications and Networks

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Concepts of Multimedia communications, Image, Text, Audio and Video compression techniques, video compression standards, Distributed multimedia systems, Multimedia Communication Across Networks.

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

CO1 Understand basics of different multimedia networks and applications

CO2 Analyze different compression techniques to compress Image, Text, audio and video.

CO3 Apply various video compression standards for multimedia framework.

CO4 Examine the distribute multimedia system and multimedia Communication across different Networks.

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	2	2	3	1	3	1	-	-	-	-	-	-	-	-	3
CO3	2	3	3	-	2	2	-	-	-	-	-	-	-	-	3
CO4	-	1	1	-	-	2	-	-	-	-	-	-	-	-	2
Course Correlation Mapping	**2**	**3**	**3**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

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

COURSE CONTENT

Module 1: INTRODUCTION TO MULTIMEDIA COMMUNICATION ***(09 Periods)***

Introduction, multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology, network QoS and application QoS, Digitization principles, Text, images, audio and video.

Module 2: INFORMATION REPRESENTATION, TEXT AND IMAGE COMPRESSION ***(09 Periods)***

INFORMATION REPRESENTATION: Introduction, Digitization principles, Text, Images, Audio and Video

TEXT AND IMAGE COMPRESSION: Text and image compression, compression principles, text compression- Runlength, Huffman, LZW, Document Image compression using T2 and T3 coding, image compression- GIF, TIFF and JPEG

Module 3: AUDIO AND VIDEO COMPRESSION ***(09 Periods)***

Audio and video compression, audio compression – principles, DPCM, ADPCM, Adaptive and Linear predictive coding, Code-Excited LPC, Perceptual coding, MPEG and Dolby coders video compression, video compression principles.

Module 4: VIDEO COMPRESSION STANDARDS ***(09 Periods)***

Video compression standards: H.261, H.263, MPEG, MPEG 1, MPEG 2, MPEG-4 and Reversible VLCs, MPEG 7 standardization process of multimedia content description, MPEG 21 multimedia framework.

Module 5: DISTRIBUTED MULTIMEDIA SYSTEMS AND NETWORKS ***(09 Periods)***

Distributed multimedia systems: Introduction, main Features of a DMS, Resource management of DMS, Networking, Multimedia operating systems.

Multimedia Communication Across Networks: Packet audio/video in the network environment, Video transport across generic networks, Multimedia Transport across ATM Networks

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Video Streaming Quality Assessment:
   - Set up a video streaming environment using popular streaming protocols (e.g., HTTP-based adaptive streaming).
   - Vary network conditions (bandwidth, latency, packet loss) and assess video quality using metrics like PSNR, SSIM, or VMAF.
   - Discuss the impact of different codecs and adaptive bitrate algorithms.

2. Image Compression Techniques:
   - Dive into image compression algorithms (JPEG, PNG, WebP).
   - Implement both lossless and lossy compression methods.
   - Analyze trade-offs between compression ratios and visual quality.
3. Real-Time Audio Transmission:
   - Configure VoIP systems for real-time audio communication.
   - Explore audio codecs (e.g., Opus, G.711) and their effects on voice quality.
   - Measure latency, jitter, and packet loss during audio transmission.
4. Multimedia Synchronization:
   - Create multimedia presentations (slides with embedded audio/video).
   - Implement synchronization mechanisms to align audio, video, and text.
   - Investigate challenges related to synchronization across different network conditions.

RESOURCES

TEXT BOOKS:

1. Fred Halsall, —Multimedia Communications‖, Pearson education, 2001 ISBN 9788131709948.
2. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, —Multimedia Communication Systems‖, Pearson education, 2004. ISBN -9788120321458.

REFERENCE BOOKS:

1. Raifsteinmetz, Klara Nahrstedt, —Multimedia: Computing, Communications and Applications‖, Pearson education, 2002. ISBN -9788177584417
2. John Billamil, Louis Molina, "Multimedia : An Introduction", PHI, 2002.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/117105083
2. https://www.youtube.com/watch?v=KHGxigA8Jko

Web Resources:

1. Multimedia Communication - an overview | ScienceDirect Topics

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101140	**ADVANCED ROBOTICS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:

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

CO1. Demonstrate the concepts involved in robot systems.

CO2. Analyze kinematics and dynamics of robots.

CO3. Understand and analyze the principles, working mechanisms, and performance characteristics, various types of sensors used in robotics.

CO4. Design and implement motion planning strategies for robots, considering dynamic constraints and optimization objectives.

CO5. Analyze the ethical and societal implications of robots and HRI technologies.

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	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	3	-
CO3	2	3	1	1	-	-	-	-	-	-	-	-	3	3	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-	3	3	-
CO5	-	3	-	-	-	2	-	2	-	-	-	-	2	3	2
Course Correlation Mapping	**3**	**3**	**2**	**2**	**-**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**3**	**2**

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

COURSE CONTENT

Module 1: INTRODUCTION TO ADVANCED ROBOTICS ***(9 Periods)***

Robot, Brief History, Classifications, Laws of Robotics, Robotic system, Robot anatomy, common robot configurations, coordinate system, Joint notation schemes, Work volume, Degrees of freedom, Components, End effectors Classification of End effectors, Tools as end effectors; Teach pendant, sensors, Specification of robots, Applications, safety measures.

Module 2: ADVANCED KINEMATICS AND DYNAMICS ***(09 Periods)***

Introduction to Advanced Kinematics, Forward and Inverse Kinematics, Kinematic Analysis, Dynamic Modeling, Dynamic Analysis, Trajectory Planning, Motion Control, Robot Control Systems, Complex Kinematic and Dynamic Systems, Numerical Methods for Kinematics and Dynamics.

Module 3: SENSORS AND ACTUATORS USED IN ROBOTICS ***(09 Periods)***

Sensor and Actuator Fundamentals, Proximity and Distance Sensors, Vision Sensors, Force and Tactile Sensors, Position and Orientation Sensors, Actuators for Robotics, Sensor Integration and Data Acquisition, Control Systems for Sensors and Actuators.

Module 4: ROBOT PLANNING TECHNIQUES ***(10 Periods)***

Introduction, Path Planning Algorithms, Motion Planning Techniques, Trajectory Planning, Optimization in Motion Planning, Decision Making for Autonomous Robots, Probabilistic Planning Methods.

