MOHAN BABU UNIVERSITY

Sree Sainath Nagar, Tirupati – 517 102

MBU
MOHAN BABU
UNIVERSITY
DREAM. BELIEVE. ACHIEVE

SCHOOL OF ENGINEERING

B.Tech. Civil 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 CIVIL ENGINEERING

Vision

To become a leading centre of excellence in the country in Civil Engineering education through teaching, research, innovation, incubation, consultancy and public service for technical development in a knowledge society.

Mission

- Inspire the civil engineers of tomorrow to take on the challenges of creating and sustaining the built environment that support our society.
- Nurture these civil engineers with fundamental engineering knowledge, a broad set of skills, and an inquisitive attitude for creating innovative solutions to serve industry and community through contemporary curriculum, congenial learning environment, pertinent research, innovation and incubation ecosystem, industry-institute interaction, mentoring, training and placement activities, student clubs, co-curricular and extra-curricular activities.
- Encourage faculty and staff to excel in their respective fields and demonstrate the best of their abilities by way of continuing education, research and consultancy.

B.Tech. CIVIL ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES

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

PEO1. Pursue higher education in civil engineering or other fields of engineering or management or other areas of interest.

PEO2. Address the contemporary issues in Civil Engineering or related field and provide appropriate solutions through professional career in industry/teaching/research.

PEO3. Engage in 'technology innovation and deployment' and engineering system implementation, as an entrepreneur.

PEO4. Exhibit leadership qualities, participate in continuing education programs for lifelong learning and contribute individually and as a member in multidisciplinary teams to meet social and ethical constraints.

PROGRAM OUTCOMES

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

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

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

PO3. **Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and

modeling to complex engineering activities with an understanding of the limitations.

PO6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

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

PO9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

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

PO12. **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

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

PS01. Plan, draw, analyze, design, construct, valuate, manage, maintain, retrofit and rehabilitate civil engineering systems and processes by applying suitable materials, tools and techniques.

PS02. Identify minerals, rocks, structural geology problems and understand geological maps; characterize soil; choose foundations; select ground improvement techniques; and plan and design transport systems.

PS03. Perform land survey; plan, design, construct, maintain and manage water resources systems; analyze water and wastewater; manage solid waste; plan, design and execute environmental systems and processes.

B.Tech. Civil Engineering

Basket Wise - Credit Distribution

(Regular – 4 Years Program)

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. Civil Engineering

Basket Wise - Credit Distribution

(Lateral Entry – 3 Years Program)

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	-
22EE102401	Basic Electrical and Electronics Engineering	3	-	2	-	4	-
22EE102402	Fundamentals of Electrical Engineering	2	-	2	-	3	-
22CS102401	Programming in C and Data Structures	2	-	2	4	4	-
22CS102001	Programming for Problem Solving	3	-	2	-	4	-
22ME105002	Engineering Workshop	-	-	2	-	1	-
22ME105001	Computer Aided Engineering Drawing	-	1	4	-	3	-
22CE111002	Technology Extension for Societal Problems	-	-	-	4	1	-
22AI105001	Design Thinking	-	1	2	-	2	-
22CE111001	Internship	-	-	-	-	2	-
22CE108001	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)							

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
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	-
22MM101405	Numerical Methods, Probability and Statistics	3	-	-	-	3	-
22MM101406	Special Functions and Complex Analysis	3	-	-	-	3	Multivariable Calculus and Differential Equations
Physics Basket (Min. 4 Credits to be earned)							
22MM102451	Applied Physics	3	-	2	-	4	-
22MM102452	Engineering Physics	3	-	2	-	4	-
Computing Tools (Min. 1 Credits to be earned)							
22EE105405	MATLAB Practice for Engineers	-	-	2	-	1	-
22CS105401	Python Programming for Engineers	-	-	2	-	1	-
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	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22CE107602	Disaster Mitigation and Management	2	-	-	-	2	-
22CE107603	Rural Technology	2	-	-	-	2	-
22LG107603	Spoken English	-	1	2	-	2	English for Professionals
22LG107602	Essential Life Skills for Holistic Development	2	-	-	-	2	-
22AB107601	NCC/NSS Activities	-	-	-	-	2	-
22AB107602	Yoga	2	-	-	-	2	
22MG107601	Innovation, Incubation and Entrepreneurship	2	-	-	-	2	-
22EE107601	Intellectual Property Rights	2	-	-	-	2	-
22EE107602	Fundamentals of Research Methodology	2	-	-	-	2	-

*Compulsory Course

School Core (20-34 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	-
22EE102401	Basic Electrical and Electronics Engineering	3	-	2	-	4	-
22EE102402	Fundamentals of Electrical Engineering	2	-	2	-	3	-
22CS102401	Programming in C and Data Structures	2	-	2	4	4	-
22CS102001	Programming for Problem Solving	3	-	2	-	4	-
22ME105002	Engineering Workshop	-	-	2	-	1	-
22ME105001	Computer Aided Engineering Drawing	-	1	4	-	3	-
22CE111002	Technology Extension for Societal Problems	-	-	-	4	1	-
22AI105001	Design Thinking	-	1	2	-	2	-
22CE111001	Internship	-	-	-	-	2	-
22CE108001	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	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22MM102404	Transformation Techniques and Linear Algebra	3	-	2	-	4	-
22MM101405	Numerical Methods, Probability and Statistics	3	-	-	-	3	-
22MM101406	Special Functions and Complex Analysis	3	-	-	-	3	Multivariable Calculus and Differential Equations
22MM102451	Applied Physics	3	-	2	-	4	-
22MM102452	Engineering Physics	3	-	2	-	4	-
22EE105405	MATLAB Practice for Engineers	-	-	2	-	1	-
22CS105401	Python Programming for Engineers	-	-	2	-	1	-
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	English for Professionals
22LG107602	Essential Life Skills for Holistic Development	2	-	-	-	2	-
22AB107601	NCC/NSS Activities	-	-	-	-	2	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22AB107602	Yoga	2	-	-	-	2	-
22MG107601	Innovation, Incubation and Entrepreneurship	2	-	-	-	2	-
22EE107601	Intellectual Property Rights	2	-	-	-	2	-
22EE107602	Fundamentals of Research Methodology	2	-	-	-	2	-

*Compulsory Course

Program Core (45-61Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22CE101001	Engineering Mechanics	3	1	-	-	4	-
22CE102001	Fluid Mechanics and Hydraulic Machinery	3	-	2	-	4	Engineering Mechanics, Multivariable Calculus and Differential Equations
22CE102002	Civil Engineering Materials and Concrete Technology	3	-	2	-	4	-
22CE102003	Construction, Planning and Project Management	3	-	2	-	4	Civil Engineering Materials and Concrete Technology
22CE102004	Mechanics of Solids	3	-	2	-	4	Engineering Mechanics
22CE102005	Environmental Engineering	3	-	2	-	4	Engineering Chemistry
22CE102006	Soil Mechanics	3	-	2	-	4	Engineering Mechanics, Engineering Geology Lab
22CE102007	Surveying	3	-	2	-	4	-
22CE101002	Hydrology and Water Resources Engineering	3	-	-	-	3	Fluid Mechanics and Hydraulic Machinery
22CE101003	Structural Analysis	3	-	-	-	3	Mechanics of Solids
22CE101004	Foundation Engineering	3	-	-	-	3	Soil Mechanics
22CE101005	Reinforced Cement Concrete Structures	3	-	-	-	3	Civil Engineering Materials and Concrete Technology, Structural Analysis
22CE102008	Transportation Engineering	3	-	2	-	4	Surveying, Soil Mechanics
22CE101006	Steel Structures	3	-	-	-	3	Structural Analysis
22CE103001	Estimation and Quantity Surveying	3	-	-	4	4	Surveying, Computer Aided Building Planning and Drawing, Reinforced Cement Concrete Structures
22CE105001	Computer Aided Building Planning and Drawing	-	1	4	-	3	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22CE105002	Computer Aided Design and Detailing Lab	-	-	2	-	1	Reinforced Cement Concrete Structures, Steel Structures
22CE105003	Engineering Geology Lab	-	-	2	-	1	-
22CE105004	Civil Engineering Software Lab	-	-	2	-	1	-

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	
22CE105005	Construction Engineering	Spread Sheet Applications in Civil Engineering	-	-	2	-	1	-
22CE101007		Rehabilitation and Retrofitting of Structures	3	-	-	-	3	Construction, Planning and Project Management; Reinforced Cement Concrete Structures
22CE101008		Fire Engineering	3	-	-	-	3	
22CE102009		Structural Health Monitoring	3	-	2	-	4	Basic Electrical and Electronics Engineering, Civil Engineering Materials and Concrete Technology
22CE101009		Building Services	3	-	-	-	3	-
22CE101010		Alternate Building Materials	3	-	-	-	3	Civil Engineering Materials and Concrete Technology
22CE101011		Construction Equipment and Automation	3	-	-	-	3	Construction, Planning and Project Management
22CE101012	Geotechnical Engineering	Ground Improvement Techniques	3	-	-	-	3	Foundation Engineering
22CE101013		Advanced Foundation Engineering	3	-	-	-	3	Foundation Engineering
22CE101014	Environmental Engineering	Sustainable Engineering	3	-	-	-	3	-
22CE101015		Air and Noise Pollution and Control	3	-	-	-	3	-
22CE101016		Solid and Hazardous Waste Management	3	-	-	-	3	-
22CE103002		Environmental Impact Assessment and Management	3	-	-	4	4	Environmental Engineering
22CE101017		Sustainable Design of Technology Systems	3	-	-	-	3	Sustainable Engineering
22CE102010	Structural	Advanced Structural Analysis	3	-	2	-	4	Structural Analysis

Course Code	Knowledge Area	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
			L	T	P	S	C	
22CE101018	Engineering	Advanced Reinforced Cement Concrete Structures	3	-	-	-	3	Reinforced Cement Concrete Structures
22CE101019		Prestressed Concrete	3	-	-	-	3	Reinforced Cement Concrete Structures
22CE101020		Advanced Steel Structures	3	-	-	-	3	Steel Structures
22CE104001	Surveying	Advanced Surveying	2	-	2	4	4	Surveying
22CE102011		Geospatial Technologies	2	-	2	-	3	
22CE104002		GPS Surveying	2	-	2	4	4	Surveying
22CE101021	Transportation Engineering	Railway Engineering	3	-	-	-	3	
22CE101022		Highway Construction and Maintenance	3	-	-	-	3	Transportation Engineering
22CE102012		Pavement Analysis and Design	3	-	2	-	4	Transportation Engineering
22CE101023		Airport and Harbour Engineering	3	-	-	-	3	Transportation Engineering
22CE101024	Water Resources Engineering	Urban Stormwater Management	3	-	-	-	3	Hydrology and Water Resources Engineering
22CE101025		Irrigation Engineering and Hydraulic Structures	3	-	-	-	3	Hydrology and Water Resources Engineering
22CE101026		Integrated Watershed Management	3	-	-	-	3	Surveying, Hydrology and Water Resources Engineering
22CE101027		Hydropower Engineering	3	-	-	-	3	Fluid Mechanics and Hydraulic Machinery
22CE101028		Groundwater Development and Management	3	-	-	-	3	Hydrology and Water Resources Engineering
22EE102017	Interdisciplinary	Energy Audit, Conservation and Management	3	-	2	-	4	
22ME101023		Optimization Techniques	3	-	-	-	3	

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	
22CE101029	Construction Engineering	Architecture and Town Planning	3	-	-	-	3	
22CE101030		Smart Materials and Structures	3	-	-	-	3	Civil Engineering Materials and Concrete Technology Reinforced Cement Concrete Structures, Steel Structures
22CE101031		Infrastructure Development and Management	3	-	-	-	3	Construction, Planning and Project Management
22CE101032		Civil Infrastructure for Smart City Development	3	-	-	-	3	-
22CE102013		Advanced Concrete Technology	2	-	2	-	3	Civil Engineering Materials and Concrete Technology
22CE101124		AI and IoT in Construction	3	-	-	-	3	-
22CE101125		Data Science for Civil Engineers	3	-	-	-	3	-
22CE101033	Geotechnical Engineering	Geoenvironmental Engineering	3	-	-	-	3	Soil Mechanics, Environmental Engineering
22CE101034		Soil Dynamics and Machine Foundations	3	-	-	-	3	Foundation Engineering
22CE101035		Geotechnics for Underground Structures	3	-	-	-	3	Foundation Engineering
22CE101036		Rock Mechanics and Tunneling	3	-	-	-	3	Engineering Mechanics, Engineering Geology Lab
22CE103003		Geosynthetics and Reinforced Soil Structures	2	-	-	4	3	Foundation Engineering
22CE101037	Environmental Engineering	Industrial Wastewater Treatment	3	-	-	-	3	Environmental Engineering
22CE101038		Environmental Economics	3	-	-	-	3	
22CE101039		Environmental Sustainability	3	-	-	-	3	Environmental Engineering
22CE101040		Integrated Waste Management for a Smart City	3	-	-	-	3	Environmental Engineering
22CE101041		Waste to Energy	3	-	-	-	3	-
22CE101042	Structural Engineering	Earthquake Resistant Design of Structures	3	-	-	-	3	Reinforced Cement Concrete Structures
22CE101043		Analysis and Design of Composite Structures	3	-	-	-	3	Reinforced Cement Concrete Structures, Steel Structures

Course Code	Knowledge Area	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
			L	T	P	S	C	
22CE101044		Bridge Engineering	3	-	-	-	3	Reinforced Cement Concrete Structures, Steel Structures
22CE102014		Finite Element Methods in Structural Engineering	3	-	2	-	4	Multivariable Calculus and Differential Equations, Structural Analysis
22CE101045		Prefabricated Structures	3	-	-	-	3	Reinforced Cement Concrete Structures, Steel Structures
22CE103004	Surveying	Land Surveying and Real Estate Development	3	-	-	4	3	
22CE102015		Digital Land Survey and Mapping	1	-	2	-	2	
22CE102016		Drone Surveying and Mapping	1	-	2	-	2	
22CE102017		Utility Surveying and Mapping	1	-	2	-	2	
22CE102018		Hydrographic Surveying	1	-	2	-	2	
22CE101046	Transportation Engineering	Transportation Planning and Management	3	-	-	-	3	Transportation Engineering
22CE101047		Intelligent Transportation Systems	3	-	-	-	3	Transportation Engineering
22CE101048		Traffic Engineering and Management	3	-	-	-	3	Transportation Engineering
22CE102019		Pavement Materials	3	-	2	-	4	Transportation Engineering
22CE101049		Sustainable Urban Mobility	3	-	-	-	3	Transportation Engineering
22CE101050	Water Resources Engineering	Sustainable Water Resources Development	3	-	-	-	3	Hydrology and Water Resources Engineering
22CE101051		River Engineering and River Basin Management	3	-	-	-	3	Hydrology and Water Resources Engineering
22CE101052		Pipeline Engineering	3	-	-	-	3	Fluid Mechanics and Hydraulic Machinery
22CE101053		Computational and Statical Methods in Hydraulics and Hydrology	3	-	-	-	3	Hydrology and Water Resources Engineering
22CE101054		Advanced Hydraulics	3	-	-	-	3	Fluid Mechanics and Hydraulic Machinery

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	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
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	-
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	-
22LG101702	Personality Development	3	-	-	-	3	-
22CE101703	Planning for Sustainable Development	3	-	-	-	3	-
22EC101705	Principles of Communication Engineering	3	-	-	-	3	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22EE101702	Reliability and Safety Engineering	3	-	-	-	3	-
22CE101704	Remote Sensing, GIS and GPS	3	-	-	-	3	-
22CE101705	Smart Cities	3	-	-	-	3	-
22EC101706	Smart Sensors for Engineering Applications	3	-	-	-	3	-
22EE101703	Sustainable Energy Systems	3	-	-	-	3	-
22CS101702	Web Design Fundamentals	3	-	-	-	3	-
22SS101706	Women Empowerment	3	-	-	-	3	-

Note:

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

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22BS102401	**ENGINEERING CHEMISTRY**	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

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

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

CO1. Solve problems associated with water, and address the societal, health and safety issues related to quality of water

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

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

CO4. Acquire basic knowledge of instrumental methods and their applications in the analysis of materials.

CO5. Identify the quality of fuels and lubricants for their engineering applications.

CO6. Develops independent working ability, through problem solving and effective communication.

CO-PO Mapping Table:

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

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

COURSE CONTENT

Module 1: WATER TECHNOLOGY ***(09 Periods)***

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

Module 2: CHEMISTRY OF MULTI FUNCTIONAL MATERIALS ***(09 Periods)***

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

Conducting polymers: Definition, types and applications.

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

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

Module 3: ELECTROCHEMICAL CELLS, STORAGE DEVICES AND SENSORS ***(09 Periods)***

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

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

Fuel Cells: Definition, 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.

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

REFERENCE BOOKS:

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

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=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_(Analytical_Chemistry)/Analytical_Sciences_Digital_Library/Active_Learning/Shorter_Activities/Electrochemical_Sensor_Project/01_Introduction_To_Electrochemical_Sensors
3. https://www.arsdcollege.ac.in/wp-content/uploads/2020/04/Document-2.pdf
4. https://www.salon.com/2015/10/14/4_outlandish_things_our_ancestors_used_as_lube_partner/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22EE102401	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is designed to provide an overview on the fundamentals of electrical and electrical engineering concepts and hands-on experience for non-electrical graduating students. The course address the fundamentals concepts of electrical circuits, operational aspects of motors, transformers and general electrical wiring systems. The course also emphasis on the illumination design, back-up supplies like UPS and Batteries, sensors and transducers, and principles of fundamental electronic devices and their applications.

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

CO1. Analyze the electrical circuits by applying the principles of electrical circuits.

CO2. Understand the operation of various motors used in domestic application, transformers and general wiring schemes.

CO3. Understand the operational aspects of UPS, batteries and design the appropriate lighting system for various industrial and domestic applications.

CO4. Understand the principle of various sensor and transducers to sense/measure various non-electrical parameters.

CO5. Understand the fundamentals of basic electronic devices, their characteristics and applications of electronic devices.

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	-	-	2	-	-	-	-	-	-	-
CO2	3	2	-	-	-	1	-	-	-	-	-	-
CO3	3	2	2	-	-	1	1	-	-	-	-	-
CO4	3	1	-	-	-	1	-	-	-	-	-	-
CO5	3	1	-	1	2	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-
Course Correlation Mapping	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**-**	**3**	**3**	**-**	**-**

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

COURSE CONTENT

Module 1: FUNDAMENTALS OF ELECTRIC CIRCUITS (10 Periods)

Classification of network elements; Voltage-Current relations for passive elements; Kirchhoff's laws; Series-Parallel connection; Mesh and Nodal analysis (With DC Independent Sources only). AC sources–Single loop generator, Phasor representation, Voltage, Current, Impedance, Power factor and Apparent power.

Module 2: ELECTRICAL SYSTEMS (09 Periods)

Motors: Types of motors, working principle and applications—DC motor, Three Phase Induction motor, Synchronous motor, Stepper motor.

Single Phase Transformer: Construction, principle of operation; EMF equation.

Electrical wiring: Methods of electrical wiring systems; Earthing procedure, Switch fuse unit (SFU), Operation of MCB and Relays.

Module 3: UTILIZATION OF ELECTRICAL SYSTEMS (09 Periods)

Illumination: Light sources, Terminologies, Laws of illumination; Types of lamps, Lighting calculations; Interior Lighting - Industrial lighting; Exterior lighting- Street lighting and Flood lighting.

Uninterruptible Power Supply (UPS) - Components in UPS, Functionality and Calculation of ratings for UPS components to a specific load.

Emergency supply: Batteries -Types of batteries, Elementary calculations for energy consumption for a specified application.

Module 4: SENSORS ANDTRANSDUCERS (08 Periods)

Sensors- Light sensor, Voltage sensor, Temperature and Humidity sensor, Motion detection sensors, Wireless bluetooth sensors and Distance measurement with Ultrasound sensor.

Transducers -Basic requirements of transducers, Passive transducers - Strain gauge, Hall-Effect transducer, LVDT and Active transducers- Piezoelectric and Thermocouple, Data acquisition system (overview and concept only).

Module 5: FUNDAMENTALS OF ELECTRONICS ENGINEERING (09 Periods)

Half wave and full wave rectifier, Zener diode, characteristics, application – Regulator. BJT—operation; Introduction to Operational amplifier: Inverting and non-inverting amplifier. Application—Adder, Comparator, Integrator and Differentiator; Analog to Digital Convertors—Flash type and Successive approximation types; Digital to Analog converters—Weighed resistor and R-2R types.

Total Periods: *45*

EXPERIENTIAL LEARNING

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

1. Verification of Kirchhoff’s laws (Mesh and Nodal Analysis).
2. Performance evaluation by brake test on DC Shunt Motor.
3. Performance evaluation of a 1-Phase Transformer by Load test.
4. Practicing plate and pipe earthing system.
5. Operation and testing of Fuse, MCB and Relays.

6. Design and estimation of wiring for a typical house: One lamp controlled by one switch, Two lamp controlled by two switch and stair case wiring.
7. Calibration of LVDT for linear displacement measurement.
8. Analyze the characteristics of Resistance Temperature Detector (RTD) sensor.
9. Analyze the characteristics of piezoelectric sensor.
10. Investigate ripple factor and load regulations of rectifier with and without filters.
11. Design of inverting and non-inverting amplifiers using op-amp.
12. D-A converter (R-2R ladder) using Op-Amp 741 with required voltage levels.

RESOURCES

TEXT BOOKS:

1. AshfaqHussain, Fundamentals of Electrical Engineering, Dhanpatrai& Co. (P) Ltd., 3rd Edition, New Delhi, 2009.
2. R. L. Boylestad and Louis Nashelsky, Electronics Devices and Circuits, PHI, 11th edition, 2009.

REFERENCE BOOKS:

1. Wadhwa, C. L. Basic Electric Engineering. 4th Edition, New Age International Private limited.
2. D. Patranabis, Sensors and Transducers, PHI Learning Private Limited, 2nd Edition, 2003.
3. A.K.Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, DhanpatRai& Co., 19th Edition, 2015.
4. C.L. Wadhwa, Generation, Distribution and Utilization of Electrical Energy, New Age International Private Limited, 2015.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/108108076
2. https://nptel.ac.in/courses/108105061
3. https://nptel.ac.in/courses/108108147
4. https://nptel.ac.in/courses/108101091

WEB RESOURCES:

1. https://www.electrical4u.com/electric-circuit-or-electrical-network/
2. https://www.electronicshub.org/dc-circuits-basics/
3. https://www.electrical4u.com/working-of-electric-motor/
4. https://electricalbaba.com/what-is-ups-working-types-of-ups-explained/
5. https://www.lrc.rpi.edu/resources/publications/pdf/illuminationfund.pdf
6. https://www.sitsitamarhi.ac.in/wp-content/uploads/2020/04/file_5e8ef00b06190.pdf
7. https://www.electronics-tutorials.ws/io/io_1.html
8. https://www.homemade-circuits.com/making-ups-tutorial/
9. https://www.engineersgarage.com/introduction-to-uninterruptible-power-supply-ups-and-its-design-part-1-17/
10. https://www.dfliq.net/blog/the-basics-of-electrical-components/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22EE102402	**FUNDAMENTALS OF ELECTRICAL ENGINEERING**	**2**	**-**	**2**	**-**	**3**

Pre-Requisite -

Anti-Requisite - 22EE102401-BasicElectricalandElectronicsEngineering

Co-Requisite -

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

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

CO1. Analyze the DC electrical circuits by applying the principles of network reduction techniques, mesh and nodal analysis.

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

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

CO4. Understand the operational aspects of Special Machines used in industry and for domestic applications

CO5. Analyse the equivalent circuit of a single phase transformer, to determine the performance and assess its sustainability for various load conditions.

CO6. Work in dependently 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***

COURSECONTENT

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

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: SINGLEPHASEACCIRCUITS (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, band width 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: SPECIALMACHINES (04 Periods)

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

Module 5: SINGLE PHASE TRANSFORMERS (05 Periods)

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

Total Periods: 30

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

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 are sonant 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 singlephase 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*, Mc Graw Hill Education(India) Private Limited, NewDelhi, 5th Edition, 2015.
2. JB Gupta, *Theory and performance of Electrical Machines* (DC machines, PolyphaseCircuits & AC machines) in SI Units, S.K. Kataria & Sons, New Delhi, 15th Edition,2015.

REFERENCE BOOKS:

1. Charles K. Alexander, Mathew NOSadiku, *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&CompanyLtd,New Delhi,Multicolourillustrativeedition,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
22CS102401	PROGRAMMING IN C AND DATA STRUCTURES	2	-	2	4	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed introduction and hands-on experience to programming in C language. Topics covered in the course include Algorithms, Flowcharts, Operators and expressions, Input and output functions, Control statements, Arrays, Strings, Functions, Pointers, User-defined data types, Linked lists, Overview of data structures, Stack, Queue, Searching algorithms, Sorting algorithms.

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

CO1. Develop flowcharts, algorithms for given problems.

CO2. Design algorithmic solutions by analyzing programming problems and using appropriate C language constructs.

CO3. Apply linear data structures such as arrays, linked lists, stacks, queues for efficient data organization and manipulation.

CO4. Select and apply appropriate techniques for searching and sorting problems.

CO5. Work independently and communicate effectively in oral and written forms.

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	3	-	-	-	-	-	-	-	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	-
CO4	2	3	3	2	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	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 C PROGRAMMING *(08Periods)*

Introduction to Algorithms and Flowcharts: What is an algorithm, Different ways of stating algorithms, Key features of algorithm, What are variables, Subroutines, Flowcharts, Strategy for designing algorithms, Tracing an algorithm to depict logic, Specification for converting algorithms into programs.
Basis of C Programming: Introduction, Structure of a C program, Concept of a variable, Data types in C, Program statement, Declaration, How does the computer store data in memory, Tokens, Operators and expressions, Expressions revisited, Type conversion in C.

Module 2: INPUT AND OUTPUT, CONTROL STATEMENTS *(09 Periods)*

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

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

Arrays and Strings: One-dimensional array – Declaration, Initialization, Manipulation; Multi-dimensional arrays – Declaration, Initialization, Manipulation; Strings – Declaration, Initialization, String input/output, Character manipulation, String manipulation; Arrays of strings – Declaration, Initialization, Manipulation.
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, USER-DEFINED DATA TYPES, LINKED LISTS *(10 Periods)*

Pointers in C: Understanding memory addresses, Address operator (&), Pointer, Arrays and pointers, Pointers and strings, Pointer arithmetic, Pointers to pointers, Array of pointers, Pointers to an array, Two-dimensional arrays and pointers, Dynamic memory allocation.
User-Defined Data Types: Structures - Declaration, Initialization, Accessing members, Arrays of structures, Arrays within structure, Structures and pointers, Structures and functions; Enumeration types.
Linked Lists: Single linked lists – Definition, Representation, Operations, Inserting a node, Deleting a node; Applications of linked lists, Disadvantages of linked lists, Array versus linked list revisited.

Module 5: DATA STRUCTURES *(08 Periods)*

Basic Data Structures: Overview of data structures, Stack – Definition, Array representation, Implementation of stack operations using arrays; Queue - Definition, Array representation, Implementation of queue operations using array.
Searching and Sorting: Linear Search, Binary Search, Bubble sort, Selection sort.

Total Periods: 45

EXPERIENTIAL LEARNING

1. a) Let a and b are two integer variables whose values are 10 and 13 respectively. Write a program to evaluate the following arithmetic expressions.
   i) a + b ii) a–b iii) a * b iv) a/b v) a % b

b) Write a program to evaluate the following algebraic expressions after reading necessary values from keyword.
   i) (ax + b)/(ax – b)
   ii) 2.5 log x + Cos 32^0+ | $x^2 + y^2$|
   iii) $x^5 + 10\ x^4 + 8$ and $x^3 + 4\ x + 2$
   iv) ae^{kt}

2. a) Mr. Gupta deposited Rs.1000 in a bank. The bank gives simple interest at the rate of 15% per annum. Write a program to determine the amount in Mr. Gupta's account at the end of 5 years. (Use the formula I = PTR / 100)

   b) A cashier has currency notes of denominations Rs.10, Rs. 50 and Rs. 100. If the amount to be withdrawn is input in hundreds, find the total number of notes of each denomination the cashier will have to give to the withdrawer.

   c) In a town, the percentage of men is 52. The percentage of total literacy is 48. If total percentage of literate men is 35 of the total population; write a program to find the total number of illiterate men and women if the population of the town is 8000.

3. a) Write a program that prints the given three integers in ascending order using if - else.

   b) Write a program to calculate commission for the input value of sales amount. Commission is calculated as per the following rules:
      i) Commission is NIL for sales amount Rs. 5000.
      ii) Commission is 2% for sales when sales amount is >Rs. 5000 and <= Rs. 10000.
      iii) Commission is 5% for sales amount >Rs. 10000.

   c) If cost price and selling price of an item is input through the keyboard, write a program to determine whether the seller has made profit or incurred loss. Also determine how much profit or loss he incurred in percentage.

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

   Write a 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.

   b) Write a program, which takes two integer operands and one operator as input from the user, performs the operation and then prints the result. (Consider the operators +, -, *, /, %. Use switch statement)

5. a) Write a program to find the sum of individual digits of a positive integer.

   b) A Fibonacci sequence is defined as follows: The first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a program to generate the first N terms of the sequence.

6. a) Write a program to find the largest and smallest number in a given list of integers.

   b) Write a program to perform addition of two matrices.

c) Write a program to determine whether the given string is palindrome or not.

7. a) Write a program using functions to perform the following operations:
   i) To convert a given decimal number into binary number
   ii) To convert a given binary number into decimal number

   b) Write a program using functions insert a sub-string in main string at a specified position.

8. a) Write a C program to print the elements of an array in reverse order using pointers.

   b) Write a program to accept the elements of the structure as: Employee-name, Basic pay. Display the same structure along with the DA, CCA and Gross salary for 5 employees.
   Note: DA=51% of Basic pay, CCA=Rs.100 consolidated.

9. A college has N number of students and the following details of all the students are maintained – register number, name, branch, phone number. Write a program to store the details of the students using a singly linked list. Develop functions to perform the following operations on the data.
   i) Insert new student's details
   ii) Display the details of the students
   iii) Delete a given student's information

10. a) Develop a menu driven program to perform the following operations on a stack of integers (Array implementation of stack with maximum size MAX)
   i) Push an element
   ii) Pop an element
   iii) Display the status
   iv) Demonstrate overflow and underflow situations

   b) Develop a menu driven program to perform the following operations on a queue of characters (Array implementation of queue with maximum size MAX).
   i) Insert an element
   ii) Delete an element
   iii) Display the status
   iv) Demonstrate overflow and underflow situations

11. Store register numbers of students who attended placement training program in a random order in an array. Write a function to search whether a student has attended placement training program or not using
   a) Linear Search
   b) Binary Search

12. Given marks of N number of students in mathematics subject, write a program to display the marks of students in ascending order using
   a) Bubble Sort
   b) Selection Sort

RESOURCES

TEXT BOOKS:

1. Pradip Dey and Manas Ghosh, Programming in C,Oxford University Press,2018.
2. Debasis samanta, Classic Data Structures,2nd Edition, PHI Learning, 2009.

REFERENCE BOOKS:

1. Byron S Gottfried and Jitender Kumar Chhabra, *Programming with C*, 4th Edition, McGraw Hill Education, 2019.

2. Yashavant Kanetkar, *Let Us C,* 17th Edition, BPB Publications, 2020.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106/104/106104128/
2. https://nptel.ac.in/courses/106/103/106103069/
3. https://www.digimat.in/nptel/courses/video/106105171/L01.html
4. https://nptel.ac.in/courses/106102064
5. https://nptel.ac.in/courses/106105171
6. https://archive.nptel.ac.in/courses/106/106/106106127/
7. https://www.youtube.com/watch?v=4OGMB4Fhh50
8. https://nptel.ac.in/courses/106105151

WEB RESOURCES:

1. https://www.coursera.org/learn/data-structures
2. https://www.edureka.co/blog/c-data-structures/
3. https://www.coursera.org/specializations/data-structures-algorithms
4. https://www.udemy.com/course/data-structures-and-algorithms-in-c/
5. https://www.udemy.com/course/data-structures-and-algorithms-in-c-for-beginners/
6. http://www.java2s.com/Tutorial/C/0260__Data-Structure/Catalog0260__Data-Structure.htm
7. https://www.programiz.com/dsa

SCHOOL CORE

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

Pre-Requisite -

Anti-Requisite - 22CS102401-Programming in C and Data Structures

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 ***(09Periods)***

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, L values and R values, 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 TOPROBLEMSOLVING ***(08 Periods)***

Control Statements: Specifying test condition for selection and iteration, Writing test expression, Conditional execution and selection, Iteration and repetitive execution, go to statement, Special control statements, Nested loops.
Introduction to Problem Solving: Algorithms, Flowcharts, Problem solving aspect, Top-down design, Implementation of algorithms, program verification an deficiency of algorithms.

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

Arrays and Strings: One-dimensional array–Declaration, Initialization, Accessing elements, operations; Multi-dimensional arrays – Declaration, Initialization, Working with2D 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-DEFINEDDATATYPESANDFILES ***(10 Periods)***

User-Defined Data Types: Structures-Declaration, Accessing the members, Initialization, typed and its use, Arrays of structures, Arrays within structure, Structures and pointers, Structures and functions; Unions, Enumeration types, Bit fields.
Files: Using files in C, Working with text and binary files, Direct File Input and Output, Files of records, R and om 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) Writeaprogramtoevaluatethefollowingexpressionsbyreadingthenecessaryvalues from the keyboard.

   i.$(ax+ b)/(ax- b)$ ii.$2.5\log x+\cos 32^0+ |x^2+y^2|$
   iii.$ax^5+bx^3+ c$ iv.ae^{kt}

2. a) Write a C program to find the roots of a quadratic equation.

   b) Inatown,thepercentageofmenis52.Thepercentageoftotalliteracyis48andthetotal 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 is7000.

c) Thetotaldistancetravelledbyavehicleint secondsisgivenbythedistance$ut+at^2/2$where $u$and$a$aretheinitialvelocity(m/sec.) and acceleration(m/sec^2).
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
Above300	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. Ifaperson'shealthisexcellentandthepersonisbetween25and35yearsofageand lives in a city, and is a male then the premium is Rs.4 per thousand and the policy amount cannot exceed Rs.2lakhs.

ii. If a person satisfies all the above conditions and is female then the premium isRs.3perthousandandthepolicyamountcannotexceedRs.1lakh.

iii. If a person's health is poor and the person is between 25 and 35 years of age and lives in a village and is a male then premium is Rs.6 per thousand and the policy cannot exceed Rs.10000.

iv. In all other cases the person is not insured.

Write a C program to determine whether the person should be insured or not, his/her premium rate and maximum amount for which he/she can be insured.

c) Write a C Program to find the grade for a student using a Switch case. The user needs to enter a subject score(varies from 0 to 100) and then display the grade as described below.

Score	Grade	Score	Grade
>=90	O	>=50to<60	D
>=80to<90	A	>=40to<50	E
>=70to<80	B	<40	Fail
>=60to<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 $n$is3 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.

   c) Write a C program to store *n* elements in an array and print the elements in sorted order 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. Afunctiontostore10 employee details.
   ii. A function to implement the following rules while revising the basic pay. If Basic-pay<=Rs.5000thenincreaseit by15%.
   If Basic-pay>Rs.5000and<=Rs.25000then itincreaseby10%.IfBasic-pay>Rs.25000 then there is no change in Basic-pay.
   iii. A function to print the details of employees who have completed 20 years of service from the Date-of-Joining.

10. a) Write a C program to reverse the first *n* characters of a given text file.

   b) Write a C program to merge two files into a new file.

RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

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

SOFTWARE/TOOLS:

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

VIDEO LECTURES:

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

WEB RESOURCES:

1. Learn C Programming
2. Learn C Programming
3. C Programming Exercises, Practice, Solution
4. Basic programming exercises and solutions in C
5. C Programming Exercises, Practice, Solution
6. Basic programming exercises and solutions in C

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22ME105002	**ENGINEERING WORKSHOP**	-	-	2	-	1

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Knowledge on various workshop hand and power tools; hands on experience in different manufacturing trades such as fitting, carpentry, sheet metal forming and foundry; Demonstration on dismantling and assembling of various two wheeler parts, power tools in machining and metal joining, basics of plumbing and working of 3D printer.

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

CO1. Design and model various basic prototypes in the trade of fitting such as square/half round mating, V- mating and dovetail mating from the given MS workpieces using fitting tools.

CO2. Develop different prototypes in the carpentry trade such as cross lap joint, dovetail / bridle joints and Mortise and Tenon joint using carpentry tools.

CO3. Design and model different prototypes in the sheet metal forming trade such as rectangular tray, square vessel/cylinder, Funnel as per the dimensions using sheet metal forming tools.

CO4. Develop sand mold using single piece pattern and split piece pattern in the foundry trade using foundry tools.

CO5. Develop electric circuits for series and stair case connections.

CO6. Demonstrate the knowledge on power tools, plumbing operation, 3D printing technology involved in different engineering applications.

CO7. 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	3	1	-	1	-	-	-	-	-	-
CO2	3	3	3	1	-	1	-	-	-	-	-	-
CO3	3	3	3	1	-	1	-	-	-	-	-	-
CO4	3	3	3	1	-	1	-	-	-	-	-	-
CO5	3	3	3	1	-	1	-	-	-	-	-	-
CO6	3	1	1	1	1	1	-	-	-	-	-	-
CO7	-	-	-	-	-	-	-	-	3	3	-	-
Course Correlation Mapping	**3**	**3**	**3**	**1**	**1**	**1**	**-**	**-**	**3**	**3**	**-**	**-**

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

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. **FITTING:** Conduct a detailed study on various aspects in fitting trade which includes the details of fitting operations, safety precautions, types of tools, tool holders, miscellaneous tools, care and maintenance of hand tools, marking and measurement tool, and finishing tool.

   Exercises :

   a) Make a square/half round mating from the given MS workpieces

   b) Make a V- mating from the given MS workpieces

2. **CARPENTRY:** Conduct a detailed study on various aspects in carpentry trade which includes the details of types of wood, carpentry tools, wood working techniques, types of joints, safety precautions, and care and maintenance of tools.

   Exercises:

   a) Prepare a cross lap joint

   b) Prepare dovetail / bridle joints

3. **SHEET METAL FORMING:** Conduct a detailed study on various aspects in sheet metal forming which includes the details of sheet materials, hand tools, sheet metal fabrication, and safety and precautions

   Exercises:

   a) Fabricate a rectangular tray as per the dimensions

   b) Fabricate square vessel/cylinder as per the dimensions

4. FOUNDRY: Conduct a detailed study on various aspects in foundry which includes the details of moulding sand, properties of moulding sand, types of patterns and pattern, materials, foundry tools, and safety and precautions
   Exercises:
   a) Prepare a sand mold, using the given single piece pattern (stepped pulley/cube)
   b) Prepare a sand mold, using the given split piece pattern (pipe bent/dumbbell)

5. ELECTRICAL WIRING: Prepare electrical wiring with associated devices such as switches, distribution boards, sockets, and light fittings in a structure considering safety standards for design and installation.
   Exercises:
   a) Prepare electrical circuits with Series.
   b) Prepare electrical circuits with Stair case connections.

6. DEMONSTRATION:
   a) Demonstrate the usage of power tools.
   b) Demonstrate the plumbing operation and identify the essential tool and materials required for plumbing.
   c) Demonstrate the working of 3D printer

RESOURCES

REFERENCES:

1. P. Kannaiah and K. L. Narayana, *Workshop Manual*, SciTech Publishers, 2009.
2. K. Venkata Reddy, *Workshop Practice Manual*, BS Publications, 2008.
3. V. Ramesh Babu, *Engineering Workshop Practice*, V R B Publishers Private Limited, 2009.

ADDITIONAL LEARNING RESOURCES:

1. R. K. Jain, Production Technology, Khanna Publishers, 17th edition, 2012.
2. Kalpakjian, Serope, Manufacturing Engineering and Technology, Pearson Education, 7th edition, 2014.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=ZyN9Tw9VTSo
2. https://www.youtube.com/watch?v=A9m_3onoVV8
3. https://www.youtube.com/watch?v=PkjpmPLNKZs
4. https://www.youtube.com/watch?v=IDajw2S78zg

WEB RESOURCES:

1. https://www.jiit.ac.in/sites/default/files/Workshop_Lab.pdf
2. https://mechanicalenotes.com/engineering-workshop/
3. https://www.studocu.com/in/document/indian-institute-of-technology-guwahati/engineering-mechanics/engineering-workshop/8571486
4. https://lecturenotes.in/download/note/25089-note-for-engineering-workshop-ew-by-technical-genius

SCHOOLCORE

Course Code	Course Title	L	T	P	S	C
22ME105001	COMPUTER AIDED ENGINEERING DRAWING	-	1	4	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:

Engineering drawing conventions; Importance of engineering drawing; fundamental concepts of sketching; computer aided drafting and different types of projections of geometric entities (both 2D and 3D) through computer aided drafting packages.

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

CO1. Apply the principles of engineering drawing, Methods and CAD tools to draw the Geometries and Curves to communicate in engineering field.

CO2. Understand and draw projections of points (0D) lines (1D) and planes (2D) (inclined to both planes of projection) located in first quadrants

CO3. 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)

CO4. Develop lateral surfaces of solids of given objects for engineering communication using principles of engineering drawing and CAD tools.

CO5. Understand 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)***

Introduction to Engineering graphics: Principles, significance -Conventions in drawing-lettering - BIS conventions-Dimensioning principles and conventional representations – Lettering and dimensioning - Scales: Representative Fraction, Type of Scale, Plain and Diagonal Scale, Scale of chords.

Exercises:

1. Practice exercise on Basic Lettering Practice, Dimensioning Practice,
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 with basic drawing commands
2. Practice exercise with editing commands

Module 2: CONICS, CURVES, PROJECTION OF POINTS, LINES AND PLANES ***(06 Periods)***

Conics & Special Curves: (a) Conic sections: Construction of ellipse, parabola and hyperbola including the rectangular hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle. Drawing of tangents and normal to the above curves.

Exercises:

1. Practice exercises on Ellipse, Parabola, Hyperbola and Rectangular Hyperbola
2. Practice exercises on Cycloid, epicycloids, hypocycloid and Involutes
3. Practice exercises on Projection of points in 3rd angle projections

Projection of points, lines and planes: Projection of points in any quadrant, lines inclined to one or both planes, Traces, finding true lengths, angle made by line. Projections of regular plane surfaces and inclined to both the principal planes by rotating object method.

Exercises:

1. Practice exercises on Projection of points
2. Practice exercises on lines inclined to one plane
3. Practice exercises on lines inclined to both planes
4. Practice exercises on Projections of regular plane surfaces
5. Practice exercises on Projection of polygonal plane surfaces
6. Practice exercises on Projection of circular plane surfaces
7. Practice exercises on Projection of polygonal plane surfaces inclined to both principal planes
8. Practice exercises on Projection of circular plane surfaces inclined to both principal planes

Module 3 PROJECTION OF SOLIDS AND SECTION OF SOLIDS ***(8 Periods)***

Projection of solids: Projection of regular solids in simple position, Projection of solids with axes inclined to one of the reference planes and parallel to the other, Projections of solids with axes inclined to both H.P. and the V.P.

Sections of solids: Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone, True shapes of the sections. Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.

Exercises:

1. Practice exercises on Projections of regular solids
2. Practice exercises on Sections of solids
3. Practice exercises on Projection of pentagonal pyramids
4. Practice exercises on Projection of Hexagonal pyramids
5. Practice exercises on Projection of pentagonal pyramids inclined to both principal planes
6. Practice exercises on Projection of Hexagonal pyramids inclined to both principal planes
7. Practice exercises on Projection of pentagonal prism
8. Practice exercises on Projection of Hexagonal prism
9. Practice exercises on Projection of pentagonal prism inclined to both principal planes
10. Practice exercises on Projection of Hexagonal prism inclined to both principal planes

Module 4 DEVELOPMENT OF SURFACES ***(6 Periods)***

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

Exercises:

1. Practice exercises on Development of surfaces of right regular solids
2. Practice exercises on Development of surfaces of pentagonal pyramids
3. Practice exercises on Development of surfaces of hexagonal pyramids
4. Practice exercises on Development of surfaces of pentagonal prism
5. Practice exercises on Development of surfaces of hexagonal prism

Module 5 ORTHOGRAPHIC AND ISOMETRIC PROJECTIONS ***(10 Periods)***

ORTHOGRAPHIC AND ISOMETRIC PROJECTIONS

Orthographic Projections: Systems of projections, conventions and application to orthographic projections. Projections of regular plane surfaces-triangle, square, rectangle, pentagon, hexagon and circle-in simple positions inclined to both the planes; planes in different positions by change of position method only.

Isometric Projections: Principles of isometric projection- of simple solids and truncated solids – Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Isometric scale; Isometric views: lines, planes, simple solids.

Exercises:

1. Practice exercises on Orthographic Projections
2. Practice exercises on Isometric Projections

Total Periods: 36

RESOURCES

TEXT BOOKS:

1. D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi, Revised edition, 2010. 2. 1.. 2.
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&RajashekarPatil, Computer Aided Engineering Drawing, New Age International Publishers, 4th edition, 2012.
3. T.Jeyapoovan, Engineering Drawing and Graphics Using AutoCAD, Vikas Publishing House, 3rd Edition, 2010.
4. Jolhe, Engineering Drawing, Tata McGraw Hill Education Private Limited, 1st Edition, 2007.
5. Basant Aggarwal, Engineering Drawing, Tata McGraw Hill Education Private Limited, 1st Edition, 2008

VIDEO LECTURES:

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

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CE111002	TECHNOLOGY EXTENSION FOR SOCIETAL PROBLEMS	-	-	-	4	1

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed project based learning on identification of real world civil engineering and allied societal problems and leveraging technology extension to solve them through innovative solutions following relevant standards, codes, policies, regulations and latest developments considering health, safety, environment, sustainability, economics and project management. Majorly, this emphasizes on identification of problem area for the project work, literature survey, obtaining necessary approval from competent authorities/individuals, site visit and collection of preliminary data, identification of implementation tools and methodologies, performing critical study and analysis of the topic identified, time and cost analysis, mobilization of funds, implementation of the project work, preparation of report and presentation.

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

CO1. Create/Design civil engineering systems or processes to solve complex real world civil engineering and allied societal problems using appropriate tools and techniques following relevant standards, codes, policies, regulations and latest developments; and arrive at innovative solutions.

CO2. Consider society, health, safety, environment, sustainability, economics and project management in solving complex real world civil engineering and allied societal problems.

CO3. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on civil engineering systems or processes to solve complex real world civil engineering and allied societal 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	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

1. Identification of real world civil engineering and allied societal problems.
2. Field visits can be arranged by the faculty concerned
3. 6 – 10 students can form a team (within the same discipline)
4. Minimum of four hours per week on self-managed team activity
5. Appropriate scientific methodologies to be utilized to solve the identified problem
6. Solution should be in the form of fabrication/coding/modeling/product design/process design/formulation of relevant scientific methodology(ies)
7. Public fund raising for implementation of the designed solution
8. Develop a strategy for implementation
9. Mobilization of necessary human resources and material
10. Implementation of the designed solution
11. Verification of the implemented solution
12. Consolidated report to be submitted for assessment
13. Participation, involvement and contribution in group discussions during the week with faculty concerned will be used as the modalities for the continuous assessment of the course.
14. Project outcome to be evaluated in terms of technical, economical, social, environmental, political and demographic feasibility.
15. Contribution of each group member to be assessed

Total Periods: 45

PROJECT BASED LEARNING

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

SCHOOLCORE

Course Code	Course Title	L	T	P	S	C
22AI105001	**DESIGNTHINKING**	-	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 frame works.

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 blue prints to visualize user attitudes and behavior for gainingin sights of customers.

CO4. Design prototypes of innovative products or services for a customer base.

CO5. Develop relevant products or services by choosing good design and applying empathy tools for experiencing user requirements.

CO6. Work independently and communicate effectively in oral and written forms.

CO-PO Mapping Table:

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

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

EXPERIENTIAL LEARNING

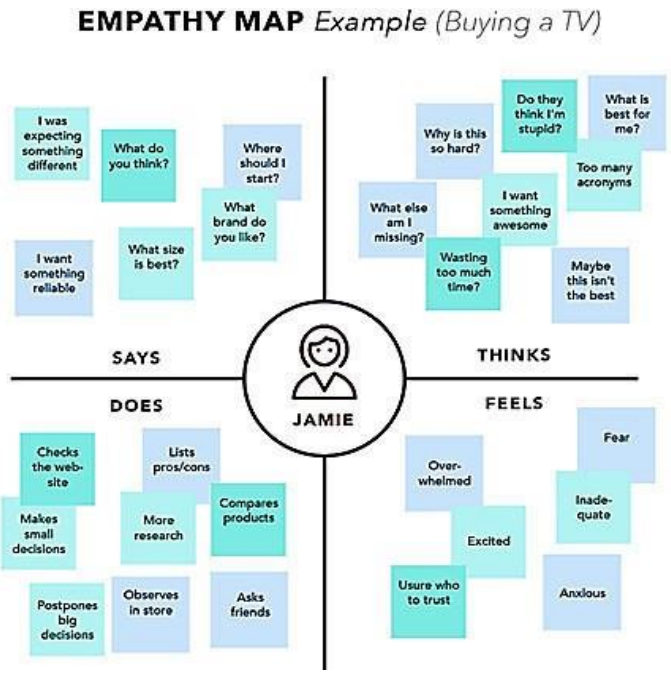
LIST OF EXERCISES:

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

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

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

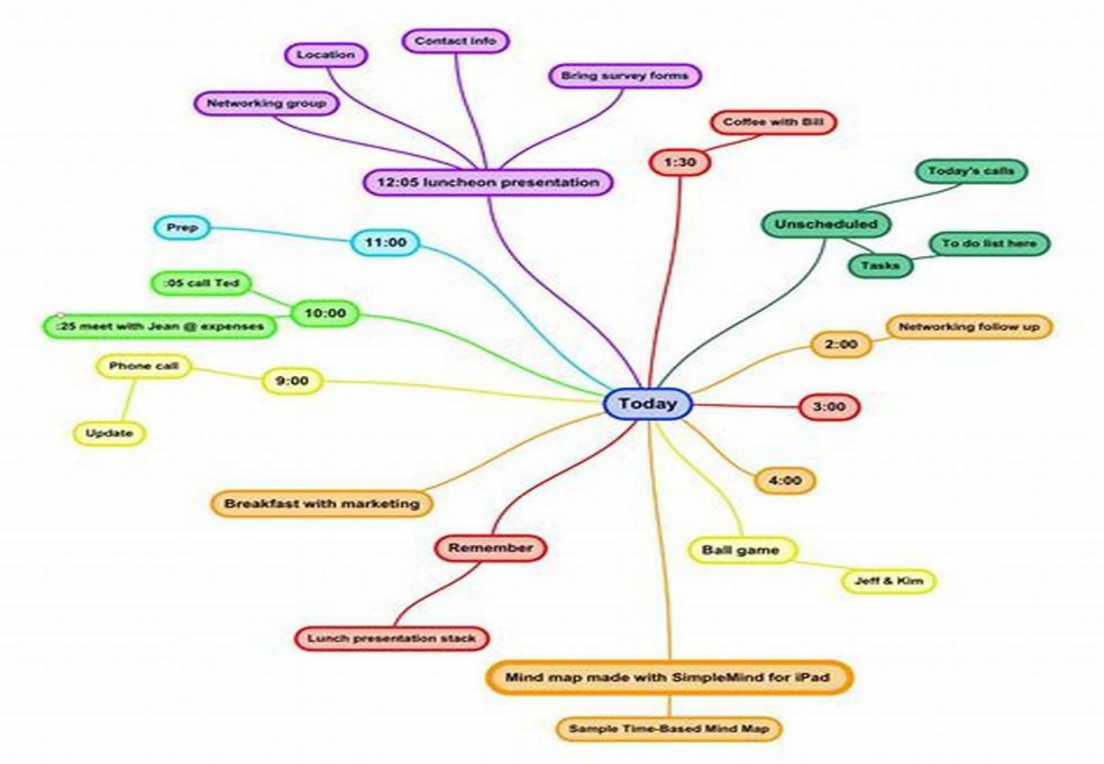
3. Build a Customer Journey Map (CJM-Before-During-After) and identify touch points for any mock scenario or persona created during last experiment and frame 2-3questionsusing HMW(How MightWe).
4. Create an Empathy Map using Coggle design thinking tool.
   Sample Empathy Map:



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 mocks cenario and create user stories and story boards 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 frame work 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

REFERENCES:

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 Your Organization, 2012.
3. Kathryn Mc Elroy, Prototyping for Designers: Developing the best Digital and Physical Products, O'Reilly, 2017.
4. S.Salivahanan, S.Suresh Kumar, D.PraveenSam, Introduction to Design Thinking, Tata McGraw Hill, 1st Edition, 2019.

SOFTWARE/TOOLS:

1. Canva(https://www.canva.com/)
2. Coggle(https://coggle.it/)
3. MarvelPOP

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
22CE111001	**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-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	-	-	-	3	3	3	3
CO2	-	3	-	-	-	3	3	-	-	-	3	-	3	3	3
CO3	-	-	-	-	-	-	-	-	3	3	-	-	3	3	3
Course Correlation Mapping	**3**	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

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

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CE108001	**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 civil engineering systems or processes to solve complex civil 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 civil engineering and allied problems.

CO3. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on civil engineering systems or processes

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	-	-	3	-	-	-	3	3	3	3
CO2	-	3	-	-	-	3	3	-	-	-	3	-	3	3	3
CO3	-	-	-	-	-	-	-	-	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

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG102401	**ENGLISH FOR PROFESSIONALS**	2	-	2	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

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

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

CO1. Understand the basics of Reading, Writing, Listening, and Speaking skills.

CO2. Analyze the rules of English grammar in speaking and writing.

CO3. Demonstrate knowledge of English pronunciation in speaking.

CO4. Apply the knowledge of reading strategies and vocabulary in communication.

CO5. Apply the strategies of writing in preparing are port.

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

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

COURSE CONTENT

Module 1: SUPERHEROES–THESCIENCEBEHINDSUPERHEROES ***(06 Periods)***

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

Module 2: ALIENS–THECYLINDEROPENS ***(06 Periods)***

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

Module 3 INVENTORS–THERAMANEFFECT ***(06 Periods)***

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

Module 4 HEALTH AND NUTRITION–WHAT SHOULD YOU BEEATING ***(06 Periods)***

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

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

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

Total Periods: 30

EXPERIENTIAL LEARNING

PART-A
Any six modules among the following:

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

PART-B
Any four modules among the following

1. Communicating effectively is important to become successful in any business. Prepare a Case study of successful business personnel regarding communication competence.
2. Prepare a Power Point 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 inventor sand their role in present socio, political and economic changes.
7. Prepare a collage of entrepreneurs' pictures and their achievements.
8. NASA released recent photos of the universe with the help of the James 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 problem and prepare food habits to overcome.

10. Epics of India deals with super heroes 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 hotcake in the market.
12. Illustrate the essential rules for good précis writing.

RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

1. KlineJ.A.,*Speakingeffectively:Achievingexcellenceinpresentations.UpperSaddleRiver,*NJ:Pearson/PrenticeHall,2004.
2. Kuiper,*S.Contemporarybusinessreportwriting*Cincinnati,OH:Thomson/South,Western,3rdEdition, 2007.
3. Locker,K.O.&Kaczmarek,*S.K.Businesscommunication*:*Buildingcriticalskills,* McGrawHill,3rdEdition,2007.
4. Mascull,*B.Businessvocabularyinuse:Advanced.Cambridge,*CambridgeUniversityPress,2004.
5. Matthews,C.B.&Matthews,andM.*Quickstepstowinningbusinesspresentations:Makethemostofyour PowerPointpresentations*,McGrawHill,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.*Guidetopresentations*,Pearson,2ndEdition,2008.
8. Reardon,K.K.*Theskillednegotiator:Masteringthelanguageofengagement*,Jossey,Bass, 2004.
9. Stiff,J. B.*Persuasive communication*, Jossey,Bass, 2ndEdition2003.

VIDEO LECTURES:

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

WEBRESOURCES:

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 pronunciationin 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

TEXTBOOK:

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	**SOFTSKILLS**	-	-	2	-	1

Pre-Requisite -

Anti-Requisite 22LG102401-English for Professionals

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 toemployoralandwrittencommunication,teamwork,leadership,problem-solving,anddecision-makingskills,togainthebestresults.

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. AnalyzevarioussituationsbyapplyingAssertivecommunicationandNon-verbalformsin developing Interpersonal Skills.

CO3. Applyappropriatemanagerialstrategiesbyanalyzingtheconflictsinvarioussituations.

CO4. Demonstrate various communication styles by analyzing and applying Thinking SkillsindiverseteamsasanindividualandateammemberandduringInterviewsandGroupDiscussions.

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

*Any ten modules are mandatory among the following:

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: GOALSETTING

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

Module 4: THINKINGSKILLS

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

Module 5: TEAMBUILDING

Learning Activities, Management Essentials, and Team Building Scenarios

Module 6: CONFLICTMANAGEMENT

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

Module 7: EMOTIONALINTELLIGENCE

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

Module 8: ADAPTABILITYSKILLS

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

Module 9: GROUPDISCUSSIONS

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

Module 10: INTERVIEWSKILLS

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

Module 11: INTERPERSONALSKILLS

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

Module 12: ETIQUETTE

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

RESOURCES

REFERENCE:

1. Manual.
2. Dr.K.Alex, *Soft Skills*, S.Chand & Company LTD, LatestEdition, 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.

SOFTWARE/TOOLS:

1. K-VANSolutions.
2. LearningtoSpeakEnglish8.1, The Learning Company,4CDs.
3. English in Mind, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
4. Language in Use1, 2&3.
5. CambridgeAdvancedLearner'sDictionary,3rdEdition.
6. Let's Talk English, Regional Institute of English South India

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(dealingwithcomplaints)
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; Berufs deutcsch (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 grammarin 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***

EXPERIENTIALLEARNING

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

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

COURSE CONTENT

Module 1: INTRODUCTION ***(06Periods)***

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 1^{st} and 2^{nd} type, verb Conjugation 3^{rd}type, 'Wh' questions (simple sentences) Nominative (definite and indefinite) Articles

Module 2: CITY AND FOOD ***(06Periods)***

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 ***(06Periods)***

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

Module 4: BASIC GRAMMAR ***(06Periods)***

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 ***(06Periods)***

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

TotalPeriods:30

EXPERIENTIAL LEARNING

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

RESOURCES

TEXT BOOKS:

1. Stefanie Dengler, Paul Rusch, Helen Schmitz, Tana Sieber, *Netzwerk Deutschals Fremdsprache, ArbeitsbuchA1*, Goyal Publisher sand 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***

EXPERIENTIALLEARNING

3. Prepare are port on the importance of the German language in India
4. Why is German taught in Indian schools?

(Note: It's an indicative one. Course Instruct or may change activities and shall be reflected

In course Handout)

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 ***(06Periods)***

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

Module 3: GREETINGS ***(06Periods)***

Greetings, Good-byes, Names, Vousvstu, Courtesy, Formal Speech Titles, Asking for One's Name

Module 4: CONVERSATIONS & NUMBERS ***(06Periods)***

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

Module 5: THE DATE & TIME ***(06Periods)***

Numbers 01-31, Seasons, Days of the week, Months of the Year, Numbers 3060,TimesofDay,Asking for the time.

TotalPeriods:30

EXPERIENTIAL LEARNING

1. Prepare are port on the importance of the French language in India
2. Why is French taught in Indian schools?
   (Note: It' san 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 Wiki books, the open-content text books collection, athttp://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

SCHOOLCORE

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

EXPERIENTAL LEARNING

1. American Airlines requires that the total outside dimensions (length + width + height) of a checked bag not exceed 62 inches. Suppose you want to check a bag whose height is equal to its width. What is the largest volume bag of this shape that you can check on an American Airlines flight?
2. An insulated rod of length l has its ends *A*and*B* maintained at 0^0C and 100^0C respectively until steady state conditions prevail. If *B* is suddenly reduced to 0^0C and maintained at 0^0C, 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 $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$ 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. 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 (MVC)
2. https://nptel.ac.in/courses/111106100 (ODE)
3. https://nptel.ac.in/courses/111103021 (PDE)

WEB RESOURCES:

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

SCHOOLCORE

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 behavior of periodic functions and their applications and Fourier transform to connect the frequency and time domain systems.

CO2. Apply the techniques of Laplace transform to solve ordinary differential equations.

CO3. Make use of echelon forms in finding the solution of system of linear equations.

Compute Eigen values and Eigen vectors of square matrices.

CO4. Use the fundamental concept of a basis for a subspace to give a precise definition of dimensions and rank, and to solve problems in appropriate situations.

CO-PO Mapping Table:

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

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

COURSE CONTENT

Module 1: FOURIER SERIES & FOURIER TRANS FORMS ***(09 Periods)***

Introduction to Fourier series, Convergence of Fourier series(Dirichlet's conditions), Fourier Series in(□□,□), Half-range Fourier sine and cosine expansions in(0,□), 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 INVERSELAPLACETRANSFORMS ***(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 LINEARALGEBRA-MATRICES ***(09 Periods)***

Rankofamatrix: 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 LINEARALGEBRA-VECTORSPACES ***(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

EXPERIENTAL 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
4. https://www-users.cse.umn.edu/~mille003/fouriertransform.pdf
5. https://nitkkr.ac.in/docs/12%20Laplace%20Transforms%20and%20their%20Applications.pdf

SCHOOLCORE

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, INTERPOLATION ***(09 Periods)***

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/ 3rd and 3/ 8th rules.

Module 3 RANDOM VARIABLE AND DISTRIBUTIONS *(09 Periods)*

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

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

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

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

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

Total Periods: 45

EXPERIENTIAL LEARNING

1. Write a Python program to solve algebraic equation by bisection method
2. Write a Pseudo code on numerical integration using Simpson1/3 method.
3. What is the importance of probability distribution in computer science engineering?
4. If you draw from a normal distribution with known values of parameters, how do you generate draws in a uniform distribution?
   (Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

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

VIDEO LECTURES:

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

WEB RESOURCES:

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

SCHOOL CORE

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

Pre-Requisite 22MM101406 - Multivariable Calculus and Differential Equations

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:

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

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

CO1. Evaluate integrals by applying Beta and Gamma functions.

CO2. Analyze the analyticity of complex functions and apply Cauchy-Riemann equations & harmonic functions to solve engineering problems.

CO3. Determine the image of given region under the given conformal mapping

CO4. Identify singularities of complex functions and determine the values of integrals using complex variable techniques.

CO-PO Mapping Table:

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

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

COURSE CONTENT

Module 1 SPECIAL 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:

i) $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$

ii) $\int_{-\infty}^{\infty} f(x)dx$

iii) $\int_{-\infty}^{\infty} e^{imx} f(x)dx$.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Apply the Gamma function, obtain the mass of an octant of the ellipsoid $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$ with the density at any point being $\rho = k\,x\,y\,z$.

2. Discuss how to prepare a geographical map (Atlas) of the earth on a piece of paper using complex plane.

3. Two concentric circular cylinders of radii r_1 and $r_2\,(r_1<r_2)$ are kept at potentials ϕ_1 and ϕ_2 respectively. Using complex function $w = a\log z + c_1$, prove that the capacitance per unit length of the capacitor formed by them is $\frac{2\pi\lambda}{\log\left(r_2/r_1\right)}$, where λ is the dielectric constant of the medium.

(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, 7thedition, 2004.

REFERENCE BOOKS:

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

VIDEO LECTURES:

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

WEB RESOURCES:

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

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
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 ultra sonics 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. Understandthecharacteristicsandapplicationsofmodernengineeringmaterials.
CO6. Workindependentlyandinteamstosolveproblemswitheffectivecommunications.

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 FIBEROPTICS **(07 Periods)**

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

Module 2 ACOUSTICS AND ULTRASONICS (09 Periods)

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

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

Module 3 KINEMATICS AND KINETICS (10 Periods)

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

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

Module 4 THERMAL PHYSICS (08 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 NiTialloy-Applications of SMA.

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

Total Periods: 45

EXPERIENTIAL LEARNING

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

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

RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

1. B.K.Pandey and S.Chaturvedi, *Engineering Physics*, Cengage Learning, 2012.
2. Brij Laland N.Subrahmanyam, *Heat and Thermo dynamics,* S.Chand and Company Ltd., 1995.
3. William D. CallisterJr., DavidG. Rethwisch, *Material Science and Engineering*, 9thEdition, 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
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, nano materials, and super conducting 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 super conductors and nano materials 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'sprism-Half wave and Quarter wave plate-Engineering applications of interference, diffraction, and polarization.

Module 2 ELECTROMAGNETICWAVESANDFIBEROPTICS (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-Vnumber(qualitative)-Classification of fibers based on Refractive index profile, modes-Applications of optical fiber-Fiber optic Sensors(temperature, displacement).

Module 3 SEMICONDUCTORS AND OPTOELECTRONIC DEVICES (10 Periods)

Semiconductors: Introduction - Intrinsic semiconductors - Density of electrons in intrinsic semiconductor-Intrinsic carrier concentration-Fermi energy-Extrinsic semi conductors-Density of charge carriers in Extrinsic semiconductors (qualitative)-Drift and Diffusion currents - Direct and Indirect band gap semiconductors - Hall effect - pn junction ***Optoelectronicdevices***:LightEmittingDiode(LED)–Photodiode-Semiconductordiodelaser.

Module 4 DIELECTRICSANDMAGNETICMATERIALS (09 Periods)

DielectricMaterials:Introduction-Electricpolarization-Typesofpolarizations(qualitative) - Frequency dependence of polarization - Lorentz (internal) field – Dielectric breakdown - 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 SUPERCONDUCTORSANDNANOMATERIALS (08 Periods)

Superconductors: Introduction–Critical parameters of Super conductors-Meissner effect - Types of Superconductors - BCS Theory - Applications of Super conductors. ***Nano materials:*** Basic principles of nano materials-Synthesis of nano materials by Ball Milling and Pulsed Laser Deposition(PLD) methods-Properties of nano materials-Applications of nano materials.

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 wave length 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 ap-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. Determinationofparticlesizeusinglasersourcewithhelpofdiffraction technique.

RESOURCES

TEXT BOOKS:

1. M.N.Avadhanulu, P.G.Kshirsagar, and T.V.SArunMurthy, *A Textbook of Engineering Physics*, S.ChandPublications,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 Mc Graw Hill Publications Ltd, 7thEdition, NewDelhi, 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
22EE105405	**MATLAB PRACTICE FOR ENGINEERS**	-	-	2	-	1

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is emphasized on the fundamental concepts of MATLAB, visualization by interacting with MATLAB, advanced programming concepts decisions, loops and their control, debugging methods and applications of MATLAB for fundamental data analysis. The course also provides an overview of MATLAB integrated SIMULINK tool box and its application.

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

CO1. Develop syntax for creating vectors, matrices and perform operations on the arrays using MATLAB.

CO2. Create script and function m-files for developing MATLAB programs and syntax for visualizing the plots.

CO3. Develop syntax for advanced programming concepts such as decision and iterative programs, and tools for debugging and data analysis.

CO4. Apply the programming sills of MATLAB for solving engineering problems.

CO5. Develop Simulink models for modelling real world systems and understand their simulation in the SIMULINK environment.

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	2	-	3	-	-	-	-	-	-	2
CO2	3	2	2	-	3	-	-	-	-	-	-	2
CO3	3	2	2	-	3	1	-	-	-	-	-	2
CO4	3	1	2	-	3	1	-	-	-	-	-	2
CO5	3	1	2	-	3	1	-	-	-	-	-	2
CO6	-	-	-	-	-	-	-	-	3	3	-	-
Course Correlation Mapping	**3**	**2**	**2**	**-**	**3**	**1**	**-**	**-**	**3**	**3**	**-**	**2**

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

EXPERIMENTIAL LEARNING

1. Salient features, The MATLAB Environment; MATLAB Basics – Variables, Rules for Naming of Variables; Numbers, formats; Input and output.
   Exercise: Perform all of the following.
   i. Defining variables in MATLAB.

ii. Swapping of variables.
iii. Special variable in MATLAB.
iv. Input and output formats on the command window.

2. Matrices and Vectors: Creating, Indexing, Extracting, Manipulation.
Exercise: *Perform all of the following.*
i. Methods of generating vectors using linspace and colon operator.
ii. Create a vector spanning the range from 0 to 2π, containing 100 equally spaced components, so that the first value is 0, and the last value is 2π.
iii. Create a vector that goes at equal steps from −2 to +2 with an increment of 0.01.
iv. Create the matrices with the help of the matrix generation functions: zeros, eye, and ones.
v. Creating Matrices of different size and access the data form matrix, manipulate the matrix elements.

3. Operations: Operators, Arithmetic Operations; Elementary math functions.
Exercise: *Perform all of the following.*
i. Create two matrix of order 3x3 and perform the addition, subtraction, multiplication on the matrices on the command window.
ii. Find the inverse, determinant and transpose of the matrix using math functions.
iii. Perform dot operator on the matrix/vector elements.

4. Relational operations, Logical operations.
Exercise: *Perform all of the following.*
Create a matrix of size 10x10 and idenify the elements of the matrix based on the following criteria.

<	All the elements whose value is less than a specified number
<=	All the elements whose value is less than or equal to a specified number
>	All the elements whose value is greater than a specified number
>=	All the elements whose value is greater than or equal to a specified number
==	All the elements whose value is equal to a specified number
~=	All the elements whose value not equal to a specified number
&	*And operator*: elements between two specified limits.
|	*Or operator*: elements satisfying either of two criteria.

5. The Current Directory and Search Path; M-Files:Basic rules and anatomy of Script and Function M-Files, Creating, Saving and Executing Script and Function M-Files.
Exercise: *Perform any two of the following (One script file and one function file).*
i. Create a script file and write the program for addition, subtraction, multiplication and division of the numbers/Matrices and display them using formatted print.
ii. Crate a script file and write a program to evaluate the following $\pi r^2; x^2+2x-3; \sin(2t)$ by taking the input from the key board interactively.
iii. Develop a function file to take a vector as an input argument and return minimum and maximum numbers as an output arguments.
iv. Develop a function file to take a temperature in degrees as an input argument and return it in Fahrenheit as an output argument.

6. Basic 2-D Plots: Graphing with plot—Labels, title, legend, and other text objects, Modifying plots with the plot editor; Subplot for Multiple Graphs; 3-D Plots: Mesh and surface plots.
   Exercise: *Perform all of the following.*
   i. A simple sine plot: Plot $y = \sin(2x)\ 0 \le x \le 2\pi$, taking 100 linearly spaced points in the given interval. Label the axes and put title, xlabel, ylabel, grid, line options and legend on the plot.
   ii. Write a script file to plot overlay plots on a same figure window and apply the plotting options on the graph.
   iii. Write a script file to create multiple plots using subplot function and apply the plotting option on the graph.
   iv. Write a script file to create 3-D plot and apply the plotting option on the graph.
7. **Data analysis functions**: isinteger, islogical, isnumeric, length, min, max, size, sort, sum, mean, std, corrcoef, roots, polyval, polyfit functions.
   Exercise: *Perform all of the following.*
   Write a script files to validate the applications of various data analysis functions mentioned.
8. **Conditional Statements**: if, if else, elseif and nested if conditions, switch.
   Exercise: *Perform all of the following.*
   i. Write a MATLAB if statement to calculate y where y = 1 if x > pi/2, y = sin(x) if x is in [0, pi/2] and y = 0 otherwise, by taking the input for x from the keyboard.
   ii. Write a script file to validate if else and elseif syntax for decision making.
   iii. Write a script file to apply switch and perform various tasks based on the switch input.
9. **Loops Structures**: *For* loop, *While* loop; Loop controls: *break*, *continue;* nested loops;
   Errors and Debugging: Syntax errors, Errors in logic, Numerical Errors, Rounding error.
   Exercise: *one exercise using for loop, one using While loop and one on loop control programs.*
   i. Create a matrix A of size m × n, whose elements a(i, j) are calculated from the row and column indices as follows: $a(i, j) = \left(j - 4\right)^2 \left(i + 1\right) + ij$
   ii. Create a random matrix of order 10x10 and replace the upper triangle elements by the number 5, the lower triangle numbers by 4 and the diagonal elements by 1.
   iii. Find and display all integers between 1 and 10000 which divide by 37.
   iv. Write a program to terminate the iterations if the error is less than the specified tolerance limit.
   v. Write a script to find the sum of n natural numbers, sum of squares of n natural numbers, sum of cubes of n natural numbers or a series.
   vi. Write a script file to determine the number of terms required for the sum of the series $5k2 - 2k$, $k = 1, 2, 3, \ldots$, to exceed 10,000. What is the sum for this many terms?
   vii. Determine how long it will take to accumulate at least $10,000 in a bank account if you deposit $500 initially and $500 at the end of each year, if the account pays 5 percent annual interest.
   i. Write a program to exit the loop and to skip the loop base on the criteria mentioned.

10. Applications of MATLAB: introduction to images and types, two dimensional signals and gradient method of solving the linear equations and linear regression.
Exercise: *one on image/signal processing and one on numerical techniques.*
    i. Load a JPEG image and plot the histograms of the red, green and blue planes of the image. Note; the histograms should appear on one figure.
    ii. Load an audio signal and plot the spectral information of the signal.
    iii. Solution to differential equations using *dsolve* function; integration using *int* function.
    iv. Gradient method of solving linear equations.
    v. Develop a linear regression line based on least square errors for fitting the given data and perform interpolation/extrapolation on the data set.
11. Basics of SIMULINK; Operating Principle And Management of Simulink: Constructing a Simulink Block Diagram, Parametrizing Simulink Blocks, Simulink Simulation; Solving Differential Equations with Simulink; Simplification of Simulink Systems: Construction of Subsystems.
Exercise: *any one exercise.*
    i. A certain model of the motion light plastic ball tossed into the air is given by $mx'' + cx' + mg = 0;\ \ x'(0) = v_0 \ and\ x(0) = 0$ Here m is the mass of the ball, $g=9.8\ m/s^2$ is the acceleration due to gravity and *c* is a measure of the damping.
        a. Model this problem using Simulink.
        b. Determine how long it takes for the ball to reach it's maximum height?
        c. Assume that $c/m = 5\ s^{-1}$. For v_0 = 5, 10, 15 and 20 m/s, plot the solution, x(t), versus the time.
        d. From your plots determine the rise time. Do these answers agree?
        e. What can you say about the time it takes for the ball to fall as compared to the rise time?
    ii. Develop a Simulink model to simulate the aircraft dynamics modelled as a transfer function $G(s) = \frac{964}{976s2 + 11.25s + 1}$ and the sensor for feedback as $H(s) = \frac{1}{0.01s + 1}$. Control the dynamics using an optimal PID controller to improve the dynamics. Investigate various time domain specifications before and after the use of PID controller.
12. Introduction to toolboxes

Exercise: *Demonstrate any one toolbox.*
    i. Demonstration of *genetic algorithm* toolbox and its application to solve a test problem.
    ii. Demonstration of *fuzzy logic* toolbox and its application to solve a test problem.
    iii. Demonstration of *Neural Networks* toolbox and its application to solve a test problem.

RESOURCES

TEXT BOOKS:

1. Chapman, Stephen J. *MATLAB programming for engineers*. Cengage Learning, 2015.

2. Pratap, Rudra. *Getting Started with MATLAB 5-A Quick Introduction for Scientists and Engineers*. 1998.

REFERENCE BOOKS:

1. Otto, Stephen Robert, and James P. Denier. *An introduction to programming and numerical methods in MATLAB*. Vol. 1. London: Springer, 2005.
2. Hunt, Brian R., Ronald L. Lipsman, and Jonathan M. Rosenberg. *A guide to MATLAB: for beginners and experienced users*. Cambridge university press, 2014.
3. McMahon, David. *MATLAB demystified*. New York, NY: McGraw-Hill, 2007.
4. Beucher, Ottmar, and Michael Weeks. *Introduction to MATLAB & SIMULINK (A Project Approach)*. Laxmi Publications, Ltd., 2008.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=qGiKv3-02vw
2. https://www.youtube.com/watch?v=EtUCgn3T9eE
3. https://www.youtube.com/watch?v=1PSFLKiEV7U
4. https://www.youtube.com/watch?v=pFICO_syIIs

WEB RESOURCES:

1. https://matlabacademy.mathworks.com/
2. http://jeti.uni-freiburg.de/vorles_stat_num/getstart.pdf
3. https://www.geeksforgeeks.org/variable-names-in-matlab/
4. https://www.educba.com/loops-in-matlab/
5. https://uomustansiriyah.edu.iq/media/lectures/6/6_2020_05_02!10_51_42_AM.pdf
6. https://www.tutorialspoint.com/matlab/matlab_plotting.htm
7. https://www.fsd.ed.tum.de/wp-content/uploads/Training_TUM_GS_Simulink_14b.pdf
8. https://eelabs.faculty.unlv.edu/docs/guides/Simulink_Basics_Tutorial.pdf
9. https://www.cs.uic.edu/~jbell/CourseNotes/Matlab/Functions.html
10. https://www.cs.uic.edu/~jbell/CourseNotes/Matlab/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CS105401	PYTHON PROGRAMMING FOR ENGINEERS	-	-	2	-	1

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides hands-on practice on Python programming fundamentals, Control structures, Sequences, Modular programming, Data representation and Data visualization.

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

CO1. Demonstrate the practical knowledge on python programming constructs.

CO2. Apply python programming constructs to provide solutions for logical and societal problems.

CO3. Use python modules for data representation and visualization.

CO4. Work independently or in teams to solve problems with effective communication.

CO-PO-PSO Mapping Table:

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

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

EXPERIENTIAL LEARNING

1) a) Write a python program to perform the arithmetic operations on two integer numbers.

   b) Write a python program to evaluate the following expressions by reading necessary inputs from the keyboard.

   i) $ax^2 + bx + c$ ii) $ax^4 + bx^2 + c$ iii) (ax - b) / (ax * b) iv) be^{kt}

2) a) Write a python program to swap two variable values without using a third variable.

b) Write a python program to read four integer values separated with commas and display the sum of those four numbers.

3) a) Write a python program that computes amount payable after discount from the price and quantity. The discount on amount is as follows:

i) No discount when the amount less than or equal to 2000.

ii) 5% discount when the amount exceeds 2000.

iii) 10% discount when the amount exceeds 5000.

iv) 15% discount when the amount exceeds 10000.

b) Write a python program to print the following pattern.

```
        1
    1   2   1
1   2   3   2   1
    1   2   1
        1
```

4) a) Write a python program to find Armstrong numbers between *N1* and *N2*, where *N1* and *N2* are two integer numbers and *N1<N2*.

b) Write a python program to sort *n* numbers without using a predefined function.

5) a) Write a python program to read *n* student details like name, roll number, branch and age. Sort the student details based on their names and display.

b) Write a python program to delete duplicate strings from a list of strings. (Insertion order should maintain after deleting duplicate string).

6) a) Write a python program to read *n* number of student details into nested list and convert that as a nested dictionary.

b) Write a python program to generate a dictionary that contains numbers between 1 and *n* in the form (x, x+x).

7) a) Write a python function to perform the sum of integers that are sent to a function as variable lengtharguments.

b) Write a python program to calculate GCD of two numbers using recursion.

8) a) Write a python program to perform arithmetic operations on NumPyarrays.

b) Write a python program to perform following matrix operations using NumPy.

i) Dot product ii) Matrix product iii) Determinant iv) Inverse

9) a) Write a python program to create Pandas DataFrameusing list of lists.

b) Write a python program to load data from a CSV file into a Pandas DataFrame and perform basic operations on it.

10) a) Draw a Scatter Plot by considering an appropriate data set.

b) Draw histograms by considering an appropriate data set.

RESOURCES

REFERENCES:

1. R. Nageswara Rao, *Core Python Programming*, 3rd Edition, Dreamtech Press, 2021.
2. Paul J. Deitel, Harvey Deitel, Python for Programmers with Big Data and Artificial Intelligence Case Studies, Pearson, 2019.
3. Charles Dierbach, *Introduction to Computer Science using Python: A Computational Problem Solving Focus*, Wiley India, 2016.
4. Christian Hil, Learning Scientific Programming with Python, 2nd Edition, Cambridge University Press, 2020.

SOFTWARE/TOOLS:

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
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 VsPostponable 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 Publishing Platform, 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, Bad Choices examples, how to be an ethical leader, 8 Ethical Actions for Leaders.

Module 5: COMMITMENT ***(06 Periods)***

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

Total Periods:30

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

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

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

RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Conger J, *Inspiring others: 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/Peter Cox/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 behavior 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 andnature of motivation, Theories of Motivation(Maslow,Alderfer)-Leadership–Traits-Styles–Leadershipskills–Challengestoleaders.

Module 4: ORGANIZATIONALCONFLICTS ***(06 Periods)***

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

Module 5: ORGANIZATIONAL COMMUNICATION ***(06 Periods)***

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

Total Periods:30

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

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

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

RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Steven LMcShane, Mary AnnVon Glinow, Radha R Sharma:"Organizational Behaviour", 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

13. Refer to any video lecture on project evaluation methods and give a brief seminar using PPT
14. Select any company wherein you will get the details of activities and time and draw the project network diagram and submit a report.
15.

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

Determine a crashing scheme for the above project so that the total project time is reduced by 3 weeks

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

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

RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

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

VIDEO LECTURES:

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

WEB RESOURCES:

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

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG107601	**PROFESSIONAL ETHICS AND HUMAN VALUES**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

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

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

CO1. Demonstrate the principles of ethics, professional values, and social responsibility.

CO2. Analyze the problems in the implementation of moral autonomy and use ethical theories in resolving moral dilemmas.

CO3. Develop suitable strategies to resolve problems that arise in practicing professional ethics and Industrial standards.

CO4. Function as a member, consultant, manager, advisor and leader in multi-disciplinary teams.

CO5. Provide solutions to complex problems associated with professional ethics using analysis and interpretation.

CO-PO Mapping Table:

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

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

COURSE CONTENT

Module 1: PROFESSIONAL ETHICS ***(06 Periods)***

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

Module 2: PROFESSIONAL IDEALS AND VIRTUES ***(06 Periods)***

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

Module 3: SOCIAL EXPERIMENTATION ***(06 Periods)***

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

Module 4: RESPONSIBILITIES AND RIGHTS ***(06 Periods)***

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

Module 5: HARMONY WITH PROFESSIONAL ETHICS ***(06 Periods)***

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

Total Periods: 30

EXPERIENTIAL LEARNING

1. Demonstrate orally using your experiences of what is naturally acceptable in a relationship – Feeling of respect or disrespect and what is naturally acceptable is to nurture or exploit others.
2. Identify community partners and discuss with a community partner or organization. Prepare a report by identifying and analysing the issues or opportunities.
3. Field experiences may be directed to include a range of time-intensive endeavours that require varying levels of student interaction. Prepare a report on visiting a Juvenile home.
4. Students read a speech in the classroom by former United Nations Secretary-General Kofi Annan on human values.
5. Students are encouraged to bring a daily newspaper to class or to access any news related to the need for human values and note down the points.
6. Bring out the relevance of engineering ethics theory and practice with relevance to current trends.
7. Professional ideals and virtues are important to everyone. Prepare a case study on the professional ideals and virtue of any one of the famous sports personalities from India.
8. Compare the present to the past in engineering experimentations concerning the change in professionalism.
9. Make a study on occupational crime and the role of modern technology in finding solutions.
10. Prepare a case study on how to maintain harmony with different cultural people using professional ethics.

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

RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

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

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=jfGIq_EiXzI
2. https://www.youtube.com/watch?v=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 can be improved through proper education.
2. Make an awareness program in the villages for the development of natural resources, ecosystems and biodiversity.
3. Prepare a document by visiting a local urban waste dumping yard near to the Tirupati city.
4. Visit a local village and find a barren land and make the land into a useful land by planting plants or providing the soil and fertilizers required to improve the soil.
5. Visit a local zoological park and identify the species variety and variability.

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

RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

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

VIDEO LECTURES:

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

WEB RESOURCES:

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

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CE107602	**DISASTER MITIGATION AND MANAGEMENT**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

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

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

CO1. Analyze the vulnerability of an area to natural and man-made disasters/hazards as per the guidelines to solve complex problems using appropriate techniques ensuring safety, environment and sustainability.

CO2. Propose appropriate mitigation strategies for earthquake and tsunami impacts as per code of practice using suitable techniques ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze the causes and impacts of floods, cyclones and droughts using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze the causes and impacts of landslides using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.

CO5. Design disaster management strategies to solve pre, during and post disaster problems using appropriate tools and techniques following the relevant guidelines and latest developments ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO-PO Mapping Table:

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

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

COURSE CONTENT

Module 1: DISASTERS ***(06 Periods)***

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

Module 2: EARTHQUAKES ***(06 Periods)***

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

Module 3: FLOODS, CYCLONES AND DROUGHTS ***(07 Periods)***

Floods and Cyclones: Onset, Types, Causes, Warnings, Elements at risk, Typical effects, Indian floods and cyclones, Hazard zones, Potential for reducing hazards, Mitigation strategies and community based mitigation, Case studies.
Droughts: Onset, Types and warning; Causes, Impact, Early warning and response mechanisms, Mitigation strategies, Droughts in India, Case studies.

Module 4: LANDSLIDES ***(06 Periods)***

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

Module 5: DISASTER MANAGEMENT ***(05 Periods)***

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

Total Periods: 30

EXPERIENTIAL LEARNING

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

RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

4. Donald Hyndman and David Hyndman, *Natural Hazardsand Disasters*, Cengage Learning, USA, 5th Edition, 2015.
5. *Disaster Management in India,* A Status Report, Ministry of Home Affairs, Govt. of India, May 2011.
6. Rajendra Kumar Bhandari, *Disaster Education and Management: A Joyride for Students, Teachers, and Disaster Managers*, Springer India, 2014.
7. 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, Need and necessity of technology, Corporate social responsibilities, Private sector participation (Activities in different spheres: Employment, Education, Health, Agriculture and service sectors) and Saansad Adarsh Gram Yojana (SAGY), Village adoption schemes.

Total Periods: 30

EXPERIENTIAL LEARNING

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

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

RESOURCES

TEXT BOOKS:

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

VIDEO LECTURES:

1. http://nptel.ac.in/courses/109/104/109104047
2. https://www.youtube.com/channel/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 22LG102401 - English for Professionals

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 ***(06Periods)***

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

Module 5: COMMUNICATION SKILLS: ***(06 Periods)***

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

Total Periods: 30

EXPERIENTIAL LEARNING

1. Critically analyse the value of Indian money and its impact on the common man and Prepare a PowerPoint Presentation.
2. Prepare a conversation between you and a sanitary officer regarding sanitary conditions in your locality.
3. The English Language has a rich vocabulary and it increases day by day. Present a seminar on the norms adhered to in adding new words and list out the words added in the last five years with their meaning.
4. Enact roleplays in different situations.
5. Participate in group discussions and debate on present issues
6. A conversation is an exchange of ideas, thoughts, and feelings between two or more persons. Explain it with suitable examples
7. Prepare a schedule and identify various committees to be formed for celebrating the Annual Day of a college and explain team involvement in the celebration.
8. Gather various ideas on discussing with parents the role of higher education and job opportunities.
9. Imagine you see a person wasting water. Write a dialogue objecting to such wastage of natural resources.
10. Since social media offers a wide reach easily, it becomes easier for bullies to spread gossip or issue threats. How do you think Cybercrime is a menace brought about by social media?

SCHOOL CORE

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

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

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

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

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

CO2 Analyze 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 Ethics like ASME, ASCE, IEEE.

Module 2: STRESS MANAGEMENT ***(06 Periods)***

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

Module 3 TRANSFORMATIONAL SKILLS ***(06 Periods)***

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

Module 4 GROUP AND TEAM DYNAMICS ***(06 Periods)***

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

Module 5 LEADERSHIP ***(06 Periods)***

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

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare an attitude test and measure the attitudes of your class.
2. Prepare a Case study on the Campus Interview pressure and stress of students using SWOT analysis.
3. Record and prepare videos of various cultural people and make a comment on their accents.
4. Prepare a short film of a leader of your choice and list out the best qualities.
5. Prepare a presentation on the impact of social media on leadership management.
6. 'Knowledge of present technologies helps us to live a harmonious life.'
   Make a video to justify the statement.

7. Identify life skills needed in our day-to-day life and explain their importance.
8. Come up with strategies to become successful in professional life.
9. Find methods and solutions to overcome the self-pity of a person.
10. Identify the persons who are irregular to class. Find out their problems and come up with solutions.

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

RESOURCES

TEXTBOOK:

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 choose
to become an entrepreneur, Entrepreneurial mind-set, Intrapreneurship

Module 2: PRODUCT INNOVATION ***(06 Periods)***

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

Module 3: DIGITAL TECHNOLOGY ENTREPRENEURSHIP ***(06 Periods)***

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

Module 4: STARTUP ECONOMICS & MARKET CONSIDERATIONS ***(06 Periods)***

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

Module 5: SUCCESSFUL BUSINESS INCUBATION ***(06 Periods)***

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

Total Periods: 30

EXPERIENTIAL LEARNING

1. Create and present a prototype of a new product of your choice.
2. Present at least three cases of successful business Ideas in recent times
3. Discuss in the group Entrepreneurship opportunities in terms of Orientation and 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 trademarks and the judicial consequences for violating laws of trademark protection.