Module 5: HUMAN-ROBOT INTERACTION ***(08 Periods)***

HRI Principles and Models, User Interface Design for Robots, Robot Perception and Understanding, Collaborative Robots (Cobots), Safety and Reliability in HRI, Ethics in Human-Robot Interaction.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. What were the key challenges you faced while implementing the SLAM algorithm, and how did you overcome them?
2. How did you validate the accuracy of your map and the robot's localization? What methods did you use for testing?
3. What improvements would you make to your SLAM implementation for better performance in different environments (e.g., outdoor vs. indoor)?
4. How did you handle dynamic obstacles in the environment, and what strategies did you use to update the map in real-time?
5. How did you test the effectiveness of different grasping techniques, and which techniques proved most successful for your application?
6. What were the main obstacles in scaling your multi-robot system for larger or more complex tasks, and how did you address them?

RESOURCES

TEXT BOOKS:

1. John. J. Craig, Introduction to Robotics: Mechanics and Control, Edition 3, Pearson/Prentice Hall, 2005.
2. M.P.Groover, Industrial Robotics: Technology, Programming, and Applications, Tata McGraw-Hill Edition 2008.

REFERENCE BOOKS:

1. Modern Robotics. Mechanics, Planning, and Control. Kevin M. Lynch and Frank C. Park. May 3, 2017.
2. Richard. D.Klafter, Robotics Engineering: an integrated approach, Prentice-Hall publisher, 1 Edition 1988.

VIDEO LECTURES:

1. https://www.youtube.com/playlist?list=PLwRJQ4m4UJjNBPJdt8WamRAt4XKc639wF
2. https://www.youtube.com/watch?v=UEbw7dIOg0g

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc23_me51/preview
2. https://www.coursera.org/specializations/modernrobotics

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101141	**QUANTUM COMPUTION AND INFORMATION**	3	-	-	-	3

Pre-Requisite Electronic Devices and Circuits, Semiconductor Devices and Circuits

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Fundamental Concepts; Quantum Mechanics; Quantum Computation; Quantum Computers; Quantum Information.

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

CO1. Understand fundamental concepts and algorithms of quantum computing.

CO2. Analyze the quantum mechanics using postulates and operators.

CO3. Apply quantum operations and algorithms for developing quantum circuits and systems.

CO4. Analyze the various types of quantum computers.

CO5. Analyze quantum noise and perform quantum error correction to develop fault-tolerant Quantum computation.

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	3	-	3	-	-	-	-	-	-	-	-	3	3	-
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	3	-
CO4	3	3	-	3	-	-	-	-	-	-	-	-	3	3	-
CO5	3	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: FUNDAMENTAL CONCEPTS ***(07 Periods)***

Global Perspectives, Quantum Bits, Quantum Computation, .Quantum Algorithms, Experimental Quantum Information Processing, Quantum Information.

Module 2: QUANTUM MECHANICS ***(09 Periods)***

Linear Algebra, The Postulates of Quantum Mechanics, Application: Superdense Coding, The Density Operator, The Schmidt decomposition and Purifications, EPR and the Bell Inequality.

Module 3: QUANTUM COMPUTATION ***(10 Periods)***

Quantum Circuits – Quantum Algorithms, Single qubit operations, Controlled operations, Measurement, Universal Quantum Gates, Quantum Systems. The Quantum Fourier Transform – Phase Estimation, Applications – Order Finding, Factoring, Period Finding, Discrete Logarithms.

Module 4: QUANTUM COMPUTERS ***(07 Periods)***

Guiding Principles, Conditions for Quantum Computation, Harmonic Oscillator Quantum Computer, Optical Photon Quantum Computer, Optical Cavity Quantum Electrodynamics, Ion Traps, Nuclear Magnetic Resonance.

Module 5: QUANTUM INFORMATION ***(12 Periods)***

Quantum Noise and Quantum Operations – Classical Noise and Markov Processes, Quantum Operations, Examples – Bit Flip and Phase Flip Channels, Depolarizing Channel, Amplitude Damping, Phase Damping. Quantum Error Correction – The Shor Code, Theory of Quantum Error Correction, Constructing Quantum Codes, Stabilizer Codes, Fault-tolerant Quantum Computation.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Using QuTip – Quantum Toolbox in Python, perform the following
2. Visualize Energy level diagrams.
3. Visualize Pseudo-probability functions.
4. Visualize Quantum Process Tomography.
5. Decompose Toffoli gate in terms of CNOT and single-qubit rotations.
6. Compile and simulate a 10 qubit Quantum Fourier Transform Algorithm.
7. Customize the pulse level simulation.
8. Simulate the Deutsch – Jozsa algorithm at the pulse level.
9. Measure the relaxation time with the idling gate.
10. Simulate a two – qubit gate using a resonator as coupler.

RESOURCES

TEXT BOOKS:

1. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 2010.

REFERENCE BOOKS:

1. Joachim Stolze, Dieter Suter, Quantum Computing – A Short Course from Theory to Experiment, WILEY-VCH Verlag GmbH & Co. KGaA, 2004.
2. Sandar Imre and Ferenc Balazs, Quantum Computing and Communications – An Engineering Approach, John Wiley & Sons Ltd., 2005.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/115/101/115101092/
2. https://nptel.ac.in/courses/106106232
3. https://elearn.nptel.ac.in/shop/iit-workshops/completed/quantum-computing/?v=c86ee0d9d7ed

Web Resources:

1. https://www.baeldung.com/cs/quantum-computing#:~:text=The%20basic%20unit%20of%20information,%2Dstate%20quantum%2Dmechanical%20system!
2. https://www.javatpoint.com/what-is-quantum-computing

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101142	**MACHINE LEARNING APPLICATIONS FOR FUTURE WIRELESS COMMUNICATIONS**	3	-	-	-	3

Pre-Requisite Machine Learning and Wireless Communications

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Continuous wave modulations; Modulators and De-Modulators; Transmitters; Receivers; Noise performance; Pulse modulations; Multiplexing.

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

CO1. Understand the fundamental concepts in machine learning and evolution of wireless communication systems.

CO2. Apply appropriate machine learning techniques in channel estimation and signal detection.

CO3. Apply ML-based methods for efficient resource allocation, power control, and scheduling in wireless networks, enhancing network performance.

CO4. Implement ML-based solutions for intrusion detection, anomaly detection, and privacy preservation.

CO5. Understand next-generation wireless technologies (6G, massive MIMO, mmWave) and emerging ML techniques (transfer learning, federated learning) for future industry trends.

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	3	-	-	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	2	2	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	3	-	-	-	-	-	-	-	-	-	3	-
CO5	3	-	-	-	-	3	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**2**	**3**	**3**	**3**	**-**	**-**	-	-	**-**	**-**	**-**	**3**	**-**

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

COURSE CONTENT

Module 1: INTRODUCTION TO WIRELESS COMMUNICATIONS AND MACHINE LEARNING ***(10 Periods)***

Fundamentals of Wireless Communications **-** Overview of wireless communication systems, Evolution of wireless technologies (2G to 5G and beyond), Key performance metrics (SNR, BER, throughput, latency). Introduction to Machine Learning **-** Supervised, unsupervised, and reinforcement learning, Basic concepts: regression, classification, clustering, Neural networks and deep learning. Intersection of Wireless Communications and Machine Learning **-** Role of machine learning in wireless communications, Benefits and challenges, Case studies of ML applications in current wireless systems

Module 2: CHANNEL ESTIMATION AND SIGNAL DETECTION ***(08 Periods)***

Channel Modeling and Estimation - Wireless channel characteristics, Traditional channel estimation techniques, Machine learning approaches for channel estimation, Signal Detection Techniques. Basics of signal detection in wireless communications - ML-based signal detection methods, Performance comparison: traditional vs. ML-based methods.

Module 3: RESOURCE ALLOCATION AND MANAGEMENT ***(09 Periods)***

Resource Allocation in Wireless Networks **-** Spectrum allocation, power control, and scheduling,Traditional resource allocation algorithms. ML for Resource Allocation **-** Reinforcement learning for dynamic resource allocation, Deep learning for power control and scheduling, Case studies and real-world applications. Optimization Techniques **-** Optimization problems in wireless communications, ML-based optimization methods, Performance metrics and evaluation.

Module 4: NETWORK SECURITY AND PRIVACY ***(10 Periods)***

Security Challenges in Wireless Networks **-** Common security threats (e.g., eavesdropping, jamming, spoofing), Traditional security mechanisms. ML for Enhancing Network Security - Intrusion detection systems using ML, Anomaly detection in wireless networks, Privacy-preserving machine learning techniques.

Module 5: FUTURE TRENDS AND EMERGING TECHNOLOGIES ***(08 Periods)***

Next-Generation Wireless Networks - Overview of 6G and beyond, Key technologies: massive MIMO, mmWave, terahertz communications. Emerging ML Techniques - Transfer learning, federated learning, and edge AI, Application of these techniques in wireless communications.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF ACTIVITIES:

1. Implement ML algorithms for channel estimation and signal detection using Simulation tools and platforms (MATLAB, Python, etc.). Also evaluate performance.
2. Implementing ML-based security solutions and perform Case studies of ML in securing wireless networks. Prepare a detailed report on the Future trends in network security and privacy.
1. Prepare a detailed report on the following:
    - Real-world examples of ML in next-gen wireless networks
    - Collaboration between academia and industry
    - Future research directions and open challenge

RESOURCES

TEXT BOOKS:

1. F.-L. Luo, *Machine Learning for Future Wireless Communications*, Wiley-IEEE Press, February 2020.
2. T. S. Rappaport, *Wireless Communications: Principles and Practice*, Prentice Hall, 2nd edition, 2002.

REFERENCE BOOKS:

1. C.M.Bishop, *Pattern Recognition and Machine learning*, Springer, August 2006
2. A. C. Müller and S. Guido, *Introduction to Machine Learning with Python: A Guide for Data Scientists*. Sebastopol, CA: O'Reilly Media, 2016.

VIDEO LECTURES:

1. https://digimat.in/nptel/courses/video/106105152/L01.html
2. https://archive.nptel.ac.in/courses/117/102/117102062/

Web Resources:

1. https://ieeexplore.ieee.org/book/8958790
2. https://www.mdpi.com/journal/futureinternet/special_issues/ML_Wireless_Communications

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101143	**MACHINE LEARNING MODELS**	3	-	-	-	3

Pre-Requisite Probability Theory, Linear Algebra, Differential equations and Multivariable calculus & Transformation Techniques, Introduction to Machine Learning

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Students will explore various types of machines learning models, including supervised and unsupervised learning, and learn how to implement, evaluate, and optimize these models. Through practical examples and projects, students will gain hands-on experience with machine learning tools and libraries, preparing them for real-world applications.

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

CO1. Understand the foundational concepts and principles of machine learning.

CO2. Implement and evaluate various supervised and unsupervised learning algorithms.

CO3. Preprocess and analyze data to build effective machine learning models.

CO4. Optimize and fine-tune models to improve performance.

CO5. Apply machine learning techniques to solve real-world 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	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	1	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	-	-	**-**	**-**	**3**	**-**	**-**

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

COURSE CONTENT

Module 1: Introduction to Machine Learning ***(10 Periods)***

Overview of Machine Learning, Types of Machine Learning: Supervised, Unsupervised, and Reinforcement Learning; Key Concepts: Training, Testing, Validation, Overfitting, Underfitting, Applications of Machine Learning.

Module 2: Supervised Learning Models ***(09 Periods)***

Linear Regression, Logistic Regression, Decision Trees and Random Forests, Support Vector Machines (SVM), Model Evaluation Metrics for Classification and Regression.

Module 3: Unsupervised Learning Models ***(09Periods)***

Clustering Algorithms: K-Means, Hierarchical Clustering, Density-Based Spatial Clustering of Applications with Noise(DBSCAN); Dimensionality Reduction Techniques: Principal component analysis(PCA), T-distributed Stochastic Neighbor Embedding(T-SNE); Anomaly Detection, Model Evaluation Metrics for Clustering.

Module 4: Advanced Machine Learning models ***(10 Periods)***

Ensemble Methods: Bagging, Boosting, Stacking; Neural Networks and Deep Learning Basics; Recurrent Neural Networks (RNNS) and Convolutional Neural Networks (CNNS)

Transfer Learning.