CO3 Understand the legislative practices and protocols for the acquisition of copyrights and the judicial consequences for violating laws of copyright protection.

CO4 Understand the fundamentals of patent laws, legislative practices, and protocols for acquisition of trade secrets and the judicial consequences for violating laws of trade secrets protection.

CO5 Understand the importance of geographical indications and various laws and protocols for protecting geographical indications.

CO-PO Mapping Table:

Course Outcome	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 Level	**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.

Total Periods: *30*

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/trade mark/ 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 Outcome	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 Level	**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)

RESOURCE

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
22CE101001	**ENGINEERING MECHANICS**	3	1	-	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on statics of particles and rigid bodies, support reactions, analysis of perfect frames, centroid, centre of gravity and moment of inertia, simple stresses and strains and friction.

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

CO1. Analyze complex engineering problems related to statics of particles and rigid bodies for effective solutions using appropriate methods ensuring safety besides communicating effectively in graphical form.

CO2. Analyze complex engineering problems related to pin jointed frames for effective solutions using appropriate methods ensuring safety besides communicating effectively in graphical form

CO3. Analyze complex engineering problems related to sectional properties for effective solutions using appropriate methods besides communicating effectively in graphical form.

CO4. Analyze simple stresses and strains in structural elements to solve complex engineering problems using appropriate methods ensuring safety besides communicating effectively in graphical form.

CO5. Analyze complex friction problems for effective solutions ensuring safety besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: STATICS ***(10 Periods)***

Statics of Particles: Basic concepts, System of units, System of concurrent coplanar forces in plane, Resultant of forces, Laws of mechanics, Equilibrium of forces, Lami's theorem, Vectorial representation of forces.

Statics of Rigid Bodies: Moment of a force, Varignon's theorem, Moment of a couple, Vectorial representation of moments and couples, Coplanar non-concurrent forces, Equilibrium of rigid bodies, Types of supports and loads, Types of frames, Perfect frame analysis, Method of joints, Method of sections, Principle of virtual work.

Module 2: FRICTION ***(08 Periods)***

Frictional force, Types of friction, Laws of friction, Co-efficient of friction, Angle of friction, Angle of repose, Cone of friction, Applications: Body on horizontal/inclined plane, Two bodies in contact, Ladder friction, Wedge friction.

Module 3: CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA ***(09 Periods)***

Centroids of simple and composite areas, centre of gravity of bodies, Theorems of Pappus and Guldinus, Parallel axis and perpendicular axis theorems, Moment of Inertia of Composite areas, Radius of gyration – Section modulus, Mass Moment of Inertia of simple and composite masses.

Module 4: SIMPLE STRESSES AND STRAINS ***(10 Periods)***

Elasticity and plasticity, Types of stresses and strains, Hooke's law, Stress-strain diagram for mild steel, Working stress, Factor of safety, Lateral strain, Poisson's ratio, Volumetric strain, Types of elastic moduli and relations, Bars of varying section, Composite bars, Temperature stresses, Strain energy - Gradual, sudden and impact loadings, Simple applications.

Module 5: THIN AND THICK CYLINDERS ***(08 Periods)***

Thin Cylinders: Thin cylindrical shells, Longitudinal and circumferential stresses; Hoop, Longitudinal and volumetric strains; Changes in dimensions of thin cylinders.

Thick Cylinders: Lame's theory, Distribution of hoop and radial stresses across thickness, Design of thick cylinders, Compound cylinders, Difference of radii for shrinkage.

Total Periods: 45

EXPERIENTIAL LEARNING

1. A Beam Prototype Model: In this assignment, students will be able to understand the concept of reactions induced in different types of supports. The students will next analyze the given beam to determine the support reactions.
2. Practical Visual Learning of a Truss: In this assignment, students will be able to visualize and understand the concept of analyzing the given truss. The objective is to identify the support reactions in the truss and to identify the magnitude and nature of force in the existing steel trusses in the campus.
3. Practical Laboratory Testing of a Steel Bar: In this assignment, students will be able to understand the concept of stress and strain of a given steel bar. The objective is to figure out the behaviour of the steel bar when subjected to a tensile load. The students will next draw the stress-strain relationship of a steel bar through this laboratory test.
4. Practical Learning of a Friction: In this assignment, students will be able to understand the concept of ladder friction of a given ladder. The objective is to identify the co-efficient of friction for both the contact surfaces of the ladder with the vertical wall.

5. A Prototype Model: In this assignment, students will be able to understand the concept of centroid, centre of gravity and moment of inertia. The students will be given some prototype model to determine its centroid, centre of gravity and moment of inertia.

(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. S. S. Bhavikatti and K. G. Rajashekarappa, Engineering Mechanics, New Age International (P) Ltd., 3rd Edition, 2009.
2. Punmia, B. C., Ashok Kumar Jain and Arun Kumar Jain, Mechanics of Materials, Laxmi Publications Pvt. Ltd., 2001.

REFERENCE BOOKS:

1. *J.* L. Meriam and L. G. Kraige, Engineering Mechanics: Statics (Vol. 1), Dynamics (Vol. 2), John Wiley & Sons Ltd., 5th Edition, 2008.
2. Junnarkar, S. B. and Shah, H. J., Mechanics of Structures – Vol. I (Strength of Materials), Charotar Publishing House Pvt. Ltd., 27th Revised and Enlarged Edition, 2008.
3. S. Rajasekaran and G. Sankarasubramanian, Engineering Mechanics – Statics and Dynamics, Vikas Publishing House Pvt. Ltd., 3rd Edition, 2009.
4. Bhavikatti, S. S., Strength of Materials, Vikas Publishing House, 3rd Edition, 2010.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/112106286
2. https://nptel.ac.in/courses/105105108
3. https://www.youtube.com/watch?v=tXPks3VXUPY
4. https://www.youtube.com/watch?v=cMdVzMRWZTk&list=PLCiOuVdcDqQVwqV6CDAo_CHyc5hSwW76j

WEB RESOURCES:

1. https://pressbooks.library.upei.ca/statics/chapter/method-of-joints/
2. https://www.youtube.com/watch?v=PbQWbx32uak
3. https://www.youtube.com/watch?v=lUJjFm1XhIA
4. https://www.studocu.com/in/document/galgotias-university/structures-and-engineering/simple-stress-and-strains/17493680

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE102001	**FLUID MECHANICS AND HYDRAULIC MACHINERY**	3	-	2	-	4

Pre-Requisite 22CE101001-Engineering Mechanics,
22MM101402-Multivariable Calculus and Differential Equations

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on fluid properties and fluid statics, fluid kinematics, fluid dynamics, closed conduit flow and hydraulic similitude, open channel flow, turbines and pumps.

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

CO1. Evaluate fluid properties and fluid statics using various tools and techniques to solve complex civil engineering problems by following relevant codes of practice and considering safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO2. Evaluate the fluid kinematics and dynamics using various tools and techniques through continuous learning to solve complex civil engineering problems by following relevant codes of practice and considering safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO3. Design pipes and piping systems using various tools and techniques to solve complex civil engineering problems by following latest developments,relevant codes of practice and considering safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO4. Evaluate the problems associated with hydraulic similitude and model studies using various tools and techniques to solve complex civil engineering problems by following relevant codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO5. Design open channels to solve complex problemsusing various tools and techniques to solve complex civil engineering problems by following relevant codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO6. Design turbines and pumps to solve complex hydraulic engineering problems using various tools and techniques to solve complex civil engineering problems by following relevant codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

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	2	2	2	2	2	2	-	-	-	-	3
CO2	2	3	-	2	2	2	2	2	2	2	-	-	-	-	3
CO3	2	3	3	3	2	2	2	2	2	2	-	2	-	-	3
CO4	2	3	-	2	2	2	2	2	2	2	-	-	-	-	3
CO5	2	3	3	3	2	2	2	2	2	2	-	-	-	-	3
CO6	3	3	3	3	2	2	2	2	2	2	-	-	-	-	3
Course Correlation Mapping	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**-**	**2**	-	**-**	**3**

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

COURSE CONTENT

Module 1: FLUID PROPERTIES AND FLUID STATICS ***(09 Periods)***

Dimensions and units, Physical properties of fluids, Pressure at a point, Pascal's law,Hydrostatic law; Atmospheric, gauge and absolute pressures; Measurement of pressure, Manometers, Hydrostatic forces on submerged plane and curved surfaces – Centre ofpressure on plane and curved surfaces, Buoyancy, Centre of Buoyancy, Stability of floating bodies.

Module 2: FLUID KINEMATICS AND DYNAMICS ***(08 Periods)***

Fluid Kinematics: Description of fluid flow, Stream line, Path line and streak line, Stream tube, Classification of flows, Equation of continuity, Stream and velocity potential functions,Flow net and its uses.

Fluid Dynamics: Surface and body forces, Euler's Equation, Bernoulli's equation for flow along a stream line and its applications, Vortex flows, Momentum equation and its application, Forces on pipe bend, Moment of momentum equation and its application, Torque on sprinklers.

Module 3: CLOSED CONDUIT FLOW AND HYDRAULIC SIMILITUDE ***(09 Periods)***

***Closed Conduit Flow*:** Laws of fluid friction, Major loss, Darcy–Weisbach equation, Minor losses, Pipes in series, Pipes in parallel, Total energy line and hydraulic gradient line, Venturimeter, Orificemeter, Pitot tube, Orifices and mouthpieces, Notches and weirs, Latest flow measuring devices.

***Hydraulic Similitude*:** Dimensional analysis, Rayleigh's method and Buckingham's pi theorem, Model studies, Similarities - Geometric, kinematic and dynamic similarities; Dimensionless numbers, Model laws, Types of model, Distorted and undistorted model, Resistance on floating and submerged bodies.

Module 4: OPEN CHANNEL FLOW ***(09 Periods)***

Types of flows, Types of channels, Velocity distribution, Chezy's, Manning's and Bazin's formulae for uniform flow, Most Economical sections, Critical flow, Specific Energy, Critical depth, Computation of critical depth, Critical, subcritical and supercritical flows, Non-uniform flow, Dynamic equation for gradually varied flow, Types of slopes, Surface profiles, Rapidly varied flow, Hydraulic jump and its applications, Surges.

Module 5: TURBINES AND PUMPS ***(10 Periods)***

***Turbines*:**Jet on plane and curved surfaces, Classification of turbines, Pelton wheel, Francis turbine, Kaplan turbine, Working proportions, Velocity diagrams, Work done and efficiency, Hydraulic design, Runaway speed, Draft tube theory, Function and efficiency, Governing of turbines, Surge tanks, Unit quantities and specific speed, Performance of turbines, Characteristic curves, Cavitation, Causes, Effects.

***Pumps*:**Pumps-Components, Classification; Centrifugal pumps-Classification, Heads, Losses and efficiencies, Limitation of suction lift, Work done, Minimum starting speed, Specific speed; Multistage pumps, Pumps in parallel and series, Performance of pumps, Characteristic curves, Net positive suction head, Priming, Cavitation.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Measurement of fluid properties (density, specific gravity, capillarity and viscosity)
2. Verification of Archimedes' principle
3. Determination of centre of pressure on a plane surface
4. Studyof buoyancy and stability of a floating body (viz. centre of buoyancy, metacentric height and stability)
5. Study of different types of fluid flows using Reynold's apparatus
6. Determination of the surface profile of vortex flow
7. Verification of Bernoulli's equation
8. Study of friction and minor losses (viz. sudden contraction, sudden expansion, entrance loss, exit loss) in pipes
9. Calibration of venturimeter
10. Calibration of orificemeter
11. Determination of coefficient of discharge for a small orifice by a constant head
12. Determination of coefficient of velocity for small orifice by variable head method
13. Calibration of rectangular notch
14. Study of roughness of an open channel
15. Study of velocity distribution across an open channel
16. Measurement of discharge in an open channel
17. Study of hydraulic jump
18. Study of impact of jet on vanes
19. Performance test on Pelton wheel
20. Performance test on Francis turbine
21. Performance test on Kaplan turbine
22. Performance test on single stage centrifugal pump
23. Performance test on multi stage centrifugal pump
24. Performance test on reciprocating pump
25. Study of pumps in series and pumps in parallel

RESOURCES

TEXT BOOKS:

1. Rajput, R. K., *A Textbook of Fluid Mechanics and Hydraulic Machines*, S. Chand Publishers, 6th Edition, 2016.
2. Bansal, R. K., *Fluid Mechanics and Hydraulic Machines*, Laxmi Publishers, 9th Edition, 2011.

REFERENCE BOOKS:

1. Modi, P. N. and SethS. M., *Hydraulics and Fluid Mechanics Including Hydraulic Machines*, Standard Book House, 20th Edition, 2011.
2. Khurmi, R. S., *Hydraulics, Fluid Mechanics and Hydraulic Machines*, S. Chand Publishing, 2014.
3. Douglas, J. F., Gaserek, J.M. and Swaffirld, J.A., *Fluid Mechanics*, Longman, 5thEdition, 2010.
4. Cimbala, J. M. and Cengel, Y. A., *Fluid Mechanics: Fundamentals and Applications*, Tata McGraw–Hill Publishers Pvt. Ltd, 2019.
5. Streeter, V. L., Wylie, E. B. and Bedford, K. W., *Fluid Mechanics*, McGraw Hill Book Company, 9th Edition, Indian Edition, 2017.

LAB MANUAL:

1. *Fluid Mechanics and Hydraulic Machinery Laboratory Manual(MBU22 Regulations)*, Department of Civil Engineering, School of Engineering, Mohan Babu University, Tirupati.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=buKTOE9dOII
2. https://www.youtube.com/watch?v=whCu4Xl3m98
3. https://www.youtube.com/watch?v=G3fVsnFf8Fo
4. https://www.youtube.com/watch?v=CAZNIuQTE-0
5. https://www.youtube.com/watch?v=JQmkQQVYnJU
6. https://archive.nptel.ac.in/courses/112/106/112106311/https://mg
7. https://www.digimat.in/nptel/courses/video/112106200/L01.html

WEB RESOURCES:

1. https://elibrary.phindia.com/ebooks/reader/9789354432026
2. https://www.phindia.com/Books/BookDetail/9788120351172/fluid-mechanics-and-hydraulic-machines-goyal
3. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://www.jnit.org/wp-content/uploads/2020/04/NEW-FM-HM-PRACTICAL-LAB-MANUAL.pdf
4. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.pmec.ac.in/images/lm/2_FMHM_Lab_Manual.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE102002	CIVIL ENGINEERINGMATERIALS AND CONCRETE TECHNOLOGY	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onstones, bricks, tiles; timber, miscellaneous materials in construction; cement, admixtures and aggregates; fresh and hardened concrete; elasticity, shrinkage, creep and concrete mix design.

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

CO1. Evaluate the properties of stones, bricks and tiles using various tools and techniques to solve complex civil engineering problems by following relevant codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO2. Evaluate the properties of timber and miscellaneous materials using various tools and techniques and through continuous learning to solve complex civil engineering problems by following relevant codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO3. Evaluate the properties of cement, admixtures and aggregates using various tools and techniques to solve complex civil engineering problems by following relevant codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO4. Evaluate the properties of fresh and hardened concrete using various tools and techniques to solve complex civil engineering problems by following relevant codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO5. Evaluate elasticity, shrinkage and creep of concrete using various tools and techniques to solve complex civil engineering problems by following relevant codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO6. Design a concrete mix using appropriate methods for solving complex concrete technology problems considering codes of practice, safety, environment and sustainability.

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	-	2	3	2	2	2	1	1	-	-	3	-	-
CO2	2	3	-	2	3	2	2	2	1	1	-	2	3	-	-
CO3	2	3	-	2	3	2	2	2	1	1	-	-	3	-	-
CO4	2	3	-	2	3	2	2	2	1	1	-	-	3	-	-
CO5	2	3	-	2	3	2	2	2	1	1	-	-	3	-	-
CO6	2	3	3	2	3	2	2	2	-	-	-	-	3	-	-
Course Correlation Mapping	**2**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**1**	**1**	**-**	**2**	**3**	-	**-**

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

COURSE CONTENT

Module 1: STONES, BRICKS AND TILES ***(09 Periods)***

Stones: Properties of building stones and structural requirements, Classification of stones, Stone quarrying, Blasting and dressing of stones.

Bricks and Tiles: Composition of good brick earth, Manufacture of bricks, Qualities of a good brick, Efflorescence in bricks, Classification of bricks, Characteristics of good tile, Manufacturing methods, Types of tiles.

Module 2: TIMBER AND MISCELLANEOUS MATERIALS FOR CONSTRUCTION ***(08 Periods)***

Timber: Structure, Properties, Seasoning of timber, Classification of various types of wood used in buildings, Defects in timber, Decay of timber, Mechanical treatment, Alternative materials for wood, Paints, Varnishes, Bituminous wooden products in construction.

Miscellaneous Materials For Construction: Use of Materials like galvanized iron, steel, aluminium, glass, bituminous materials, rubber, fibre–reinforced plastics, ceramic products, asbestos and their quality; Modern building materials; Building materials for low cost housing, Utilisation of waste for alternative building materials, Sustainable materials in construction.

Module 3: CEMENT, ADMIXTURES AND AGGREGATES ***(09 Periods)***

Cement and Admixtures:Ingredients of cement, Manufacture of OPC, Types of cement and their properties, Grades of Cement, Various field and laboratory tests on cement, Admixtures - mineral admixtures, chemical admixtures.

Aggregates: Classification of aggregate, Physical properties, Mechanical properties, Bond strength, Bulking of sand, Deleterious substance in aggregate, Soundness of aggregate, Alkali aggregate reaction, Sieve analysis, Gradation, Maximum aggregate size.

Module 4: FRESH AND HARDENED CONCRETE ***(09 Periods)***

Fresh Concrete: Ingredients of cement concrete and their importance, Manufacture of concrete, Workability, Factors affecting, Measurement of workability, Setting times of concrete, Effect of time and temperature on workability, Segregation and bleeding, Ready mix concrete, Quality of mixing water.

Hardened Concrete: Water/Cement ratio, Abram's Law, Gel space ratio, Curing, Nature of strength of concrete, Maturity concept, Strength in tension and compression, Factors affecting strength, Tests on hardened concrete, Relation between compressive and tensile strength,Non-destructive testing methods – Rebound hammer, ultrasonic pulse velocity method, codal provisions.

Module 5: ELASTICITY, SHRINKAGE, CREEP AND CONCRETE MIX DESIGN ***(10 Periods)***

***Elasticity, Shrinkage and Creep*:** Modulus of elasticity, Dynamic modulus of elasticity, Poisson's ratio, Shrinkage – Types, factors; Creep of concrete - Factors, Relation between creep and time, Effects.

Concrete Mix Design:Factors in the choice of mix proportions, Durability of concrete, Quality control of concrete, Statistical methods, Acceptance criteria, Proportioning of concrete mixes by various methods – ACI method and IS 10262 method.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

A) Properties and identification of building materials

B) Tests on bricks
- (a) Visual inspection test for colour, shape and size
- (b) Soundness of brick
- (c) Water absorption test of brick
- (d) Efflorescence test of brick
- (e) Compressive strength of brick

C) Tests on timber
- (a) Identification of defects in timber
- (b) Moisture content of timber
- (c) Volumetric shrinkage of timber
- (d) Density of timber

D) Tests on tiles
- (a) Water absorption of vitrified tile & cement concrete floor tile
- (b) Flexural strength of tile
- (c) Compressive strength of paver block tile

E) Determination of fineness of cement
- (a) Dry sieving
- (b) Blaine's air permeability method

F) Determination of standard consistency, and initial and final setting time of cement

G) Determination of specific gravity and soundness of cement

H) Determination of compressive strength of cement

I) Tests on fine aggregate
   (a) Sieve analysis of fine aggregate
   (b) Specific gravity of fine aggregate
   (c) Bulking of fine aggregate

J) Determination of workability of fresh concrete by
   (a) Slump cone test
   (b) Compaction factor test
   (c) Vee-Bee consistometer test

K) Determination of strength of concrete by
   (a) Compressive strength test
   (b) Split tensile strength test
   (c) Flexural strength test
   (d) Modulus of elasticity of concrete

L) Non-destructive tests on concrete
   (a) Rebound hammer test
   (b) PUNDIT

RESOURCES

TEXT BOOKS:

1. Duggal S.K., *Building Materials*, New Age International Publishers, 4th Edition, 2012.
2. Shetty M.S., *Concrete Technology*, S. Chand and Company Ltd., 7th Revised Edition, 2013.

REFERENCE BOOKS:

1. Varghese P.C., *Building Materials*, PHI Learning Private Ltd., Delhi, 2nd Edition, 2015.
2. Neville A.M., *Properties of Concrete*, 5th Edition, John Wiley and Sons, New Delhi, 2012.
3. Gambhir M.L., *Concrete Technology*, 3rd Edition, Tata McGraw-Hill Publishers, New Delhi, 2008.
4. Santha Kumar A.R., *Concrete Technology*, 7th Edition, Oxford University Press, New Delhi 2011.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105106206
2. https://nptel.ac.in/courses/105102012
3. https://www.youtube.com/channel/UCFSVEUyfRszdnA2ej9zdZTQ/videos

WEB RESOURCES:

1. https://lecturenotes.in/subject/188/concrete-technology-ct
2. https://backbencher.club/building-material-and-construction/
3. https://www.engineeringcivil.com/low-cost-housing.html
4. https://theconstructor.org/concrete/ready-mixed-concrete-types-advantages/6712/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE102003	**CONSTRUCTION, PLANNING AND PROJECT MANAGEMENT**	3	-	2	-	4

Pre-Requisite 22CE102002-Civil Engineering Materials and Concrete Technology

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course discusses aboutmasonry and foundations, building components, finishings, shoring, scaffolding, form work, organization and resource management, project management, network development, PERT and CPM.

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

CO1 Evaluate the characteristics of masonry, foundations and building components using various tools and techniques by considering codes of practice, safety, either individually or in a team besides communicating effectively in graphical form.

CO2 Evaluate the finishings, shoring, scaffolding and form work using various tools and techniques and through continuous learning considering codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO3 Evaluate the organization and resource management through various tools and techniques in accordance with legislative laws and amendments in construction practice ensuring safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO4 Develop the charts and event networks using appropriate tools and techniques for solving complex construction project management problems either individually or in a team besides communicating effectively in graphical form.

CO5 Develop the event networks for analysing critical path by using CPM and PERT techniques and interpret various parameters for effective project management either individually or in a team besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: MASONRY, FOUNDATIONSANDBUILDING COMPONENTS ***(08 Periods)***

Masonry and Foundations: Types of masonry, English and Flemish bonds, Rubble and ashlar masonry, Cavity walls, Partition walls, Foundations, Shallow foundations, Spread, Combined, Strap and mat footings.

Building Components: Lintels, Arches, Vaults, Stair cases, Different types of floors, Concrete, Mosaic, Terrazzo floors, Pitched, Flat and curved roofs, Lean–to–Roof, Coupled roofs, Trussed roofs, King and Queen post trusses, RCC Roofs, Madras Terrace/Shell Roofs.

Module 2: FINISHINGS, SHORING, SCAFFOLDING AND FORM WORK ***(07 Periods)***

Finishings: Damp proofing, Water proofing, Termite proofing, Fire proof materials used, Plastering, Pointing, White washing and distempering, Painting, Constituents of a paint, Types of paints, Painting of new/old wood, Varnish.

Shoring and Scaffolding: Types, Erection methodology, Latest equipment, Safety precautions.

Module 3: ORGANIZATION AND RESOURCE MANAGEMENT ***(10 Periods)***

Organization: Types, Merits and demerits of different types of organization, Labour legislation in India, Workmen's compensation act of 1923 and minimum wages act of 1948, and subsequent amendments, Safety in construction.

Resource Management: Manpower: Resource smoothing, Resource leveling, establishing workers productivity. ***Materials:*** Objectives of material management, Costs, Functions of material management departments, ABC classification of materials, Inventory of materials, Material procurement, Stores management. ***Machinery:*** (Basics only) Classification of construction equipment, Earth moving Equipment, Excavation equipment, Hauling equipment, Earth compaction equipment, Hoisting equipment, Concreting plant and equipment, Selection of equipment, Task consideration, Cost consideration, Factors affecting the selection, Factors affecting cost owning and operating the equipment, Equipment maintenance.

Module 4: PROJECT MANAGEMENT AND NETWORK DEVELOPMENT ***(11 Periods)***

Project Management: Project planning, Scheduling, Controlling,Role of decision in project management, Techniques for analyzing alternatives, Operation research, Methods of planning and programming problems, Development of bar chart - Illustrative examples, Shortcomings of bar charts and remedial measures; Milestone charts, Development of PERT network problems.

Network Development: Introduction, Event, Activity, Dummy, Graphical guidelines for network, Common partial situations in network, Numbering the events, Cycles problems, Planning for network construction, Modes of network construction, Steps in development of network, Work breakdown structure, Hierarchies, Illustrative examples.

Module 5: PERT AND CPM ***(09 Periods)***

Network analyses, PERT, Slack, Critical path, Illustrative examples, Probability of meeting scheduled date problems, CPM process, CPM networks, Activity time estimate, Earliest event time, Latest allowable occurrence time, Combined tabular computations for T_E and T_L, Start and finish times of activity, Float, Critical activities and critical path, Resource allocation, leveling, Crashing, Illustrative examples.

Total Periods: 45 Periods

EXPERIENTIAL LEARNING

List of Exercises:

1. Quality inspection report on the components of a residential building
2. Field study report on finishings and shoring techniques in construction
3. Inspection report on scaffolding, shuttering and formwork
4. Inspection report on the functioning of an organization
5. Field report on the resource management at a construction site
6. Spreadsheets for project management
7. Software tools (MS Project, PRIMAVEERA etc.) for effective project management
8. Creation of major activity, sub activity, activity links and precedence using software tools
9. Creation of resource list and allocation to activities
10. Creation of scheduling report for a G+5 residential apartment
11. Creation of scheduling report for a canal of 5 km stretch
12. Creation of scheduling report for an electrical transmission tower
13. Field study report on project management in a construction site

RESOURCES

TEXT BOOKS:

1. Chitkara, K. K., *Construction Project Management*, Tata McGraw Hill Education Pvt. Ltd., 4th Edition, 2019.
2. Punmia, B. C. and Khandelwal, K. K., *Project Planning and Control with PERT and CPM,* Lakshmi Publications (P). Ltd., 5th Edition, 2016.

REFERENCE BOOKS:

1. Neeraj Kumar Jha, *Construction Project Management,* Pearson Publications, 2nd Edition, 2015.
2. Chudly, R., *Construction Technology – Vol. I, II, III, IV,* Pearson India Education, 2nd Edition, 2014.
3. Seetharaman, S., *Construction Engineering and Management,* Umesh Publications, 5th Edition, 2017.
4. Punmia, B. C., Jain, Ashok Kumar and Jain, Arun Kumar, *Building Construction,* Laxmi Publications (P) Ltd., 11th Edition, 2016.
5. Project Management Body of Knowledge (PMBOK), Project Management Institute, 7th Edition, 2021.

LAB MANUAL:

1. *Construction, Planning and Project Management Laboratory Manual (MBU22 Regulations)*, School of Engineering, Department of Civil Engineering, Mohan Babu University, Tirupati.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=UNAV8qs11OE
2. https://archive.nptel.ac.in/courses/105/104/105104161/
3. https://nptel.ac.in/courses/105106149
4. https://onlinecourses.nptel.ac.in/noc20_ar04/preview

WEB RESOURCES:

1. https://civiconcepts.com/blog/components-of-building
2. https://www.letsbuild.com/blog/construction-management-the-ultimate-guide
3. https://theconstructor.org/construction/planning-scheduling-and-construction-management/14/
4. https://constructionblog.autodesk.com/construction-resource-management/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE102004	**MECHANICS OF SOLIDS**	3	-	2	-	4

Pre-Requisite 22CE101001-Engineering Mechanics

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on shear force and bending moment, stresses in beams, combined direct and bending stresses, torsion, springs, principal stresses and strains, theories of failures and columns and struts.

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

CO1. Evaluate the shear force and bending moment distributions for determinate beams with different loadings using different tools and techniques to solve complex structural analysis problems considering codes of practice, safety, either individually or in a team besides communicating effectively in graphical form.

CO2. Design beams considering bending stresses, shear stress, strain energy and theories of failures using different tools and techniques to solve complex problems considering codes of practice, ensuring safety either individually or in a team besides communicating effectively in graphical form.

CO3. Evaluate the direct and bending stresses for columns and chimneys using different tools and techniques to solve complex problems considering codes of practice, ensuring safety either individually or in a team besides communicating effectively in graphical form.

CO4. Design shafts and springs to solve complex problems using different tools and techniques to solve complex problems considering codes of practice, ensuring safety either individually or in a team besides communicating effectively in graphical form.

CO5. Evaluate the principal stresses and strains for bars and beams using different tools and techniques to solve complex problems considering codes of practice, ensuring safety either individually or in a team besides communicating effectively in graphical form.

CO6. Evaluate the columns and struts for critical loads using appropriate methods using different tools and techniques to solve complex problems considering codes of practice, ensuring safety either individually or in a team besides communicating effectively in graphical form.

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	-	2	3	3	-	2	2	2	-	-	3	-	-
CO2	2	3	3	2	3	3	-	2	2	2	-	-	3	-	-
CO3	2	3	-	2	3	3	-	2	2	2	-	-	3	-	-
CO4	2	3	3	2	3	3	-	2	2	2	-	-	3	-	-
CO5	2	3	-	2	3	3	-	2	2	2	-	-	3	-	-
CO6	2	3	-	2	3	3	-	2	2	2	-	-	3	-	-
Course Correlation Mapping	**2**	**3**	**3**	**2**	**3**	**3**	**-**	**2**	**2**	**2**	**-**	**-**	**3**	-	**-**

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

COURSE CONTENT

Module 1: SHEAR FORCE AND BENDING MOMENT ***(09 Periods)***

Types of beams, Supports and loads, Concept of shear force and bending moment, SF and BM diagrams - Cantilever, Simply supported, Overhanging beams subjected to point loads, Uniformly distributed load, Uniformly varying load and its combination, Point of contraflexure, Relation between SF and BM, Rate of loading at a section of beam.

Module 2: STRESSES IN BEAMS, DIRECT AND BENDING STRESSES ***(08 Periods)***

Stresses in Beams: Theory of simple bending, Basic bending equation, Neutral axis, Bending stresses, Section modulus of different cross sections, Design of simple beam sections, Strain energy due to bending, Basic shear stress equation, Shear stress distribution for different cross sections, Strain energy due to shear.

Direct and Bending Stresses**:** Stresses under the combined action of direct loading and bending moment, Core of a section, Stresses in chimneys, Conditions for stability, Stresses due to direct loading and bending moment about both axes.

Module 3: TORSION AND SPRINGS ***(09 Periods)***

Torsion: Theory of pure torsion, Torsional equation, Torsional moment of resistance, Polar section modulus, Power transmitted by shafts; combined bending, torsion and end thrust; Design of shafts.

Springs: Deflection of close and open coiled helical springs under axial load and axial twist, Springs in series and parallel.

Module 4: PRINCIPAL STRESSES AND STRAINS & THEORIES OF FAILURE ***(10 Periods)***

Principal Stresses and Strains: Stresses on an inclined plane under axial loading, Compound stresses, Normal and tangential stresses on an inclined plane for biaxial stresses, Two perpendicular normal stresses accompanied by a state of simple shear, Mohr's circle of stresses, Triaxial state of stresses, Principal stresses and strains.

Theories of Failure: Maximum principal stress theory, Maximum principal strain theory, Maximum shear stress theory, Maximum strain energy theory, Maximum shear strain energy theory.

Module 5: COLUMNS AND STRUTS ***(08 Periods)***

Short, medium and long columns, Axially loaded compression members, Euler's theorem for long columns, Euler's critical load, Equivalent length of a column, Slenderness ratio, Limitations of Euler's theory, Rankine–Gordon formula, Long columns subjected to eccentric loading.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Study of shear force and bending moment distributions in beams under different loading and support conditions
2. Tension test on mild steel/HYSD bar
3. Compression test on wood/bricks/mild steel
4. Shear test on mild steel
5. Charpy impact test
6. Izod impact test
7. Brinell hardness test
8. Rockwell hardness test
9. Study of stresses in beams under different loading and support conditions
10. Torsion test on mild steel
11. Compression test on coiled spring
12. Tension test on coiled spring
13. Bending test on carriage spring
14. Study of principal stresses and strains in beams
15. Study of behavior of columns and struts

RESOURCES

TEXT BOOKS:

1. Punmia, B. C., Ashok Kumar Jain and Arun Kumar Jain, *Mechanics of Materials*, Laxmi Publications Pvt. Ltd., 2005.
2. Bhavikatti, S. S., *Strength of Materials*, Vikas Publishing House, 4th Edition, 2013.

REFERENCE BOOKS:

1. Rajput, R. K., *Strength of Materials(Mechanics of Solids),* S. Chand & Company LTD, 6th Edition, 2015.
2. Basu, A. R., *Strength of Materials,* Dhanpat Rai & Co. (P) Ltd., 3rd Revised Edition, 2017.
3. Junnarkar, S. B. and Shah, H. J., Mechanics of Structures – Vol. I (Strength of Materials), Charotar Publishing House Pvt. Ltd., 32nd Revised and Enlarged Edition, 2016.
4. Khurmi, R. S., Strength of Materials, S. Chand & Company Ltd., 23rd Edition, 2005

LABORATORY MANUAL

1. *Mechanics of Solids Laboratory Manual (MBU22 Regulations),* Department of Civil Engineering, School of Engineering, Mohan Babu University, Tirupati.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/104/105104160/
2. https://archive.nptel.ac.in/courses/105/105/105105108/
3. https://web.iitd.ac.in/~ajeetk/APL104.html

WEB RESOURCES:

1. https://nitsri.ac.in/Department/Mechanical%20Engineering/Mechanics_of_Solids.pdf
2. https://byjusexamprep.com/solid-mechanics-i
3. https://www.vssut.ac.in/lecture_notes/lecture1423904647.pdf
4. https://www.springer.com/journal/11964

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE102005	**ENVIRONMENTAL ENGINEERING**	3	-	2	-	4

Pre-Requisite 22BS102401-Engineering Chemistry

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on water sources, quality and quantity, intakes, water treatment and distribution systems, sewage characteristics, collection and quantity, sewage treatment, sewage effluent, sludge treatment and disposal.

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

CO1. Evaluate the water sources, quality and quantity using different tools and techniques for solving water supply problems considering codes of practice, public health and safety, environment and sustainability, either individually or in a team besides communicating effectively in graphical form

CO2. Design water treatment and distribution systems using different methods to solve water supply problems by following current developments and considering codes of practice, public health and safety, environment and sustainabilityeither individually or in a team besides communicating effectively in graphical form

CO3. Design sewage collection systems for treatment and disposal to solve complex problems considering appropriate methods, code of practices, public health and safety, environment and sustainability, either individually or in a team besides communicating effectively in graphical form

CO4. Design sewage treatment and sludge digestion units to solve complex problems by following latest developments and considering code of practices, public health and safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form

CO5. Evaluate sewage effluent, sludge treatment and disposal, house drainage plumbing systems in buildings using different tools and techniques considering codes of practice, health and safety, environment and sustainability either individually or in a team besides communicating graphically.

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

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

COURSE CONTENT

Module 1: WATER SOURCES, QUALITY AND QUANTITY, INTAKES ***(08 Periods)***

Water Sources – Types, Quality, Quantity, Drinking water quality analysis and standards; Protected water supply – Need, Objectives; Population forecasting – Methods, Design period; Water demand – Types, Per capita demand, Factors affecting, Fluctuations; Intakes – Types, Factors influencing site selection.

Module 2: WATER TREATMENT AND SUPPLY ***(10 Periods)***

Water Treatment:Units, Functions, Processes – Aeration, Coagulation, Flocculation, Optimum Coagulant Dosage; Sedimentation – Types, Factors affecting, Design of sedimentation tank; Filtration – Types; Slow and Rapid Gravity Sand Filters - Design, Operation and Maintenance; Disinfection – Methods, Chlorination, Chlorine demand, Break point chlorination; Latest techniques in water treatment.

Water Supply: Systems and methods; Distribution systems – Layouts, Design by Hardy Cross and equivalent pipe methods; Water supply arrangements in buildings - Flow meters, Pipe appurtenances, Laying and testing of pipe lines, Leakage prevention, Repair and maintenance.

Module 3: SEWAGE CHARACTERISTICS, COLLECTION AND QUANTITY ***(08 Periods)***

Sewage characteristics - Physical, Chemical and Biological; Sewage collection systems – Types, Comparison; Estimation of sanitary sewage and storm water runoff, Hydraulic design of sewers, Sewer appurtenances, BOD Equations and Self-purification of streams.

Module 4: SEWAGE TREATMENT ***(11 Periods)***

Layout of sewage treatment plant; Design of primary treatment units - Screen chamber, Grit chamber, Sedimentation tank; Design of secondary treatment units – Attached growth systems - Trickling filters, Rotating Biological Contactors, Bio-towers; Suspended growth systems - Activated Sludge process, Oxidation ditch, Stabilization pond; Design of sludge digestion tank – Aerobic and anaerobic, Factors influencing the digestion process; Latest techniques in sewage treatment.

Module 5: SEWAGE EFFLUENT, SLUDGE TREATMENT AND DISPOSAL ***(08 Periods)***

Disposal of sewage effluent – Dilution, Sewage farming, ISI Effluent disposal standards; Design of septic tank, Soak pit, Dispersion trench; Sludge treatment and disposal, House drainage plumbing systems in buildings.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXEPERIMENTS:

A) DRINKING WATER

1. Collection of water samples
2. Determination of suspended and dissolved solids, volatile and fixed solids of a water sample
3. Determination of alkalinity and acidity of a water sample
4. Determination of pH and electrical conductivity of a water sample
5. Determination of nitrate nitrogen as NO3 of a water sample
6. Determination of sulphates as SO4 of a water sample
7. Determination of phosphates as PO4 of a water sample
8. Determination of iron, manganese and fluoride of a water sample
9. Determination of chlorides of a water sample
10. Determination of color and odour of a water sample
11. Bacterial examination of a water sample

B) WATER TREATMENT AND SUPPLY

12. Determination of pH, turbidity and optimum coagulant dose of a water sample
13. Determination of dissolved oxygen and residual chlorine of a water sample
14. Field study of water treatment plant
15. Field study of water supply system in a building

C) SEWAGE

16. Determination of physical, chemical and biological characteristics of a sewage sample (Temperature, BOD and COD)
17. Determination of ammonia of a wastewater sample

D) SEWAGE TREATMENT

18. Design of activated sludge treatment process
19. Design of sludge digestion tank
20. Field study of a sewage treatment plant

E) SEWAGE EFFLUENT, SLUDGE TREATMENT AND DISPOSAL

21. Study of ISI effluent disposal standards
22. Determination of sludge volume index (SVI) for a sludge sample
23. Design of a septic tank
24. Study of house plumbing systems in a building

RESOURCES

TEXT BOOKS:

1. Birdie, G. S. and Birdie, J. S., *Water Supply and Sanitary Engineering*, Dhanpat Rai and Sons Publishers, 9th Edition, 2011.
2. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, *Environmental Engineering*, McGraw Hill Inc., 1985.

REFERENCE BOOKS:

1. Garg, S. K., *Environmental Engineering, (Vol. I): Water Supply Engineering*, Khanna Publishers, 20th Edition, 2011.
2. Garg, S. K., *Environmental Engineering (Vol. II): Sewage Disposal and Air Pollution Engineering*, Khanna Publishers, 27th Edition, 2013.
3. Metcalf and Eddy, *Wastewater Engineering*, TMH Education Pvt. Ltd., 4th Edition, 2010.
4. Elangovan, R. and Saseetharan, M. K, *Unit Operations in Environmental Engineering*, New Age International (P) Limited, 1st Edition, 2008.

LABORATORY MANUAL:

1. *Environmental Engineering Laboratory Manual (MBU22 Regulations)*, Department of Civil Engineering, School of Engineering, Mohan Babu University, Tirupati.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=QtWomFsjR4E
2. https://www.youtube.com/watch?v=47Sww1zC8PQ
3. https://www.youtube.com/watch?v=W8IChR0TVHw

WEB RESOURCES:

1. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SAR1202.pdf
2. https://uap-bd.edu/ce/nehreen/Lecture%201_331.pdf
3. https://www.pseau.org/outils/ouvrages/wrc_wastewater_treatment_technologies_a_basic_guide_2016.pdf
4. https://www.epa.gov/sites/default/files/2019-02/documents/emerging-tech-wastewater-treatment-management.pdf
5. https://phedharyana.gov.in/WriteReadData/Notice/2%20STP%20(1)%20%5BCompatibility%20Mode%5D.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE102006	**SOIL MECHANICS**	3	-	2	-	4

Pre-Requisite 22CE101001-Engineering Mechanics,
22CE105003-Engineering Geology Lab.

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on basic principles of soil mechanics and their application in engineering practice. Further, this course emphasizes on index properties of soil (water content, specific gravity, in-situ unit weight, relative density, particle size, particle shape and orientation, colour, consistency limits etc.), soil classification and engineering properties of soil viz. permeability, seepage, stress distribution, compaction, consolidation, shear strength.

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

CO1. Evaluate the index properties of soil using appropriate tools and techniques to solve complex soil engineering problems by following the relevant codes of practice and through continuous learning ensuring safety, environment and sustainability, cost effectiveness either individually or in a team besides communicating effectively in graphical form.

CO2. Evaluate the permeability and seepage through soils using appropriate tools and techniques to solve complex soil engineering problems by following the relevant codes of practice and ensuring safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO3. Evaluate the stress distribution and compaction characteristics of soils using appropriate tools and techniques to solve complex soil engineering problems by following the relevant codes of practice and latest developments ensuring safety, environment and sustainability, cost effectiveness either individually or in a team besides communicating effectively in graphical form.

CO4. Evaluate the consolidation characteristics of soils using appropriate tools and techniques to solve complex soil engineering problems by following the relevant codes of practice ensuring safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO5. Evaluate the shear strength characteristics of soils using appropriate tools and techniques to solve complex soil engineering problems by following the relevant codes of practice and ensuring safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: INDEX PROPERTIES OF SOILS ***(09 Periods)***

Soil formation, Types of soils, Soil structure and clay mineralogy, Adsorbed water, Volume–weight relationships, Three–phase diagram, Moisture content, Specific gravity, In–situ density, Relative density, Grain size analysis – Sieve and hydrometer methods, Plasticity of soils, Consistency limits and indices, I.S. Classification of soils, Sensitivity, Thixotropy, Activity of soil, Field identification of soils, Latest methods.

Module 2: PERMEABILITY AND SEEPAGE THROUGH SOILS ***(09 Periods)***

Permeability: Soil water, Capillary rise, Flow of water through soils, Darcy's law, Permeability, Factors affecting permeability, Laboratory determination of coefficient of permeability, Permeability of layered systems.

Seepage through Soils: Effective stress principle, Effective stress under different loading conditions, Seepage pressure, Quicksand condition, Seepage through soils, Flownets – Characteristics and uses; Seepage through earth dams with horizontal filter, Critical hydraulic gradient.

Module 3 STRESS DISTRIBUTION IN SOILS AND COMPACTION ***(09 Periods)***

Stress Distribution in Soils: Boussinesq's theory - Point loads, Line loads, Circular and rectangular loaded areas; Westergaard's theory, Newmark's influence chart, Approximate methods, Contact pressure distribution.

Compaction: Mechanism of compaction, Optimum moisture content and maximum dry density, Factors affecting compaction, Effects of compaction on soil properties, Laboratory determination of OMC and MDD, Field compaction – Methods, Latest developments; Compaction control.

Module 4 CONSOLIDATION OF SOILS ***(09 Periods)***

Initial, Primary and secondary consolidation, Spring analogy for primary consolidation, Consolidation test– e–p and e–log p curves; Terzaghi's theory of one dimensional consolidation – Coefficient of consolidation; Pre-consolidation pressure, Secondary consolidation.

Module 5 SHEAR STRENGTH OF SOILS ***(09 Periods)***

Mohr–Coulomb failure theories, Types of laboratory shear strength tests, Strength tests based on drainage conditions and their field applicability, Shear strength of cohesionless soils, Critical void ratio, Liquefaction, Shear strength of cohesive soils, Skempton's pore pressure coefficients.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. **INDEX PROPERTIES OF SOIL**
   1. Determination of water content
   2. Determination of specific gravity
   3. Grain size analysis – sieve analysis and hydrometer analysis
   4. Tests for Atterberg's limits
      (a). Determination of liquid limit – Casagrande's method and cone penetrometer method
      (b). Determination of plastic limit
      (c). Determination of shrinkage limit
   5. Determination of field density – core cutter method and sand replacement method
   6. Determination of relative density

2. **ENGINEERING PROPERTIES OF SOIL**
   7. Stress distribution on horizontal and vertical planes due to point load, line load, strip load, uniformly loaded circular and rectangular areas using a spread sheet
   8. Determination of compaction properties
      (a). Standard Proctor's compaction test
      (b). Modified Proctor's compaction test
   9. Determination of California Bearing Ratio (CBR)
      (a). Unsoaked CBR test
      (b). Soaked CBR test
   10. Determination of coefficient of permeability
      (a). Constant head test
      (b). Variable head test
   11. Determination of consolidation properties - Consolidation test
   12. Determination of shear strength properties - Direct shear test
   13. Determination of shear strength properties - Unconfined compression test
   14. Determination of shear strength properties - Triaxial compression test
   15. Determination of shear strength properties - Vane shear test

RESOURCES

TEXT BOOKS:

1. Gopal Ranjan and Rao, A. S. R., *Basic and Applied Soil Mechanics,* New Age International Pvt. Ltd., 3rd Revised Edition, 2016.
2. Arora, K. R., *Soil Mechanics and Foundation Engineering,* Standard Publishers and Distributors, 7th Edition, 2021.

REFERENCE BOOKS:

1. Das, B. M. and Sobhan, K.,*Principles of Geotechnical Engineering,* Cengage Learning India, 9th Edition, 2018.
2. Punmia, B. C., Jain, A. K. and Jain, A. K., *Soil Mechanics and Foundation,* Laxmi Publications Pvt. Ltd., 16th Edition, 2019.
3. Venkatramaiah, C., *Geotechnical Engineering,* New Age International Publishers, 5th Edition, 2017.

4. Lambe, T. W. and Whitman, R. V., *Soil Mechanics,* John Wiley and Sons, Singapore, 1st Edition, 1991.
5. Handy, R. and Spangler, M., *Geotechnical Engineering Soil and Foundation Principles and Practice*, McGraw-Hill Education, 5th Edition, 2007.
6. Holtz, R.D., Kovacs, W.D. and Sheahan, T.C., *An Introduction to Geotechnical Engineering*, Pearson Publication, 2nd Edition, 2011.

LAB MANUAL:

1. *Geotechnical Engineering Laboratory Manual (MBU22 Regulations)*, School of Engineering, Department of Civil Engineering, Mohan Babu University, Tirupati.

CODES:

IS:2720: Indian Standard on Methods of Test for Soils, Bureau of Indian Standards, New Delhi.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105/104/105104147
2. https://nptel.ac.in/courses/105101084
3. https://nptel.ac.in/courses/105103097

WEB RESOURCES:

1. https://www.geoengineer.org/education/soil-mechanics
2. http://www.geotechnicalinfo.com/geotechnical_laboratory_testing.html
3. https://vulcanhammer.net/geotechnical-courses/soil-mechanics/
4. https://www.dropbox.com/s/d12mc4lw0h1cvmw/Soil-Mechanics-Lab-Manual-2020.pdf?dl=0
5. https://expeditionworkshed.org/workshed/introduction-to-soil-mechanics/
6. https://smfe-iiith.vlabs.ac.in/List%20of%20experiments.html

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE102007	**SURVEYING**	3	-	2	-	4

Pre-Requisite

Anti-Requisite

Co-Requisite

COURSE DESCRIPTION: This course provides a detailed discussion on Chain surveying, Compass surveying, Plane tabling, Levelling and contouring, Theodolite surveying, Tacheometric surveying, Computation of areas and volumes, Curves, Electronic distance measurement, Drone surveying.

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

CO1. Develop survey plots using chain, compass and plane table surveying techniques by measuring distances, horizontal angles and preparing plans to solve complex surveying problems following ethics and considering society, environment and sustainability besides communicating effectively in graphical form as an individual or in a team.

CO2. Develop contour maps using levelling and contouring techniques by finding elevations to solve complex surveying problems following ethics and considering society besides communicating effectively in graphical form as an individual or in a team.

CO3. Develop building layouts and elevations using theodolite and tachometric surveying techniques by finding distances, angles and elevations to solve complex surveying problems following ethics and considering society besides communicating effectively in graphical form as an individual or in a team.

CO4. Develop longitudinal profiles of areas and volumes to solve complex surveying problems associated with civil engineering applications using appropriate techniques following ethics and considering society besides communicating effectively in graphical formas an individual or in a team.

CO5. Design different types of curves to solve transportation engineering problems using appropriate techniques following ethics and considering society besides communicating effectively in graphical form as an individual or in a team.

CO6. Develop orthomosaic maps and contour maps using EDM and drone surveying techniques for various applications following ethics and latest developments considering society besides communicating effectively in graphical form as an individual or in a team.

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	2	2	1	1	-	2	-	-	-	-	3
CO2	3	3	-	2	2	2	-	2	-	1	-	-	-	-	3
CO3	3	3	-	2	2	2	-	2	-	1	-	-	-	-	3
CO4	3	3	-	2	2	2	-	2	-	2	-	-	-	-	3
CO5	3	2	3	3	2	2	-	2	-	2	-	-	-	-	3
CO6	3	3	-	-	2	2	-	2	-	2	-	2	-	-	3
Course Correlation Mapping	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**-**	**2**	**-**	**2**	**-**	**-**	**3**

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

COURSE CONTENT

Module 1: CHAIN AND COMPASS SURVEYING *(10 Periods)*

Chain Surveying: Classification of surveying, Objectives, Principles of surveying; Influence of surveying on society, environment and sustainability; Distance measurement, Accuracy and errors, Chain and its types, Optical square, Cross staff, Reconnaissance and site location, Locating ground features by offsets, Field book, Chaining for outline of structures, Methods for overcoming obstacles, Conventional symbols, Plotting chain survey, Computation of areas, Errors in chain surveying and their elimination.

Compass Surveying: Types of compass, Bearings, Included angles, Errors and adjustments.

Module 2: PLANE TABLE SURVEYING, LEVELING ANDCONTOURING *(09 Periods)*

Plane Table Surveying: Equipment, Methods of plane tabling, Errors, Two and three point problems.

Leveling and Contouring: Types of leveling, Types of leveling instruments, Temporary and permanent adjustments, Height of instrument and rise and fall methods, Plotting longitudinal sections and cross sections, Effect of curvature and refraction, Characteristics of contours, Uses of contour maps.

Module 3 THEODOLITE AND TACHEOMETRIC SURVEYING *(08 Periods)*

Theodolite Surveying: Description of theodolite, Temporary and permanent adjustments of vernier transit, Measurement of horizontal and vertical angles, Heights and distances, Traversing, Closing error and distribution, Gale's traverse table, Omitted measurements.

Tacheometric Surveying: Principle of stadia method, Distance and elevation formulae for staff held vertical and normal, Instrumental constants, Analytic lens, Tangential method.

Module 4 COMPUTATION OF AREAS AND VOLUMES, AND CURVES *(09 Periods)*

Computation of Areas: Areas dividing into number of triangles, By offsets to a base line, By coordinates, Areas from maps.

Computation of Volumes: Volume from cross-section, Embankments and cutting for a level section and two level sections with and without transverse slopes, Determination of the capacity of reservoir.

Curves: Different types and their characteristics, Setting out, Design of curves by Rankine's and offset methods - Circular, Transition, Combined and vertical curve.

Module 5 ELECTRONIC DISTANCE MEASUREMENT (EDM) AND DRONESURVEYING ***(09 Periods)***

EDM: EDM Principle, Modern electronic surveying equipment – Digital levels, Digital theodolites, Total station; Total station – Working principle, Applications: Measurement of distance, Area, Height, Angles, Gradients, Traversing, Contouring, Stake out, Data analysis; DGPS; Latest developments in EDM survey techniques.

Drone Surveying: Working principle, Benefits of drones in surveying, Applications, Interior and exterior drone surveying, Calculation of length, area and stockpile volume.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. **CHAIN SURVEY**
   1. Cross staff survey and plotting
   2. Chain traversing and plotting
2. **COMPASS SURVEY**
   3. Determination of area by radiation method andplotting
   4. Compass traversing and plotting
3. **PLANE TABLE SURVEY**
   5a. Resection – Two point problem
   5b. Resection – Three point problem
4. **LEVELLING**
   6a. Longitudinal and cross–sectioning of a road profileand plotting
   6b. Contour plan of given area
5. **THEODOLITE SURVEY**
   7. Measurement of horizontal angles by method of repetition and reiteration
   8a. Trigonometric leveling – Measurement of heightsand distances
   8b. Setting out a simple curves by Rankine's methodof tangential angles
6. **TOTAL STATION SURVEY**
   9a. Determination of area using total station
   9b. Determination of remote height; distance, gradient and differential heightbetween two inaccessible points using total station.

   DEMONSTRATION ONLY:
   - Stake-out using total station
   - Traversing using total station
   - Contouring using total station
7. **AREA BY PLANIMETER**
   10. Determination of area of irregular figure by using planimeter.
8. **DRONE SURVEY**
   11. Determination of length and area using drone survey
   12. Route mapping using drone survey
   13. Contouring using drone survey

RESOURCES

TEXT BOOKS:

1. Punmia, B. C., Ashok Kumar Jain and Arun Kumar Jain, Surveying – Vol. I, II and III, Laxmi Publications (P) Ltd., 17th Edition, 2016.
2. Subramanian, R., Surveying and Levelling, Oxford University Press, 2nd Edition, 2012.

REFERENCE BOOKS:

1. Duggal, S. K., Surveying – Vol. I and II, Tata McGraw–Hill Publishing Co. Ltd., 5th Edition, 2019.
2. Benton, A. R. and Taetz, P. J., Elements of Plane Surveying, McGraw-Hill, 3rd Edition, 2010.
3. Arora, K. R., Surveying – Vol. I and II, Standard Book House, 15th Edition, 2018.
4. Kanetkar, T. P. and Kulakarni, S. V., Surveying and Leveling, Pune Vidyarthi Griha Prakashan, Pune, 24th Edition, 2013.
5. Venkatramaiah, C., Textbook of Surveying, Universities Press (India) Limited, Hyderabad, 2nd Edition, 2011.
6. Nathanson, J. A, Lanzafama, M. T. and Kissam, P., Surveying Fundamentals and Practices, Pearson Publications, 7th Edition, 2017.

SOFTWARE/TOOLS:

1. STADD Pro
2. AutoCAD
3. SurvCE
4. Access

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105104101
2. https://nptel.ac.in/courses/105103176
3. https://nptel.ac.in/courses/105107158

WEB RESOURCES:

1. https://theconstructor.org/surveying/surveying-principles-methods-civil-engineering/13048/
2. https://www.researchgate.net/publication/277179669_Importance_of_Surveying_to_Civil_Engineers_and_Some_Practical_Examples
3. https://civilsnapshot.com/applications-surveying-civil-engineering/
4. https://www.alexander.com.au/case-studies/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE101002	HYDROLOGY AND WATER RESOURCES ENGINEERING	3	-	-	-	3

Pre-Requisite 22CE102001-Fluid Mechanics and Hydraulics Machinery

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on hydrologic cycle, applications and history, weather and seasons in India, precipitation, evaporation, evapotranspiration, runoff, stream flow, groundwater hydrology, hydrograph analysis, design flood, water resources planning and management, reservoir and dams.

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

CO1. Analyze hydrologic cycle and precipitation to solve complex hydrology problems using appropriate techniques considering environment and sustainability besides communicating effectively in graphical form.

CO2. Analyze abstractions from Precipitation, runoff and groundwater hydrology using appropriate tools and techniques for solving complex hydrology problems considering safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze hydrographs using appropriate techniques to solve complex hydrology problems considering society, environment and sustainability besides communicating effectively in graphical form.

CO4. Design floods using appropriate techniques to solve flood routing problems following ethics and considering safety, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyze water resources planning and management using appropriate techniques to solve complex water resources problems considering society, environment and sustainability besides communicating effectively in graphical form.

CO6. Analyze reservoir and dams to solve complex water resources problems using appropriate techniques considering environment and sustainability besides communicating effectively in graphical form

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	1	-	2	-	-	1	-	-	-	-	3
CO2	2	3	-	1	2	2	2	-	-	1	-	-	-	-	3
CO3	2	3	-	2	2	-	2	-	-	1	-	-	-	-	3
CO4	2	2	3	2	1	2	2	2	-	1	-	-	-	-	3
CO5	2	3	-	1	1	2	2	1	-	1	3	-	-	-	3
CO6	2	3	-	1	2	2	2	1	-	1	-	-	-	-	3
Course Correlation Mapping	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	-	**1**	**3**	**-**	-	-	**3**

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

COURSE CONTENT

Module 1: HYDROLOGY AND PRECIPITATION ***(09 Periods)***

Scope of hydrology, Hydrologic cycle, Practical applications and historical development; *Precipitation*-Types and forms, Weather and seasons in India, Measurement of rainfall; Recording and non-recording rain gauges, Errors, Analysis and interpretation of rainfall data, Methods of calculation of mean precipitation over an area.

Module 2: ABSTRACTIONS FROM PRECIPITATION, RUNOFF AND GROUNDWATER HYDROLOGY ***(10 Periods)***

***Abstractions from Precipitation*:** Process, Factors, Estimation, Methods of reduction of evaporation**,** Evapotranspiration - Factors, Measurement, Estimation, Penman Monteith method; Infiltration – Process, Factors, Double ring infiltrometer, Infiltration equation and indices, Interception, Horton's equation and Green Ampt method.

Runoff: Components, Factors, Rainfall–runoff relationships, Flow mass curve, Flow duration curve, Mass curve of rainfall, Hyetograph, Double mass curve; Streamflow -Concept, Measurement, Stage, Discharge - Area velocity method, Moving boat method.

***Groundwater Hydrology*:** Occurrence and movement of groundwater, Darcy's law and its application, Types and properties of aquifers, Aquifer parameters, Well hydraulics**.**

Module 3 HYDROGRAPH ANALYSIS AND DESIGN FLOOD ***(10 Periods)***

Components of hydrograph, Unit hydrograph, Derivation, Use and limitation of unit hydrograph, Design flood – Estimation of peak discharge, Methods - Envelope curves, Empirical formulae, Rational method, Unit hydrograph method, S-Curve unit hydrograph, Frequency analysis, Gumbel's and log Pearson Type III methods; Flood routing – Concepts of flow routing, hydraulic and hydrologic routing, Reservoir routing, Channel routing, Muskingum's method.

Module 4 WATER RESOURCES PLANNING AND MANAGEMENT ***(08 Periods)***

Requirement of water resources schemes, Principles and objectives of water resources planning, Levels in planning, Functional requirements of water resources projects, Steps in water resources planning, Environmental aspects in water resources planning, Management strategies.

Module 5 RESERVIOR AND DAMS ***(08 Periods)***

Reservoir: Types, Investigations, Site selection, Zones of storage, Safe yield, Reservoir capacity; Erosion – Process, Types, Estimation; Useful life of reservoir, Reservoir sedimentation and control, Reservoir sedimentation problems in India.

Dams: Cross section, Types, Investigations, Site selection and selection of type of dam.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Engage the students to visit nearby rain gauge station and prepare a report to determine the rainfall and its variations in precipitation patterns.
2. Suggest a suitable rainfall simulator using sprinklers or a rainfall generator. Set up a plot or container with different surface conditions, such as bare soil, vegetation cover, or impermeable surfaces. Apply simulated rainfall and measure the amount of runoff generated from each surface. Observe how different surface characteristics affect the amount of water abstracted through infiltration or interception.
3. Collect historical stream flow data from gauging stations or online databases. Analyze the data to calculate flood frequencies using statistical methods such as the Log-Pearson Type III distribution or the Gumbel distribution. Plot frequency curves and determine design floods for specific return periods. Compare the results with historical flood events in the area.
4. Organize meetings or workshops with stakeholders involved in water resources planning and management, such as government agencies, water utilities, agricultural organizations, and environmental groups. Engage in discussions on water-related issues, challenges, and potential solutions. Learn about their perspectives, interests, and concerns regarding water resources.
5. Arrange a visit to a local reservoir or dam. Observe the reservoir's physical characteristics, such as its size, shape, and location and prepare a document about the dam's construction, including the materials used and engineering techniques employed.

RESOURCES

TEXT BOOKS:

1. Subramanya, K., *Engineering Hydrology*, Tata McGraw–Hill Education Pvt. Ltd., 5th Edition, 2020.
2. Garg, S. K., *Irrigation Engineering and Hydraulic Structures*, Khanna Publishers, 36th Edition, 2019

REFERENCE BOOKS:

1. Chow, V. T., *Hand Book of Applied Hydrology*, Mc Graw–Hill Education Pvt. Ltd., 3rd Edition, 2011.
2. Punmia, B. C. and Lal, P. B. B.*, Irrigation and Water Power Engineering,* Laxmi Publications, 16th Edition, 2011
3. *Jaya Rami Reddy, P., A Text Book of Hydrology,* University Science Press, An Imprint of Laxmi Publications Pvt. Ltd., 3rd Edition, 2011.
4. Ray K. Linsley, Max Adam Kohler and Joseph L. H., *Hydrology for Engineers, McGraw-Hill Series in Water Resources and Environmental Engineering,* McGraw-Hill Education, 3rd Edition, SI Metric Edition, 1988.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=TWvxYnu6hE0
2. https://www.youtube.com/watch?v=YAFj2mo4Y3A
3. https://www.youtube.com/watch?v=Eth8f4mnkns
4. https://archive.nptel.ac.in/courses/105/105/105105110/
5. http://www.digimat.in/nptel/courses/video/105108130/L23.html

WEB RESOURCES:

1. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://kanchiuniv.ac.in/coursematerials/H&WRE.pdf
2. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.vssut.ac.in/lecture_notes/lecture1424715183.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE101003	**STRUCTURAL ANALYSIS**	3	-	-	-	3

Pre-Requisite 22CE102004-Mechanics of Solids

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Deflection of beams, Energy method, Fixed beams, Clapeyron's theorem, Slope deflection method, Moment distribution method, Kani's method, Moving loads and influence lines and Plastic analysis.

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

CO1. Analyze slope and deflection of beams and pin-jointed trusses to solve complex structural analysis problems using various methods besides communicating effectively in graphical form.
CO2. Analyze fixed beams using force method to solve complex structural analysis problems besides communicating effectively in graphical form.
CO3. Analyze continuous beams using various methods to solve complex structural analysis problems besides communicating effectively in graphical form.
CO4. Analyze determinate beams using the concept of moving loads and influence lines to solve complex structural analysis problems besides communicating effectively in graphical form.
CO5. Analyze beams using plastic analysis technique to solve complex structural failures ensuring safety besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: DEFLECTION OF BEAMS ***(09 Periods)***

Bending into a circular arc, Slope, deflection and radius of curvature; Differential equation for the elastic curve of a beam, Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, U.D.L. and uniformly varying loads; Double integration method, Macaulay's method, Moment area method, Conjugate beam method, Deflections of propped cantilevers for simple loading cases.

Module 2: ENERGY METHOD AND FIXED BEAMS ***(09 Periods)***

Energy Method:Strain in linear elastic system, Expression of strain energy due to axial load, BM and SF, Castigliano's first theorem, Deflections of simple beams and pin-jointed plane trusses.

Fixed Beams: Shear force and bending moment diagrams for fixed end moment due to - Point loads, uniformly distributed load, Uniformly varying load, Couple and combination of loads, Effect of sinking and rotation of support, Deflection of fixed beams.

Module 3: CLAPEYRON'S THEOREM AND SLOPE DEFLECTION METHOD ***(09 Periods)***

Clapeyron's Theorem:Continuous beams, Clapeyron's theorem of three moments, Analysis of continuous beams with one or both ends fixed, Continuous beams with overhang, Effect of sinking of supports.

Slope–Deflection Method: Basic concepts, Slope deflection equation, Application to continuous beams with and without settlement of supports.

Module 4: MOMENT DISTRIBUTION METHOD AND KANI'S METHOD ***(09 Periods)***

Moment Distribution Method:Basic concepts, Stiffness factor, Carryover, Distribution factor, Application to continuous beams with and without settlement of supports.

Kani's Method: Basic concepts, Rotation contribution, Rotation factor, Analysis of continuous beams with and without settlement of supports.

Module 5: MOVING LOADS, INFLUENCE LINES AND PLASTIC ANALYSIS ***(09 Periods)***

Moving Loads and Influence Lines:Moving loads; Influence line for support reaction, SF and BM; Load position for maximum SF and for maximum BM at a section; Loading - Point loads, UDL longer than the span, UDL shorter than the span; Equivalent uniformly distributed load.

Plastic Analysis: Idealized stress–strain diagram, Moment curvature relationships, Shape factors for various sections, Plastic hinge, Upper bound and lower bound theorems; Collapse loads and plastic moments for simply supported beams, Propped cantilevers, Fixed beams and continuous beams.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Practical Laboratory Testing on Verification of Maxwell's reciprocal theorem
2. Practical Laboratory Testing of a bending test on cantilever beam, simply supported beam and overhanging beam.

3. Practical Laboratory Testing of a bending test on fixed beam and continuous beam.
4. Analysis of simply supported beam subjected to various types of moving loads.
5. Analysis of collapse and plastic moments for portal frames.

RESOURCES

TEXT BOOKS:

1. Vazirani, V. N., Ratwani, M. M. and Duggal, S. K., *Analysis of Structures– Vol. I and Vol. II*, Khanna Publications, 17th Edition, 1999.
2. Vaidyanathan, R. and Perumal, P., *Structural Analysis - Vol. I and II*, Laxmi Publications, 4th Edition, 2016.

REFERENCE BOOKS:

1. Bhavikatti, S. S., *Structural Analysis– Vol. I and II*, Vikas Publishing House, 4th Edition, 2013.
2. Khurmi, R. S. and Khurmi, N., *Theory of Structures*, S. Chand & Company Ltd., 12th Edition, 2020.
3. Pandit, G., Gupta, S. and Gupta, R., *Theory of Structures – Vol. I and II*, Tata Mc–Graw Hill Publishing Co. Ltd., 1st Edition, 2017
4. Punmia, B. C., Ashok Kumar Jain and Arun Kumar Jain, *Mechanics of Materials*, Laxmi Publications Pvt. Ltd., 2001.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/105/105105166/
2. https://archive.nptel.ac.in/courses/105/105/105105109/
3. https://www.youtube.com/channel/UC17zdOWzhzIyfhIbt9IBfYA/videos?view=0&sort=da
4. https://sites.google.com/site/civilengineeringnitrourkela/specilizations/structural-engineering/nptel-video-links

WEB RESOURCES:

1. https://temple.manifoldapp.org/read/structural-analysis/section/156da66f-a619-48c1-ba0f-c6afdbf39088
2. https://structville.com/2022/05/introduction-to-theory-of-structures-structural-analysis.html
3. https://www.sciencedirect.com/topics/engineering/structural-analysis
4. https://www.madeeasy.in/Uploads/examsolution/Structural-Analysis.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE101004	**FOUNDATION ENGINEERING**	3	-	-	-	3

Pre-Requisite 22CE102006-Soil Mechanics

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onsoil exploration, lateral earth pressure, earth retaining structures, stability of earth slopes, bearing capacity of shallow foundations, pile foundations, caissons and well foundations.

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

CO1. Analyze soil exploration to solve complex foundation engineering problems using appropriate tools and techniques by following the relevant codes of practice and through continuous learning ensuring safety, environment and cost effectiveness besides communicating effectively in graphical form.

CO2. Analyze lateral earth pressures to solve complex foundation engineering problems using appropriate techniques ensuring safety and environment besides communicating effectively in graphical form.

CO3. Analyze stability of earth slopes to solve complex slope stability problems using appropriate techniques by following the relevant codes of practice and ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO4. Design shallow foundations to solve complex foundation engineering problems using appropriate techniques by following the relevant codes of practice and ensuring safety and environment besides communicating effectively in graphical form.

CO5. Design pile foundations; well and caisson foundations to solve complex foundation engineering problems using appropriate techniques by following the relevant codes of practice and ensuring safety and environment besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: SOIL EXPLORATION ***(09 Periods)***

Need, Planning, Methods of soil exploration- Geophysical methods, Open excavation methods, Boring and sampling methods; Types of soil samples, Field tests- SPT, CPT, Plate load test, In–situ vane shear test; Borehole logging, Soil investigation report, Latest methods.

Module 2: LATERAL EARTH PRESSURE ***(09 Periods)***

Types of earth pressures, Plastic equilibrium in soils, Rankine's theory - Earth pressures in cohesionless and cohesive soils; Coulomb's wedge theory, Earth pressure on retaining walls of simple configurations, Graphical methods (Rebhann and Culmann), Types of earth retaining structures, Stability considerations of gravity and cantilever retaining walls.

Module 3: STABILITY OF EARTH SLOPES ***(09 Periods)***

Infinite and finite earth slopes, Types of failures, Factor of safety of infinite slopes, Stability analysis of finite slopes, Bishop's simplified method, Taylor's stability number, Stability of slopes of earth dams under different conditions,Improving stability of slopes.

Module 4: BEARING CAPACITY OF SHALLOW FOUNDATIONS ***(10 Periods)***

Types and choice of foundation, Depth of foundation, Types of shear failure, Safe bearing capacity, Bearing capacity theories- Terzaghi, Meyerhof, Skempton and IS methods; Effect of groundwater table on bearing capacity, Bearing capacity from SPT and CPT, Allowable bearing pressure, Safe bearing capacity and settlement from plate load test, Allowable settlements of structures, Settlement analysis.

Module 5: PILE FOUNDATIONS, CAISSONS AND WELL FOUNDATIONS ***(09 Periods)***

Pile Foundations: Types of pile foundations, Factors influencing the selection of pile, Load carrying capacity of piles in granular and cohesive soils, Static and dynamic pile formulae, Pile load test, Negative skin friction, Load carrying capacity of pile groups in sands and clays, Settlement of pile groups, Design of piles and pile groups.

Caissons and Well Foundations: Types of caissons, Bearing capacity, Construction, Advantages and disadvantages, Well foundations - Shapes, Components, Sinking, Tilts and shifts.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Submit a report on a case study of soil investigation of any civil engineering project, after thoroughly analysing it.
2. Develop spread sheets to calculate lateral earth pressures using Rankine's and Coulomb theories.
3. Develop a spread sheet to check stability of an earth retaining wall.
4. Find the factor of safety of an earth slope using commercially available software viz. Geoslope – SlopeW, Galena etc.
5. Develop a spread sheet to calculated bearing capacity of a shallow footing using all bearing capacity theories.
6. Submit a report on a case study of piling for any civil engineering project.
7. Submit a report on a case study of well foundations for any civil engineering project.
8. Develop a spread sheet to calculate pile capacity using static and dynamic pile formulae.

RESOURCES

TEXT BOOKS:

1. Venkataramaiah, C., *Geotechnical Engineering*, New Age International Publishers, 3rd Edition, 2010.
2. Arora, K. R., *Soil Mechanics and Foundation Engineering*, Standard Publishers and Distributors, 7th Edition, 2010.

REFERENCE BOOKS:

1. Punmia, B. C., Ashok Kumar Jain and Arun Kumar Jain, *Soil Mechanics and Foundations*, Laxmi Publications, 16th Edition, 2005.
2. Gopal Ranjan and Rao, A. S. R., *Basic and Applied Soil Mechanics,* New Age International, 2nd Revised Edition, 2010.
3. Braja M. Das, *Principles of Foundation Engineering,* Cengage Learning India, 6th Edition, 2007.
4. Bowles, J. E., *Foundation Analysis and Design,* McGraw–Hill Publishing Company, 5th Edition, 2001.
5. Braja M. Das,*Advanced Soil Mechanics*, CRC Press, 5th Edition, 2019.
6. Murthy, V. N. S., *Advanced Foundation Engineering*, CBS Publisher, 4th Edition, 2017.

IS CODES:

IS 6403 - 1981	:	Determination of Bearing Capacity for Shallow Foundations.
IS 2911 – 2010	:	Design and Construction of Pile Foundations.
IS 1080 – 1985	:	Design and Construction of Shallow Foundations in Soils (other than Raft, Ring and Shell).
IS 1892 – 1979	:	Subsurface Investigation of Shallow Foundations in Soils.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/101/105101083/
2. https://archive.nptel.ac.in/courses/105/105/105105185/
3. https://archive.nptel.ac.in/courses/105/105/105105176/
4. https://archive.nptel.ac.in/courses/105/104/105104162/
5. https://archive.nptel.ac.in/courses/105/106/105106142/
6. https://www.youtube.com/watch?v=z9uGLGs6QTg

WEB RESOURCES:

1. https://ocw.mit.edu/courses/1-364-advanced-geotechnical-engineering-fall-2003/
2. https://ocw.mit.edu/courses/1-364-advanced-geotechnical-engineering-fall-2003/pages/calendar/
3. https://www.accessengineeringlibrary.com/content/book/9781260468489
4. https://theconstructor.org/geotechnical/foundations/
5. https://civilblog.org/advanced-foundation-engineering-civil-engineering-video-lecture/
6. https://www.fhwa.dot.gov/engineering/geotech/library_listing.cfm

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE101005	**REINFORCED CEMENT CONCRETE STRUCTURES**	3	-	-	-	3

Pre-Requisite 22CE102002-Civil Engineering Materials and Concrete Technology, 22CE101003-Structural Analysis

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Design of reinforced cement concrete structural elements: Beams (Working stress and limit state methods),Shear, torsion and bond, Slabs, Columns, Shallow footings and stair cases.

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

CO1. Design of beams for flexure to solve complex problems related to reinforced cement concrete structures using appropriate methods and relevant codes of practice ensuring safety and serviceability besides communicating effectively through schematic detailing.

CO2. Design of beams for shear, torsion and bond to solve complex problems associated with reinforced cement concrete structures using appropriate methods and relevant codes of practice ensuring safety and serviceability besides communicating effectively through schematic detailing.

CO3. Design of slabs to solve complex problems related to reinforced cement concrete structures using appropriate methods and relevant codes of practice ensuring safety and serviceability besides communicating effectively through schematic detailing.

CO4. Design of columns to solve complex problems associated with reinforced cement concrete structures using appropriate methods and relevant codes of practice ensuring safety, stability and serviceability besides communicating effectively through schematic detailing.

CO5. Design footings and staircases to solve complex problems associated with reinforced cement concrete structures using appropriate methods and relevant codes of practice ensuring safety and serviceability besides communicating effectively through schematic detailing.

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

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

COURSE CONTENT

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

Beams (Working Stress Method): Methods of design used in reinforced concrete structural elements, Behaviour of RCC beam in bending, Concept of working stress method, Design of singly reinforced rectangular beams for bending.

Beams (Limit State Method):Concept of limit state method, Design of simply supported singly and doubly reinforced beams for flexure - Rectangular, T and L beams.

Module 2: SHEAR, TORSION, BOND, DEFLECTION AND CRACKING ***(08 Periods)***

Limit state analysis and design of section for shear and torsion; Concept of bond, anchorage and development length; I.S. code provisions, Design of simply supported and continuous beams - Detailing; Limit state design for serviceability for deflection, cracking and codal provision.

Module 3: SLABS (LIMIT STATE METHOD) ***(08 Periods)***

Limit state design of one way, two way and continuous slabs.

Module 4: COLUMNS (LIMIT STATE METHOD) ***(08 Periods)***

Design of axially and eccentrically loaded short and long column.

Module 5: SHALLOW FOOTINGS AND STAIRCASES (LIMIT STATE METHOD) ***(12 Periods)***

Shallow Footings: Design of isolated square and rectangular footings for axially and eccentrically loaded columns, Design of combined footing.

Staircases: Types of staircases, Stairs spanning longitudinally and transversally.

Total Periods: 45

EXPERIENTIAL LEARNING

1. A beam Prototype Model: In this assignment, students will be able to understand the concept and design of singly and doubly reinforced beam.
2. A Column Prototype Model: In this assignment, students will be able to understand the concept and design of axially and eccentrically loaded short and long column.
3. A footing Prototype Model: In this assignment, students will be able to understand the concept and design of square, rectangular and combined footings.
4. Practical Visual Learning of slab: In this assignment, students will be able to understand the concept and design of one way and two way slabs by visiting nearby site.
5. Practical Visual Learning of footing: In this assignment, students will be able to understand the concept and design of square, rectangular and combined footings by visiting nearby site.

RESOURCES

TEXT BOOKS:

1. Unnikrishna Pillai, S., and Devdas Menon, *Reinforced Concrete Design*, Tata Mc. Graw Hill, 3rd Edition, 2016.
2. Krishna Raju, N. and Pranesh, R. N., *Reinforced Concrete Design*, CBS Publishers Distributors, 4th Edition, 2016.

REFERENCE BOOKS:

1. Varghese, P. C., Limit *State Designed of Reinforced Concrete*, Prentice Hall of India, 2nd Edition, 2010.
2. Punmia, B. C., Ashok Kumar Jain and Arun Kumar Jain, *Reinforced Concrete Structures - Vol. I*, Laxmi Publications Pvt. Ltd., 7th Edition, 2013.
3. Roy, S. K., and Sinha, N., *Fundamentals of Reinforced Concrete*, S. Chand & Company Ltd., 6th Edition, 2013.
4. Gambhir, M. L., *Fundamentals of Reinforced Concrete Design,* Printice Hall of India Pvt. Ltd., 2010.

CODES

IS 456 - 2000	:	Plan and Reinforced Concrete – Code of Practice
SP 16 – 1980	:	Design Aids for Reinforced Concrete to IS 456
SP 34 - 1987	:	Concrete Reinforcement and Detailing
IS 875 – 2015	:	Design Loads and Structures
IS 1893 – 2016	:	Earthquake Resistant Design
IS 4326 – 2013	:	Earthquake Resistant Design and Construction of Buildings
IS 13920 – 2016	:	Ductile Detailing of Framed Structures

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=pIdaC_I6H_M&list=PL51300B0778FB5784
2. https://www.youtube.com/watch?v=XjlD-yBzAmo&t=2167s
3. https://www.youtube.com/watch?v=6qeo6A0QVnM
4. https://www.youtube.com/watch?v=OR3mzB0SjtE

WEB RESOURCES:

1. https://byjusexamprep.com/design-of-beams-i
2. https://aquibzafar.files.wordpress.com/2018/02/4-slab.pdf
3. https://aquibzafar.files.wordpress.com/2018/02/2-column.pdf
4. https://www.slideshare.net/MDMAHBUBULALAM3/ch-7-design-of-rcc-footing

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE102008	**TRANSPORTATION ENGINEERING**	3	-	2	-	4

Pre-Requisite 22CE102007-Surveying,
22CE102006-Soil Mechanics

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on highway development and planning; highway geometric design; pavement materials; pavement design; traffic engineering; railway engineering; airport engineering.

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

CO1. Analyze highway development, planning and highway materials to solve complex highway engineering problems using appropriate tools and techniques following relevant codes considering society and environment besides communicating effectively in graphical form.

CO2. Evaluate the properties of pavement materials to solve complex highway engineering problems using appropriate techniques and following relevant codes considering society, environment and sustainability besides communicating effectively in graphical form.

CO3. Evaluate various traffic parameters to solve complex traffic engineering problems using appropriate tools and techniques following relevant codes and latest developments considering society and environment.

CO4. Evaluate various components of p-way to solve complex railway engineering problems using appropriate tools and techniques considering society and environment besides communicating effectively in graphical form.

CO5. Evaluate the features of taxiway to solve complex airport engineering problems using appropriate tools and techniques considering society and environment besides communicating effectively in graphical form.

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	-	1	1	2	1	1	-	1	-	-	-	3	-
CO2	2	3	3	2	1	2	1	1	-	1	-	-	-	3	-
CO4	2	3	-	1	1	2	1	1	-	-	-	1	-	3	-
CO5	2	3	3	1	1	1	1	-	-	2	-	-	-	3	-
CO6	2	3	3	1	1	1	1	-	-	2	-	-	-	3	-
Course Correlation Mapping	**2**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**-**	**2**	**-**	**1**	-	**3**	**-**

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

COURSE CONTENT

Module 1: HIGHWAY DEVELOPMENT, PLANNING AND GEOMETRICDESIGN ***(09 Periods)***

Highway Development and Planning:Highway development in India, Highway planning, Different road development plans, Classification of roads, Road network patterns, Highway alignment – Factors affecting, Engineering surveys, Drawings and reports.

Highway Geometric Design: Importance of geometric design, Design controls and criteria, Highway cross sectional elements, Sight distance elements, Stopping sight distance, Overtaking sight distances, Design of horizontal curves - Design of super elevation and extra widening, Design of transition curves, Design of vertical alignment - Gradients, Vertical curves.

Module 2: PAVEMENT MATERIALS AND DESIGN ***(09 Periods)***

Pavement Materials: Soil, Aggregates and bitumen –Desirable properties, Tests on subgrade soil – CBR test, Tests on aggregate and bitumen, Aggregate-bitumen mixes – Desirable properties, Mix design by Marshal method, Cement and cement concrete.

Pavement Design: Pavements – Types, Functions and components, Design factors, Flexible pavement design methods – G.I., CBR and Triaxial method, Design of rigid pavements - Critical load positions, Westergaard's stress analysis, Computing radius of relative stiffness and equivalent radius of resisting section, Stresses in rigid pavements, Design of expansion and contraction joints in CC pavements, Design of dowel bars and tie bars.

Module 3: TRAFFIC ENGINEERING ***(09 Periods)***

Significance and scope, Characteristics of road users – Driver and vehicle characteristics, Skid resistance and braking efficiency, Components of traffic engineering - Road, Traffic and land use characteristics, Basic characteristics of traffic – Human characteristics, Vehicle characteristics, Traffic parameters and their studies - Volume, Speed and density, Latest trends, Highway Capacity – Definition, Importance and Factors, Levels of service – Concept, Types, Concept of service volume.

Module 4: RAILWAY ENGINEERING ***(09 Periods)***

General features of Indian railways; Route alignment surveys - Conventional and modern methods; Gauges – types, choice of gauge; Permanent way – cross section, components, functions, coning of wheels; Rails - Rail joints,Welding of rails, Creep of rails, Sleeping – Types, Density and spacing, Adzing of sleepers; Ballast; Subgrade; Track geometric design; Points and crossings; Signaling and interlocking.

Module 5: AIRPORT ENGINEERING ***(09 Periods)***

Aircraft characteristics; Planning and site selection; Obstruction criteria; Air traffic control; Runways - orientation, length, design of geometric features, capacity, configuration; Taxiways -design of geometric features, fillets, high speed exit taxiway; Taxiways -design of geometric features, fillets, high speed exit taxiway; Terminal building - functional areas and facilities; Visual aids; Airport drainage.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

(A) PAVEMENT MATERIALS

Aggregates

1. Sieve analysis of aggregates
2. Shape test and angularity number test for coarse aggregate
3. Aggregate crushing value test and 10% fines value
4. Aggregate impact test
5. Attrition test for coarse aggregate
6. Abrasion test for coarse aggregate
7. Specific gravity and water absorption test

Bituminous Materials

8. Penetration test
9. Ductility test
10. Softening point test
11. Flash and fire point test
12. Viscosity test
13. Specific gravity test

Bituminous Mixes

14. Theoretical maximum specific gravity (G_{mm}) of bituminous mix test
15. Bitumen extraction and determination of bitumen content and gradation of aggregates

(B) TRAFFIC STUDIES

16. **Spot speed studies**
17. **Traffic volume studies at mid-block section and at typical intersections**

(C) PERMANENT WAY

18. **Track geometry studies**

(D) TAXIWAY

19. Marshall stability test on Marshall bituminous mix design
20. Stripping value test of coated bituminous mix

RESOURCES

TEXT BOOKS:

1. Khanna, K. and Justo, C. E. G., *Highway Engineering,* Nem Chand & Bros, Roorkee, 10th Edition, 2014.
2. Chandra, S. and Agarwal, M.M., *Railway Engineering*, Oxford University Press, New Delhi, India, 2nd Edition, 2013.
3. Khanna, S. K. and Arora, M. G., *Airport Planning and Design*, Nem Chand & Bros., 6th Edition, 2017.

REFERENCE BOOKS:

1. Kadiyali, L. R., *Traffic Engineering and Transport Planning*, Khanna Technical Publications, Delhi, 7th Edition, 2010.
2. JotinKhisty, C. and Kent Lall, B., *Transportation Engineering – An Introduction,* Prentice Hall of India Pvt. Ltd., 3rd Edition, 2016.
3. Partha Chakroborthy and Animesh Das, *Principles of Transportation Engineering,* Prentice Hall of India Pvt. Ltd, 2nd Edition, 2017.
4. Papacostas, C. S. and Prevedouros, P. D., *Transportation Engineering and Planning,* Prentice Hall of India Pvt. Ltd.,3rd Edition, 2009.
5. Mannering, F. L. And Washburn, S. S., *Principles of Highway Engineering and Traffic Analysis*, John Wiley& Sons, Inc., 5th Edition, 2013.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105105107
2. https://nptel.ac.in/courses/105107123
3. https://archive.nptel.ac.in/courses/105/107/105107219/

WEB RESOURCES:

1. https://jntukucen.ac.in/ebook_files/166.pdf
2. http://www.gpcet.ac.in/wp-content/uploads/2017/04/TE-I-Unit-V-LEcture-Notes.pdf
3. https://www.vssut.ac.in/lecture_notes/lecture1428280600.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE101006	**STEEL STRUCTURES**	3	-	-	-	3

Pre-Requisite 22CE101003-Structural Analysis

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on bolted connections, welded connections, Beams, Tension members, Compression members, Built-up compression members, Column foundations, Roof trusses and Tubular trusses.

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

CO1. Design bolted and welded connections to solve complex problems associated with steel structures using appropriate techniques following relevant codes considering safety and stability besides communicating effectively in graphical form.

CO2. Design steel beams to solve complex problems associated with steel structures using appropriate techniques following relevant codes and steel tables considering safety and serviceability besides communicating effectively in graphical form.

CO3. Design steel tension and compression members to solve complex problems associated with steel structures using appropriate techniques following relevant codes and steel tables considering safety and stability besides communicating effectively in graphical form.

CO4. Design steel built-up compression members and column foundations to solve complex problems associated with steel structures using appropriate techniques following relevant codes and steel tables considering safety and stability besides communicating effectively in graphical form.

CO5. Design steel roof trusses and tubular trusses to solve complex problems associated with steel structures using appropriate techniques following relevant codes considering safety and stability besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: BOLTED AND WELDED CONNECTIONS ***(09 Periods)***

Bolted Connections: Strength and efficiency of a joint, Lap Joint, Butt joint, Eccentric connections.

Welded Connections: Strength of welds, Butt and fillet welds, Design of fillet welds subjected to axial load, Design of fillet welds subjected to moment acting in the plane and at right angles to the plane of the joints, Beam to beam and beam to column connections.

Module 2: BEAMS ***(09 Periods)***

Bending, Shear and bearing strength, Design of simple beams, Design of compound beams, Design of connection of cover plates with the flanges of beams.

Module 3: TENSION AND COMPRESSION MEMBERS ***(09 Periods)***

Tension Members: Net effective sectional area for angle and tee sections, Design of tension members, Lug angles.

Compression Members: Effective length, Radius of gyration and slenderness of compression members, Design strength, Design of axially loaded compression members.

Module 4: BUILT–UP COMPRESSION MEMBERS AND COLUMN FOUNDATIONS ***(09 Periods)***

Built–up Compression Members: Design of built–up compression members, Design of lacings and battens, Design principles of eccentrically loaded columns, Splicing of columns.

Column Foundations: Design of slab base and gusseted bases, Column bases subjected moment..

Module 5: ROOF AND TUBULAR TRUSSES ***(09 Periods)***

Roof Trusses: Different types of trusses, Design loads, Load combinations, IS Code recommendations, Structural details, Design of simple roof trusses involving the design of purlins, members and joints.

Tubular Trusses: Design of tension members, compression members and connections.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Field study report on bolted and welded connections
2. Analysis and design of laterally supported and laterally unsupported beams.
3. Field study report on tension and compression members in truss members
4. Field study report on built-up compression members and column bases.
5. Analysis and design of roof and tubular trusses.

RESOURCES

TEXT BOOKS:

1. Bhavikatti, S. S., *Design of Steel Structures*, I. K. International Publishing House Pvt. Ltd., 5th Edition, 2017.
2. Ram Chandra, Virendra Gehlot, *Limit State Design of Steel Structures LSD:SS*, Scientific Publishers, 11th Edition,2017.