Module 5: Model Deployment and Real-World Applications ***(07 Periods)***

Model Deployment Techniques, Introduction to ML Pipelines and Model Serving, Ethical Considerations in Machine Learning, Case Studies of Machine Learning Applications in Various Industries.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Implement a simple linear regression model.
2. Explore a dataset using basic statistical methods.
3. Build and evaluate classification and regression models.
4. Cross-validation and hyperparameter tuning.
5. Apply clustering algorithms to real datasets.
6. Perform dimensionality reduction and visualize high-dimensional data.
7. Implement ensemble methods to improve model performance.
8. Build and train a simple neural network using a deep learning framework.
9. Deploy a machine learning model using a web service.
10. Work on a capstone project to solve a real-world problem using machine learning.

RESOURCES

TEXT BOOKS:

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 1st Edition, 2006. ISBN: 978-0387310732.
4. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective",MIT Press, 1st Edition,2012.

REFERENCE BOOKS:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", MIT Press, 1stEdition 2016, ISBN: 9780262035613
2. Sebastian Raschka and Vahid Mirjalili, "Python Machine Learning" Packt, 2ndEdition, 2017
3. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" O'Reilly Media, 2nd Edition 2019.

VIDEO LECTURES:

1. https://www.coursera.org/specializations/machine-learning-introduction
2. https://www.youtube.com/watch?v=i_LwzRVP7bg

Web Resources:

1. https://www.springboard.com/resources/learning-paths/machine-learning-python/
2. https://www.analyticsvidhya.com/blog/2016/01/complete-tutorial-learn-data-science-python-scratch-2/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC102121	AI IN NATURAL LANGUAGE PROCESSING	3	-	2	-	4

Pre-Requisite - Digital Signal Processing

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Regular expressions, N-Gram model, machine learning methods in NLP, NLP system, Text Pre-Processing tasks, language models with evaluation techniques, RNN and attention, language models such as BERT and GPT3, NLP applications.

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

CO1. Understand the basic concepts of Regular Expressions, Text Normalization, Edit Distance, Natural Language processing.

CO2. Understand various step or stages involved in the designing natural language processing system

CO3. Analyze the various machine learning and deep learning model in order to develop natural language processing system

CO4. Analysing various applications of Natural language processing such as Text Classification, Sentiment Analysis etc.

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	2	-	1	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	2	2	-	-	-	-	-	-	-	-	-	-	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	3
CO4	3	3	-	3	3	2	-	-	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	3	-	-	-	-	-	3
Course Correlation Mapping	**3**	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**3**	-	**-**	**-**	**-**	-	**3**

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

COURSE CONTENT

Module 1: INTRODUCTION ***(12 Periods)***

Regular Expressions, Text Normalization, Edit Distance: Regular Expressions, Words, Corpora, Text Normalization, Minimum Edit Distance. **N-gram Language Models:** N-Grams , Evaluating Language Models, Sampling sentences from a language model, Generalization and Zeros, Smoothing, Kneser-Ney Smoothing. Subsets of AI, Three horizons od DL applications, Natural Language processing.

Module 2: MACHINE LEARNING METHODS OF NLP ***(09 Periods)***

Support vector machine, **Naive Bayes and Sentiment Classification**: Naive Bayes Classifiers, Training the Naive Bayes Classifier, Worked example, Optimizing for Sentiment Analysis,Naive Bayes for other text classification tasks, Naive Bayes as a Language Model, Evaluation: Precision, Recall, F-measure, Test sets and Cross-validation. **Logistic Regression:** Classification: the sigmoid, Learning in Logistic Regression, The cross-entropy loss function, Gradient Descent, Regularization.

Module 3: NATURAL LANGUAGE PROCESSING SYSTEM. ***(09 Periods)***

Natural Language Processing, Generic NLP Pipeline, Text Pre-processing, Feature Engineering, Modeling:Start with Simple Heuristics, Building Your Model, Metrics to Build Model. Evaluation, Deployment, Monitoring and Model Updating, Vector Representation for NLP, Language Modeling with n-grams, Vector Semantics and Embeddings.

Module 4: STATE-OF-THE-ART NATURAL LANGUAGE PROCESSING ***(10 Periods)***

Introduction, Sequence-to-Sequence Models, **Recurrent Neural Networks**: Unrolling RNN, RNN-based POS Tagging Use Case, Challenges in RNN. **Attention Mechanisms:** Self-attention Mechanism, Multi-head Attention Mechanism, Bahdanau Attention, Luong Attention, Global Attention versus Local Attention, Hierarchical Attention. **Transformer Model:** Bidirectional Encoder, Representations, and Transformers (BERT), GPT3..

Module 5: APPLICATIONS OF NATURAL LANGUAGE PROCESSING. ***(05 Periods)***

Word Sense Disambiguation, Text Classification, Sentiment Analysis, Spam Email Classification, Chatbots and Dialog Systems

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Basics of corpus and wordnet using python.
2. Compute the average polysemy of nouns, verbs, adjectives, andadverbs according to WordNet.
3. Taking PDF, DOCX, and plain text files and creating a user-definedcorpus from them

4. Tokenization – learning to use the inbuilt tokenizers of NLTK
5. Stopwords – learning to use the stopwords corpus and seeing thedifference it can make.
6. Implement N-Gram algorithm
7. Segmenting sentences using classification
8. Perform, Exploring sentiment analysis, Creating a conversational assistant or chatbot
9. Implement RNN model.
10. Classification of emails using deep neural networks after generating RNN.

RESOURCES

TEXT BOOKS:

1. L. Ashok Kumar, D. Karthika Renuka, "Deep Learning Approach for Natural Language Processing, Speech, and Computer Vision" CRC Press, 1st edition, 2023.
2. D. Jurafsky, J.H. Martin, Speech and Language Processing, 3rd Online Edition (available at https://web.stanford.edu/~jurafsky/slp3/)..

REFERENCE BOOKS:

1. Krishna Bhavsar, Naresh Kumar, Pratap Dangeti, Natural Language Processing with Python Cookbook, Packt Publishing Ltd, 1st edition, 2017.
2. J. Eisenstein, Introduction to Natural Language Processing, MIT Press, 2019.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc23_cs45/preview
2. https://nlp-iiith.vlabs.ac.in/List%20of%20experiments.html

Web Resources:

1. https://www.deeplearning.ai/resources/natural-language-processing/
2. https://learn.nlpca.com

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101030	**LOW POWER CMOS VLSI DESIGN**	3	-	-	-	3

Pre-Requisite VLSI System Design

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course describes Basic Principles; Methodologies and techniques of CMOS Circuit Designs; Need for Low Power VLSI Design; Principles of Low Power Circuit Design; Simulation Analysis of Low Power; Logic and Circuit Analysis; Special Techniques and Advanced Techniques of Low Power Design; Performance Management in Architecture or System level.