REFERENCE BOOKS:

1. Subramanian, N., *Design of Steel Structures Limit State Method*, Oxford University Press, 2nd Edition, 2018.
2. Duggal, S. K., *Limit State Design of Steel Structures*, Mc.Graw Hill, 3rd Edition, 2019.
3. Ramachandra, S., *Design of Steel Structures*, Dhanpat Rai Publishing Company, 2nd Edition, 2016.
4. Punmia, B. C., Ashok Kumar Jain and Arun Kumar Jain, *Design of Steel Structures,* Laxmi Publications, 2nd Edition, 2013.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105105162
2. https://archive.nptel.ac.in/courses/105/105/105105162/
3. https://shorturl.at/ahkvz
4. https://shorturl.at/dnoz1

WEB RESOURCES:

1. https://www.aisc.org/technical-resources/
2. https://theconstructor.org/structural-engg/steel/
3. https://timesproperty.com/news/post/introduction-to-steel-design-method-in-construction-blid4508
4. https://housing.com/news/design-of-steel-structure-a-complete-guide/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE103001	**ESTIMATION AND QUANTITY SURVEYING**	3	-	-	4	4

Pre-Requisite 22CE102007-Surveying
22CE105001-Computer Aided Building Planning and Drawing
22CE101005-Reinforced Cement Concrete Structures

COURSE DESCRIPTION: This course provides a detailed discussion on Estimation of residential buildings; Estimation of other structures; Specifications and rate analysis; Contracts and tenders; Valuation.

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

CO1. Estimate various components of residential buildings to solve complex problems of estimation using appropriate techniques by following relevant standards and codes besides communicating effectively in graphical form.

CO2. Estimate other structures to solve complex problems of estimation using appropriate techniques by following relevant standards and codes besides communicating effectively in graphical form.

CO3. Analyse specifications and rates for different items of building construction to solve complex problems of estimation using appropriate techniques by following relevant standards, codes and latest developments considering society.

CO4. Prepare contracts and tenders to solve the complex problems using appropriate techniques by following relevant standards and latest developments considering society, legal issues, environment, sustainability, project management and financial besides communicating effectively in graphical form.

CO5. Prepare valuation reports to solve the complex problems using appropriate techniques by following relevant standards and latest developments considering society, legal issues, project management and financial besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: ESTIMATION OF RESIDENTIAL BUILDINGS ***(10 Periods)***

Types of estimation, Methods of estimation, Load bearing and framed structures – Calculation of quantities of earth work excavation, Brick work, RCC, PCC, Plastering, White washing, Color washing and painting/varnishing for shops, rooms; Residential building with flat and pitched roof, Various types of arches, Calculation of brick work and RCC works in arches; Estimate of joineries for paneled and glazed doors, windows, ventilators etc.

Module 2: ESTIMATION OF OTHER STRUCTURES ***(10 Periods)***

Estimating different structures - Septic tank, Soak pit, Sanitary andwater supply installations, Water supply pipe line, Sewer line, Tube well, Open well, Roads, Retaining walls, Culverts.

Module 3: SPECIFICATION AND RATE ANALYSIS ***(09 Periods)***

Purpose and method of writing specifications, General and detailed specification for different items of building construction, Lead statement, Data, Schedule of rates, Rate analysis - Concrete, Brick work, Plastering, Flooring and Painting.

Module 4: CONTRACTS AND TENDERS ***(08 Periods)***

Purpose of contract, Types of contract, Agreement, Tenders, Tender notice and form, Arbitration, Legal requirements.

Module 5: VALUATION ***(08 Periods)***

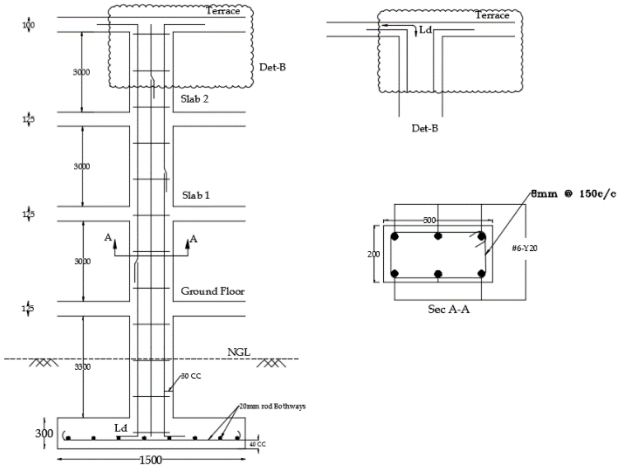
Necessity, Basics of value engineering, Capitalized value, Depreciation, Escalation, Value of building, Calculation of standard rent, Mortgage, Lease.

Total Periods: 45

PROJECT BASED LEARNING

1. Estimate the quantities of different items of work for residential building with a minimum of 2BHK considering the setbacks, compound wall and necessary requirements as per NBC.

2. Estimate the total reinforcement detailing for the following column.



3. Prepare a review report on detailed and abstract estimation for residential buildings in different locations.
4. Identify and prepare a detailed report on possible factors that affect the cost variation in abstract estimation.

5. Prepare a contract document for a project of detailed below:

   A Canal work to a branch of river swarnamukhi at A.Rangampet to facilitate the water service to the green lands of the village. The canal of length of 3km length and with a maximum discharge of $30m^3$/sec.

6. Prepare a valuation report for M-Plaza in Mohan Babu University.

Note: Projects relevant to the contents of the course will be provided by the course instructor at the beginning.

RESOURCES

TEXT BOOKS:

1. Dutta. B.N., *Estimating and Costing in Civil Engineering*, UBS Publishers & Distributors Pvt. Ltd., 28th Edition, 2003.
2. Kohli, D.D. and Kohli, R.C., *A Text Book of Estimating and Costing (Civil)*, S. Chand & Company Ltd., 13th Edition, 2013.

REFERENCE BOOKS:

1. Chakraborthi, M., *Estimating Costing Specification and Valuation in Civil Engineering*, Laxmi Publications, New Delhi, 23rd Edition, 2010.
2. Frank R. Dagastino and Steven J. Peterson, *Estimating in Building Construction*, 1989 Pearson Education, Inc., 7th Edition, 2011.
3. Rangawala, *Estimation, Costing and Valuation*, Charotar Publishing House Pvt. Ltd., 17th Edition, 2020.
4. Dieter Jacob and Clemens Muller, *Estimating in Heavy Constructions*, Wilhem Ernst and Sohn Publisher, Berlin, Germany, 2017.

ADDITIONAL LEARNING RESOURCES:

1. National Building Code of India, BIS, Government of India, New Delhi, 2005
2. Standard Schedule of Rates and Standard Data Book, Public Works Department.

CODES

1. IS 1200 (Part I to XXV) – 1974: Method of Measurement of Building and Civil Engineering Works.

VIDEO LECTURES:

1. NPTEL :: Management - NOC:Cost Accounting
2. Estimation and Costing - 1 | SSC JE 2021 | STATE AE 2022 | Jaspal Singh - YouTube
3. Estimation || Building Estimation and Costing || Estimation and Costing || cost estimation 2023 - YouTube

WEB RESOURCES:

1. Using Intelligent Techniques in Construction Project Cost Estimation: 10-Year Survey (hindawi.com)
2. Construction Cost Estimating: A Step-By-Step Guide | Procore

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE105001	**COMPUTER AIDED BUILDING PLANNING AND DRAWING**	-	1	4	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provide theoretical and practical learning on conventional signs and symbols used in building drawing; Planning and computer aided drawing of Load bearing walls, RCC framed structures and industrial buildings.

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

CO1 Analyze conventional signs and symbols used in building drawing using Auto CAD following relevant standards.

CO2 Develop complex2D plans, elevations and sections of doors, windows, isolated footings, buildings and RCC framed structures using AutoCAD by adopting building bye-laws and principles of planningconsidering safety, serviceability andenvironment.

CO3 Develop complex2D sectional views of various trusses using AutoCAD by adopting building bye-laws considering safety and serviceability.

CO4 Develop complex 3D perspective views of one and two storey buildings using Auto CAD by adopting building bye-laws.

CO5 Perform individually or in a team besides communicating effectively in written, oral and graphical forms in connection with building planning and drawing.

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

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

COURSE CONTENT

Module 1: SYMBOLS AND SIGN CONVENTIONS ***(03 Periods)***

Symbols and sign conventions - Materials, Architectural, Structural, Electrical and Plumbing.

Module 2: DOORS, WINDOWS, VENTILATORS AND ROOFS ***(03 Periods)***

Panelled door, Panelled and glazed door, Glazed windows, Panelled windows, Swing ventilators, Fixed ventilators, Coupled roof, Collar roofs, King post roof truss, Queen post roof truss, North light roof truss.

Module 3: PRINCIPLES OF PLANNING, REGULATIONS AND BUILDING BYELAWS ***(03 Periods)***

Principles of planning - Aspect, Prospect, Privacy, Circulation, Roominess, Grouping, Elegance, Sanitation, Flexibility, Economy; Planning regulations and building byelaws, Floor area ratio, Foor space index, Principles under lying building bye laws, Classification of buildings, Open space requirements, Built up area limitations, Height of buildings, Wall thickness, Lightening and Ventilation requirements.

Module 4: RESIDENTIAL AND PUBLIC BUILDINGS ***(03 Periods)***

Residential Buildings: Minimum standards for various parts of buildings, Requirements of different rooms and their grouping, Characteristics of various types of residential buildings and relationship between plan, elevation and forms and functions.

Public Buildings: Planning of educational institutions, hospitals, dispensaries, office buildings, banks, industrial buildings, hotels and motels; Buildings for recreation, Landscaping requirements.

Module 5: PERSPECTIVE DRAWING ***(03 Periods)***

Definition, Types of perspective, Terms used in perspective drawing, Principles used in perspective drawing, Perspective view of one storey buildings and two storey buildings.

Total Periods: 15

EXPERIENTIAL LEARNING

SOFTWARE: AutoCAD

LIST OF EXERCISES:

1. Conventional signs in building drawing
2. Elevation and sectional view of doors
3. Elevation and sectional view of windows
4. Sectional view of Isolated footings
5. Plan, elevation and sectional views of building (Load bearing wall structure)
6. Plan, section and elevation of RCC framed structures – Residential buildings
7. Plan, section and elevation of RCC framed structures – Public buildings
8. King post truss with details
9. Queen post truss with details
10. North light roof truss with details
11. Perspective view of one storey buildings
12. Perspective view of two storey buildings

RESOURCES

TEXT BOOKS:

1. Kumaraswamy N. and Kameswara Rao A., *Building Planning and Drawing*, Charotar Publishing House Pvt. Ltd., 9th Edition, 2023.
2. Bhavikatti, S. S. and Chitawadagi, M. V., *Building Planning and Drawing*, I. K. International Publishing House Pvt. Ltd., 2014.

REFERENCES:

1. Varma B.P., *Civil Engineering Drawing and House Planning*, 13th Edition, Khanna Publishers, 2023.
2. Shah M., Kale C. and Patki S., *Building Drawing with an Integrated Approach to Built Environment,* Tata McGraw Hill Education, 4th edition, 2001.
3. Malik R.S. and Meo G.S., *Civil Engineering Drawing,* Computech Publications Limited (Asian Publishers), 2001.
4. Linkan Sagar, *Autocad 2022 Training Guide: CAD Language*, BPB Publications, 2022.

LABORATORY MANUAL:

1. *Computer Aided Building Planning and Drawing Laboratory Manual(MBU22 Regulations)*, Department of Civil Engineering, School of Engineering, Mohan Babu University, Tirupati.

VIDEO LECTURES:

1. https://tinyurl.com/y5syanev
2. https://shorturl.at/IJLT6
3. https://www.youtube.com/watch?v=h00yrxrJwW8

WEB RESOURCES:

1. https://en.wikipedia.org/wiki/Civil_drawing
2. https://www.chegg.com/learn/topic/civil-engineering-drawing
3. https://www.united-bim.com/a-comprehensive-guide-42-types-of-drawings-used-in-building-design/
4. https://www.treistek.com/post/types-of-drawings-used-in-building-construction

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE105002	**COMPUTER AIDED DESIGN AND DETAILING LAB**	-	-	2	-	1

Pre-Requisite 22CE101005-Reinforced Cement Concrete Structures
22CE101006-Steel Structures

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-onexperience onAnalysis and design of Simple beams, 2–D and 3–D RCC Frames, Trusses, Solid slabs, Retaining walls, Water tanks, Plate Girder Bridges.

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

CO1. Design RCC structures and structural elements to solve complex structural engineering problems using appropriate software tools and techniques following relevant IS Codes considering safety and serviceability.
CO2. Design steel structures to solve complex structural engineering problems using appropriate software tools and techniques following relevant IS Codes considering safety and serviceability.
CO3. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on computer aided structural design and detailing.

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

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

DETAILED SYLLABUS:

SOFTWARE: STAAD.Pro or any other industry popular structural analysis and design softwares.

LIST OF EXERCISES

1. Analysis and design of simple beams
   a) Simply supported beam
   b) Cantilever beam
   c) Continuous beam
   d) Fixed beam
2. 2–D RCC Frame analysis and design
3. 3–D RCC Frame analysis and design
4. Analysis and design of Steel Truss
   a) Howe roof truss
   b) Howe bridge truss
   c) Warren truss
   d) Pratt truss
5. Simple tower analysis and design
6. Analysis and design of solid slab
7. Retaining wall analysis and design
8. Design of RCC Tee beam bridges for IRC loading
9. Analysis and design of INTZ type water tank
   a) Circular water tanks
   b) Rectangular water tanks
10. Analysis and design of plate girder bridge

TEXT BOOKS:

1. Shah, V. L., and Karve., S. R., *Illustrated Design of Reinforced Concrete Building*, Structures Publication, Pune, 7th Edition, 2014.
2. Krishnamurthy. D., *Structural Design and Drawing,* Vol-II and Vol-III, CBS Publishers and Distributors, Delhi, 2006.

REFERENCE BOOKS:

1. *Computer Aided Design and Detailing Lab* (SVEC19 Regulations), Department of Civil Engineering, Sree Vidyanikethan Engineering College, Tirupati.

CODES:

IS 456 – 2000 : Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi .
IS 800 – 2007 : General Construction in Steel, Bureau of Indian Standards, New Delhi.
SP-16 – 1980 : Design Aids for Reinforced Concrete, Bureau of Indian Standards, New Delhi.
SP-34 – 1987 : Hand Book on Concrete Reinforcement and Detailing, Bureau of Indian Standards, New Delhi.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=1klH7a26H_8
2. https://www.youtube.com/watch?v=WRZVcrISOqU
3. https://www.youtube.com/watch?v=ZVOkGrQsjHk

WEB RESOURCES:

1. http://www.northsouth.edu/assets/files/CEE%20Publications/CEE%20330L%20Manual.pdf
2. https://www.researchgate.net/publication/354058835_Structural_Analysis_and_Design_of_Multistorey_Reinforced_Concrete_Building_using_STAAD_Pro
3. https://www.researchgate.net/publication/351710185_Analysis_and_Design_of_a_Residential_Building_By_Using_STAAD_Pro
4. https://www.academia.edu/27808874/PLANNING_ANALYSIS_and_DESIGN_OF_A_FOUR_STORED_RESIDENTIAL_BUILDING_BY_USING_STAAD_PRO_pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE105003	**ENGINEERING GEOLOGY LAB**	-	-	2	-	1

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on physical properties and identification of minerals and rocks, rock forming minerals; ore forming minerals, igneous rocks, sedimentary rocks, metamorphic rocks, geological maps and problems on structural geology. This course also examines norm form calculations, geophysical studies and measurement of groundwater level.

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

CO1. Identify minerals and rocks using appropriate tools and techniques in order to understand the impact of geological features on civil engineering projects considering standard protocols.
CO2. Analyze structural geology problems for feasible inferences associated with civil engineering projects.
CO3. Develop and interpret geological sections from the geological maps for the benefit of civil engineering projects.
CO4. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on geological information.

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

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

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

A) MINERALS

1. Study of physical properties and identification of rock forming minerals
2. Study of physical properties and identification of ore forming minerals

B) ROCKS

3. Study of physical properties and identification of common igneous rocks
4. Study of physical properties and identification of common sedimentary rocks
5. Study of physical properties and identification of common metamorphic rocks

C) GEOLOGICAL MAPS

6. Study of geological maps, drawing and interpretation of geological sections in horizontal beds
7. Study of geological maps, drawing and interpretation of geological sections in vertical beds
8. Study of geological maps, drawing and interpretation of geological sections in beds with fault plane
9. Study of geological maps, drawing and interpretation of geological sections in beds with folding

D) STRUCTURAL GEOLOGY PROBLEMS

10. Thickness
11. Strike and dip
12. Bore hole

E) NORM FORM CALCULATIONS

13. Normative minerals analysis (not for the examination)

F) GEOPHYSICAL STUDIES

14. Electrical resistivity survey (not for the examination)
15. Seismic surveys (not for the examination)

G) MEASUREMENT OF GROUNDWATER LEVEL

16. Measurement of groundwater level using water level meter (not for the examination)

RESOURCES

REFERENCES:

1. Engineering Geology Laboratory Manual (SVEC20 Regulations), Department of Civil Engineering, Sree Vidyanikethan Engineering College, Tirupati.
2. Chenna kesavulu, N., Engineering Geology, Mc–Millan India Ltd.,3rd Edition, 2018.
3. Subinoy Gangopadhyay, Engineering Geology, Oxford university press, 3rd Edition, 2015.

VIDEO LECTURES:

1. http://www.digimat.in/nptel/courses/video/105105106/L37.html
2. https://mg-nitk.vlabs.ac.in/mining-geology/
3. https://www.youtube.com/watch?v=aTVDiRtRook

WEB RESOURCES:

1. https://nptel.ac.in/courses/105105106
2. https://www.geologypage.com/2019/04/engineering-geology.
3. https://en.wikipedia.org/wiki/Engineering_geology
4. https://www.schoolofpe.com/blog/2017/05/importance-of-geology-in-structural-engineering.html

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CE105004	CIVIL ENGINEERING SOFTWARE LAB	-	-	2	-	1

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Software tools in modeling, analysis and design of systems in different domains of Civil Engineering: Structural Engineering; Geotechnical Engineering; Transportation Engineering; Environmental Engineering; Water Resources Engineering; Construction Engineering; Surveying.

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

CO1. Design structures, structural components and pavements to solve complex structural engineering and pavement engineering problems using appropriate software tools and techniques following relevant codes considering safety, serviceability, environment, sustainability and cost effectiveness.

CO2. Analyze geotechnical, water resources and environmental engineering systems to solve complex engineering problems using appropriate software tools and techniques following relevant codes considering safety, serviceability, environment, sustainability and cost effectiveness.

CO3. Prepare project management schedules, estimation and costing reports to solve complex construction engineering problems using appropriate software tools and techniques following relevant codes and standards considering safety, serviceability, environment, sustainability.

CO4. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on computer aided structural design and detailing

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

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

EXPERIENTIAL LEARNING

1. **ROBOT Structure** for Structural Analysis and Design.
2. **ETABS** for Integrated Analysis, Design and Drafting of Building Systems.
3. **ANSYS** for Finite Element Analysis.
4. **PLAXIS 2D/3D** for Geotechnical Modelling Software.
5. **ARC GIS** for Surveying Earth's Water Bodies, Land Surveys.
6. **Civil 3D** for Computer Aided Civil Engineering Drafting.
7. **EPANET** for Hydraulic and Water Quality Behaviour of water Distribution System.
8. **PRIMAVEERA** for Project Management.
9. **Visual MODFLOW** for Water Resources Engineering.
10. **Auto Plotter** for Analysis of Surveying Results.
11. **Match Software** for XRD and XRF Data Analysis.
12. **Estimator 2.0** for Detailed, Abstract Estimation and Rate Analysis of Civil Engineering Structures.

RESOURCES

REFERENCES:

1. Shah V. L. and Karve S. R., *Illustrated Design of Reinforced Concrete Building*, Structures Publication, Pune, 7th Edition, 2014.
2. Krishnamurthy. D., *Structural Design and Drawing, Vol-II and Vol-III*, CBS Publishers and Distributors, Delhi, 2006.
3. Shah V. L. and Karve S. R., *Illustrated Design of Reinforced Concrete Building*, Structures Publication, Pune, 7th Edition, 2014.

CODES

1. IS 456 – 2000 : Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi.
2. IS 800 – 2007 : General Construction in Steel, Bureau of Indian Standards, New Delhi.
3. SP-16 – 1980 : Design Aids for Reinforced Concrete, Bureau of Indian Standards, New Delhi.
4. SP-34 – 1987 : Hand Book on Concrete Reinforcement and Detailing, Bureau of Indian

VIDEO LECTURES:

1. MS Project Tutorial 2 Basics on setup and calendars - YouTube
2. EPANET Tutorial - YouTube
3. Starting Estimator 2.0 |How To Use Estimator 2.0|Estimate of a Building|Estimator 2.0 Lesson1 - YouTube

WEB RESOURCES:

1. Best Civil Engineering Software Updated List 2023 (constructionplacements.com)
2. List of Top Civil Engineering Software 2023 (trustradius.com)
3. Civil Engineering Software: Exploring The Essential Tools And Software Used In Civil Engineering Projects (civiconcepts.com)

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE105005	SPREAD SHEET APPLICATIONS IN CIVIL ENGINEERING	-	-	2	-	1

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on MS Excel as a spreadsheet tool, Spreadsheet creation, Design of slabs, Footings, Analysis of frames, Design of notches, Weirs, Design of pipes and Design of pavements.

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

CO1. Apply the principles of spreadsheet for the formation of cells, formatting and creation of tables following latest developments.
CO2. Design structures and structural components to solve complex structural engineering problems using spreadsheet tool following relevant codes considering safety, serviceability, environment, sustainability and cost effectiveness.
CO3. Design footings and pavements to solve complex geotechnical engineering and pavement engineering problems using spreadsheet tool following relevant codes considering safety, serviceability, environment, sustainability and cost effectiveness.
CO4. Design water resources and environmental engineering systems to solve complex engineering problems using spreadsheet tool following relevant codes considering safety, serviceability, environment, sustainability and cost effectiveness.
CO5. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on spread sheet applications in civil engineering

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

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

DETAILED SYLLABUS:

This laboratory provides training to the students in using MS Excelas a spreadsheet tool for various Civil Engineering Applications as mentioned below.

LIST OF EXERCISES:

1. Introduction to MS Excel as a Spreadsheet tool, overview of toolbars, accessing, saving excel files, using help and resources. Creating a spreadsheet using the features: Gridlines, format cells, summation, auto fill, formatting text, formulae in excel charts.
2. Creating a spreadsheet using the features: Split cells, Sorting, Conditional formatting, freeze panes, pivot tables, data validation.
3. Design of singly reinforced beam
4. Design of doubly reinforced beam
5. Design of one-way slab
6. Design of two-way slab
7. Design of isolated footings
8. Design of frames
9. Design of surplus weir
10. Design of trapezoidal notch
11. Design of canal regulator
12. Design of sewer pipe
13. Design of sewage treatment plant
14. Design of pavement

TEXT BOOKS:

1. Sylvan Charles Bloch, *Excel for Engineers and Scientists in Geotechnical Engineering*, Wiley, 2002.
2. Craig T. Christy, *Engineering with the Spreadsheet: Structural Engineering Templates using Excel*, ASCE Publications, 2006.

REFERENCE BOOKS:

1. Thomas F. Wolff, *Spreadsheet Applications in Geotechnical Engineering*, 1st Edition, PWS Publishing Company, 1995.

CODES:

1. IS 456 – 2000 :*Plain and Reinforced Concrete*, Bureau of Indian Standards, New Delhi.
2. IS 800 – 2007 :*General Construction in Steel*, Bureau of Indian Standards, New Delhi.
3. SP-16 – 1980 :*Design Aids for Reinforced Concrete*, Bureau of Indian Standards, New Delhi.
4. SP-34 – 1987 : *Hand Book on Concrete Reinforcement* and Detailing, Bureau of Indian Standards, New Delhi.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=N8jRM738m6M
2. https://www.youtube.com/watch?v=1CYhVNoTjE0
3. https://www.youtube.com/watch?v=YjhmGQ7WNoI

WEB RESOURCES:

1. https://www.routledge.com/downloads/C4959/Introduction%20to%20Excel.pdf
2. https://web.itu.edu.tr/~tasking/Gulsen_Taskins_homepage/bil101e_files/excelAll.pdf
3. https://www.civilengineeringweb.com/2019/10/beam-design-excel.html
4. https://www.scribd.com/document/426104535/Slab-Design-Excel

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101007	**REHABILITATION AND RETROFITTING OF STRUCTURES**	3	-	-	-	3

Pre-Requisite 22CE102003-Construction, Planning and Project Management
22CE101005-Reinforced Cement Concrete Structures

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Maintenance and repair strategies; Serviceability and durability of concrete; Materials and techniques for repair; Repairs, Rehabilitation and Retrofitting of structures; Demolition techniques.

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

CO1. Analyze maintenance and repair strategies to solve rehabilitation and retrofitting problems of structures using various tools and techniques following relevant codes and standards considering safety, serviceability, environment and sustainability.

CO2. Analyze the serviceability and durability of concrete to solve complex rehabilitation and retrofitting problems of structures using various tools and techniques following relevant codes and standards considering safety, serviceability, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze materials for repair to solve complex rehabilitation and retrofitting problems of structures using tools and techniques to following relevant codes and standards considering safety, serviceability, environment and sustainability.

CO4. Analyze various techniques for repair to solve complex rehabilitation and retrofitting problems of structures to following relevant codes, standards and latest development considering safety, serviceability, environment and sustainability.

CO5. Analyze various rehabilitation, retrofitting and demolition procedures for repair to solve complex rehabilitation and retrofitting problems of structures to following relevant codes, standards and latest developments considering safety, serviceability, environment and sustainability besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: MAINTENANCE AND REPAIR STRATEGIES ***(08 Periods)***

Maintenance, Repair and rehabilitation, Facets of maintenance, Importance of maintenance, various aspects of inspection, Assessment procedure for evaluating a damaged structure, Causes of deterioration.

Module 2: SERVICEABILITY AND DURABILITY OF CONCRETE ***(10 Periods)***

Quality assurance for concrete construction, Concrete properties – Strength, Permeability, Thermal properties; Cracks – Causes and effects due to climate, temperature, chemicals, and corrosion; Design and construction errors – Effects of cover thickness and cracking

Module 3: MATERIALS FOR REPAIR ***(08 Periods)***

Special concretes and mortar, Concrete chemicals, Special elements for accelerated strength gain, Expansive cement, Polymer concrete, Sulphur infiltrated concrete, Ferrocement, Fiber reinforced concrete, Rust eliminators and polymers coating for rebars during repair, Foamed concrete, Mortar and dry pack, Vacuum concrete.

Module 4: TECHNIQUES FOR REPAIR ***(10 Periods)***

Load test for stability, Gunite and shotcrete, Epoxy injection, Mortar repair for cracks, Shoring and underpinning, Methods of corrosion protection, Corrosion inhibitors, Corrosion resistant steels, Coating to reinforcement and cathodic protection; Repairs to overcome low member strength, deflection, chemical disruption, weathering, corrosion, wear, fire, leakage and marine exposure; Latest developments.

Module 5: REHABILITATION, RETROFITTING AND DEMOLITION OF STRUCTURES ***(09 Periods)***

Rehabilitation, Retrofitting of Structures: Introduction to beam-shear capacity strengthening, Flexural strengthening, Column strengthening, Failure mode of masonry building, Retrofitting strategies for RC members global level and local level retrofitting; Retrofitting of historical buildings, strengthening and case studies; Latest developments.

Demolition of Structures: Engineered demolition techniques for dilapidated structures – Case studies.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Deterioration Prototype Model: In this assignment, students will be able to understand the concept of Maintenance, Repair and rehabilitation, Facets of maintenance, Importance of maintenance, various aspects of inspection, Assessment procedure for evaluating a damaged structure and Causes of deterioration.
2. Practical Visual Learning of Deterioration: In this assignment, students will be able to visualize and understand the concept of Facets of maintenance, Importance of maintenance, various aspects of inspection, Assessment procedure for evaluating a damaged structure and Causes of deterioration by visiting nearby site.
3. A Repair material Prototype Model: In this assignment, students will be able to understand special concretes and mortar and techniques involved in the repair of structures.

4. Practical Visual Learning: In this assignment, students will be able to visualize and understand special concretes and mortar and techniques involved in the repair of structures by visiting nearby site.
5. Practical Visual Learning: In this assignment, students will be able to visualize and understand the Engineered demolition techniques for dilapidated structuresby visiting nearby site.

RESOURCES

TEXT BOOKS:

1. Vidivelli, B., *Rehabilitation of Concrete Structures*, Standard Publishers Distributors, 2008.
2. Bhattacharjee. J., *Concrete Structures Repair, Rehabilitation and Retrofitting*, CBS Publishers and Distributors (P). Ltd., New Delhi, 2019.

REFERENCE BOOKS:

1. Shetty, M. S., *Concrete Technology*, S. Chand and Company Ltd., New Delhi, 2003.
2. Zongjinli, *Advanced Concrete Technology*, John Wiley and Sons, 2011.
3. Alexander, M. G., Beushausen, H. D., Dehn, F. and Moyo, P., *Concrete Repair, Rehabilitation and Retrofitting III*, CRC Press, Balkama, 2012.
4. Guha, P. K., *Maintenance and Repairs of Buildings*, New Central Book Agency (P) Ltd., 2006.

CODES

IS 13935 – 2009 : Repair and Seismic Strengthening of Building

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=taa4FqfERQ&list=PLq46p_ppqQemCi6i4SvZ1kCpFREHQkF
2. https://www.youtube.com/watch?v=21372BZHYVI&list=PLq46p_ppqQemCi6i4SvZ1kCpFREHQkF__&index=2
3. https://www.youtube.com/watch?v=uYRHkSWHoWM&list=PLq46p_ppqQemCi6i4SvZ1kCpFREHQkF__&index=3
4. https://www.youtube.com/watch?v=MWLSnzesJos&list=PLq46p_ppqQemCi6i4SvZ1kCpFREHQkF__&index=4

WEB RESOURCES:

1. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_RRS_Lecture_Notes_0.pdf
2. https://archive.nptel.ac.in/courses/105/105/105105213/
3. http://www.bgsit.ac.in/documents/civil/Course/7thSem/theory/RRS%20Notes.pdf
4. https://jntuh239529920.files.wordpress.com/2018/08/rehabilitation-and-retrofitting-of-structuresnotes.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101008	**FIRE ENGINEERING**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on physics and chemistry of fire, fire prevention and protection, industrial fire protection systems, building fire safety and explosion protecting systems.

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

CO1. Analyze fire characteristics to solve fire engineering problems by using appropriate tools and techniques considering health, safety and environment.

CO2. Analyze the principles of fire prevention, detection and warning to solve fire engineering problems using appropriate tools and techniques considering health, safety and environment besides communicating effectively in graphical form.

CO3. Analyze industrial fire protection systems to solve complex fire engineering problems by using appropriate tools and techniques considering health, safety, environment, relevant codes of practice and manage effectively.

CO4. Design building fire safety to solve complex fire engineering problems by using appropriate techniques considering health, safety, environment, relevant codes of practice and manage effectively.

CO5. Analyze explosion protecting systems to solve complex fire engineering problems by using appropriate tools and techniques considering health, safety, environment, sustainability, relevant codes of practice and manage effectively.

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

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

COURSE CONTENT

Module 1: PHYSICS AND CHEMISTRY OF FIRE ***(09 Periods)***

Fire properties of solid, liquid and gases; Fire spread, Toxicity of products of combustion, Theory of combustion and explosion, Vapour clouds, Flash fire, Jet fires, Pool fires, Unconfined vapour cloud explosion, Shock waves, Auto-ignition, Boiling liquid expanding vapour explosion, Case studies

Module 2: PRINCIPLES OF FIRE PREVENTION, DETECTION AND WARNING ***(09 Periods)***

Sources of ignition, Fire triangle, Principles of fire extinguishing, Various classes of fires – A, B, C, D and E, Types of fire extinguishers, Fire stoppers, Fire alarm and detection systems, Fire station - Fire alarms and sirens, Maintenance of fire trucks, Firefighting foams, Escape from fire rescue operations, Fire drills, Notice, First aid for burns.

Module 3: INDUSTRIAL FIRE PROTECTION SYSTEMS ***(09 Periods)***

Active and passive fire protection systems, Sprinkler-hydrants-stand pipes, Special fire suppression systems like deluge and emulsifier, Selection criteria of the above installations, Reliability, Maintenance, Evaluation and standards, Hydrant pipes, Hoses, monitors, Fire watchers, Layout of stand pipes, Other suppression systems, CO2 system, Foam system, Dry chemical powder (DCP) system, Halon system, Need for halon replacement, Smoke venting, Portable extinguishers, Flammable liquids, Tank farms, Indices of inflammability..

Module 4: BUILDING FIRE SAFETY ***(09 Periods)***

Design of building elements for passive fire protection, Fire load, Fire resistant material and fire testing, Structural fire protection, Structural integrity, Classification of buildings based on occupancy, Concept of egress design, Exit requirements, Width calculations, fire certificates, Fire safety requirements for high rise buildings

Module 5: EXPLOSION PROTECTING SYSTEMS ***(09 Periods)***

Principles of explosion, Detonation and blast waves, Explosion parameters, Explosion Protection, Containment, Flame Arrestors, Isolation, Venting,Suppression, Explosion relief of large enclosure, Explosion venting, Inert gases, Plant for generation of inert gas,Rupture disc in process vessels and lines explosion, Suppression system based on carbon dioxide (CO2) and halons-hazards in LPG, ammonia (NH3), sulphur dioxide (SO2), chlorine (CL2) etc.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Field study report on physics and chemistry of fire.
2. Field study report on principles of fire prevention, detection and warning for a building.
3. Field study report on industrial fire protection systems for any industrial building.
4. Field study report on building fire safety of any public building.
5. Field study report on explosion protection systems at hazardous places.

RESOURCES

TEXT BOOKS:

1. Jain, V. K., *Fire Safety in Buildings,* New Age international Publishers, 3rd Edition, 2010.
2. Akhil Kumar Das, *Principles of Fire Safety Engineering*, Prentice Hall India Learning Pvt. Ltd., 2014.

REFERENCE BOOKS:

1. Gupta, R. S*., Hand Book of Fire Technology*, Orient Longman, Bombay 2017.
2. Sunil S. Rao, Jain, R. K. and H. I. Saluja, *Electrical Safety, Fire Safety Engineering and Mangament*, Kanna Publications, New Delhi, 2012.
3. John A. Purkiss and Long-yuan Li, *Fire Safety Engineering Design of Structures*, CRC Press, 3rd Edition, 2013.
4. Butcher, E. G. and Parnell, A. C., *Designing of Fire Safety*, David Fulton Publishers, 1983.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/102/105102176/
2. https://nptel.ac.in/courses/110105094
3. https://archive.nptel.ac.in/courses/110/105/110105160/

WEB RESOURCES:

1. https://www.steelconstruction.info/Structural_fire_engineering
2. https://www.fireengineering.com/firefighter-training/#gref
3. https://www.sciencedirect.com/journal/fire-safety-journal
4. https://ascelibrary.org/doi/book/10.1061/9780784415047

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE102009	**STRUCTURAL HEALTH MONITORING**	3	-	2	-	4

Pre-Requisite 22EE102401-Basic Electrical and Electronics Engineering
22CE102002-Civil Engineering Materials and Concrete Technology

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course providesa detailed discussion on structural health monitoring, vibration based techniques for structural health monitoring, non-destructive testing of concrete structures, sensors and it for health monitoring systems, applications and case studies of SHM in civil infrastructure systems.

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

CO1. Evaluate structural health monitoring system to solve complex problems using appropriate techniques by following relevant standards considering safety and society besides communicating effectively in graphical formas an individual or in a team.

CO2. Evaluate vibration based techniques for structural health monitoring to solve complex problems using appropriate techniques by following relevant standards considering safety, society and environment besides communicating effectively in graphical form as an individual or in a team.

CO3. Evaluate non-destructive testing of concrete structuresto solve complex problems using appropriate tools and techniques by following standards, codes and latest developments by considering safety and environment besides communicating effectively in graphical form as an individual or in a team.

CO4. Evaluate sensors and IT for health monitoring systemsto solve complex problems using appropriate tools and techniques by following relevant standards, codes and latest developments considering safety and environment besides communicating effectively in graphical form as an individual or in a team.

CO5. Evaluate applications and case studies of SHM in civil infrastructure systems to solve complex problems using appropriate tools and techniques by following relevant standards, codes and latest developments considering safety, society and environment, besides communicating effectively in graphical form as an individual or in a team.

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

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

COURSE CONTENT

Module 1: STRUCTURAL HEALTH MONITORING ***(09 Periods)***

Need for SHM, SHM - A way for smart materials and structures, SHM and biomimetic analog between the nervous system of a man and a structure with SHM, SHM as a part of system management, Passive and active SHM, NDE, SHM and NDECS, Basic components of SHM, Materials for sensor design.

Module 2: VIBRATION BASED TECHNIQUES FOR STRUCTURAL HEALTH MONITORING ***(09 Periods)***

Introduction, Basic vibration concept for SHM, Mathematical description for structural system with damage, Linking experimental and analytical data, Damage localization and quantification, Neural network approach to SHM, Connectionist algorithms for anomaly detection, Time domain damage detection methods for linear system, Damage identification in non-linear system and application.

Module 3: NONDESTRUCTIVE TESTING OF CONCRETE STRUCTURES ***(10 Periods)***

Situations and contexts, Need, Classification of NDT procedures, Visual inspection, Half-cell electrical potential methods, Schmidt rebound hammer test, Resistivity measurement, Electrical resistance, Electromagnetic methods, Radiographic testing, Ultrasonic testing, Infrared thermography, Ground penetrating radar, Radio isotope gauges, Other methods.

Module 4: SENSORS AND IT FOR HEALTH MONITORING SYSTEMS ***(9 Periods)***

Sensors for SHM: Acoustic emission sensors, Ultrasonic sensors, Piezoelectric sensors and actuators, Fibreoptic sensors and Laser shearography techniques, Imaging techniques.
Information Technology for Health Monitoring: Information gathering, Signal analysis, Information storage, Archival, Retrieval, Security, Wireless communication, Telemetry, Real time remote monitoring, Network protocols, Data analysis and interpretation.

Module 5: APPLICATIONS AND CASE STUDIES OF SHM IN CIVIL INFRASTRUCTURE SYSTEMS ***(9 Periods)***

Capacitance probe for concrete cover, Applications for external post tensioned cables, Structural health monitoring of bridges, Structural health monitoring of cable–supported bridges, Structural health monitoring of historical buildings.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Study of SHM components
2. Vibration characteristics of aluminium cantilever beam using piezoelectric sensor
3. Identification of high frequency axial modes of beam in "free-free" condition using Electro-Mechanical Impedance (EMI) technique
4. Forced excitation of steel beam using portable shaker
5. Photogrammetry for displacement measurement
6. Modes of vibration of simply supported beam under flexure
7. Modes of vibration of simply supported plate
8. Damage detection and qualitative quantification using Electro-Mechanical Impedance (EMI) technique
9. Structural health monitoring using low-cost instruments and EMI.
10. Shear lag effect in Electro-Mechanical Impedance (EMI) technique

11. Rebar corrosion detection and assessment Using Electro-Mechanical Impedance (EMI) technique
12. Study on sensors and IT for SHM
13. Study on case studies of SHM in civil infrastructure projects

RESOURCES

TEXT BOOKS:

1. Daniel Balageas, Claus-Peter Fritzen and Alfredo Guemes, *Structural Health Monitoring*, ISTE Ltd., U.K. 2006.
2. Vistasp M. Karbhari and Farhad Ansari, *Structural Health Monitoring of Civil Infrastructure System*, Wood Head Publishing Limited, Cambridge, 2009.

REFERENCE BOOKS:

1. Wang, M. L., Lynch, L. P., and Sohn, H., *Sensors Technologies for Civil Infrastructure*, *Vol.1 & 2*, Wood Head Publishing Limited, Cambridge, 2009.
2. Philip, W., *Industrial Sensors and Applications for Condition Monitoring*, MEP, 1994.
3. Prasad, J. and Nair, C. G. K., *Non-destructive Test and Evaluation Materials*, McGraw Hill, 2nd Edition, 2011.
4. Poonam, Modi, I., and Chirag N. Patel, *Repair and Rehabilitation of Concrete Structures,*Prentice-Hall of India Pvt. Ltd., New Delhi, 2016.

CODES:

1. IS 13311 – 1992 (PART1): Non–destructive testing of concrete – Methods of test

VIDEO LECTURES:

1. https://nptel.ac.in/courses/114106046
2. https://nptel.ac.in/courses/112104160

WEB RESOURCES:

1. https://link.springer.com/book/10.1007/978-3-030-74258-4
2. https://www.diva-portal.org/smash/get/diva2:991115/FULLTEXT01.pdf
3. https://theconstructor.org/digital-construction/structural-health-monitoring-civil-engineering/554160/
4. https://www.encardio.com/dam-monitoring
5. http://vssd-iitd.vlabs.ac.in/Introduction.html
6. https://web.iitd.ac.in/~sbhalla/cvl864.html

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101009	**BUILDING SERVICES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on necessity and overview of building services, general building requirements, vertical transportation in buildings; lighting, ventilation, acoustics and electrical installations; water supply and sanitation services; and fire protection of buildings.

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

CO1. Analyze buildings with respect to services to solve problems associated with building services using appropriate tools and techniques considering codes of practice, safety, environment and sustainability besides communicating effectively in graphical forms.

CO2. Analyze vertical transportation in buildings to solve problems associated with building services using appropriate tools and techniques following latest developments considering codes of practice, safety, environment and sustainability besides communicating effectively in graphical forms.

CO3. Analyze lighting, ventilation, acoustics and electrical installationsin buildings to solve problems associated with building servicesusing appropriate tools and techniques following latest developments considering codes of practice, safety, environment and sustainability besides communicating effectively in graphical forms.

CO4. Analyze water supply and sanitation systems in buildings to solve problems associated with building services using appropriate tools and techniques following latest developments considering codes of practice, safety, environment and sustainability besides communicating effectively in graphical forms.

CO5. Analyze fire protection systems in buildings to solve problems associated with building services using appropriate tools and techniques following latest developments considering codes of practice, safety, environment besides communicating effectively in graphical forms.

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

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

COURSE CONTENT

Module 1: OVERVIEW OF BUILDING SERVICES *(08 Periods)*

Introduction to building services, Classification of buildings as per national building code, Necessity of building services, Functional requirements of a building, Different types of building services i.e. HVAC (Heat, Ventilation and Air Conditioning), Escalators and lifts, Fire safety, Protection and control, Plumbing services, Rain water harvesting, Lightening, Acoustics, Sound insulation and Electric installation etc, Role and responsibility of Building Service Engineer, Introduction to Building Management Services (BMS), Role of BMS, Concept of smart building.

Module 2: VERTICAL TRANSPORTATION IN BUILDINGS *(09 Periods)*

Lifts: Different types of lifts and its uses component parts of lift - Lift Well, Travel, Pit, Hoist way, Machine, Buffer, Door Locks, Suspended rope, Lift car, Landing door, Call indicators, Call push etc., Design provisions for basic size calculation of space enclosure to accommodate lift services, Safety measures.

Escalators**:** Different types of escalators and its uses, Components of escalators, Design provisions for basic size calculation of space enclosure to accommodate escalator services, safety measures.

Ramp**:** Necessity, Design consideration, Gradient calculation, Layout and special features required for physically handicapped and elderly.

Module 3: LIGHTING, VENTILATION, ACOUSTICS AND ELECTRICAL INSTALLATIONS *(10 Periods)*

Lighting: Concept of lighting, Types of lighting (natural and artificial), Factors influencing the brightness of room, Factors affecting selection of artificial lighting, installation of light, Types of light control, Types of lamps, Lamp selection as per room sizes.

Ventilation: Concept of ventilation, Necessity and types of ventilation, Overview of air conditioning system for building.

Acoustics**:** Building acoustic, Objectives, Acoustic control in a building, Acoustic material (porous absorber and cavity resonator).

Electrical installations: Electricity distribution, Cable capacity and voltage drop, Construction site distribution, Safety cut-outs, Lighting conductors.

Module 4: WATER SUPPLY AND SANITATION SERVICES ***(9 Periods)***

Plumbing **-** Importance, Terms, Types of plumbing fixtures, Shapes/sizes, Capacities, Situation and where used, Traps, Interceptors; System of plumbing for building water supply **-** Sources of water, Storage of water, Hot and cold water supply system; System of plumbing for building drainage**-** Types of drainage system such as two pipe system, One pipe system, Types of vents and purpose of venting, Concept of gray water and reclaimed water; Rain water harvesting(RWH) system; RWH Components - Catchments, Gutters, Conduits, Filters, Storage facility, Recharge structures etc.; Advantages of RWH, Application of RWH.

Module 5: FIRE PROTECTION OF BUILDINGS ***(9 Periods)***

Fire protection requirements for multi-storeyed building, Causes of fire in building, Fire detecting and various extinguishing systems, Working principles of various fire protection systems, Safety against fire in residential and public buildings, National building code provision for fire safety, Fire resisting materials and their properties, Fire resistant construction, Procedures for carrying out fire safety inspections of existing buildings, Provisions for evacuation.