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

CO1 Demonstrate low power design requirements for CMOS VLSI circuits.

CO2 Analyze and estimate power at Logic and Circuit abstraction levels of digital systems.

CO3 Develop alternate circuits and logic for analysis of low power circuits.

CO4 Apply special and advanced low power techniques at circuit, architecture and system levels to develop CMOS devices.

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	-	-	-	3	-	-	-	-	3	-	-
CO2	3	3	2	2	-	-	-	3	-	-	-	-	3	-	-
CO3	3	2	3	2	1	-	1	3	-	-	-	-	3	-	-
CO4	3	2	2	2	3	-	1	3	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**2**	**2**	**2**	**2**	**-**	**1**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

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

COURSE CONTENT

Module 1: BASICS OF LOW POWER DESIGN ***(07 Periods)***

Needs For Low Power VLSI Chips, Charging And Discharging Capacitances, Short Circuit Current in CMOS, CMOS Leakage Current, Static Current, Basic Principles Of Low Power Design, Low Power Figure Of Merits, Low Power VLSI Design Limits.

Module 2: POWER ANALYSIS AND ESTIMATION ***(10 Periods)***

Spice Circuit Simulation, Discrete Transistor Modeling and Analysis, Gate Level Logic Simulation, Architecture Level Analysis, Data Correlation Analysis, Monte Carlo Simulation.

Module 3: LOW POWER CIRCUITS ***(11 Periods)***

CIRCUIT ANALYSIS: Transistor and Gate Sizing, Equivalent Pin Ordering, Network Restructuring and Reorganization, Special latches and Flip flops.

LOGIC ANALYSIS: Gate Reorganization, Signal and Power Gating (as per IEEE 1801 Standard for UVM), Logic Encoding, State Machine Encoding, Pre computation Logic.

Module 4: SPECIAL TECHNIQUES ***(08 Periods)***

Power Reduction in Clock Networks, CMOS Floating Node, Low Power Bus, Delay Balancing, Low Power Techniques for SRAM.

Module 5: ARCHITECTURE, SYSTEM & ADVANCED TECHNIQUES ***(09 Periods)***

Power and Performance Management, Switching Activity Reduction, Adiabatic Computation, Pass Transistor Logic Synthesis, Asynchronous Circuit.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Model alternate CMOS Logic styles for Logic Gates using SPICE and assess theparameters like power dissipation, delay and output waveform characteristics.
2. Model static and dynamic CMOS Logic for sequential circuits using SPICE andassess the parameters like power dissipation, delay and output waveform characteristics.
3. Model clock generation circuits for synchronization to avoid skew using SPICE andassess the parameters like power dissipation, delay and output waveform characteristics.
4. Model the effect of Logical Effort on CMOS Logic using SPICE and assess the parameters like power dissipation, delay and output waveform characteristics.
5. Model SRAM and DRAM using SPICE and assess the parameters like power dissipation, delay and output waveform characteristics.
6. Model n-bit Adder using Hardware Description Language and perform its functional simulation.
7. Model n-bit Modified Booth Multiplier using Hardware Description Language and perform its functional simulation.

8. Model n-bit Barrel Shifter using Hardware Description Language and perform itsfunctional simulation.

9. Model n-bit Arithmetic and Logic Unit using Hardware Description Language and perform its functional simulation.

10. Design Read Only Memory (ROM), Random Access Memory (RAM), Model them using Hardware Description Language and perform its functional simulation.

11. Design a 4-bit Arithmetic Processor with and without pipelining, Model it using Hardware Description Language and perform its functional simulation.

(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. Gary Yeap, Practical Low-Power Digital VLSI Design, Springer Publication, 2012.

REFERENCE BOOKS:

1. A.P.Chandrakasan, R.W.Broadersen, Low Power Digital CMOS Design, Kluwer, Springer US, 2012.
2. Kaushik Roy, Sharat Prasad, *Low-Power CMOS VLSI Circuit Design*, Wiley Student Edition,2009.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/106/105/106105034/
2. https://onlinecourses.nptel.ac.in/noc21_ee09/preview

Web Resources:

1. https://www.youtube.com/watch?v=ruClwamT-R0&list=PLTEh-62_zAfHmJE-pcjgREKiKyPSgjkxj
2. https://www.youtube.com/watch?v=TFOO1JAlI2Y

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101031	**ANALOG IC DESIGN**	3	-	-	-	3

Pre-Requisite VLSI System Design

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: MOS Device Physics, Single Stage Amplifiers, Differential Amplifiers, Current Mirrors, Operational Amplifiers, Frequency Compensation, Bandgap Reference circuits.

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

CO1 Analyze small signal Models and layout considerations of MOS devices.

CO2 Analyze Single Stage Amplifiers, Differential Amplifiers and Current Mirrors.

CO3 Apply gain boosting techniques, frequency compensation techniques to achievestability in operational amplifiers.

CO4 Analyze the bandgap reference circuits to meet the optimial 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**
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	1	2	-	-	-	-	-	-	-	3	-	-
CO3	3	2	3	1	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	1	1	1	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

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

COURSE CONTENT

Module 1: BASIC MOS DEVICE PHYSICS ***(09 Periods)***

The MOSFET – Structure, Symbol, Switch operation, MOS I/V Characteristics, Second Order Effects, MOS Device Models – Layout, Capacitances, Small – Signal Model, SPICE Models, NMOS versus PMOS Devices, Long Channel versus Short Channel Devices.

Module 2: SINGLE STAGE AMPLIFIERS ***(07 Periods)***

General Considerations, Common Source Stage with different loads, Source Follower, Common – Gate Amplifier, Cascode Stage – Folded Cascode Stage.

Module 3: DIFFERENTIAL AMPLIFIERS AND CURRENT MIRRORS *(11 Periods)*

Single ended and Differential Operation, Basic Differential pair, Common Mode Response, Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors.