Total Periods: 45

EXPERIENTIAL LEARNING

1. a) Prepare electrical layout plan for given building.
   b) Prepare lighting plan for a given building.
2. Identify proper locations for Lift/ Escalator/ Elevator in a given building.
3. Prepare a plan for fire safety measures for a given building.
4. Prepare water supply, sanitary layout plan for given building.
5. Estimate the rain water harvesting potential for the given plan of the residential building and given data.
6. Compute the space requirements for the lift for the given type of building as per guidelines of national building code.

RESOURCES

TEXT BOOKS:

1. P. Rethaliya, *Building Services*, Atul Prakashan, 2018.
2. M. N. Gangrade and P. V. Patil, Building *Services*, Nirali Prakashan, 2020.

REFERENCE BOOKS:

1. B. C. Punmia, *Building Construction*, Eleventh Edition, Laxmi Publications, 2016.
2. *National Building Code of India*, Bureau of Indian Standards (BIS), New Delhi, 2016.
3. P. C. Varghese, *Building Construction*, 2nd Edition, PHI Learning (P) Ltd., 2016.
4. S. M. Patil, *Building Services*, Standard Publishers, 2014.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105102176
2. https://archive.nptel.ac.in/courses/105/107/105107156/

WEB RESOURCES:

1. www.bis.org.in/sf/nbc.htm
2. cpwd.gov.in/Units/handbook.pdf
3. http://www.understandconstruction.com/building-services.html
4. https://www.academiccourses.com/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101010	**ALTERNATE BUILDING MATERIALS**	3	-	-	-	3

Pre-Requisite 22CE102002-Civil Engineering Materials and Concrete Technology

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Elements of Structural Masonry; Structural masonry mortars; Alternate building materials; Alternate building technologies; Equipments for production of alternate materials.

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

CO1. Analyze building materials to solve environmental problems related to building materials using various tools and techniques following relevant codes and standards considering safety, serviceability, environment and sustainability.

CO2. Design masonry compression elements of structural masonry to solve complex problems of structures using various tools and techniques following relevant codes and standards considering safety, serviceability, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze alternate building materials to solve complex problems of building materials considering safety, serviceability, environment and sustainability.

CO4. Analyze alternate building materials using various techniques to solve complex problems of building materials following standards and latest development considering safety, serviceability, environment and sustainability.

CO5. Analyze building materials to solve complex building material problems following standards and latest developments considering safety, serviceability, environment and sustainability.

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

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

COURSE CONTENT

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

Energy in building materials, Environmental issues concerned to building materials, Embodied energy and life-cycle energy, Global warming and construction industry, Green concepts in buildings, Green building ratings – IGBC and LEED manuals – mandatory requirements, Rainwater harvesting & solar passive architecture. Environmental friendly and cost effective building technologies, Requirements for buildings of different climatic regions.

Module 2: ELEMENTS OF STRUCTURAL MASONRY ***(10 Periods)***

Elements of Structural Masonry:

Elements of Structural Masonry, Masonry materials, requirements of masonry units characteristics of bricks, stones, clay blocks, concrete blocks, stone boulders, laterite Blocks, Fal- G blocks and Stabilized mud block. Manufacture of stabilized blocks.

Structural Masonry Mortars:

Mortars, cementations materials, sand, natural & manufactured, types of mortars, classification of mortars as per BIS, characteristics and requirements of mortar, selection of mortar. Uses of masonry, masonry bonding, Compressive strength of masonry elements, Factors affecting compressive strength, Strength of Prisms/wallets and walls, Effect of brick bond on strength, Bond strength of masonry: Flexure and shear, Elastic properties of masonry materials and masonry, Design of masonry compression elements subjected to axial load.

Module 3: ALTERNATE BUILDING MATERIALS ***(08 Periods)***

Lime, Pozzolana cements, Raw materials, Manufacturing process, Properties and uses. Fibers-metal and synthetic, Properties and applications. Fiber reinforced plastics, Matrix materials, Fibers organic and synthetic, Properties and applications. Building materials from agro and industrial wastes ,Types of agro wastes, Types of industrial and mine wastes, Properties and applications. Masonry blocks using industrial wastes. Construction and demolition wastes.

Module 4: ALTERNATE BUILDING TECHNOLOGIES ***(10 Periods)***

Use of arches in foundation, alternatives for wall constructions, composite masonry, confined masonry, cavity walls, rammed earth, Ferro cement and ferroconcrete building components, Materials and specifications, Properties, Construction methods, Applications. Top down construction, Mivan Construction Technique, Concepts, Filler slabs, Composite beam panel roofs, Masonry vaults and domes.

Module 5: EQUIPMENT FOR PRODUCTION OF ALTERNATE MATERIALS ***(9 Periods)***

Machines for manufacture of concrete, Equipments for production of stabilized blocks, Moulds and methods of production of precast elements, Cost concepts in buildings, Cost saving techniques in planning, design and construction, Cost analysis: Case studies using alternatives.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prototype Model: In this assignment, students will be able to understand the concept of energy in building materials, Embodied energy and life-cycle energy, Global warming and construction industry and Green concepts in buildings.

2. Practical Visual Learning of Deterioration: In this assignment, students will be able to visualize and understand the characteristics of bricks, stones, clay blocks, concrete blocks, stone boulders and laterite Blocks.
3. A Prototype Model: In this assignment, students will be able to understand the concept involved in the equipments for production of stabilized blocks, Moulds and methods of production of precast elements and Cost concepts in buildings.

RESOURCES

TEXT BOOKS:

1. KS Jagadish, B V Venkatarama Reddy and K S Nanjunda Rao, *Alternative Building Materials and Technologies*, New Age International publishers, 2009.
2. Arnold W Hendry, *Structural Masonry*, Macmillan Publishers, 1998.

REFERENCE BOOKS:

1. Ashwini Manjunath B.T, *Alternative Building Materials*, Medtech scientific international publishers, 2017.
2. RJS Spence and DJ Cook, *Building Materials in Developing Countries*, Wiley publishers, 1983.
3. LEED India, *Green Building Rating System*, IGBC publishers, 2014.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=wtUZpK4sO0Y
2. https://www.youtube.com/watch?v=RWck4EnfdSE&list=PLyqSpQzTE6M-81uKP3sjj0lZX_nnrOwpV
3. https://www.youtube.com/watch?v=dqetJPJ-y2w
4. https://www.youtube.com/watch?v=5cH7HlhDe3A

WEB RESOURCES:

1. https://www.vssut.ac.in/lecture_notes/lecture1424085991.pdf
2. https://www.scribd.com/document/455423821/Alternative-building-materials-notes
3. https://backbencher.club/alternative-building-materials-and-technologies/
4. https://www.currentscience.ac.in/Volumes/87/07/0899.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101011	**CONSTRUCTION EQUIPMENT AND AUTOMATION**	3	-	-	-	3

Pre-Requisite 22CE102003-Construction, Planning and Project Management

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Construction equipment and management; Earthwork equipment and material handling equipment; Asphalt and concrete plants and other construction equipment; Building automation system; Automation and robotics in construction.

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

CO1. Categorize construction equipment to solve complex construction problems considering safety, project management and finance besides communicating effectively in graphical form.

CO2. Analyze earthwork and material handling equipment to solve complex construction problems ensuring safety and environment besides communicating effectively in graphical form.

CO3. Analyze asphalt and concrete plants and other construction equipment to solve construction problems following latest developments ensuring safety and environment besides communicating effectively in graphical form.

CO4. Analyze building automation system to solve construction problems using appropriate tools and techniques following relevant standards and latest developments considering society, project management and finance besides communicating effectively in graphical form.

CO5. Analyze automation and robotics in construction to solve construction problems using appropriate techniques following latest developments considering society, project management and finance besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: CONSTYRUCTION EQUIPMENT AND MANAGEMENT ***(08 Periods)***

Identification, Planning of equipment, Selection of Equipment, Equipment Productivity, Equipment Management in Projects, Maintenance Management, Equipment cost, Operating cost, Cost Control of Equipment, Depreciation Analysis, Replacement of Equipment, Replacement Analysis, Safety Management.

Module 2: EARTHWORK EQUIPMENT AND MATERIAL HANDLING EQUIPMENT ***(10 Periods)***

Earthwork Equipment: Fundamentals of Earth Work Operations, Earth Moving Operations, Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers; Front end Waders – Dozer, Excavators, Rippers, Loaders, Compacting Equipment, Finishing equipment.

Material Handling Equipment: Forklifts and related equipment, Portable Material Bins, Conveyors, Trucks and Hauling equipment.

Module 3: ASPHALT AND CONCRETE PLANTS AND OTHER CONSTRUCTION EQUIPMENT ***(10 Periods)***

Asphalt and Concrete plants: Aggregate production, Different Crushers, Feeders, Screening Equipment, Handling Equipment, Batching and Mixing Equipment, Pumping Equipment, Ready mix concrete equipment, Concrete pouring equipment. Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment

Other Construction Equipment*:* Equipment for Dredging, Trenching, Drag line and clamshells, Tunnelling, Equipment for Drilling and Blasting, Pile driving Equipment, Erection Equipment, Crane, Mobile crane, Types of pumps used in Construction, Equipment for Dewatering and Grouting, Equipment for Demolition.

Module 4: BUILDING AUTOMATION SYSTEM ***(8 Periods)***

Building Automation System (BAS)**-** Concept, Applications, Requirements, Design considerations, Effect on functional efficiency, Architecture and Components of BAS; Building Information Modelling (BIM) – Construction life cycle using BIM, Applications; Sensors to collect and process data, Virtual reality during project planning, training and management.

Module 5: AUTOMATION AND ROBOTICS IN CONSTRUCTION ***(9 Periods)***

Automation: Advantages and disadvantages, Need, Applications - Automation in precast construction industry, high rise building construction, prefabrication of masonry, onsite masonry construction, manufacture of brick wall masonry blocks, timber construction, production of steel components; Autonomous machines on the construction site, Drones to survey working areas, Automatic concrete screeding machine.

Robotics in Construction: Tele-operated robots, Programmed Robots and Cognitive Robots - Use of robots for repetitive activities; Challenges in construction robotics, Robotics in concrete works, Concrete surface finishing robot,Transformable welding robot.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Write a report on the importance of Automation in the field of civil engineering. Also, provide necessary factors that affects the industry.
2. Visit a construction site and write a report on the equipment used in the construction

process.

3. Visit a stone quarry and write detailed report on aggregate production equipment used.
4. Prepare a 3D Model using Rivet and represent a BIM Model using the rivet extension tools.
5. Prepare a detailed report on use of robotics in construction with neat examples.

RESOURCES

TEXT BOOKS:

1. Sharma, S.C. *Construction Equipment and Management*, Khanna Publishers, New Delhi, 6th Edition, 2015.
2. Mahesh Varma, *Construction Equipment and its Planning and Application*, Metropolitan Book Company, New Delhi. 1983.

REFERENCE BOOKS:

1. Deodhar, S.V., *Construction Equipment and Job Planning*, Khanna Publishers, New Delhi, 1988.
2. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., *Construction Planning, Equipment and Methods*, McGraw Hill, Singapore, 2006.
3. Thomas Boak and Thomas Linner, *Construction Robots - Elementary Technologies and Single-Task Construction Robot*, Cambridge University Press, 2017.
4. Bimal Kumar, *A Practical Guide to Adopting BIM in Construction Projects*, Whittles Publishing Pvt. Ltd., Dunbeath, Scotland, 2015.

VIDEO LECTURES:

1. Construction methods and equipment management - Course (nptel.ac.in)
2. What is BIM (Building Information Modeling) ? | Use & advantages of BIM in Construction Industry - YouTube
3. Wheel Loaders, Heavy Transports, Excavators And Construction Sites - Heavy Machinery Movie - YouTube

WEB RESOURCES:

1. Construction Equipment Management (slideshare.net)
2. Construction Equipment Management Guide: Everything You Need to Know (autodesk.com)
3. The impact and opportunities of automation in construction | McKinsey

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101012	**GROUND IMPROVEMENT TECHNIQUES**	3	-	-	-	3

Pre-Requisite 22CE101012-Foundation Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course emphasizes on scope of ground improvement, methods of ground improvement, drainage and dewatering, in–situ densification of granular soils and cohesive soils, soil stabilization, geosynthetics and earth reinforcement.

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

CO1. Analyze ground improvement techniques to solve complex ground engineering problems through continuous learning considering safety, environment and sustainability besides communicating effectively in graphical form.

CO2. Analyze drainage and dewatering techniques to solve complex ground engineering problems considering safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze in-situ densification techniques of granular soils and cohesive soils to solve complex ground engineering problems by following the relevant codes of practice and ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze soil stabilization techniques to solve complex ground engineering problems by following the relevant codes of practice and ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyze geosynthetics and earth reinforcement techniques to solve ground engineering problems through continuous learning considering safety, environment and sustainability besides communicating effectively in graphical form.

CO6. Design geosynthetic reinforced earth walls to solve complex stability problems associated with earth retaining structures using appropriate techniques and following relevant codes considering society, environment and sustainability besides communicating effectively in graphical form.

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	-	2	2	1	1	2	-	2	-	2	-	3	-
CO2	2	3	-	2	2	1	1	2	-	2	-	-	-	3	-
CO3	2	3	-	2	2	1	1	2	-	2	-	-	-	3	-
CO4	2	3	-	2	2	1	1	2	-	2	-	-	-	3	-
CO5	2	3	-	2	2	1	1	2	-	2	-	2	-	3	-
CO6	2	2	3	2	2	1	1	2	-	2	-	-	-	3	-
Course Correlation Mapping	**2**	**3**	**3**	**2**	**2**	**1**	**1**	**2**	**-**	**2**	**-**	**2**	**-**	**3**	**-**

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

COURSE CONTENT

Module 1: GROUND IMPROVEMENT ***(08 Periods)***

Role of ground improvement in foundation engineering, Methods of ground improvement, Geotechnical problems in alluvial, laterite and black cotton soils; Selection of suitable ground improvement techniques based on soil condition; Latest Methods.

Module 2: DRAINAGE AND DEWATERING ***(09 Periods)***

Drainage techniques, Well points, Vacuum and electroosmotic methods, Dewatering after construction, Control of surface water, Well pointing in deep excavation, Drainage on slopes, Electro kinetic dewatering system.

Module 3: IN-SITU DENSIFICATION OF GRANULAR SOILS AND COHESIVE SOILS ***(10 Periods)***

Granular Soils: Principles of in-situ densification, In-situ densification methods – Dynamic compaction, Blasting, Vibro compaction, Granular piles, Relative merits and their limitations.

Cohesive Soils: Principles of in-situ densification, In-situ densification methods – Vertical drains, Sand wick, Geodrains, Stone columns, Granular pile anchors, Lime columns and thermal methods, Relative merits and their limitations.

Module 4: SOIL STABILIZATION ***(09 Periods)***

Soil Stabilization – Mechanical, Bitumen, Cement, Lime, Fly ash and Chemical; Stabilization of expansive soils; Soil stabilization by grouting - Types of grouts, Grouting equipment and machinery, Injection methods, Grout monitoring; Shotcreting and guniting technology.

Module 5: GEOSYNTHETICS AND EARTH REINFORCEMENT ***(09 Periods)***

Concept of reinforcement, Types of reinforcement material, Components and applications of reinforced earth, Soil nailing, Geosynthetics – Types, Functions, Applications; Design of geosynthetic reinforced earth walls; Latest developments in earth reinforcement techniques.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Submit a report on different problematic soils and suitable ground improvement techniques after a field study and thorough literature review.
2. Submit a report on a case study of any of the dewatering methods adopted in a civil engineering project.
3. Submit a report on a case study of any one of the in-situ densification methods of cohesionless soils in a civil engineering project.
4. Submit a report on a case study of any one of the in-situ densification methods of cohesive soils in a civil engineering project.
5. Submit a report on a case study of any one of the soil stabilization methods in a civil engineering project.
6. Submit a report on a case study of shotcreting and guniting methods of stabilizing the walls of deep excavations.

7. Submit a report on commercial availability of geosynthetics for various civil engineering applications.
8. Develop a spread sheet to design and check the stability of a geosysnthetic reinforced soil retaining wall.
9. Design a geosynthetic reinforced soil retaining wall and check its stability using a using commercially available software viz. Geoslope – SlopeW, Galena etc.
10. Design a soil nailing system using either a spreadsheet or any other commercially available software viz. Geoslope – SlopeW, Galena etc.

RESOURCES

TEXT BOOKS:

1. Hausmann, M. R., *Engineering Principles of Ground Modification,* McGraw–Hill Publishers, 2013.
2. Purushotham Raj, P., *Ground Improvement Techniques,* Laxmi Publications Pvt. Ltd., 2nd edition, 2016.

REFERENCE BOOKS:

1. Moseley, M. P. and Kirsch. K., *Ground Improvement,* Taylor Francis Ltd., 2nd Revised Edition, 2004.
2. Xanthakos P. P., Abramson, L. W and Bruce, D. A., *Ground Control and Improvement,* John Wiley and Sons, 1994.
3. Koerner, R. M., *Designing with Geosynthetics,Xlibris* Publishers*,* 6th Edition, 2012.
4. Jewell, R. A., *Soil Reinforcement with Geotextiles (Report),* CIRIA Special Publication, 1996.
5. Chattopadhyay, B. C. and Maity, J., *Ground Improvement Techniques*, PHI Learning, 2017.
6. Han, J*., Principles and Practice of Ground Improvement*, John Wiley, 2015.
7. Siva Kumar Babu, G. L., *An Introduction to Soil Reinforcement & Geosynthetics*, Universities Press, 2005.

IS CODES:

IS 13094 – 1992	:	Selection of Ground Improvement Techniques for Foundations in Weak Soils.
IS 15284 (Part 2)- 2004	:	Design and Construction for Ground Improvement.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/108/105108075/
2. https://archive.nptel.ac.in/courses/105/105/105105210/
3. https://archive.nptel.ac.in/courses/105/106/105106052/
4. https://www.issmge.org/education/recorded-webinars/geosynthetics-reinforced-soil-structures-developments-from-walls-to-bridges

WEB RESOURCES:

1. https://ocw.mit.edu/courses/1-364-advanced-geotechnical-engineering-fall-2003/
2. https://www.sciencedirect.com/topics/engineering/ground-improvement-method
3. http://www.nitttrc.edu.in/nptel/courses/video/105106052/lec2.pdf
4. https://theconstructor.org/geotechnical/ground-improvement-techniques-soil-stabilization/1836/
5. https://www.kellerindia.com/
6. https://www.menard-group.com/techniques/
7. https://www.engineeringcivil.com/ground-improvement-techniques.html

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101013	**ADVANCED FOUNDATION ENGINEERING**	3	-	-	-	3

Pre-Requisite 22CE101012-Foundation Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on shallow foundations - bearing capacity, settlements, design principles; pile foundations – bearing capacity, settlements, design; sheet pile walls; foundations on expansive soils; marine substructures.

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

CO1. Design shallow foundations to solve complex foundation engineering problems using appropriate techniques by following relevant codes of practice considering society, environment and sustainability besides communicating effectively in graphical form.

CO2. Design pile foundations to solve complex foundation engineering problems using appropriate techniques by following relevant codes of practice considering society, environment and sustainability besides communicating effectively in graphical form.

CO3. Design sheet pile walls based on ground characteristics for its stability to solve complex foundation engineering problems using appropriate techniques by following relevant codes of practice considering society, environment and sustainability besides communicating effectively in graphical form.

CO4. Design under reamed piles and breakwaters to solve complex foundation engineering problems using appropriate techniques by following relevant codes of practice considering society, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyze different foundation techniques in expansive soils to solve complex foundation engineering problems by following the ethics and considering society, environment and sustainability besides communicating effectively in graphical form.

CO6. Analyze marine substructures to solve complex marine engineering problems by following the ethics and considering society, environment and sustainability besides communicating effectively in graphical form.

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	2	1	1	2	-	2	-	-	-	3	-
CO2	3	2	3	2	2	1	1	2	-	2	-	-	-	3	-
CO3	3	2	3	2	2	1	1	2	-	2	-	-	-	3	-
CO4	3	2	3	2	2	1	1	2	-	2	-	-	-	3	-
CO5	3	3	-	2	2	1	1	2	-	2	-	-	-	3	-
CO6	3	3	-	2	-	1	1	2	-	2	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**2**	**-**	**2**	**-**	**-**	**-**	**3**	**-**

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

COURSE CONTENT

Module 1: SHALLOW FOUNDATIONS ***(09 Periods)***

Theories of bearing capacity–Hansen, Vesic; Effect of tilt, eccentricity, compressibility, non–homogeneity and anisotropy of soil on bearing capacity; Bearing capacity of footings resting on stratified soils, on slope and on top of the slopes, Settlement of foundation – 3D consolidation settlement; Bearing pressure using SPT, CPT, Dilatometer and Pressure meter, Design principles - Isolated, Combined footing and mat foundation (conventional rigid method only).

Module 2: PILE FOUNDATIONS ***(10 Periods)***

Bearing capacity of vertically loaded piles - Static capacity-α, β and λ Methods, IS Code; Dynamic pile capacity – Simplex and Janbu methods; Point bearing resistance with SPT and CPT results; Bearing resistance of piles on rock, Uplift resistance, Laterally loaded piles, Ultimate lateral resistance, Batter piles, Under reamed piles, Mini and micro piles; Ultimate capacity of pile groups in compression, Pullout and lateral load, Efficiency; Settlements of pile groups, Design of simple R.C.C piles.

Module 3: SHEET PILE WALLS ***(09 Periods)***

Sheet pile structures, Cantilever sheet pile walls in granular soils and cohesive soils, Anchored bulk head – Free earth support method, Fixed earth support method; Lateral earth pressure on braced sheet pile walls.

Module 4: FOUNDATIONS ON EXPANSIVE SOILS ***(08 Periods)***

Expansive soils - Nature, identification and classification; Foundations in black cotton soils – Basic foundation problems associated with black cotton soils, Lime column techniques, Use of Cohesive Non Swelling (CNS) layer below shallow foundations; Under reamed piles – Principle of functioning of under reamed pile, Analysis and design of under reamed pile.

Module 5: MARINE SUBSTRUCTURES ***(09 Periods)***

Introduction, Types of marine structures – Breakwaters, Wharves, Piers, Seawalls, Docks, Quay walls; Design loads, Wave action, Wave pressure on vertical wall, Ship impact on piled wharf structure, Design of rubble mount breakwater and wall type breakwater.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Develop a spread sheet to calculate allowable bearing capacity of a shallow footing using all bearing capacity theories.
2. Develop a spread sheet to calculate settlement of a shallow footing using available theories.
3. Develop a spread sheet to calculate bearing capacity of a shallow footing resting on a stratified deposit.
4. Develop a spread sheet to calculate pile group capacity using different formulae.
5. Submit a report on a case study of piling for any civil engineering project.
6. Submit a report on a case study of sheet piles for any civil engineering project.
7. Submit a report on a case study of foundations on expansive soils for any civil engineering project.
8. Submit a report after a field visit to different sites with different expansive soils.
9. Submit a report on marine substructures after a field visit to any port in India.
10. Develop a spread sheet to design breakwaters.

RESOURCES

TEXT BOOKS:

1. Donald P. Coduto, *Foundation Design Principles and Practices*, Pearson, 3rd Edition, 2015.
2. Swami Saran, *Analysis and Design of Substructures – Limit State Design,* Oxford & IBH Publishing Company Pvt. Ltd., 2nd Edition 2018.

REFERENCE BOOKS:

1. Murthy, V. N. S., *Text Book of Soil Mechanics and Foundation Engineering,* CBS Publishers & Distributors Pvt. Ltd., 3rd Edition, 2018.
2. Braja M. Das, *Principles of Foundation Engineering,* Cengage Learning India, 9th Edition, 2017.
3. Bowles J.E., *Foundation Analysis and Design,* McGraw–Hill Publishing Company, 5th Edition, 2001.
4. Shamsher Prakash, Gopal Ranjan and Swami Saran, *Analysis and Design of Foundations and Retaining Structures,* Sarita Publishers, 2nd Edition, 1987.
5. Murthy, V. N. S., *Advanced Foundation Engineering,* CBS Publishers & Distributors Pvt. Ltd., 1st Edition, 2017.
6. Sitharam, T. G., *Advanced Foundation Engineering,* CRC Press, 1st Edition, 2017.

IS CODES:

IS 1080 – 1985	:	Design and Construction of Shallow Foundations in Soils (Other than Raft, Ring and Shell).
IS 2911 (Part 1/Sec 3) - 2010	:	Design and Construction of Pile Foundations.
IS 6403 - 1981	:	Determination of Bearing Capacity of Shallow Foundations.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/105/105105207/
2. https://archive.nptel.ac.in/courses/105/105/105105039/
3. https://www.keller-na.com/expertise/techniques/sheet-piles
4. https://www.youtube.com/watch?v=aHsTFooJfq4
5. https://www.youtube.com/watch?v=DvmpafNVYps
6. https://www.youtube.com/watch?v=qeUMbBgKYGs

WEB RESOURCES:

1. https://ocw.mit.edu/courses/1-364-advanced-geotechnical-engineering-fall-2003/
2. https://www.accessengineeringlibrary.com/content/book/9781260468489
3. https://civilblog.org/advanced-foundation-engineering-civil-engineering-video-lecture/
4. https://www.fhwa.dot.gov/engineering/geotech/library_listing.cfm
5. https://www.engineeringcivil.com/foundation-in-expansive-soil.html
6. https://theconstructor.org/geotechnical/avoid-expansive-soil-effects-buildings/409740/
7. https://www.kennisbank-waterbouw.nl/DesignCodes/rockmanual/chapter%206.pdf
8. https://constrofacilitator.com/sheet-piles-advantages-types-and-methods/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101014	**SUSTAINABLE ENGINEERING**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Principles of sustainability; Sustainability metrics and assessment tools; Sustainable engineering practices; Sustainable engineering applications; Sustainable urbanization and industrialization.

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

CO1. Analyze the principles of sustainability to solve complex environmental problems following relevant standards/protocols considering society, health, safety and environment.

CO2. Analyze sustainability metrics and assessment tools to solve complex environmental problems following relevant standards and emerging trends considering society, health, safety, environment and economics besides communicating effectively in graphical form.

CO3. Analyze sustainable engineering practices to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO4. Design sustainable engineering applications to solve complex environmental 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 sustainable urbanization and industrialization principles to solve complex environmental 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-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	3	2	-	-	-	-	-	-	3
CO2	3	3	-	2	2	2	2	2	-	1	2	1	-	-	3
CO3	3	3	-	2	2	2	2	2	-	1	2	-	-	-	3
CO4	3	3	3	2	2	2	2	2	-	1	2	-	-	-	3
CO5	3	3	-	2	2	2	2	2	-	1	2	-	-	-	3
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	-	**1**	**2**	**1**	**-**	-	**3**

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

COURSE CONTENT

Module 1: PRINCIPLES OF SUSTAINABILITY ***(09 Periods)***

Emerging challenges, Sustainability and sustainable engineering; Environmental concerns; Social, economic and legal issues; Availability and depletion of natural resources, Disaster resiliency; Multilateral environmental agreements – Basel convention, Clean development mechanism (CDM), Montreal and Kyoto protocols.

Module 2: SUSTAINABILITY METRICS AND ASSESSMENT TOOLS ***(09 Periods)***

Sustainability indicators, metrics and assessment tools, Material flow analysis and material budget, Carbon footprint analysis, Life cycle assessment, Streamlined life-cycle assessment (SLCA), Economic input output-life cycle analysis, Environmental health risk assessment, Other emerging assessment tools.

Module 3 SUSTAINABLE ENGINEERING PRACTICES ***(09 Periods)***

Sustainable energy engineering, Sustainable waste management, Green and sustainable buildings and infrastructure, Sustainable civil infrastructure, Sustainable remediation of contaminated sites, Climate geoengineering.

Module 4 SUSTAINABLE ENGINEERING APPLICATIONS ***(09 Periods)***

Environmental and chemical engineering projects, Materials engineering projects, Infrastructure engineering projects – Background, Methodology, Goal and Scope, Study area, Technical design, Environmental sustainability, Life cycle assessment, Economic sustainability, Social sustainability, Rating systems – ENVISION, LEED, GRIHA, IGBC; Conclusions.

Module 5 SUSTAINABLE URBANIZATION AND INDUSTRIALIZATION ***(09 Periods)***

Sustainable urbanization and industrialization, United Nations sustainable development goals – Right to education, Poverty eradication, Social and technological changes; Industrial Processes - Material selection, Energy efficiency, Pollution prevention and control techniques, Industrial Ecology, Industrial symbiosis.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Group discussion on depletion of natural resources
2. Poster presentation on Clean Development Mechanism
3. Submit a case study report on Life Cycle Analysis of any one type of the products such as home appliances, and daily used products (clothes, leather belt, bag, shoe, etc.).
4. Design sustainable remediation for any of the contaminated sites (any one site can be taken up as a case study and design)
5. Submit a case study report on Green Rating Systems for any one of the green rated buildings (methods used for green rating may be ENVISION, LEED, GRIHA, IGBC.)
6. Submit a case study report on any one of the smart cities including its advantages and disadvantages.
7. Prepare a report on various IOT options available for design of smart city and implementation.
8. Debate on challenges, limitations and solutions for design and implementation of smart city.

RESOURCES

TEXT BOOKS:

1. Reddy, K.R., Cameselle, C., and Adams, J.A., *Sustainable Engineering: Drivers, Metrics, Tools, and Applications*, John Wiley & Sons, Inc., Hoboken, New Jersey, 2019.
2. Allen, D. T. and Shonnard, D. R., *Sustainability Engineering: Concepts, Design and Case Studies*, Pearson Education, 1st Edition, 2012.

REFERENCE BOOKS:

1. Bradley. A.S; Adebayo, A. O., Maria, P., *Engineering Applications in Sustainable Design and Developmen*t, Cengage Learning, 1st Edition, 2016.
2. Purohit, S. S., *Green Technology: An Approach for Sustainable Environment*, Agrobios Publication, 1st Edition, 2016.
3. *Energy Conservation Building Code (ECBC) 2007*, Bureau of Energy Efficiency, Govt. of India, New Delhi.
4. Twidell, J. W. and Weir, A. D., *Renewable Energy Resources*, Routledge, Taylor & Francis Group, 3rd Edition, 2015.
5. Michael Braungart and William McDonough, *Cradle to Cradle: Remaking the Way We Make Things*, Vintage publications, 2009.
6. Mathew Hampshire-Waugh, *CLIMATE CHANGE and the road to NET-ZERO: Science - Technology - Economics – Politics*, Crowstone Publishing, 2021.
7. R. L. Rag and Lakshmi Dinachandran Ramesh, *Introduction to Sustainable Engineering*, 2nd Edition, PHI Learning, 2015.

VIDEO LECTURES:

1. Introduction to Sustainable Engineering Principles: Lecture-03 (https://www.youtube.com/watch?v=a5i9RVyhBtc)
2. Sustainable Engineering Design Principles (https://www.youtube.com/watch?v=fH_iIVPTujE)
3. "Sustainable Engineering" - Full Program (https://www.youtube.com/watch?v=c2eNrFK5M8I)

WEB RESOURCES:

1. https://www.ceh.org.in/wp-content/uploads/2019/02/GGHH-Case-Study-Energy_KGMU.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://archive.nptel.ac.in/courses/105/105/105105160/
5. https://archive.nptel.ac.in/courses/105/105/105105157/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101015	**AIR AND NOISE POLLUTION AND CONTROL**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Air and noise pollution; Effects of air and noise pollution; Sampling and analysis; Control methods and equipment. This course also examines air and noise pollution from industrial operations.

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

CO1. Analyze air and noise pollution to solve complex environmental problems using appropriate tools and techniques considering society, health and the environment besides communicating effectively in graphical form.

CO2. Analyze the effects of air and noise pollution to solve environmental problems considering society, health, environment and economics besides communicating effectively in graphical form.

CO3. Analyze air and noise sampling techniques to solve complex environmental problems using appropriate tools following relevant standards, codes and latest developments considering society, health and the environment besides communicating effectively in graphical form.

CO4. Analyze the air and noise pollution control methods and equipment to solve complex environmental problems following relevant standards and codes considering society, health, environment and economics besides communicating effectively in graphical form.

CO5. Analyze the air and noise pollution from industrial operations to solve complex environmental problems following relevant standards, codes and regulations considering society, health, and the environment besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: AIR AND NOISE POLLUTION ***(08 Periods)***

Scope and significance of air pollution, Episodes in India and other nations – Overview; Sources and classification of air pollutants, Meteorology and air pollution – Plume behaviour, Wind rose; Dispersion theories and model, Stack height; Scope and significance of noise pollution.

Module 2: EFFECTS OF AIR AND NOISE POLLUTION ***(09 Periods)***

Effects of air pollution on human health, animals and plants; Global effects of air pollution – Greenhouse effect, Heat islands, Acid rains, Ozone holes; Economic effects of air pollution – Material damage; Art treasures in India and other countries; Effects of noise pollution on human health.

Module 3 SAMPLING AND ANALYSIS ***(09 Periods)***

Classification, Stages and methods of sampling, Difficulties encountered, Instruments of sampling, Duration and location of sampling sites, Sampling - High volume filtration, Stack sampling techniques; Recent trends in sampling of stack emissions; Noise measurement methods and analysis.

Module 4 CONTROL METHODS AND EQUIPMENT ***(10 Periods)***

Analytical methods – Chemical, Instrumental and biological methods; Types of collection equipment – Settling chambers, Inertial separators, Cyclones, Bag Filters, Electrostatic precipitators, Scrubbers; Choice of equipment and economical aspects, Control of smoke, Gaseous contaminants, Odours and by process changes; Noise control methods and equipment.

Module 5 AIR AND NOISE POLLUTION FROMINDUSTRIAL OPERATIONS ***(09 Periods)***

Air Pollution from Industrial Operations: Air pollution from major industrial operations – Mining, Cement industry, Petroleum refineries, Ferrous and non-ferrous metallurgical operations, Thermal power plants; National ambient air quality standards; Emission standards and air pollution indices.

Noise Pollution from Industrial Operations: Noise pollution from industrial operations and permitted noise levels as per the regulatory authority.

Total Periods: 45

EXPERIENTIAL LEARNING

1. What's up there besides air? Make a Do-it-yourself pollution catcher an experiment to make a Tetra Pak carton air pollution catcher. An opportunity to take a closer look at what is floating around in the air. You could make one to set up now (while the roads are quieter) and one for another time (when the roads are busier), to see if there is a difference. https://www3.epa.gov/airnow/flag/Whats-UpThere-Besides-Air.pdf
2. Smog in a jar What does smog / polluted air look like? This experiment is a quick and easy way to find out. https://www.youtube.com/watch?v=RoAjQA6KJSA
3. IOT Air & Sound Pollution Monitoring System - https://nevonprojects.com/iot-air-sound-pollution-monitoring-system/
4. Evaluation of Noise Pollution: A Case Study of Udaipur, Tripura, India - https://www.ijert.org/evaluation-of-noise-pollution-a-case-study-of-udaipur-tripura-india

5. The Causes of Noise Pollution - Sound Fighter Systems - https://www.soundfighter.com/what-are-the-causes-of-noise-pollution/

RESOURCES

TEXTBOOKS:

1. Rao, M.N. and Rao, H.V.N.,Air Pollution, Tata McGraw- Hill Education Pvt. Ltd., New Delhi, 19thEdition, 2010.
2. Thod Godish, Air Quality, Levis Publishers, Taylor and Francis Group, New Delhi, 4thEdition, 2003.
3. Wark, K. and Warner, C.F., Harper and Row, Air Pollution: Its Origin and Control, Addison–Wesley, New York, 3rdEdition, 1998.

REFERENCE BOOKS:

1. Trivedy, R.K. and Goel,P.K.,An Introduction to Air Pollution, B.S.P. Books Pvt. Ltd., Hyderabad, 2ndEdition, 2005.
2. Crawford, M., Air pollution Control Theory, Tata McGraw-Hill, New Delhi, 1980.
3. Perkins, H. C.,Air Pollution, McGraw Hill Higher Education, Lincoln, United Kingdom, 1974.
4. Dara, S.S. and Mishra, D.D., A Textbook of Environmental Chemistry and Pollution Control, S. Chand Publishing, New Delhi, 2006.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105104099
2. https://nptel.ac.in/courses/112104227
3. https://www.youtube.com/watch?v=f8q4txT04yE&ab_channel=Ekeeda
4. https://www.britannica.com/science/noise-pollution
5. http://www.infocobuild.com/education/audio-video-courses/earth-environment/EnvironmentalAirPollution-IIT-Kanpur/lecture-07.html

WEB RESOURCES:

1. Fact Sheets on the European Union: https://www.europarl.europa.eu/factsheets/en/sheet/75/air-and-noise-pollution
2. Air and Water Pollution: Burden and Strategies for Control: https://www.ncbi.nlm.nih.gov/books/NBK11769/
3. Clean Air Act | Noise Pollution | US EPA: https://www.epa.gov/clean-air-act-overview/clean-air-act-title-iv-noise-pollution
4. Noise Pollution - CPCB | Central Pollution Control Board -https://cpcb.nic.in/noise-pollution/
5. Control Strategies to Achieve Air Pollution Reduction | US EPA - https://www.epa.gov/air-quality-management-process/managing-air-quality-control-strategies-achieve-air-pollution

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101016	SOLID AND HAZARDOUS WASTE MANAGEMENT	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on the Sources and types of municipal solid wastes; Onsite handling; Storage and processing; Collection and transfer; Off-site processing and disposal, Hazardous waste management.

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

CO1. Analyze municipal solid waste to solve complex problems associated with it using appropriate tools and techniques, following relevant codes, regulations and latest developments considering health, society, environment, sustainability and economics besides communicating effectively in graphical form.

CO2. Analyze on–site storage and processing of municipal solid waste to solve complex problems using appropriate tools and techniques following relevant guidelines and latest developments considering health, society, environment and sustainability and economics besides communicating effectively in graphical form.

CO3. Analyze collection and transfer of municipal solid waste to solve complex problems using appropriate tools and techniques following relevant guidelines and latest developments considering health, society, environment, sustainability and economics besides communicating effectively in graphical form.

CO4. Analyze off–site processing of municipal solid waste to solve complex problems using appropriate tools and techniques following relevant guidelines and latest developments considering health, society, environment, sustainability, economics and project management besides communicating effectively in graphical form.

CO5. Design sanitary landfills to solve complex municipal solid waste disposal problems using appropriate tools and techniques following relevant guidelines and latest developments considering health, society, environment, sustainability, economics and project management besides communicating effectively in graphical form.

CO6. Analyze hazardous waste to solve complex problems associated with it using appropriate tools and techniques following relevant codes, regulations and latest developments considering health, society, environment, sustainability and project management besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: MUNICIPAL SOLID WASTE ***(09 Periods)***

Sources and types of solid wastes – Quantity, Factors affecting generation of solid wastes, Characteristics, Methods of sampling and characterization, Public health effects, Social and economic aspects, Public awareness, Role of NGOs, Legislation.

Module 2: ON–SITE STORAGE AND PROCESSING ***(09 Periods)***

Principles of solid waste management, On–site segregation and storage methods, Materials used for containers, Public health and economic aspects of storage, Options under Indian conditions, Critical evaluation of options.

Module 3 COLLECTION AND TRANSFER ***(09 Periods)***

Methods of collection, Types of vehicles, Manpower requirement, Analysis of Collection routes, Transfer stations, Selection of location, Operation and maintenance, Collection options under Indian conditions.

Module 4 OFF–SITE PROCESSINGAND DISPOSAL ***(08 Periods)***

Off–Site Processing: Processing techniques and equipment, Resource and energy recovery from solid wastes – Composting, Incineration and pyrolysis.

***Disposal*:** Dumping of solid waste, Effects of improper disposal of solid wastes, Sanitary landfills – Site selection, Design and operation of sanitary landfills, Leachate collection and treatment.

Module 5 HAZARDOUS WASTE MANAGEMENT ***(10 Periods)***

Introduction to Hazardous wastes, Definition of Hazardous waste, The magnitude of the problem, Risk assessment, Environmental legislation, Characterization and site assessment, Waste minimization and resource recovery, Transportation and disposal of hazardous waste; Biomedical waste management – Incineration and pyrolysis.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Group discussion on "Factors affecting the generation of solid wastes"
2. Poster presentation on "Methods of sampling and characterization"
3. Poster presentation on "On–site segregation and storage methods"
4. Submit a case study report of any one the towns/cities on "Collection and Transfer of Municipal Solid Waste" of any one town/city.
5. Prepare a report on any one of the Off-site processing methods such as Composting, Incineration and pyrolysis of solid waste management.
6. Design a sanitary landfill for the management of solid waste generated in your town.
7. Analyze and Submit a report on the Biomedical waste management rules and regulations.
8. Prepare and submit a report on Biomedical Waste Management techniques such as Autoclave, Incineration and pyrolysis.

RESOURCES

TEXT BOOKS:

1. George Tchobanoglous et. al., *Integrated Solid Waste Management*, McGraw–Hill Publishers, 2nd Edition, 2002.
2. Woodside, G., *Hazardous Materials and Hazardous Waste Management*, John Wiley & Sons, 2nd Edition, 1999.

REFERENCE BOOKS:

1. Ramachandra, T. V., *Management of Municipal Solid Waste*, The Energy and Resources Institute (TERI), 1st Edition, 2011.
2. *Manual on Municipal Solid Waste Management*, CPHEEO, Ministry of Urban Development, Government of India, 2000.
3. Asnani, P. U., and Chris Zurbrugg, *Improving Municipal Solid Waste Management in India: A Sourcebook for Policymakers and Practitioners*, World Bank Publications,1stEdition, 2007.
4. Bhide, A. D. and Sundaresan, B. B., *Solid Waste Management in Developing Countries*, INSDOC, 1st Edition, 2010.

VIDEO LECTURES:

1. Solid and hazardous waste management- I (https://www.youtube.com/watch?v=4usR910eqeU)
2. Solid waste Management | Treatment and Disposal | Environment Crash Course (https://www.youtube.com/watch?v=XHi7kV-ZMT0)
3. Integrated Municipal Solid Waste Management Plant (https://www.youtube.com/watch?v=UAscjVNNF0Q)
4. How to start New Business in Waste Management || Mission Atmanirbhar Bharat (https://www.youtube.com/watch?v=VlZkINpPGOU)
5. Top 10 awesome RECYCLING BUSINESSES with high profit in future (https://www.youtube.com/watch?v=cQqhKzcHnAg)

WEB RESOURCES:

1. https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/WEDC/es/ES07CD.pdf
2. https://lecturenotes.in/subject/494/solid-waste-management-swm/note?orderBy=desc&sortBy=popular
3. https://mohua.gov.in/upload/uploadfiles/files/Part2.pdf
4. file:///C:/Users/Admin/Downloads/paperid-212014116.pdf
5. https://nptel.ac.in/courses/105106056
6. https://nptel.ac.in/courses/105103205

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE103002	ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT	3	-	-	4	4

Pre-Requisite 22CE102005-Environmental Engineering.

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Environmental Impact Assessment; EIA methodologies; EIA on soil, groundwater and surface water; EIA on air, vegetation and wild life; Environmental acts and management system.

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

CO1. Analyze the environmental impact assessment to provide solutions to environmental problems using appropriate tools and techniques following relevant standards and regulations considering the society, health, safety, environment, sustainability and economics besides communicating effectively in graphical form.

CO2. Analyze EIA methodologies to solve environmental problems following relevant standards, regulations and latest developments considering the society, health, safety, environment, sustainability and economics besides communicating effectively in graphical form.

CO3. Analyze EIA on soil, groundwater and surface water to provide solutions to environmental problems using appropriate tools and techniques following relevant standards and regulations considering the society, health, safety, environment, sustainability and project management besides communicating effectively in graphical form.

CO4. Analyze EIA on air, vegetation and wildlife to provide solutions to environmental problems using appropriate tools and techniques following relevant standards and regulations considering the society, health, safety, environment, sustainability and project management besides communicating effectively in graphical form.

CO5. Analyze environmental acts and management system to solve complex environmental problems using appropriate tools and techniques following relevant standards, regulations and latest developments considering the society, health, safety, environment, sustainability and project management besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: ENVIRONMENTAL IMPACT ASSESSMENT *(09 Periods)*

Basic concept of EIA, Introduction to life cycle analysis, Initial environmental examination, Elements of EIA, Factors affecting EIA, Impact evaluation and analysis, Preparation of environmental base map and classification of environmental parameters.

Module 2: EIA METHODOLOGIES *(08 Periods)*

Criteria for the selection of EIA Methodology; EIA Methods – Adhoc method, Matrix method, Network method, Environmental medium quality index method, Overlay method and Cost/benefit analysis, Latest developments.

Module 3 EIA ON SOIL, GROUNDWATER AND SURFACE WATER *(10 Periods)*

Soil and water quality, Impact assessment on soil – Delineation of study area, Identification of activities, Impact prediction, Assessment of impact significance, Identification and incorporation of mitigation measures; EIA on surface and ground water - Methodology for the assessment of impacts on water environment, Identification and incorporation of mitigation measures, Watershed management.