Module 4: OPERATIONAL AMPLIFIERS AND COMPENSATION *(10 Periods)*

General Considerations, One-Stage Op-Amps, Two-Stage Op-Amps, Gain Boosting Techniques, Stability and Frequency Compensation – General Considerations, Multipole Systems, Phase Margin, Basic Frequency Compensation, Compensation of Two-Stage Op-Amps

Module 5: BANDGAP REFERENCES ***(08 Periods)***

Bandgap References: Supply-Independent Biasing, Temperature-independent References, PTAT Current Generation, Constant - Gm Biasing, Speed and Noise Issues.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Model the single stage amplifiers (Common Source Amplifier, Common Drain Amplifier, Common Gate Amplifier) using SPICE Language, develop their schematic and layout to evaluate the Parameters like Gain, Output Resistance, Power Dissipation, etc.
2. Model the Differential Amplifiers using SPICE Language, develop their schematic and layout to evaluate the Parameters like Gain, Output Resistance, Power Dissipation.
3. Model the Cascode Amplifiers using SPICE Language, develop their schematic and layout to evaluate the Parameters like Gain, Output Resistance, Power Dissipation,etc.
4. Model the Operational amplifiers using SPICE Language, develop their schematic and layout to evaluate the Parameters like gain, Output Resistance, Power Dissipation,etc.
5. Model the Feedback Amplifiers using SPICE Language, develop their schematic andlayout to evaluate the Parameters like gain, Output Resistance, Power Dissipation, etc.
6. Model and apply the gain boosting techniques to CMOS amplifiers using SPICE Language, develop their schematic and layout to evaluate the Parameters like Gain,Power

Dissipation, etc.

7. Model and apply the frequency compensation techniques to CMOS amplifiers using SPICE Language, develop their schematic and layout to obtain their frequency response.
8. Model Bandgap Reference Circuits by using SPICE Language, develop their schematic and layout to obtain their Characteristics.
9. Model Sampling Switches using SPICE Language, develop their schematic and layout to obtain their characteristics.
10. Model Switched Capacitor Amplifier and Integrator using SPICE Language, develop their schematic and layout to obtain their characteristics.
11. Model Ring Oscillator using SPICE Language, develop their schematic and layout toobtain their characteristics.
12. Model Phase Locked Loop using SPICE Language, develop their schematic and layout to obtain their characteristics.

(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. Behzad Razavi, "*Design of Analog CMOS Integrated Circuits*", McGraw Hill Education,2ndedition, 2017.
2. David A.Johns, Ken Martin "*Analog Integrated Circuit Design*", Wiley, 2nd edition 2013.

REFERENCE BOOKS:

1. Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, "*Analysis and Design of AnalogIntegrated Circuits*", Wiley India, Fifth Edition, 2013.
2. Philip E. Allen and Douglas R. Holberg, "*CMOS Analog Circuit Design*". Oxford University Press,International third Edition/Indian Edition, 2012.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc22_ee37/preview
2. https://nptel.ac.in/courses/117101105

Web Resources:

1. https://www.youtube.com/watch?v=311XkpNGs8c&list=PL3pGy4HtqwD0rl7gQoESHR-chSq4OPN5p .
2. https://www.youtube.com/watch?v=HelDopJmAfc&list=PLG4LDxYH2oQrdrSuXwfi0IeFVl2-VTWsF

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101032	**TESTING AND TESTABILITY**	3	-	-	-	3

Pre-Requisite VLSI System Design

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

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

COURSE CONTENT

Module 1: INTRODUCTION TO TESTING ***(09 Periods)***

Role of Testing, VLSI Technology Trends Affecting Testing, Types of Testing, Test Economics, Yield, Fault Modeling, Fault Equivalence, Fault Collapsing, Fault Dominance and Checkpoint Theorem.

Module 2: TEST METHODS ***(10 Periods)***

Simulation for Design Verification and Test Evaluation, Algorithms for Fault Simulation –Serial, Parallel, Deductive, Concurrent Fault Simulations; Fault Sampling.

Module 3: COMBINATIONAL AND SEQUENTIAL CIRCUIT TEST GENERATOR ***(11 Periods)***

ATPG Algorithms – D-Algorithm, PODEM, FAN; Test Compaction, Time Frame Expansion Method – Nine-Value Algorithm; Simulation Based Sequential ATPG - CONTEST Algorithm.

Module 4: DELAY AND IDDQ TESTS ***(06Periods)***

Delay Test – Path-Delay Test, Transition Faults, At-Speed Testing; IDDQ Test – Limitations, Delta IDDQ Testing, IDDQ Built-in Current Testing.

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 bereflected 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 Pulishers, 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.Mclntyre, "*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
4. https://archive.nptel.ac.in/courses/106/103/106103116/

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/

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 CPROGRAMS ***(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 timestam

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 Publising, EagleRock, 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

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跨珞.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 systemdesign.

CO3 Analyze target architectures in designing data-dominated and control-dominated embedded systems.

CO4 Use compilation techniques and tools for embedded processor architectures andperform 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 bereflected 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 ontinuous/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 POSSIX 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 an non-pre-emption Workload Models
3. Real Time CPU Utilization calculation
4. Scheduling Tools Overview: TORSCHE, 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 thesame 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/
2. https:// onlinecourses.nptel.ac.in/noc20_cs16/

Web Resources:

1. http://rtime.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 LINKDESIGN ***(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 thesame shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Timothy Pratt, Charles W Bostian and Jeremy E Allnutt, WSE, *Satellite Communications,* Wileypublications, 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 CommunicationsEngineering,* 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 ervices/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 usedin broadband communication.*
2. *Discuss a case study of broadband service regulations for maintaining QoS bytelecom regulatory bodies such as TRAI.*

(Note: It's an indicative one. The course instructor may change the activities and thesame 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 Kasera 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 interferencesin 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 componentleads, 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/AXSI 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 surfacein 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 thesame 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−762O3

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 toovercome 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 thesame 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://mrajacse.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_sQHNMwWRWS_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 sta琀椀s琀椀cal machine learning based on mathema琀椀cal founda琀椀ons, discrete signals (sampling, quan琀椀za琀椀on, and coding), linear Gaussian systems, nonlinear and non-Gaussian signal processing, and sta琀椀s琀椀cal machine learning algorithms

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

CO1 Implement efficient algorithms for data compression, informa琀椀on theory, and sta琀椀s琀椀cal machine learning by applying mathema琀椀cal founda琀椀ons

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 sta琀椀s琀椀cal machine learning algorithms for signal processing applica琀椀ons.

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 ANDCODING ***(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 andcomputational 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 UniversityPress; 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 & DEVELOPMENT OF ADAPTIVE FILTER THEORY *(10 Periods)*

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 sturucters,Approaches to the development of linearadaptive filters. Linear Optimum Filtering: Statement of the problem, Principle of Orthogonality, Minimum Mean Square Error, Wiener- Hopf equations, Error- PerformanceSurface

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 AND RECURSIVE LEAST-SQUARES ADAPTIVE FILTERS *(10 Periods)*

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 FILTERING *(10 Periods)*

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, Buss Gang 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. Strearns, *"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 densityes□ma□on 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 signalorigin 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. Weiner filters – steepest descent algorithm – LMS adaptive algorithm – Adaptive noise canceller – cancellation of 50 Hz signal in ECG – Cancellation of maternalECG 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 spectrumestimation.

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 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 aboutthe result.

7. Read an image and apply
    1) Gaussian 3x3 mask for burring
    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 andwithout inbuilt function.

RESOURCES

TEXT BOOKS:

1. D. C Reddy, "Biomedical Signal Processing, Principles and Techniques", Tata McGraw HillPublishing 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=ezfPl8kUdbg&list=PLVDPthxoc3lNzu07X-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&ei =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:l9GBf0sTk4s
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:

CO1 Demonstrate knowledge on architecture and technology of M2M to IoT.

CO2 Demonstrate knowledge on IoT architectures and identify design constraints of IoT.

CO3 Select suitable protocols of data link and network layer protocols for different applications of IoT.

CO4 Identify appropriate protocols of session and application layer protocols for different applications of IoT.

CO5 Evaluate security issues and challenges during implementation of real worldmodels.

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	2	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	2	2	3	2	-	-	-	-	-	-	-	-	-	-	3
CO3	2	2	3	2	2	2	-	-	-	-	-	-	-	-	3
CO4	2	2	3	2	-	2	-	-	-	-	-	-	-	-	3
CO5	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 LAYERPROTOCOLS ***(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 bereflected 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/c lient/user/guide/ecap-app.html#:~:text=Encapsula珞椀on%20protocols%20connect%20the%20layer,set%20the%20ASE's%20enc apsula珞椀on%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 deploymentin 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, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, 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. Madisetti; Internet of Things: A Hands-on Approach, 1st Edition, UniversitiesPress (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: NetworkingTechnologies, Protocols, and Use Cases for the Internet of Things, 1st Edition, Pearson IndiaPvt. 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 andsensors)
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 inAI.

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 INHEALTHCARE ***(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 DiabetesSelf-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 andPrognosis Assessment of a patient.
2. How does drug discovery happen and how does AI is helping in drug discovery andLabs.

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 bereflected 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 Insurancecompanies.

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 sameshall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. RanganadhaChary, A.V. and Paul, R.R., *Banking and Financial system*, Kalyani Publisher, New Delhi, 3rdedition, 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 proteinsby applying different 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 ofproteins.

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) forthe 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 sameshall 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 Animals and 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 sameshall 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 andCareer.

(Note: It's an indicative one. The course instructor may change the activities and the sameshall 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/infocecs/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
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 CIVILENGINEERING ***(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 FinanceTech-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 sameshall 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 AmendmentProcedure.

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 awake 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 Ministerof 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 sameshall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Briji 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 theelements 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 ofproduction

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 foranalyzing 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 manufacturingcompanies.

(Note: It's an indicative one. The course instructor may change the activities and the sameshall 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 KluwerIndia Pvt. Ltd., New Delhi, 2018.

VIDEO LECTURES:

1. https://www.youtube.com/ watch?v=ESqO8sFgQa0&list=PLLhSIFfDZcUVE2kzOhEubO9rkvUOAgZbz
2. https://www.youtube.com/ watch?v=tzasFmP1CpAhttps://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 ad 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 minimizethe 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 ANDPHISHING 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 TERRORISMAND ILLUSTRATIONS ***(09 Periods)***

Cyber Crime & Terrorism: Introduction, Intellectual property in the cyber space, Theethical 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 sameshall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Nina Gobole, SunitBelapure, *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 India2018

VIDEO LECTURES:

1. Learn Cyber Security | Cyber Security Training: https://www.youtube.com/watch?v=PlHnamdwGmw
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 ANDSAFETY 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 electricalappliances; 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 ANDMAINTENANCE ***(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 inthe industry.
3. Study and submit a report on standard practices followed during themaintenance/commissioning of the electrical apparatus in any industry.
4. Collect information about various safety/alert sign boards and the relative measuresfor a particular situation.
5. Should practice preliminary first aidassistance such asCardiopulmonary resuscitation (CPR) and shall demonstrate.

(Note: It's an indicative one. The course instructor may change the activities and the sameshall 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 Developmentation.

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

RESOURCES

TEXT BOOKS:

1. Peavy, H. S, Rowe, D. R., and Tchobanoglous, G., *Environmental Engineering*, McGraw Hill 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*, DhanpatRai & 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/20200501211601643 5Ranvijay-Pratap-Singh-Environmental-Pollution.pdf
2. 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 bereflected 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 Pulishers, 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.Mclntyre, *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 SCANNINGNETWORKS ***(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 Publishing Co., 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 issuesand 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 bereflected 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, Principlesof 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 aspecific 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 sameshall 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 EconomicForum
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 ManagementReview

RESOURCES

TEXT BOOKS:

1. Francis Cherunilam, *Strategic Management*, Himalaya Publishing House, 3rdEdition, 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 StrategicApproach*, Cengage Learning, 1stEdition, 2007.
2. S.K.Mandak, *Ethics in Business and Corporate Governance*, TMH, 2ndEdition,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:

CO1 Understand the green technology concepts and the consequences of greenhouse gas emissions.

CO2 Acquire basic knowledge on cleaner development mechanism, the importance ofre-use of materials, and the oxidation technology for wastewater.

CO3 Go beyond energy-efficient machinery, biofuels, and environmentally friendlymaterials.

CO4 Acquire basic knowledge on man-made ecosystems, sources, and control ofpollution.