Module 4 EIA ON AIR, VEGETATION AND WILDLIFE *(09 Periods)*

Air pollution sources, generalized approach for assessment of impact due to air pollution caused by the various anthropogenic activities, Identification and incorporation of mitigation measures; Assessment of impact on vegetation and wildlife caused by the various developmental activities; Environmental impact due to deforestation – Causes and effects; Case studies.

Module 5 ENVIRONMENTAL ACTS AND MANAGEMENT SYSTEM *(09 Periods)*

Environmental Acts - Environmental protection act, The water act, The air act, Wild life act; Environmental management system– Objectives, Environmental audit, Types and Stages of environmental audit, Evaluation of audit data and preparation of audit report, Post audit activities, case studies.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Classify the environmental parameters for impact assessment study and do prepare the environmental base map considering any of the case study.
2. Discuss the latest developments in the EIA methodologies and compare the old with new methodologies.
3. Identify the activities that likely to cause impact during the construction stage of paper mill on soil and water and assess the impact due to it and suggest mitigation measures considering the any one of the case studies.
4. Identify the activities that likely to cause impact during the post-construction stage of thermal power plant on air and water and assess the impact due to it and suggest mitigation measures considering any one of the case studies.
5. What are the objectives of environmental management system? Explain different types and stages of environmental audit taking into account any one of the industries.

PROJECT BASED LEARNING:

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

RESOURCES

TEXT BOOKS:

1. Anjaneyulu, Y., *Environmental Impact Assessment Methodologies,* B.S. Publications, 2nd Edition, 2007.
2. Khandeshwar, S.R., Raman, N.S., Gajbhiye, A.R., *Environmental Impact Assessment*, Wiley Publications, Wiley India Pvt. Ltd., Noida, 2019.

REFERENCE BOOKS:

1. Marriott, B., *Environmental Impact Assessment: A Practical Guide*, McGraw-Hill, New York, USA. 1997.
2. Charless H. Eccleston, *Environmental Impact Assessment*, CRC Press, Taylor and Francis Group, 2011.
3. Suresh K. Dhameja, *Environmental Engineering and Management*, S.K. Kataria and Sons, 2010.
4. Rakesh Kumar and Singh, R. N., *Municipal Water and Wastewater Treatment*, TERI, 2009.
5. Bhatia, H. S., *A Text Book of Environmental Pollution and Control*, Galgotia Publications (P) Ltd., 2003

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105105178
2. https://nptel.ac.in/courses/105105048

WEB RESOURCES:

1. https://research.iaun.ac.ir/pd/aminsharei/pdfs/UploadFile_1633.pdf
2. https://www.sciencedirect.com/science/article/abs/pii/S0045653521017173
3. https://www.researchgate.net/publication/326586068_Industrial_wastewater_treatment_process
4. https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_6_Ch6_Wastewater.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101017	SUSTAINABLE DESIGN OF TECHNOLOGY SYSTEMS	3	-	-	-	3

Pre-Requisite 22CE101014-Sustainable Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Sustainability and sustainable development; Product life cycle design – Methods and strategies; Product life cycle design – Software tools; Designing for sustainable product-service system – Methods and tools; Design for sustainability – Engineering design criteria and guidelines.

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

CO1. Analyze sustainability and sustainable development to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.

CO2. Analyze product life cycle design methods and strategies to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.

CO3. Analyze product life cycle design software tools to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.

CO4. Design sustainable product-service systems to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.

CO5. Design engineering criteria and guidelinesto solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT ***(09 Periods)***

Sustainability and sustainable development - Understanding un-sustainability and need for Sustainability, Definitions, Pathway, and Systems approach to design; Evolution of sustainability within design - Diverse approaches to design for sustainability, Relationship between approaches to design for sustainability and the application context.

Module 2: PRODUCT LIFE CYCLE DESIGN – METHODS AND STRATEGIES ***(08 Periods)***

Life Cycle Assessment (LCA) - Product Life Cycle Assessment, LCA introduction, LCA methodology, LCA goal, LCA scope, Inventory analysis, Impact assessment, Interpretation; Environmental risk, Environmental impacts calculation by using LCA technique, Risk assessment with concepts of LCA.

Module 3 PRODUCT LIFE CYCLE DESIGN – SOFTWARE TOOLS ***(08 Periods)***

History of product design by LCA with examples; ISO 14000, Life cycle analysis, SIMA PRO, LCA software and other software for LCA, LCA methodical challenges - Allocation and uncertainty, Sensitivity analysis.

Module 4 DESIGNING FOR SUSTAINABLE PRODUCT-SERVICE SYSTEM – METHODS AND TOOLS ***(10 Periods)***

Sustainable product service system design – Definition, Types and examples; Sustainable product service system – Transition path and challenges, Sufficiency economy philosophy applied to sustainable product-service system (PSS) thinking, Khadi movement as a precursor to PSS thinking.

Module 5 DESIGN FOR SUSTAINABILITY – ENGINEERING DESIGN CRITERIA AND GUIDELINES ***(10 Periods)***

Sustainable product-service system design applied to distributed economy, Other design for sustainability tools and approaches – Agriculture, Cities and communities, Carbon footprint, Green buildings, Green materials, Green energy, Sustainable development, Zero waste, Circular economy.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Describe about Design for Sustainability with any one example.
2. Analyze Life Cycle Analysis techniques for a product and service.
3. Mention the software tools available for product life cycle design and using the same do solve any one problem as an example.
4. Discuss about challenges faced in sustainable design of products.
5. Discuss about Zero waste and Circular economy, differentiate between them.

RESOURCES

TEXT BOOKS:

1. Horne, Ralph, Tim Grant, and Karli Verghese, *Life Cycle Assessment: Principles, Practice and Prospects*, Csiro Publishing, 2009.
2. Bhamra, Tracy, and Vicky Lofthouse, *Design For Sustainability: A Practical Approach*. Routledge, 1st Edition, 2016.
3. R.L Rag and Lakshmi Dinachandran Ramesh, Introduction to SUSTAINABLE ENGINEERING, 2ndEdition, PHI Learning, 2015.

REFERENCE BOOKS:

1. Vezzoli, C., Kohtala, C., Srinivasan, A., Diehl, J. C, Fusakul, S. M., Xin, L. and Sateesh, D., Product-service System Design for Sustainability, Routledge, 1st Edition, 2017.
2. Curran, Mary Ann, *Life Cycle Assessment Student Handbook*, John Wiley & Sons, 1st Edition, 2015.
3. Hauschild, Michael Z., Ralph K. Rosenbaum and Stig Irvin Olsen, *Life Cycle Assessment*, Springer International Publishing, 2018.
4. Hendrickson, Chris T., Lester B. Lave, and H. Scott Matthews, *Environmental Life Cycle Assessment of Goods and Services: An Input-Output Approach*. Routledge, 2010.
5. Curran, Mary Ann, *Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products*, John Wiley & Sons, 3rd Edition, 2012.
6. Mathew Hampshire-Waugh, CLIMATE CHANGE and the road to NET-ZERO: Science - Technology - Economics – Politics, Crowstone Publishing, 2021.

VIDEO LECTURES:

1. https://sites.google.com/view/designandinquiry/dp-sl-design/topic-2-resource-management-and-sustainable-production
2. https://www.oneclicklca.com/bim-based-life-cycle-assessment-guidelines/
3. https://www.youtube.com/watch?v=bXWtU9j0o2M
4. https://www.youtube.com/watch?v=uaJ8wGMAPD0
5. https://zerowastecities.eu/webinar/creating-effective-systems-for-reuse/

WEB RESOURCES:

1. https://nptel.ac.in/ courses/107/103/107103081/
2. https://ecochain.com/knowledge/life-cycle-assessment-software-overview-comparison/
3. https://esg.tech/how-to/top-5-life-cycle-assessment-software/
4. https://www.conserve-energy-future.com/top-sustainable-construction-technologies-used-green-construction.php
5. https://isd.engin.umich.edu/course-listings/mecheng-589-sustainable-design-of-technological-systems/
6. https://www.gsa.gov/real-estate/design-and-construction/sustainability/sustainable-design

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE102010	**ADVANCED STRUCTURAL ANALYSIS**	3	-	2	-	4

Pre-Requisite 22CE101003-Structural Analysis

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on flexibility method, stiffness method, portal frames, approximate methods, redundant pin–jointed frames, two hinged arches, three hinged arches, Cables and suspension bridges.

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

CO1. Evaluate the continuous beams to solve complex advanced structural analysis problems using different tools and techniques considering safety, either individually or in a team besides communicating effectively in graphical form.

CO2. Evaluate the portal frames to solve complex advanced structural analysis problems using appropriate methods considering safety, either individually or in a team besides communicating effectively in graphical form.

CO3. Evaluate the redundant pin-jointed plane trusses to solve complex advanced structural analysis problems using Castigliano's theorem considering safety, either individually or in a team besides communicating effectively in graphical form.

CO4. Evaluate the three hinged and two hinged arches to solve complex advanced structural analysis problems using appropriate techniques considering safety, either individually or in a team besides communicating effectively in graphical form.

CO5. Evaluate the cables and suspension bridges to solve complex advanced structural analysis problems using appropriate techniques considering safety, either individually or in a team besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: MATRIX METHODS ***(09 Periods)***

Flexibility Method:Flexibility coefficients, Flexibility matrices, Application to continuous beams without and with settlement of supports

Stiffness Method: Stiffness coefficients, Stiffness matrices, Application to continuous beams without and with settlement of supports.

Module 2: PORTAL FRAMES ***(09 Periods)***

Analysis of single bay, single storey, portal frame including side sway;Shear force and bending moment diagrams by slope deflection method, moment distribution method and Kani's method.

Module 3: APPROXIMATE METHODSAND REDUNDANT PIN–JOINTED FRAMES ***(09 Periods)***

Approximate Methods: Analysis of multi-storey frames for lateral loads using portal and cantilever methods.

Redundant Pin–Jointed Frames: Indeterminate frames, Static and kinematic indeterminacies, Castigliano's theorem, Analysis of pin–jointed frames up to two degrees of internal and external indeterminacies.

Module 4: ARCHES ***(09 Periods)***

Three Hinged Arches: Types of arches, Elastic theory of arches, Eddy's theorem, Determination of horizontal thrust, bending moment, normal thrust and radial shear; Effect of temperature.
Two Hinged Arches: Determination of horizontal thrust bending moment, normal thrust and radial shear; Rib shortening and temperature stresses.
Tied arches; Fixed arches(No analytical question).

Module 5: CABLES AND SUSPENSION BRIDGES ***(09 Periods)***

Basic concepts, Suspension cables, Reactions, Tension and length of suspension cable; Effect of change in temperature, Suspension bridges with two and three stiffening girders.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:
SOFTWARE: STADD PRO, ETABS etc.

1. Analysis of determinate beams
    a) Cantilever beam
    b) Simply supported beam
    c) Overhanging beam
2. Analysis of indeterminate beams
    a) Propped cantilever beam
    b) Fixed beam
    c) Continuous beam
3. Analysis of 2–D Portal Frame

4. Analysis of 3–D Portal Frame
5. Analysis of multi-storey frames for lateral loadings
6. Analysis of redundant pin–jointed frames
7. Analysis of two hinged arches
8. Analysis of three hinged arches
9. Analysis of fixed arches
10. Analysis of cables and suspension bridges

RESOURCES

TEXT BOOKS:

1. Vaidyanathan, R. and Perumal, P., *Structural Analysis- Vol. I and II*, Laxmi Publications, 4tl Edition, 2016.
2. Vazirani, V. N., Ratwani, M. M. and Duggal, S. K., *Analysis of Structures– Vol. I and Vol. II* Khanna Publications, 17th Edition, 2013.

REFERENCE BOOKS:

1. Bhavikatti S. S., *Structural Analysis– Vol. I and II,* Vikas Publishing House Pvt. Ltd., 4tl Edition, 2010.
2. Thandavamoorthy, T. S., *Structural Analysis*, Oxford University Press, 5th Edition, 2011.
3. Punmia, B. C., Ashok Kumar Jain and Arun Kumar Jain, *SMTS–II –Theory of Structures* Laxmi Publications (P) Ltd., 12th Edition, 2004.
4. Khurmi, R. S., *Theory of Structures*, S. Chand & Company Ltd., 22nd Edition, 2010.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/106/105106050/
2. https://archive.nptel.ac.in/courses/105/105/105105109/
3. https://sites.google.com/site/civilengineeringnitrourkela/specilizations/structural-engineering/nptel-video-links

WEB RESOURCES:

1. https://temple.manifoldapp.org/read/structural-analysis/section/156da66f-a619-48c1-ba0f-c6afdbf39088
2. https://structville.com/2022/05/introduction-to-theory-of-structures-structural-analysis.html
3. https://www.sciencedirect.com/topics/engineering/structural-analysis
4. https://www.madeeasy.in/Uploads/examsolution/Structural-Analysis.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101018	**ADVANCED REINFORCED CEMENT CONCRETE STRUCTURES**	3	-	-	-	3

Pre-Requisite 22CE101005-Reinforced Cement Concrete Structures

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion ON Advanced reinforced cement concrete structures: Foundations, Flat slabs, Retaining walls, Water tanks, Bunkers, Silos and Chimneys.

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

CO1. Design foundations to solve complex problems related to reinforced cement concrete structures using appropriate methods and relevant codes of practice ensuring safety and serviceability besides communicating effectively through schematic detailing.

CO2. Design flat slabs to solve complex problems related to reinforced cement concrete structures using appropriate methods and relevant codes of practice ensuring safety and serviceability besides communicating effectively through schematic detailing.

CO3. Design retaining walls to solve complex problems related to reinforced cement concrete structures using appropriate methods and relevant codes of practice ensuring safety and serviceability besides communicating effectively through schematic detailing.

CO4. Design water tanks to solve complex problems related to reinforced cement concrete structures using appropriate methods and relevant codes of practice ensuring safety and serviceability besides communicating effectively through schematic detailing.

CO5. Design bunkers, silos and chimneys to solve complex problems related to reinforced cement concrete structures using appropriate methods and relevant codes of practice ensuring safety and serviceability besides communicating effectively through schematic detailing.

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

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

COURSE CONTENT

Module 1: FOUNDATIONS ***(10 Periods)***

Design of Strap Footings, Raft Foundations, Pile Foundations, Pile Cap.

Module 2: FLAT SLABS ***(08 Periods)***

Properties of flat slabs, Behaviour of flat slab, Shear in flat slabs, Design of flat slabs.

Module 3: RETAINING WALLS ***(09 Periods)***

Lateral earth pressure, Design of cantilever and counterfort retaining walls.

Module 4: WATER TANKS ***(09 Periods)***

Types of water tanks, IS code provisions, Design of water tanks with flexible base and rigid base.

Module 5: MISCELLANEOUS STRUCTURES ***(09 Periods)***

Design of Bunkers, Silos, Chimneys.

Total Periods: 45

EXPERIENTIAL LEARNING

1. A retaining wall Prototype Model: In this assignment, students will be able to understand the concept of lateral earth pressure and the design of retaining wall.
2. A flat slab Prototype Model: In this assignment, students will be able to understand the behaviour of flat slab due to the external load and also the design of it.
3. Practical Visual Learning of foundations: In this assignment, students will be able to understand the design of strap, raft and pile foundation by visiting nearby site.
4. Practical Visual Learning of retaining wall: In this assignment, students will be able to understand the concept of lateral earth pressure and the design of retaining wall by visiting nearby site.
5. Practical Visual Learning of Bunkers, Silos and Chimneys: In this assignment, students will be able to understand the concept and design of bunkers, Silos and Chimneys by visiting nearby industries.

RESOURCES

TEXT BOOKS:

1. Syal, I.C., Goel, A.K., *Reinforced Concrete Structures*, S. Chand & Company Ltd. 4th Edition, 2010.
2. Krishna Raju,*Advanced Reinforced Concrete Design*, CBS Publishers and Distributors, 3rd Edition 2016.

REFERENCE BOOKS:

1. Roy, S. K. and Sinha, N. C., *Fundamentals of Reinforced Concrete*, S. Chand & Company Ltd., 5th Edition, 2013.
2. Varghese, P. C., *Limit State Design of Reinforced Concrete*, Prentice Hall of India, 2nd Edition, 2010.
3. Punmia, B. C., Ashok Kumar Jain and Arun Kumar Jain, *Reinforced Concrete Structures - Vol. I*, Laxmi Publications Pvt. Ltd., 7th Edition, 2013.
4. Gambhir, M. L., *Fundamentals of Reinforced Concrete Design,* Printice Hall of India Pvt. Ltd., 2011.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=lsYFtwwlHIw&list=PLbRMhDVUMngeiZjKPTPEFl1CByXmYX3Kv
2. https://www.youtube.com/watch?v=t8oI0lKZ7sE
3. https://www.youtube.com/watch?v=mUWCnANvJdE&t=34s
4. https://www.youtube.com/watch?v=K2lGPDj2KTg

WEB RESOURCES:

1. https://www.iitmanagement.com/images/Gallery/Reinforced%20Concrete%20Design.pdf
2. https://old.amu.ac.in/emp/studym/3789.pdf
3. https://ecajmer.ac.in/facultylogin/announcements/upload/Water%20Tank%201.pdf
4. https://egyankosh.ac.in/bitstream/123456789/31116/1/Unit-13.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101019	**PRESTRESSED CONCRETE**	3	-	-	-	3

Pre-Requisite 22CE101005-Reinforced Cement Concrete Structures

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Materials for prestressed concrete, Prestressing systems**,** Analysis of prestress, Design of section for flexure and shear, Analysis of end blocks, Composite construction of prestressed and insitu concrete.

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

CO1. Analyze materials and prestressing systems to solve prestressed concrete structural problems using appropriate techniques following the relevant codes of practice ensuring safety.
CO2. Analyze prestress for flexure and losses to solve complex prestressed concrete structural problems using appropriate techniques ensuring safety.
CO3. Design a section for flexure and shear to solve prestressed concrete structural problems following the relevant codes of practice ensuring safety.
CO4. Design end blocks to solve prestressed concrete structural problems using appropriate techniques following the relevant codes of practice ensuring safety.
CO5. Design composite sections of prestressed and insitu concreteto solve composite construction problems following the relevant codes of practice ensuring safety.

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

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

COURSE CONTENT

Module 1: MATERIALS FOR PRESTRESSED CONCRETE AND PRESTRESSING SYSTEMS ***(08 Periods)***

Principles of prestressing, Types of prestressing, Materials - High strength concrete, High tensile steel; Advantages and limitations of pre-stressed concrete, Tensioning devices, Pretensioning and post-tensioning systems, Types - Hoyer system, Magnel Blaton system, Freyssinet system, Gifford-Udall system, Lee McCall system.

Module 2: ANALYSIS OF PRESTRESS ***(10 Periods)***

Analysis of sections for flexure – Stress concept, Load balancing concept, Force concept; Kern zone, Pressure line, Cable zone, Losses of prestress in pre-tensioning and post-tensioning system.

Module 3: DESIGN OF SECTION FOR FLEXURE AND SHEAR ***(08 Periods)***

Design of section for the limit state of collapse in flexure, Stress range approach, Design of shear reinforcements – IS codal provision

Module 4: ANALYSIS OF END BLOCKS ***(10 Periods)***

Anchorage zone stresses - Guyon's method, Magnel method; Anchorage zone reinforcement, Transfer of prestress pre–tensioned members.

Module 5: COMPOSITE CONSTRUCTION OF PRESTRESSED AND INSITU CONCRETE ***(09 Periods)***

Need of composite construction, Different types – Propped, Unpropped; Stress distribution of composite construction, Differential shrinkage, Design of composite section.

Total Periods: 45

EXPERIENTIAL LEARNING

1. A Prestressing device Prototype Model: In this assignment, students will be able to understand the concept of prestressing and different types of prestressing of the structural component.
2. Practical Visual Learning of a Precast Member: In this assignment, students will be able to visualize and understand the concept of prestressing and the materials used to prestress the member by going to nearby precast division.
3. A Prototype Model: In this assignment, students will be able to understand the analysis of end blocks by different method .
4. Practical Visual Learning: In this assignment, students will be able to visualize and understand the composite construction of prestressed and insitu concrete by visiting nearby site.
5. Practical Visual Learning: In this assignment, students will be able to visualize and understand the design of section and shear reinforcement by visiting nearby site.

RESOURCES

TEXT BOOKS:

1. Krishna Raju, N., *Prestressed Concrete*, Tata McGraw–Hill Publications, 6th Edition, 2018.
2. Rajagopalan, N., *Prestressed Concrete*, Narosa Publications, 2nd Edition, 2014.

REFERENCE BOOKS:

1. Ramamrutham, *Prestressed Concrete*, Dhanpat Rai Publications, 5th Edition, 2013.
2. Lin, T. Y., and Ned H. Burns, *Design of Prestressed Concrete Structures*, John Wiley and Sons, 3rd Edition, 2010.
3. Praveen Nagaraju, *Prestressed Concrete Design*, Dorling Kindersley Publication, 2013.
4. Punmia., B. C., Ashok Kumar Jain and Arun Kumar Jain, *Reinforced Concrete Structures*, *Vol. I*, Laxmi Publications Pvt. Ltd., New Delhi, 19th Edition, 2010.

CODE:

IS: 1343–2012 : Prestressed Concrete – Code of Practice

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=4KYPltsNAWs&list=PLB50EF6A79D1F8C14
2. https://www.youtube.com/watch?v=4NelroYGY3U
3. https://www.youtube.com/watch?v=SFJkU7TnllA&t=1761s
4. https://www.youtube.com/watch?v=3zKbD3C_9ZI

WEB RESOURCES:

1. https://www.colincaprani.com/files/notes/CED1/PSC%20Notes.pdf
2. https://edurev.in/t/186810/Prestressed-Concrete
3. https://www.academia.edu/38624949/Lecture_Note_17_PRESTRESS_CONCRETE_Introduction
4. https://backbencher.club/design-of-pre-stressed-concrete/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101020	**ADVANCED STEEL STRUCTURES**	3	-	-	-	3

Pre-Requisite 22CE101006-Steel structures

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Light gauge steel sections, Welded plate girders, Gantry girder, Steel water tanks and Steel-concrete composite construction.

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

CO1. Design light gauge steel section to solve complex problems associated with steel structures using appropriate techniques following relevant codes considering safety and stability besides communicating effectively in graphical form.

CO2. Design welded plate girders to solve complex problems associated with steel structures using appropriate techniques following relevant codes considering safety and stability besides communicating effectively in graphical form.

CO3. Design gantry girders to solve complex problems associated with steel structures using appropriate techniques following relevant codes considering safety and stability besides communicating effectively in graphical form.

CO4. Design steel water tanks to solve complex problems associated with steel structures using appropriate techniques following relevant codes considering safety and stability besides communicating effectively in graphical form.

CO5. Design steel concrete composite construction to solve complex problems associated with steel structures using appropriate techniques following relevant codes considering safety and stability besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: LIGHT GAUGE STEEL SECTIONS ***(09 Periods)***

Types of section, Material, Local Buckling of thin elements, Stiffened compression elements, Unstiffened compression elements, Compression members, Flexural members – Laterally supported and Unsupported flexural members, Connections.

Module 2: WELDED PLATE GIRDER ***(09 Periods)***

Design of cross section of plate girders; Design of end stiffeners, intermediate stiffeners, bearing stiffeners and horizontal stiffeners.

Module 3: GANTRY GIRDER ***(09 Periods)***

Gantry girder impact factors, Longitudinal forces, Design of gantry girders.

Module 4: STEEL WATER TANKS ***(09 Periods)***

Specifications, Design of rectangular pressed steel tank.

Module 5: STEEL - CONCRETE COMPOSITE CONSTRUCTION ***(09 Periods)***

Design principles, Shear connections, Composite beam design.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Field study report on light gauge steel sections
2. Analysis and design of welded plate girder.
3. Field study report on gantry girder from industry.
4. Field study report on steel water tanks from railway stations.
5. Field study report on Steel-concrete composite construction bridges.

RESOURCES

TEXT BOOKS:

1. Punmia, B. C., Ashok Kumar Jain and ArunKumar Jain, *Design of Steel Structures,* Laxmi Publications, 2nd Edition, 2013.
2. Johnson, R.P., *Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings - Vol.I*, Blackwell Scientific Publications, 2004.

REFERENCE BOOKS:

1. Ramachandra, S., *Design of Steel Structures*, Dhanpat Rai Publishing Company, 2nd Edition, 2016.
2. Arya, A. S., Ajmani, J.L., *Design of Steel Structures*, Nem Chand & Bros, 5th Edition, 2001.
3. Duggal, S. K., *Limit State Design of Steel Structures*, McGraw Hill, 3rd Edition, 2019.
4. Subramanian, N., *Design of Steel Structures*, Oxford University Press, 2nd Edition, 2018.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105105162
2. https://archive.nptel.ac.in/courses/105/106/105106113/
3. https://archive.nptel.ac.in/courses/114/106/114106047/
4. https://shorturl.at/dnoz1

WEB RESOURCES:

1. https://tatabluescopesteel.com/blogs/light-gauge-framing-system-lgfs-a-smart-and-sustainable-steel-building-technology/
2. https://www.structuralguide.com/plate-girder/
3. https://housing.com/news/gantry-girders-how-useful-are-they-in-moving-heavy-equipment/
4. https://www.escglobalgroup.com/post/steel-concrete-composite-construction

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE104001	**ADVANCED SURVEYING**	2	-	2	4	4

Pre-Requisite 22CE102007-Surveying

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on astronomical surveying, construction and boundary surveys, theory of errors, land surveys, triangulation and baseline measurements, GPS surveying, drone surveying.

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

CO1. Evaluate astronomical surveying techniques for measuring azimuth, distances, angles and coordinates to solve complex surveying problems using appropriate tools and techniques by following ethics and considering society, environment besides communicating effectively in graphical form as an individual or in a team.

CO2. Develop survey plots by conducting construction and boundary surveys to solve complex surveying problems using appropriate tools and techniques by following ethics and considering society, environment besides communicating effectively in graphical form as an individual or in a team.

CO3. Analyze errors in surveying to solve complex surveying problems using appropriate tools and techniques by following ethics and considering society, environment besides communicating effectively in graphical form as an individual or in a team.

CO4. Develop land layouts by conducting land surveys to solve complex surveying problems using appropriate tools and techniques by following ethics and considering, society and environment besides communicating effectively in graphical form as an individual or in a team.

CO5. Analyze triangulation and baseline measurements to solve complex surveying problems using appropriate tools and techniques by following ethics and considering society, environment besides communicating effectively in graphical form as an individual or in a team.

CO6. Develop survey plots using GPS and drone surveying to solve complex surveying problems using appropriate tools and techniques by following ethics and through continuous learning considering society by ensuring environment and sustainability besides communicating effectively in graphical form as an individual or in a team.

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	-	2	3	1	1	1	3	3	-	-	-	-	3
CO2	2	3	3	2	3	1	1	1	3	3	-	-	-	-	3
CO3	2	3	-	2	3	1	1	1	3	3	-	-	-	-	3
CO4	2	3	3	2	3	1	1	1	3	3	-	-	-	-	3
CO5	2	3	-	2	3	1	1	1	3	2	-	-	-	-	3
CO6	2	3	3	2	3	1	1	1	3	3	-	1	-	-	3
Course Correlation Mapping	2	3	3	2	3	1	1	1	3	3	-	1	-	-	3

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

COURSE CONTENT

Module 1: ASTRONOMICAL SURVEYING *(05Periods)*

Astronomical coordinate systems, Terrestrial coordinate systems, Astronomical triangle, Determination of azimuth, Determination of latitude and longitude, Time correlations.

Module 2: CONSTRUCTION AND BOUNDARY SURVEYS *(07 Periods)*

Construction Surveys: Specialized equipment for construction surveys, Staking out pipe line, Staking out buildings, Staking out highways, Construction surveys using total station and GNSS equipment, Sources of errors and mistakes in construction surveys.

Boundary Surveys: Categories of land surveys, Property description - By metes and bounds, By block and lot system and by coordinates; Retracement surveys, Partitioning land, Sources of errors and mistakes in boundary surveys.

Module 3 THEORY OF ERRORS AND LAND SURVEYS *(06 Periods)*

Theory of Errors: Types and sources of errors, Loss of accidental errors, Loss of weights, Theory of least squares, Method of weights, Method of correlates, Angle and station adjustment, Figure adjustment.

***Land Surveys*:**Layouts, Measurements.

Module 4 TRIANGULATION AND BASELINE MEASUREMENTS *(06 Periods)*

Principle and classification oftriangulation systems, Selection of base line and stations, Orders of triangulation, Station marks, Signals, Towers, Baseline measurement - Rigid bars, Flexible apparatus, Problems; Satellite station and reduction to centre.

Module 5 GPS SURVEYING AND DRONE SURVEYING ***(06 Periods)***

GPS Surveying:Principles of GPS surveying and methods, Components of GPS-Space segment, Receiver segment, User segment; Errors in observations and corrections, Mapping with GPS, Application of GPS, Advantages over conventional methods, DGPS, Latest advancements in GPS surveying.

Drone Surveying: History, Working principle, Specifications, Regulations of DGCA and drone license, Pre and post flight planning, Data collection, Surveying with drone, Data processing, Mapping and modelling, Applications -Construction, Irrigation and agricultural, Engineering land survey and transportation.

Total Periods: 30

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Determination of latitude and longitude
2. Staking out pipe line using total station
3. Staking out highways using total station
4. Staking out buildings using total station
5. Boundary survey in a layout using total station
6. Boundary survey data processing for preparation of the layout using AutoCAD
7. Generation of coordinates in AutoCAD for developing new plots within the established boundaries in the layout
8. Import the coordinates of the new plots generated to total station and marking them in the field
9. Developing layouts using total station
10. GPS Receiver setup and initialization
11. Plotting an area using GPS measurements
12. Differential Global Positioning System (DGPS) Survey
13. Flying the professional drone in the field and downloading survey data from the drone
14. Geo-referencing the drone images
15. Processing drone survey data to create orthomosaic maps (3D Maps) using data processing software tools
16. Determination of area and volume using drone
17. Route mapping using drone survey
18. Contouring using drone survey
19. Digital Surface Modeling (DSM) and Digital Terrain Modelling (DTM) using drone
20. Infrastructure quality inspection using drone
21. Construction site monitoring using drone

PROJECT BASED LEARNING:

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

RESOURCES

TEXT BOOKS:

1. Arora, K. R., *Surveying – Vol. III*, Standard Book House, 12th Edition, 2015.
2. Ghilani, C.D., *Elementary Surveying-An Introduction to Geomatics*, Pearson India Education Services Pvt. Ltd, 13th Edition, 2018.
3. Chandra, A. M., *Higher Surveying*, New Age International (P) Limited Publishers, 3rd Edition, 2015.

REFERENCE BOOKS:

1. Duggal, S. K., *Surveying – Vol. I and II*, Tata McGraw–Hill Publishing Co. Ltd., 5th Edition, 2019.
2. Benton, A. R., and Taety, P. J., *Elements of Plane Surveying*, McGraw Hill, 3rd Edition, 2010.
3. Punimia, B. C., Ashok Jain, K and Jain, A.K., *Surveying – Vol. II*, Laxmi Publications (P) Ltd, 16th Edition, 2016.
4. Kanetkar, T. P and Kulakarni, S. V., *Surveying and Leveling*, Vidyarthi Griha Prakasham, 24th Edition, 2013.
5. Satheesh, G., Sathikumar, R. and Madhu, N., *Advanced Surveying: Total Station, GPS, GIS & Remote Sensing,* Pearson, *2nd*Edition, 2017.
6. Kike Calvo, *So You Want to Create Maps Using Drones?,* Blurb Publishers, 2015.
7. Armenakis, C. and Patias, P., *Unmanned Vehicle Systems for Geomatics: Towards Robotic Mapping*, Whittles Publishing, 2019.

LAB MANUAL:

1. *Advanced Surveying Manual (MBU22 Regulations)*, Department of Civil Engineering, School of Engineering, Mohan Babu University, Tirupati.

SOFTWARE/TOOLS:

1. Total Station
2. GPS
3. DGPS
4. Drone
5. AutoCAD

VIDEO LECTURES:

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

WEB RESOURCES:

1. Digital Audio Signal Processing: https://fmipa.umri.ac.id/wp-content/uploads/2016/03/Udo-Zolzer-digital-audio-signal-processing.9780470997857.40435.pdf
2. https://www.google.co.in/books/edition/Audio_Engineering_Explained/tsT9kq4m_G8C?hl=en&gbpv=1&kptab=overview
3. List of Audio editing Software: https://www.investopedia.com/best-audio-editing-software-5191187
4. Learn Audio Editing - for Beginners: https://youtu.be/hrQXWaMyPew

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE102011	**GEOSPATIAL TECHNOLOGIES**	2	-	2	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on photogrammetry, global positioning system and remote sensing. This course also emphasizes on geographic information system, GIS spatial analysis; remote sensing and GIS applications.

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

CO1. Evaluate photogrammetry to solve complex surveying problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO2. Evaluate global positioning system and remote sensing to solve complex surveying problems using appropriate tools and techniques following the relevant guidelines considering society, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO3. Evaluate GIS to solve complex surveying problems using appropriate tools and techniques following the relevant guidelines and latest developments either individually or in a team besides communicating effectively in graphical form.

CO4. Develop maps using GIS spatial analysis tools to solve complex surveying problems following the relevant guidelines and latest developments either individually or in a team besides communicating effectively in graphical form.

CO5. Develop maps using remote sensing and GIS tools to solve complex civil engineering problems following the relevant guidelines and latest developments considering society, environment, sustainability and management principles either individually or in a team besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: PHOTOGRAMMETRY **(06 Periods)**

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.

Module 2: GLOBAL POSITIONING SYSTEM AND REMOTE SENSING **(07 Periods)**

Global Positioning System: Components of GPS – Space segment, Control segment, User segment, Reference systems, Satellite orbits; GPS observations, Applications.

Remote Sensing:Elements of remote sensing, Electromagnetic spectrum, Energy resources, Physics of radiant energy, Energy interactions with earth surface features and atmosphere, Data acquisition platforms Spectral reflectance curves, Resolution; Spectral properties of water bodies, soil and vegetation; Sensors and platforms, Visual interpretation techniques.

Module 3: GEOGRAPHIC INFORMATION SYSTEM **(05 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 4: GIS SPATIAL ANALYSIS **(05 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; Software – ArcGIS, QGIS and Global mapper; Latest developments in GIS software.

Module 5: REMOTE SENSING AND GIS APPLICATIONS **(07 Periods)**

Land use/Land cover classification, Rainfall-runoff studies, Flood and drought impact assessment and monitoring, Drainage morphometry, Watershed management for sustainable development, Inland water quality survey and management, Regional and urban planning and management, GIS based highway alignment, GIS based traffic congestion analysis, Soil mapping – Case Studies.

Total Periods: 30

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Photogrammetric analysis for land cover
2. Digitization of toposheet/map
3. Editing map elements
4. GPS Positioning accuracy assessment
5. Remote Sensing Analysis of Traffic Patterns
6. Georeferencing and projection using GIS
7. Spatial analysis tools

8. Developing digital elevation model
9. Preparation of thematic maps using GIS
10. GIS Spatial analysis for road design
11. Simple applications of GIS in watershed analysis
12. Simple applications of GIS in road network analysis
13. Simple applications of GIS in rainfall-runoff analysis

RESOURCES

TEXT BOOKS:

1. Bhatta, B., *Remote Sensing and GIS*, Oxford University Press, 2nd Edition, 2011.
2. Anji Reddi, M., *A Text Book of Remote Sensing and Geographical Information Systems*, B. S. Publications, 2nd Edition, 2012.

REFERENCE BOOKS:

1. 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.
2. Chandra, A. M. and Ghosh, S. K., *Remote Sensing and Geographic Information System*, Narosa Publishing House, 2nd Edition, 2015.
3. Panigrahi, N., *Geographical Information Science*, University Press, 2nd Edition, 2013.
4. Peter A. Burragh and Rachael Mc Donnell, *Principles of Geographical Information Systems*, Oxford University Press, 2nd Edition, 2014.

LAB MANUAL:

1. *Geospatial Technologies Laboratory Manual (MBU22 Regulations)*, School of Engineering, Department of Civil Engineering, Mohan Babu University, Tirupati.

VIDEO LECTURES:

1. http://nptel.ac.in/courses/105/107/105107206/
2. https://syslab.ceu.edu/videos/geospatial-technologies
3. https://www.youtube.com/watch?v=6EsbHPpQQcw
4. https://www.youtube.com/watch?v=GYvKB1wg5hs

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://ucsd.libguides.com/c.php?g=90732&p=584251
4. https://www.studocu.com/en-us/document/university-of-wisconsin-madison/our-digital-globe-an-overview-of-giscience-and-its-technology/lecture-1-notes/14024942

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE104002	**GPS SURVEYING**	2	-	2	4	4

Pre-Requisite 22CE102007-Surveying

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on geodesy, overview of Global Positioning System (GPS);GPS signal structure; GPS errors and accuracy; GPS surveying and applications.

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

CO1. Evaluate geodesy to solve complex problems of global positioning system using appropriate techniques considering society and ethics besides communicating effectively in graphical form as an individual or in a team.

CO2. Evaluate GPS to solve complex navigation problems using appropriate tools and techniques considering society and ethics besides communicating effectively in graphical form as an individual or in a team.

CO3. Evaluate GPS signal structure to solve complex GPS problems using appropriate tools and techniques considering society and ethics besides communicating effectively in graphical form as an individual or in a team.

CO4. Evaluate GPS errors and accuracy to solve complex GPS problems using appropriate tools and techniques considering society and ethics besides communicating effectively in graphical form as an individual or in a team.

CO5. Evaluate GPS Surveying and its applications to solve complex surveying problems using appropriate tools and techniques following latest developments considering society, environment, sustainability and ethics besides communicating effectively in graphical form as an individual or in a team.

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

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

COURSE CONTENT

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

Fundamentals of geodesy, Earth geoid and ellipsoid, Reference surface, geodetic systems, Indian geodetic system, Coordinate systems and transformations.

Module 2: OVERVIEW OF GLOBAL POSITIONING SYSTEM (GPS) ***(08 Periods)***

NAVSTAR GPS, GLONASS, Indian regional navigational Satellite system, Segments of GPS, Blocks of GPS - Block I, II/IIA; Advantages and current limitations of GPS.

Module 3 GPS SIGNAL STRUCTURE ***(09 Periods)***

Carriers, GPS codes - C/A, P, Navigational message; GPS receiver - Types and structure of receivers; Principles of GPS position fixing, Pseudo ranging.

Module 4 GPS ERRORS AND ACCURACY ***(09 Periods)***

Satellite dependent - Ephemeris errors, Satellite clock bias, Selective availability; Receiver dependent - Receiver clock bias, Cycle slip, Selective availability; Observation medium dependent: Ionospheric errors, Tropospheric errors; Station dependent - Multipath, Station coordinates; Satellite geometry based measures - Geometry dependent (Dilution of Precision: DOP),User equivalent range error.

Module 5 GPS SURVEYING AND APPLICATIONS ***(10 Periods)***

Static surveying and kinematics surveying, DGPS survey, Preparation of GPS surveys - Setting up an observation plan, Observation strategies, Network design; GPS applications - Cadastral surveys, Remote sensing and GIS, Military applications and vehicle tracking, Infrastructure development, Natural disasters, Latest advancements in GPS applications.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Study on geodesy and geodetic systems
2. Study onGPS and its accessories to find out location of various points.
3. GPS Receiver Setup and Initialization - Demonstrate the process of initializing the receiver and acquiring satellite signals.
4. Static GPS Survey - Set up a GPS receiver at each control point and collect static GPS data for a specified duration.
5. Real-Time Kinematic (RTK) Survey - Perform real-time surveys by collecting GPS data with the roving receiver while receiving corrections from the base station.
6. Differential GPS (DGPS) Survey
7. GIS Data Collection
8. Determination of orthometric height using GPS data
9. Kinematic Survey - Determine the trajectory, speed, and acceleration of the survey route using GPS data.
10. Plotting an area using GPS measurements
11. Integration with Other Surveying Techniques - Combine GPS surveying with other surveying methods, such as total stations or LiDAR.

PROJECT BASED LEARNING:

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

RESOURCES

TEXT BOOKS:

1. Sateesh Gopi, *Global Positioning Systems – Principles and Applications*, McGraw Hill Education (India) Pvt. Ltd., 2014.
2. Akash Deep Sharma, *Global Positioning System*, MD Publication Pvt. Ltd., New Delhi (India), 2008.

REFERENCE BOOKS:

1. Gunter Seeber, *Satellite Geodesy*, Walter De Gruyter, Berlin (Germany), 2nd Edition, 2003.
2. Pratap Misra and Per Enge, *Global Positioning System*, Ganga Jamuna Press, 2006.
3. Bradford, W. Parkinson and James J. Spiker Jr., *Global Positioning System: Theory and Applications*, Vol I and II, American Institute of Aeronautics and Astronautics: Washington (USA), 1996.
4. Hofmann Wellenhof, B., Lichtenegger, H. and Collins, J., *Global Positioning System: Theory and Practice*, Springer, Berlin (Germany), 1994
5. Mohinder S. Grewal, Lawrence R. Weill and Angus P. Andrews, *Global Positioning Systems, Inertial Navigation and Integration*, John Wiley & Sons, 2nd Edition, 2007.
6. Terry-Karen Steede, *Integrating GIS and the Global Positioning System*, ESRI Press, 2000.

LABORATORY MANUAL:

1. *GPS Surveying Laboratory Manual (MBU22 Regulations)*, Department of Civil Engineering, School of Engineering, Mohan Babu University, Tirupati.

SOFTWARE/TOOLS:

1. Auto CAD
2. GPS, DGPS

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/107/105107157/
2. http://nptel.ac.in/courses/106106127/

WEB RESOURCES:

1. https://www.takeoffpros.com/2019/07/31/gps-surveying-explained/
2. https://www.jurovichsurveying.com.au/faq/what-is-gps
3. https://www.gps.gov/applications/survey/
4. https://www.prodyogi.com/2022/01/what-is-gps-in-surveying-how-does-it.html

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101021	**RAILWAY ENGINEERING**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onrailways in India and alignment of railway lines; permanent way; geometric design of railway tracks; points and crossings; rolling stock; railway stations and yards; signalling and interlocking; maintenance of railway track.

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

CO1. Analyze Indian railways and alignment of railway lines considering society and environment besides communicating effectively in graphical form.

CO2. Analyze various components of permanent way to solve railway engineering problems using appropriate tools and techniques following relevant guidelines considering society and environment besides communicating effectively in graphical form.

CO3. Design the geometric features of a railway track and tongue rail to solve complex railway engineering problems using appropriate techniques and following relevant guidelines considering society, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze various components of points and crossings in a railway track to solve railway engineering problems using appropriate tools and techniques following relevant standards considering safety besides communicating effectively in graphical form.

CO5. Analyze rolling stock, layouts of railway stations and yards following relevant guidelines considering safety besides communicating effectively in graphical form.

CO6. Analyze signaling, interlocking and maintenance of railway track to solve railway engineering problems using appropriate tools and techniques following relevant specifications considering safety besides communicating effectively in graphical form.

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	-	-	-	1	1	-	-	1	-	-	-	3	-
CO2	2	3	-	1	1	1	1	1	-	2	-	-	-	3	-
CO3	3	3	3	1	1	1	1	1	-	1	-	-	-	3	-
CO4	2	3	-	1	2	1	-	1	-	2	-	-	-	3	-
CO5	2	3	-	-	-	1	-	1	-	1	-	-	-	3	-
CO6	2	3	-	1	1	2	-	1	-	1	-	-	-	3	-
Course Correlation Mapping	**2**	**3**	**3**	**1**	**2**	**2**	**1**	**1**	**-**	**2**	**-**	**-**	**-**	**3**	**-**

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

COURSE CONTENT

Module 1: RAILWAYS IN INDIA AND ALIGNMENT OF RAILWAY LINES ***(09 Periods)***

Railways in India: Role of Indian Railways in national development, Classification of railway lines in India.

Alignment of Railway Lines: Importance of good alignment, Basic requirements of an ideal alignment, Selection of a good alignment.

Module 2: PERMANENT WAY AND GEOMETRIC DESIGN ***(09 Periods)***

Permanent Way: Components and their functions, Rails – Functions and types, Rail fastenings, Concept of gauges, Coning of wheels, Creep, Sleepers – Functions and requirements, Sleeper density and spacing types, Methods of fixing rails with pre-stressed concrete and wooden sleepers, Ballast – functions, types, sizes.

Geometric Design of Railway Tracks: Necessity for geometric design, Gradients, Grade compensation on curves, Curves – Circular, Transition, Compound and reverse, Super elevation**.**

Module 3: POINTS AND CROSSINGS ***(09 Periods)***

Switches – Types, Switch angle, Flangeway clearance, Heel divergence, Throw of the switch, Tongue rails – design, Crossings – types, Turnouts – types.