CO5 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**
CO1	3	-	-	-	-	-	3	-	-	-	-	1
CO2	3	-	-	-	-	-	3	-	-	-	-	1
CO3	3	-	-	-	-	-	3	-	-	-	-	1
CO4	3	-	-	-	-	-	3	-	-	-	-	1
CO5	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 Veslind, *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 ANDCOMPENSATION ***(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 sameshall 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	Course Title	L	T	P	S	C
22SS101703	**INDIAN ECONOMY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

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 structureand society.
2. Prepare a presentation on family setups of different countries and their peculiarcustoms 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 andhow you may help to strengthen environmental security.

(Note: It's an indicative one. Course Instructor may change activities and shall bereflected 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	Course Title	L	T	P	S	C
22SS101704	**INDIAN HISTORY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

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 andcommunalism, 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 theirsignificance 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 bereflected 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 UNDERJAINISM AND BUDDHISM ***(09 Periods)***

Salient features of Jainism - contributions of Jainism to Indian culture - Contributions of Aachaarya 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, Eswarchandravidyasagar 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 bereflected 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 industrialrequirement.

CO5 Identify appropriate level and flow transducer for measurement of level and flowfor 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 andapplications.

Module 2: ACCELERATION, VELOCITY & DENSITY MEASUREMENT ***(08 Periods)***

Acceleration Measurement: Introduction, LVDT, Piezoelectric, Strain gauge andVariable 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 thesame 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 Schr¨odinger 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 thesame 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 UniversityPress, 2008
2. Karl Goser et.al, *Nanoelectronics and Nanosystems: From Transistors to Molecular andQuantum 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 aData 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, Pivot Table, 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

1. ***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 importantrole 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.

2. ***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 basedon 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 likelyto 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_Fth2tlEkdKXvV
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/YkxlRXFvZXJrTDBkVzVVZi9ESjl6eXpRZkxRc2lhOWhlVXBhUVVWaXZlNDNyZUVldU9LdlYvd20wbkQ4MC92UQ
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, compileand debug programs in Python programming language.

CO2 Use appropriate data type for handling user data and write optimized programs usingthe 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 dctionary), 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 ina 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 afunction, 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 tuplesfrom 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 linesin 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 markingXs 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:

CO1 Understand the fundamental concepts of IoT and physical computing.

CO2 Demonstrate knowledge on variety of embedded boards and IoT Platforms

CO3 Understand the communication protocols in IoT communications.

CO4 Demonstrate knowledge on Domain specific IoT applications.

CO5 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**
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-
CO5	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 anduse 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 managementtools 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, Crashingthe 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. MartandT. 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 ENTERPRENEURSHIP	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 establishingIndustrial 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 itsapplication,Performancegap,Infrastructuregap,Sustainabilitygap,Regulatory gap, Preference gap, organizational factors effecting innovation at firm level.

Module 3: SOUCES 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 & PROBLEMSOLVING ***(09 Periods)***

Concept of open innovation approach, Difference between open innovations and Cloud 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/ARTICELS:

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 cloud 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 OFALLOYS ***(09 Periods)***

Materials Structure: Space lattice, Unit cells and Metallic crystal structures (SC, BCC, FCCand 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 ableto:

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 expe 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 protectthe 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 toolsand 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 STRATAGIES ***(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, Casestudies.

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 Nationals 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 Strategiesof Sustainability*, Routledge, 3rd Edition, 2003.
4. Gabriel Moser, Enric Pol, Yvonne Bernard, MiriliaBonnes, 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)***

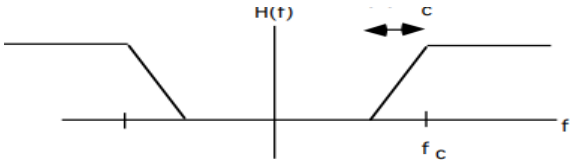
Concept of Information, Entropy and Rate of Information, Coding efficiency, Shannon-Fano and Huffman Coding.

Error Correction and Detection Codes- Linear Block Codes, Cyclic Codes, ConvolutionCodes.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Suppose that a non-linear device is available for which the output current i0 and theinput voltage vi are related by: $i_0(t) = a_1 vi(t) + a_3 v_3 i(t)$ 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 $S_I(t)$ is a +1V or -1V pulse during the interval (O, 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 $Pe \leq 10^{-7}$

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 edition2007.
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 ableto:

CO1 apply the various probability and statistics fundamentals into engineering systems to evaluate performance.

CO2 develop mathematical models for engineering networks/systems to evaluatethe 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 forpersonal and industrial safety.

CO5 understand various safety and hazard identification techniques and followappropriate 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 RELIABILITYEVALUATION ***(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, jobsafety 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 asses 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=xYWyype7cxE

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-prasenjit-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:

CO1 Analyze photogrammetry and remote sensing to solve complex surveying problem using appropriate tools and techniques following the relevant guidelines and lates developments considering society and environment besides communicating effectively in graphical form.

CO2 Analyze GIS to solve complex surveying problems using appropriate tools and techniques following latest developments besides communicating effectively in graphical form.

CO3 Analyze GIS spatial analysis to solve complex surveying problems using appropriat tools and techniques following latest developments besides communicating effectively in graphical form.

CO4 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.

CO5 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**
CO1	2	3	-	2	2	1	1	1	-	1	-	1
CO2	2	3	-	-	2	1	1	-	-	1	-	1
CO3	2	3	-	2	2	1	1	-	-	1	-	1
CO4	2	3	-	-	2	1	1	1	-	1	1	1
CO5	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, Visualinterpretation 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 GISsoftware.

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 geometryof 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 Willey 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. Burragh 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, Sustainablegreen 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) - SouthKorea.

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 inIndia.
3. Write a report on energy conservation and economy stability in world's first smartcity.
4. Write a report on need and technologies to be adopted for green buildings in asmart 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, BocaRaton, 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 Uthopia*, 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:*** Responseto 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 ENERGYSOURCES ***(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 aspectsand should prepare a technical report on the plant visited.
2. The students shall visit a wind farm, understand the operational aspects, andshould 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 findnew 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. JhonTwidell and Tony Wier, *Renewable Energy Resources*, Taylor & Francis, 2nd edition, London and Newyork, 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 - VAR Element - 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 a Web 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 finalresults 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- end-components/
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 NatureSocio–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.economicsdiscussion.net/entrepreneurship/women–entrepreneurs–in– india
2. https://www.businessmanagementideas.com/entrepreneurship–2/women entrepreneurs