Module 4: ROLLING STOCK, RAILWAY STATIONS AND YARDS ***(09 Periods)***

Re-laying of track, Layouts of railway stations and yards, Rolling stock, Tractive power, Track resistance, Level crossings.

Module 5: SIGNALING, INTERLOCKING AND MAINTENANCE OF RAILWAY TRACK ***(09 Periods)***

Signalling and Interlocking: Signalling, Interlocking and track circuiting - Construction and maintenance.

Maintenance of Railway Track: Maintenance program - Monsoon, pre monsoon, post monsoon maintenance, Causes for maintenance, Tools for railway track maintenance and their functions, Surface defects and their remedial measures.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Prepare a report on various aspects to be considered for good alignment of railway lines.
2. Write a detailed step-by-step procedure of construction of p-way.
3. Make a report on points and crossings by visiting any railway station nearby.
4. Prepare a layout showing various components of railway station and yard.
5. Visit a signal control room in nearby railway station and make a report on the working of signalling system.

RESOURCES

TEXT BOOKS:

1. Chandra, S. and Agarwal, M. M., *Railway Engineering*, Oxford University Press, New Delhi, India, 2nd Edition, 2013.
2. Saxena, S. C. and Arora, S. P., *A Text book of Railway Engineering*, Dhanpat Rai Publications, 2010.

REFERENCE BOOKS:

1. Jotin Khisty, C. and Kent Lall, B., *Transportation Engineering – An Introduction,* Prentice Hall of India Pvt. Ltd., 3rd Edition, 2016.
2. Partha Chakroborthy and Animesh Das, *Principles of Transportation Engineering,* Prentice Hall of India Pvt. Ltd., 2005.
3. Papacostas, C. S. and Prevedouros, P. D., *Transportation Engineering and Planning,* Prentice Hall of India Pvt. Ltd.,3rd Edition, 2009.
4. Mannering, F. L. And Washburn, S. S., *Principles of Highway Engineering and Traffic Analysis*, John Wiley& Sons, Inc., 5th Edition, 2013.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=445tbM7sTzE
2. https://www.youtube.com/watch?v=BnwbL0uU87c
3. https://www.youtube.com/watch?v=XJIVi5wCdDM

WEB RESOURCES:

1. https://www.vssut.ac.in/lecture_notes/lecture1428280600.pdf
2. http://stmarysguntur.com/wp-content/uploads/2018/05/Unit-II-TE-II.pdf
3. https://www.studocu.com/in/document/apj-abdul-kalam-technological-university/transportation-engineering-2/point-and-crossing-i-lecture-notes-transportation-engineering-2/24549975
4. https://indianrailways.gov.in/railwayboard/uploads/codesmanual/IRPWM/PermanentWayManualCh2_data.htm

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101022	**HIGHWAY CONSTRUCTION AND MAINTENANCE**	3	-	-	-	3

Pre-Requisite 22CE102008-Transportation Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onhighway construction, stabilized roads, highway drainage, hill roads, highway construction equipment, highway maintenance, road side development.

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

CO1. Analyze highway construction to solve complex highway engineering problems using appropriate tools and techniques following relevant codes considering society, environment and sustainability besides communicating effectively in graphical form.

CO2. Analyze road stabilization techniques to solve complex highway engineering problems following relevant codes and latest developments considering society, environment and sustainability.

CO3. Design highway drainage and geometric features of hill roads to solve complex highway engineering problems using appropriate techniques and following relevant codes considering society, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze various highway construction equipment to solve highway engineering problems using appropriate tools and techniques following latest developments ensuring safety and environment.

CO5. Analyze highway maintenance and road side development issues to solve complex highway engineering problems using appropriate tools and techniques following relevant codes considering society, environment and sustainability.

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

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

COURSE CONTENT

Module 1: HIGHWAY CONSTRUCTION ***(09 Periods)***

General construction, Earth work, Construction of fill and subgrade, Gravel roads, WBM roads, Bituminous pavements, Cement concrete pavements, Different types of joints in cement concrete pavements - Joint filler and sealer, Interlocking concrete block (ICBP) pavements.

Module 2: STABILIZED ROADS ***(09 Periods)***

Introduction, Properties of soil-aggregate mixes, Mechanical soil stabilization, Soil-cement stabilization, Soil-lime stabilization, Stabilization of soil using bituminous materials and special problems in soil stabilization work, Latest developments in soil stabilization for road works**.**

Module 3: HIGHWAY DRAINAGE AND HILL ROADS ***(09 Periods)***

Highway Drainage: Importance of highway drainage – Requirements, Surface drainage - Design of surface drainage system, Subsurface drainage, Drainage of slopes and erosion control, Road construction in water logged areas and black cotton soils.

Hill Roads: General considerations, Alignment of hill roads, Geometric design of hill roads, Design and construction, Drainage and maintenance problems in hill roads.

Module 4: HIGHWAY CONSTRUCTION EQUIPMENT ***(09 Periods)***

Excavators - Drilling rock and earth, Aggregate production – Trucks and haulage equipment, Dozers, Scrappers, Finishing equipment, Hotmix plats for bituminous mixes, Pavers and compacting equipment for hot bituminous mixes, Plants and equipment for cement concrete and paving equipment, Piles and pile driving equipment, Air compressors and pumps, Latest developments in highway construction equipment.

Module 5: HIGHWAY MAINTENANCE AND ROAD SIDE DEVELOPMENT ***(09 Periods)***

Highway Maintenance: Introduction, Pavement failures, Maintenance of highways, Pavement evaluation, Strengthening of existing pavements by overlays.

Road Side Development: Environment factors in planning and development of highways, Road side development and arboriculture - Planning plantation of trees, Species and their selection, Care of trees.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Prepare a detailed project report on earthwork excavation for highway project.
2. Conduct a survey and prepare a detailed report on latest developments in soil stabilization techniques for road works.
3. Design a surface drainage system for an existing highway.
4. Conduct a survey and prepare a report on latest highway construction equipments.
5. Prepare a detailed report on various maintenance and road side development activities on a highway nearby.

RESOURCES

TEXT BOOKS:

1. Khanna, K. and Justo, C. E. G., *Highway Engineering,* Nem Chand & Bros, Roorkee, 10th Edition, 2014.
2. Kadiyali, L. R., *Traffic Engineering and Transport Planning*, Khanna Technical Publications, 7th Edition, 2010.

REFERENCE BOOKS:

1. Jotin Khisty, C. and Kent Lall, B., *Transportation Engineering – An Introduction,* Prentice Hall of India Pvt. Ltd., 3rd Edition, 2016.
2. Partha Chakroborthy and Animesh Das, *Principles of Transportation Engineering,* Prentice Hall of India Pvt. Ltd., 2005.
3. Papacostas, C. S. and Prevedouros, P. D., *Transportation Engineering and Planning*, Prentice Hall of India Pvt. Ltd.,3rd Edition, 2009.
4. Mannering, F. L. And Washburn, S. S., *Principles of Highway Engineering and Traffic Analysis*, John Wiley& Sons, Inc., 5th Edition, 2013.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=aUL4nsdfeYA
2. https://www.youtube.com/watch?v=BxgSlTTqriQ
3. https://www.youtube.com/watch?v=47TNhLl0owg&list=PL3MO67NH2XxKuZwStwfy3GZkKRou_q9Yp&index=4

WEB RESOURCES:

1. https://theconstructor.org/transportation/processes-in-bituminous-road-construction/5316/
2. http://nebula.wsimg.com/85f3e6b05f31d5484c66e147027adc14?AccessKeyId=5887AD44AEE58F1FD65A&disposition=0&alloworigin=1
3. https://abhashacharya.com.np/wp-content/uploads/2019/02/Highway-Drainage.pdf
4. https://www.srividyaengg.ac.in/coursematerial/Civil/103565.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE102012	**PAVEMENT ANALYSIS AND DESIGN**	3	-	2	-	4

Pre-Requisite 22CE102008-Transportation Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onfactors affecting pavement design, analysis and design of flexible pavements, analysis and design of rigid pavements.

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

CO1. Analyze factors affecting pavement design to solve complex pavement engineering problems using appropriate techniques following relevant codes considering society and environment and sustainability besides communicating effectively in graphical form.

CO2. Analyze the stresses induced in flexible pavements to solve complex pavement engineering problems using appropriate techniques following relevant codes considering safety besides communicating effectively in graphical form.

CO3. Design the flexible pavements to solve complex pavement engineering problems using appropriate methods following relevant codes considering society, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze the stresses induced in rigid pavements to solve complex pavement engineering problems using appropriate techniques following relevant codes considering safety besides communicating effectively in graphical form.

CO5. Design the rigid pavements to solve complex pavement engineering problems using appropriate methods following relevant codes considering society, environment and sustainability besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: FACTORS AFFECTING PAVEMENT DESIGN ***(09 Periods)***

Types of pavement, factors affecting design of pavements - elastic modulus, Poisson's ratio, wheel load, wheel configuration and tyre pressure, ESWL concept, contact pressure, material characteristics, environmental and other factors**.**

Module 2: ANALYSIS OF FLEXIBLE PAVEMENTS ***(09 Periods)***

Stresses in flexible pavement, Layered systemsconcept - One layer system, Boussinesq's two-layer system, Burmister's two-layertheory for pavement design**.**

Module 3: DESIGN OF FLEXIBLE PAVEMENTS ***(09 Periods)***

Theoretical, empirical and semi-empirical methods –Group index method, Burmister, CBR Method, AASHTO method, IRC method.

Module 4: ANALYSIS OF RIGID PAVEMENTS ***(09 Periods)***

Stresses in rigid pavements, Relative stiffness of slab, Modulus of sub grade reaction, Westergaard's equation for calculation of stresses due to wheel loads, warping load and friction load, Bradley's stress coefficients - Design charts.

Module 5: DESIGN OF RIGID PAVEMENTS ***(09 Periods)***

General design approach, PCA method, AASHTO method, IRC method, Design of slab thickness, different types of joints, tie bars, and dowel barsas per IRC guidelines.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Field CBR test for sub-grade strength
2. Benkelman beam deflection studies on flexible pavement and analysis
3. Measurement of unevenness/roughness by MERLIN or Bump Integrator
4. Design of flexible pavement using IIT Pave
5. Modulus of elasticity and Poisson's ratio of concrete
6. Modulus of rupture test applying a third-point loading
7. Variation of temperature and stress with time
8. Concrete splitting tension test

RESOURCES

TEXT BOOKS:

1. Khanna, K. and Justo, C. E. G., *Highway Engineering,* Nem Chand & Bros, 10th Edition, 2014.
2. Yang H. Huang, *Pavement Analysis and Design*, Pearson Prentice Hall, 2nd Edition, 2004.

REFERENCE BOOKS:

1. Jotin Khisty, C. and Kent Lall, B., *Transportation Engineering – An Introduction,* Prentice Hall of India Pvt. Ltd., 3rd Edition, 2016.
2. Partha Chakroborthy and Animesh Das, *Principles of Transportation Engineering,* Prentice Hall of India Pvt. Ltd., 2005.
3. Yoder, E. J. and Witczack, M. W., *Principles of Pavement Design*, John Wily & Sons, New York, 2nd Edition, 1975.
4. Mannering, F. L. And Washburn, S. S., *Principles of Highway Engineering and Traffic Analysis*, John Wiley& Sons, Inc., 5th Edition, 2013.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=exctAga2KXY
2. https://www.youtube.com/watch?v=uJntLOgEHD4
3. https://www.youtube.com/watch?v=pe7ycTC1W_M

WEB RESOURCES:

1. https://www.civil.iitb.ac.in/~vmtom/nptel/401_lnTse/web/web.html
2. https://www.discountpdh.com/wp-content/themes/discountpdh/pdf-course/design-of-flexible-pavements.pdf
3. https://www.civil.iitb.ac.in/~kvkrao/uploads/5/9/3/7/59372049/ce742lec_14new.pdf
4. https://www.civil.iitb.ac.in/tvm/1100_LnTse/411_lnTse/plain/plain.html

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101023	**AIRPORT AND HARBOUR ENGINEERING**	3	-	-	-	3

Pre-Requisite 22CE102008-Transportation Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on airport planning, visual aids and air traffic control, airport design, harbour and port planning, harbour design and maintenance.

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

CO1. Analyze airport characteristics to solve complex airport problems using appropriate tools and techniques following relevant codes considering safety, environment and sustainability besides communicating effectively in graphical form.

CO2. Analyze visual aids in airport to solve complex air traffic problems using appropriate tools and techniques following relevant codes considering safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Design the airport runway to solve complex problems using appropriate tools and techniques following relevant codes considering safety, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze harbour characteristics using appropriate tools and techniques following relevant codes considering safety, environment and sustainability.

CO5. Design harbour components using appropriate tools and techniques following relevant codes considering safety, environment and sustainability.

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

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

COURSE CONTENT

Module 1: AIRPORT PLANNING ***(09 Periods)***

Air transport characteristics, Aircraft characteristics, Airport classification, Airport planning - Objectives, Components, Layout characteristics, Airport site selection - Site surveys and drawings, Terminal area - Functions, Site location, Noise control, Aprons, Gate positions and parking system.

Module 2: VISUAL AIDS AND AIR TRAFFIC CONTROL ***(09 Periods)***

Visual Aids, Signaling Devices, Airport Markings, Airport lighting, Airport Signage, Typical Layouts, Air Traffic Control, Air Traffic Control Network, Air Traffic Control Aids, Modern Technology in Air Transport**.**

Module 3: AIRPORT DESIGN ***(09 Periods)***

Runway design – Orientation, Wind rose diagram, Length, Geometric design, Configuration and pavement design principles, Lighting system, Airport grading, Elements of taxiway design, Airport zones, Passenger facilities and services, Characteristics and requirements of airport drainage.

Module 4: HARBOUR AND PORT PLANNING ***(09 Periods)***

Significance, Advantages and limitations of water transport, Harbour - Classification and site selection, Planning and layout of Harbours, Ports –Classification and Site Selection, Planning and layout of Ports, Docks – Types, Functions, Loading and Unloading Facilities, Navigational aids.

Module 5: HARBOUR DESIGN AND MAINTENANCE ***(09 Periods)***

Inland Water Transport, Natural phenomenon affecting Harbour Design– Tides, Winds, Waves, Currents, Drift, Silting and Erosion, Classification of Dredging, Equipment for Dredging, Execution of Dredging Work, Coast Protection.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Visit an airport nearby your location and prepare a complete layout of the airport showing all the major components of it. Explain briefly each component of the airport.
2. Prepare a detailed report on various visual aids used in airports. Also describe briefly the various operations that are carried out in air traffic control tower in airports.
3. Prepare a detailed report on various requirements and design principles for selection of site for an airport.
4. Visit a harbour nearby your location and prepare a complete layout of the harbour showing its components.
5. Observe the dredging operation taking place in nearby sea and prepare a detailed report on various operations involved in it.

RESOURCES

TEXT BOOKS:

1. Rangwala, S.C., Airport Engineering, Charotar Publishing House Pvt. Ltd., 14th Edition, 2014.
2. Hasmukh P. Oza, Gautam H. Oza, Dock and Harbour Engineering, Charotar Publishing House Pvt. Ltd., 8th Edition, 2017.

REFERENCE BOOKS:

1. Khanna S.K., Arora M.G., Jain S.S., Airport planning and Design, Nem Chand Publications, 6th Edition, 2017.
2. Subhash C. Saxena, Airport Engineering Planning and Design, CBS Publishers & Distributers, First Edition, 2020.
3. Srinivasan R., Harbour, Dock and Tunnel Engineering, Charotar Publishing House Pvt Ltd., 28th Edition, 2016.
4. Parbin Singh, Principles of Tunnelling, Ports & Harbours, S.K. Kataria & Sons, 1st Edition, 2011.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=UNRVaMykHPc&list=PLRo6dG4oqePfxRj7cUGdroz7Ly5lrC-dt
2. https://www.youtube.com/watch?v=e11SevTO-n0
3. https://www.youtube.com/playlist?list=PLmRuqPJhrsb4o5w1O-P_STCIuiZkXiVWf

WEB RESOURCES:

1. https://mrcet.com/downloads/digital_notes/AE/IV%20Year/Airport%20Planning%20and%20Operations.pdf
2. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_APO_LECTURE_NOTES_0.pdf
3. https://www.davuniversity.org/images/files/study-material/Airport%20planning%20and%20design.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101024	**URBAN STORMWATER MANAGEMENT**	3	-	-	-	3

Pre-Requisite 22CE101002-Hydrology and Water Resources Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Concept of Urban hydrology, Rainfall analysis for urban stormwater design, Rainfall abstraction, Urban stormwater analysis and management and Overview of urban stormwater models.

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

CO1. Analyze urban hydrological cycle for estimating stormwater runoff considering latest developments, society, environment, and sustainability besides communicating effectively in graphical form.

CO2. Analyze rainfall data for solving complex urban drainage problems using different techniques considering latest developments, relevant guidelines, society, environment and sustainability besides communicating effectively in graphical form

CO3. Analyze abstractions losses from urban catchments for solving for solving complex urban hydrology problems using different tools and techniques considering latest developments, relevant guidelines, environment and sustainability besides communicating effectively in graphical form.

CO4. Design synthetic hydrographs for solving complex urban stormwater drainage problems using different tools and techniques considering latest developments, relevant guidelines, safety, environment, sustainability and management besides communicating effectively in graphical form

CO5. Design urban drainage networks for solving complex urban stormwater drainage problems using different tools and techniques considering latest developments, relevant guidelines, safety, environment and sustainability besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: URBAN HYDROLOGY ***(09 Periods)***

Urban hydrological cycle, Urban water resources – Major problems, Historical perspective; Effects of urbanization on catchment hydrology, Interaction of land use and urban stormwater runoff, Need for urban drainage system.

Module 2: RAINFALL ANALYSIS FOR URBAN STORMWATER DESIGN ***(09 Periods)***

Rainfall data, Depth-duration-rainfall analysis, Areal effect of point rainfall, Design rainfall duration, Time distribution of design rainfall, examples of design rainfall development

Module 3 RAINFALL ABSTRACTION ***(10 Periods)***

Introduction, Interception, Detention and retention concepts, Depression storage, Infiltration, SCS method, The Φ-Index, Importance of losses in urbanized basins, Open channel flows in urban watersheds.

Module 4 URBAN STORMWATER ANALYSIS AND MANAGEMENT ***(09 Periods)***

Rational method, SCS composite hydrograph method, time of concentration, Synthetic unit hydrograph method, urban runoff processes, Hydraulic analysis and design guidelines, Flow and storage capacity of urban components, Temple tanks, Social awareness and involvement.

Module 5 OVERVIEW OF URBAN STORMWATER MODELS ***(08 Periods)***

Introduction, Structural and nonstructural control measures, Types of models, Role of urban stormwater models and levels of analysis, Storm water management model (SWMM), Case studies

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Select an urban watershed or catchment area and create a map of its features, including impervious surfaces (roads, buildings), green spaces, water bodies, and drainage systems. Conduct field surveys to collect data on land use, soil types, and vegetation cover. Analyze the spatial distribution of these features and their implications for water runoff and infiltration.
2. Analyze historical rainfall data from weather stations or meteorological databases. Use statistical methods to determine intensity-duration-frequency relationships, which provide information on the magnitude and probability of rainfall events of different durations. Compare IDF curves for different locations within the urban area to understand spatial variations in rainfall characteristics.
3. Install a rainwater harvesting system, such as a rain barrel or a rooftop rainwater collection system. Monitor and measure the amount of rainfall collected over a period of time. Compare the collected rainwater volume with the total rainfall in the area to assess the effectiveness of the system in intercepting and storing rainfall.
4. Conduct field inspections of storm drainage systems in urban areas. Observe the infrastructure, including catch basins, pipes, and outfall structures. Identify potential issues such as blockages, structural defects, or inadequate capacity. Document your observations and make recommendations for maintenance or improvements to ensure proper functioning of the drainage system
5. Familiarize yourself with different urban stormwater models available in the industry, such as SWMM (Storm Water Management Model), EPA-SWMM, PCSWMM, MIKE URBAN, or InfoWorks ICM. Research their features, capabilities, and applicability to different urban contexts. Choose a model that suits your learning objectives or the specific needs of a case study area. Install and set up the selected model on your computer.

RESOURCES

TEXT BOOKS:

1. Hall, M.J., Urban Hydrology, Elsevier Applied Science Publishers, 1st Edition, 1984.
2. David, F. K.,Urban Stormwater Hydrology (Water Resources Monograph), American Geophysical Union, 4th Edition, 1991.

REFERENCE BOOKS:

1. David, B., Christopher, J. D., Christos, M. and John, W. D, *Urban Drainage*, CRC Press, 4th Edition, 2018
2. Osman, A. A. and Houghtalen, R. J., Urban Hydrology, Hydraulics, and Stormwater Quality: Engineering Applications and Computer Modeling, Wiley Publications, 1st Edition, 2003.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105104029
2. https://www.youtube.com/watch?v=4rFmOxanzow

WEB RESOURCES:

1. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://priodeep.weebly.com/uploads/6/5/4/9/65495087/stormwater_management.pdf
2. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.diva-portal.org/smash/get/diva2:473728/FULLTEXT01.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101025	**IRRIGATION ENGINEERING AND HYDRAULIC STRUCTURES**	3	-	-	-	3

Pre-Requisite 22CE101002-Hydrology and Water Resources Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Water requirement of crops; Diversion head works; Gravity dams, earth dams and spillways; Canal structures; Cross drainage works.

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

CO1. Analyze irrigation water requirements considering latest developments, relevant standards, public health and safety, environment, sustainability, irrigation management besides communicating effectively in graphical form.

CO2. Analyze diversion head works for solving complex irrigation engineering problems using different techniques considering relevant codes of practice, safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Design gravity dams, earth dams and spillways for solving complex irrigation engineering problems using different tools and techniques considering codes of practice, safety, environment and sustainability besides communicating effectively in graphical form.

CO4. Design canal structures for solving complex irrigation engineering problems using different tools and techniques considering codes of practice, safety, environment and sustainability besides communicating effectively in graphical form.

CO5. Design cross drainage works for solving complex irrigation engineering problems using different tools and techniques considering codes of practice, safety, environment and sustainability besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: IRRIGATION AND WATER REQUIREMENT OF CROPS ***(09 Periods)***

Necessity and importance, Advantages and disadvantages, Types of irrigation, Application of irrigation water, Sources of water for irrigation, Standards for irrigation water, Soil–water–plant relationship, Vertical distribution of soil moisture, Soil moisture constants, Consumptive use, Duty–delta relationship, Factors affecting duty, Crops and crop seasons in India, Irrigation efficiency, Frequency of irrigation, Irrigation scheduling – Water distribution – Participatory irrigation management with a case study, Latest developments in irrigation.

Module 2: DIVERSION HEAD WORKS ***(09 Periods)***

Types of diversion head works – Weirs, Barrages; Layout of diversion works, Causes and failure of hydraulic structures on permeable foundations, Bligh's creep theory, Khosla's theory -Design principles of various weirs.

Module 3 GRAVITY DAMS, EARTH DAMS AND SPILLWAYS ***(10 Periods)***

Gravity Dams:Forces acting on gravity dam, Causes of failure of gravity dams, Elementary profile and practical profile of gravity dam, Limiting height of a low gravity dam, Stability analysis of gravity dam.
Earth Dams: Types, Causes of failure, Criteria for safe design, Seepage through earth dam, Measures of seepage control, Stability analysis.
Spillways:Types, Design of Ogee spillway, Energy dissipaters –Types, Advantages and disadvantages.

Module 4 CANAL STRUCTURES ***(10 Periods)***

Types of canals, Alignment of canals, Lining of Canals, Design of canals, Kennedy's and Lacey's theory, Falls – Types, Design of Sarda type fall; Canal regulation works, Canal outlets – Types.

Module 5 CROSS DRAINAGE WORKS ***(08 Periods)***

Types, Design and selection of site for aqueducts, super passages, level crossing; River training works.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Engage students to vist near by agricultural sites and prepare a document on method of irrigation practiced for cultivation of crops and when and how much water to apply to crops to understand the importance of efficient water management
2. Vist near by dam site and prepare a detailed document on water flow in a diversion headworks system and its characteristics such as flow patterns, velocities, and changes in hydraulic parameters to understand the behavior of water in the system.
3. Build scaled-down models of gravity dams and earth dams using materials such as clay, sand, or other suitable materials. Pay attention to the shape, dimensions, and construction details of the dams. Observe how the models interact with water and study their stability and load-bearing capacity.
4. Learn and practice different methods of flow measurement used in canals. Study devices such as weirs, flumes, or flow meters, and understand how they are installed and calibrated. Conduct flow measurements at a local canal to gain hands-on experience with these techniques.

5. Use water flow simulations or hydraulic modeling software to simulate the behavior of water flow through different types of cross drainage structures. Explore various scenarios, such as different flow rates, water levels, or obstructions, to observe how the structures handle the water flow. Analyze hydraulic parameters such as flow velocity, pressure, and energy dissipation.

RESOURCES

TEXT BOOKS:

1. *Garg, S. K.,Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 36th Edition, 2019.*
2. *Modi, P. N., Irrigation Water Resources and Water Power Engineering, Standard Book House, 22nd Edition, 2019.*

REFERENCE BOOKS:

1. *Arora, K. R., Irrigation, Water Power and Water Resources Engineering, Standard Publishers Distributers, 4th Revised Edition, 2014.*
2. Punmia, B. C. and Lal, P. B. B.*, Irrigation and Water Power Engineering,* Laxmi Publications, 16th Edition, 2011

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=e7pckUDQ9oI
2. https://www.youtube.com/watch?v=2TDCkRDg8Gc
3. https://www.youtube.com/watch?v=bDwow2-WzHo
4. https://www.youtube.com/watch?v=28uGiIwwfro
5. https://www.youtube.com/watch?v=CZ4Ou0MYBME

WEB RESOURCES:

1. https://easyengineering.net/irrigation-engineering-and-hydraulic/
2. https://khannapublishers.in/index.php?route=product/product&product_id=202

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101026	INTEGRATEDWATERSHEDMANAGEMENT	3	-	-	-	3

Pre-Requisite 22CE102007-Surveying
22CE101002-Hydrology and Water Resources Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Concept of watershed; Need and objectives; Characteristics of watershed; Principles of erosion; Measures to control erosion; Water harvesting; Land and ecosystem management; Planning and administration.

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

CO1. Understand the need for the watershed development, management, socio-economic characteristics and basic data on watersheds using appropriate techniques and methods for development of society and sustainable aquatic life systems besides communicating effectively in graphical form.

CO2. Assess soil erosion due to various factors influencing by rain water and soil loss due to different methods of farming using appropriate techniques for better soil conservation and plant growth besides communicating effectively in graphical form.

CO3. Analyzethe various rainwater harvesting systems, use modern techniques to improve efficiency and land use classification and management including soil reclamation besides communicating effectively in a graphical form.

CO4. Analyze the role of ecosystem using appropriate techniques to improve soil enrichment, cropping pattern, biomass waste management including agriculture, social forestry and afforestation to provide solutions to watershed management besides communicating effectively in graphical form.

CO5. Analyze the watershed management activities, to solve complex water problems following latest developments considering stakeholder's participation, admin requirements and trends in watershed management besides communicating effectively in graphical form.

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

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

COURSE CONTENT

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

Objectives, Need for watershed development in India, Classification, Integrated and multidisciplinary approach for watershed management, Characteristics of watershed – Socio–economic characteristics, Basic data on watersheds.

Module 2: PRINCIPLES OF EROSION ***(10 Periods)***

Types of erosion, Factors affecting erosion, Effects of erosion on land fertility, Estimation of soil loss due to erosion, Universal soil loss equation, Contour techniques, Ploughing,Furrowing, Trenching, Bunding, Terracing, Gully control, Rockfill dam, Brushwood dam, Gabion

Module 3 WATER HARVESTING AND LAND MANAGEMENT ***(09 Periods)***

Rainwater harvesting, Catchment harvesting, Harvesting structures, Soil moisture conservation, Check dams, Artificial recharge - Farm ponds, Percolation tanks, Latest techniques of harvesting; Land use and land capability classification; Management of forest, agricultural, grassland and wild land; Reclamation of saline and alkaline soils.

Module 4 ECOSYSTEM MANAGEMENT ***(09 Periods)***

Role of ecosystem, Crop husbandry, Soil enrichment; Inter, mixed and strip cropping; Cropping pattern, Sustainable agriculture, Bio–mass management, Dry land agriculture, Silvi pastures, Horticulture, Social forestry and afforestation.

Module 5 PLANNING AND ADMINISTRATION ***(08 Periods)***

Planning of watershed management activities, Stake holder's participation, Preparation of action plan, Administrative requirements, Trends in watershed management.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Collect basic data on watersheds in your locality and discuss its socio-economic characteristics and impact on the livelihood of the people over there.
2. Visit the nearest watershed management area, and observe and discuss the performance of farming surrounding it.
3. Visit the different types of check dams, artificial recharge water sources and explain the result of it.
4. Visit any one type of ecosystem nearby your local area and describe its functioning of living and non-living things.
5. Discuss the trends in watershed management activities including stakeholder's participation and administration requirements for better performance in your local area.

RESOURCES

TEXT BOOKS:

1. J. V. S. Murthy, Watershed Management, New Age International Publishers, 2nd Edition, 2009.
2. R. A. Wurbs and W.P. James, Water Resource Engineering, PHI Publications, 2001.

REFERENCE BOOKS:

1. V. V. N. Murthy, Land and Water Management, Kalyani Publications, 4th Edition, 2008.
2. D. K. Majumdar, Irrigation and Water Management, PHI, 2010.
3. Vijay P. Singh, Ram Narayan yadava, Watershed Management, Allied Publishers, 2003.
4. Timothy O. Randhir, Watershed Management: Issues and Approaches, IWA Publishing, 2007.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=b-gsUccfMVw
2. https://csrbox.org/India_organization_project_Pan-India-Integrated-Watershed-Management-Projects_7989
3. https://www.youtube.com/watch?v=8hwEllQjigY

WEB RESOURCES:

1. https://www.academia.edu/36648433/Watershed_Development_Programme_in_India_pdf
2. https://agricoop.nic.in/Documents/WSDGuidelinesfinalversion13-2-08.pdf
3. https://krishi.icar.gov.in/jspui/bitstream/123456789/32512/2/17%20Watershed%20programme%20in%20India.%20Agric..pdf
4. https://egyankosh.ac.in/bitstream/123456789/45392/1/Unit-3.pdf
5. https://www.fao.org/forestry/11728-0d6a43fd4621fb6c156afebddb1aa9a80.pdf
6. http://oar.icrisat.org/2465/1/Watershed_development_in_India_synthesis_of_past_experiences_and_needs_for_future_research.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101027	**HYDROPOWER ENGINEERING**	3	-	-	-	3

Pre-Requisite 22CE102001-Fluid Mechanics and Hydraulic Machinery

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Hydropower; Water power estimate; Hydropower plants; Pumped storage power plants; Hydraulic turbines; Water conveyance; Channel surges and intakes; Power house and equipment.

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

CO1. Analyze hydropower estimates for solving complex engineering problems using different techniques considering relevant codes of practice, safety, environment and sustainability irrigation management besides communicating effectively in graphical form.

CO2. Analyze hydropower plants for solving complex engineering problems using different techniques considering relevant codes of practice, safety, environment and sustainability irrigation management besides communicating effectively in graphical form.

CO3. Analyze hydraulic machinery for solving complex hydropower engineering problems using different techniques considering relevant codes of practice, safety, environment and sustainability irrigation management besides communicating effectively in graphical form.

CO4. Design water conveyance for solving complex hydropower engineering problems using different techniques considering relevant codes of practice, safety, environment and sustainability irrigation management besides communicating effectively in graphical form.

CO5. Analyze power house and equipment for solving complex hydropower engineering problems using different techniques considering relevant codes of practice, safety, environment and sustainability irrigation management besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: HYDROPOWER AND ESTIMATE ***(09 Periods)***

Hydropower development, Sources of energy, Estimation of water power potential, Load curve, Load factor, Capacity factor, Utilization factor, Diversity factor, Load duration curve, Firm power, Secondary power, Prediction of load, Collection and analysis of stream flow data, Mass curve, Flow duration curves, Construction and utility of these curves, Effect of storage and pondage, Estimates of available water power

Module 2: HYDROPOWER PLANTS ***(09 Periods)***

Low and high head plants: Classification of hydel plants, Run-off- river plants, General arrangement of run-off-river plants, Valley dam plants, Diversion canal plants, High head diversion plants, Storage and pondage, Basic features, Advantages of pumped storage plants, Types of pumped storage plants, Relative merits of two-unit and three-unit arrangement, Tidal power plants.

Module 3 HYDRAULIC MACHINES ***(10 Periods)***

Reciprocating Pumps, Components and working principle of Single acting and double acting reciprocating pumps, Discharge coefficient, Volumetric efficiency and Slip; Work done by reciprocating pumps, Work done and power input, Indicator diagram, Effect of acceleration and friction on indicator diagram

Module 4 WATER CONVEYANCE ***(09 Periods)***

Classification of penstocks, Design criteria, Economical diameter, Anchor blocks, Conduit valves, Bends and manifolds -Water hammer, Resonance in penstocks, Channel surges, Surge tanks, Intakes, Types, Losses, Air entrainment, Inlet aeration, Canals, Forebay, Tunnels, Selection of turbines.

Module 5 POWER HOUSE AND EQUIPMENT ***(08 Periods)***

Location of power house, General arrangement of hydroelectric unit, Number and size of units, Power house sub structure.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Organize a visit to a hydropower plant or a dam to observe the infrastructure and operations firsthand.
2. Provide hands-on experience with tools and instruments used in the maintenance of hydropower plants.
3. Assign design projects where students have to plan and design a small-scale turbine and pump.
4. Explain the importance of proper operation and control in maintaining efficient and effective water conveyance.
5. Organize visits to operating power houses, such as thermal power plants, nuclear power plants, or renewable energy facilities.

RESOURCES

TEXT BOOKS:

1. M. M. Dandekar and K.N. Sharma, Water Power Engineering, Vikas Publishing House Pvt. Ltd., India, 2007
2. R.K. Sharma and T.K. Sharma, A Text Book of Water Power Engineering, S. Chand Company, New Delhi, 2008.

REFERENCE BOOKS:

1. P. N. Modi, Irrigation Water Resources and Water Power Engineering, Standard Book House, 7th Edition, 2008.
2. K. R. Arora, Irrigation, Water Power and Water Resources Engineering, Standard Publishers Distributors, Delhi, 4th Edition, 2011.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=srjjvd6cHqA
2. https://www.youtube.com/watch?v=Rf5S714-7SI
3. https://www.digimat.in/nptel/courses/video/112103249/L01.html
4. https://www.youtube.com/watch?v=XvA7kaKX9Ns
5. https://www.digimat.in/nptel/courses/video/108102047/L01.html

WEB RESOURCES:

1. https://www.slideshare.net/CivilZone/hydropower-engineering-hydraulics
2. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.iitr.ac.in/wfw/web_ua_water_for_welfare/education/Teachers_Manual/Teachers_manual_diploma_hydropower_engineering.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101028	**GROUNDWATER DEVELOPMENT AND MANAGEMENT**	3	-	-	-	3

Pre-Requisite 22CE101002-Hydrology and Water Resources Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Groundwater occurrence and movement; Analysis of pumping test data; Saline water intrusion in an aquifer; Artificial recharge of groundwater; Groundwater exploration.

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

CO1. Analyze groundwater occurrence and movement to solve groundwater problems using appropriate techniques following relevant standards considering society

CO2. Analyze pumping test data for solving complex ground water problems using appropriate methods considering codes of practice

CO3. Analyze saline water intrusion in an aquifer for solving complex ground water problems using appropriate techniques considering codes of practice

CO4. Analyze artificial groundwater recharge sites to solve groundwater problems using appropriate tools and techniques considering society

CO5. Analyze exploration to solve complex groundwater problems using appropriate tools and techniques following relevant codes of practice and latest developments considering health

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

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

COURSE CONTENT

Module 1: GROUNDWATER OCCURRENCE AND MOVEMENT ***(09 Periods)***

Groundwater hydrologic cycle – Origin of groundwater; Vertical distribution of groundwater, Geological formations as aquifers, Types of aquifers, Aquifer parameters; Darcy's law, Groundwater flow equation; Groundwater flow contours and their applications.

Module 2: ANALYSIS OF PUMPING TEST DATA ***(10 Periods)***

Steady groundwater flow towards a well in confined and unconfined aquifers, Unsteady radial flow towards a well, Non equilibrium equations – Thies solution, Jacob and Chow's solutions; Yield of an open well.

Module 3 SALINE WATER INTRUSION IN AN AQUIFER ***(08 Periods)***

Saline water intrusion, Ghyben–Herzberg relation, Shape of interface, Effects and control of sea water intrusion, Recognition of sea water in groundwater, Case studies.

Module 4 ARTIFICAL RECHARGE OF GROUNDWATER ***(09 Periods)***

Artificial recharge - Recharge methods, Merits, Application of GIS and Remote Sensing in artificial recharge of groundwater along with case studies; Conjunctive use.

Module 5 GROUNDWATER EXPLORATION ***(10 Periods)***

Groundwater exploration, Surface methods - Electrical resistivity and seismic refraction methods; Subsurface methods – Geophysical logging and resistivity logging; Field survey using electrical resistivity method, Latest developments.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Create an aquifer model using a transparent container or sand tank. Fill it with layers of sand, gravel, and clay to represent different aquifer properties. Apply water to the model and observe how groundwater moves through the different layers. Study the effects of aquifer properties on groundwater flow patterns.
2. Collect pumping test data from literature or real-life scenarios. Organize the data and analyze it using appropriate software or spreadsheet tools. Calculate key parameters such as transmissivity, hydraulic conductivity, storativity, and specific yield. Apply analytical methods such as Theis, Jacob, or Cooper-Jacob to interpret the data.
3. Explore mitigation techniques used to manage saline water intrusion. Study methods such as groundwater pumping, injection wells, artificial recharge, or barrier construction. Design and implement small-scale experiments to evaluate the effectiveness of these techniques in reducing or controlling intrusion.
4. Design and construct rainwater harvesting systems such as rooftop catchment systems, surface runoff collection channels, or infiltration pits. Measure and record rainfall, collect and store rainwater, and observe the process of groundwater recharge. Monitor changes in groundwater levels and quality over time.
5. Conduct geophysical surveys to explore subsurface structures and identify potential groundwater resources. Use equipment such as ground penetrating radar (GPR), electrical resistivity imaging (ERI), or seismic methods to gather data. Interpret the data collected to identify geological formations, aquifer boundaries, and potential groundwater zones.

RESOURCES

TEXT BOOKS:

1. Raghunath, H. M., Groundwater, Wiley Eastern Ltd., 3rd Edition, 2007.
2. Todd, D. K., *Groundwater Hydrology*, Wiley India Pvt. Ltd., 3rd Edition, 2011

REFERENCE BOOKS:

1. Karanth,K. R., Groundwater Assessment, Development and Management, Mc. Graw Hill Education, 1st Edition, 2017.
2. Chahar, B. R., *Groundwater Hydrology*, Mc. Graw Hill India, 2017

SOFTWARE/TOOLS:

1. Modflow software

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=DBcKcGweiMo
2. https://www.youtube.com/watch?v=UCIcqIJlg3E
3. https://www.youtube.com/watch?v=9KELPk5DDSI
4. https://www.youtube.com/watch?v=W7wfmx8t9pc
5. https://www.digimat.in/nptel/courses/video/105105042/L01.html

WEB RESOURCES:

1. https://www.iaea.org/topics/groundwater
2. http://www.riversweb.org/monreCBP/index.php/en/training/context-4/groundwater

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EE102017	ENERGY AUDIT, CONSERVATION AND MANAGEMENT	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides an orientation and hands-on experience on principles of energy audit, management, and conservation practices, Energy efficient motors, lighting schemes, Energy measuring instruments, and analytical skills for the quantitative estimation of energy economics. This course also provides a procedure to asses and addresses the various societal issues related to energy management and provides feasible energy conservation techniques.

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

CO1. Apply the relevant rules, regulations and procedures to carry the energy audit in industries.

CO2. Apply and realize the relevant practices to carry effective energy conservation practices for various societal problems.

CO3. Analyze the performance of energy-efficient motors and propose an appropriate illumination system by applying the protocols of energy auditing.

CO4. Apply appropriate energy auditing instruments for energy auditing in industries and assess the economic benefits of auditing.

CO5. Apply the demand-side management techniques and relevant standards for the organization of energy conservation awareness programs.

CO6. Work independently or in teams to solve problems with effective communication.

CO-PO Mapping Table:

Course Outcome	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	1	-	-	2	2	1	1	-	-	-	1
CO2	3	1	-	-	2	2	2	1	-	-	1	-
CO3	3	1	2	-	1	2	1	1	-	-	1	2
CO4	3	2	-	2	2	2	1	-	-	2	1	2
CO5	3	1	-	-	2	1	3	1	-	-	1	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-
Course Correlation Level	**3**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**3**	**1**	**2**

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

COURSE CONTENT

Module 1: ENERGY AUDIT AND MANAGEMENT PRINCIPLES (10 Periods)

Energy audit — definitions, concept, types of audit, energy index-cost index, pie charts, Sankey diagrams, load profiles, energy audit in industries, energy saving potential, energy audit of process industry, thermal power station, building energy audit, case study. IE rules and regulations for energy audit.

Energy management — Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, and reporting.

Module 2: ENERGY CONSERVATION PRINCIPLES (08 Periods)

Energy scenario in India and world. Rules for efficient energy conservation; technologies for energy conservation. Principles of energy conservation, current energy consumption in India, roles and responsibilities of energy managers in industries.

Module 3: ENERGY EFFICIENT MOTORS AND LIGHTING (09 Periods)

Energy efficient motors - factors affecting efficiency, loss distribution, constructional details, characteristics, variable speed, variable duty cycle systems, motor energy audit.

Lighting - Good lighting system design and practice, lighting control, lighting energy audit.

Module 4: ENERGY INSTRUMENTS AND ECONOMIC ANALYSIS (09 Periods)

Energy Instruments— Infrared thermometer, data loggers, thermo-couples, pyrometers, Lux meters, tongue testers, power quality analyzer, and PLC and PIC applications. Energy Economic Analysis— The time value of money concept. Cash flow models, payback analysis, depreciation, taxes and tax credit - numerical problems.

Module 5: DEMAND SIDE MANAGEMENT (09 Periods)

Introduction to DSM, concept of DSM, benefits of DSM, different techniques of DSM – time of day pricing, multi-utility power exchange model, and time of day models for planning, load management, load priority technique. Management and organization of energy conservation awareness programs.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 08 exercises shall be conducted)

1. Demonstration of various auditing instruments for measuring electrical and non-electrical quantities for auditing purpose.
2. Measurement of active, reactive power, energy and power factor for auditing purpose.
3. Energy conservation of Electric motor drive for under variable speed conditions.
4. Determine the energy consumption of incandescent/ fluorescent/CFL/LED lamps and evaluate net energy savings.
5. Evaluate energy conservation in a ceiling fan/BLDC fan with and without an electronic regulator.
6. Determine the energy conservation in an induction motor operating in star and delta mode of operation.
7. Conserve the energy of a three-phase induction motor by employing the switched capacitor for improvement of power factor. Also, estimate the energy and economic savings by improving the power factor for a given class of consumer.
8. Assess power quality problems using power quality analyzer and suggest a suitable conservative measures to mitigate

9. Analyze star labeled electrical apparatus and compare the data sheet of various star ratings.
10. Estimate the economic benefits of improving load factor for a domestic consumer.
11. Audit the energy of a commercial consumer and suggest an appropriate energy conservation practice to reduce energy bill.

RESOURCES

REFERENCE BOOKS:

1. W.R. Murphy & G. Mckay Butter worth, *Energy management*, Butter worth-Heinemann publications, 2nd Edition, 2016.
2. Albert Thumann, William J. Younger, *Handbook of energy audits*, Taylor & Francis Ltd, 7th Edition, 2008.
3. Umesh Rathore, *Energy management*, S.K. Kataria & Sons, 2nd Edition, 2014.
4. W.C.Turner, Stevedoty, *Energy management hand boo*k, CRC press, 6th Edition, 2006.
5. D.P. Sen, K.R. Padiyar, Indrane Sen, M.A. Pai, *Recent Advances in Control and Management of Energy Systems*, Interline Publisher, Bangalore, 1993.
6. Ashok V. Desai, Wiley Eastern, *Energy Demand - Analysis, Management and Conservation Hand book on energy auditing - TERI (Tata Energy Research Institute)*, 2005.
7. Craig B. Smith, Kelly E. Parmenter, *Energy management principles Applications*, benefits, Savings, Elsevier Inc(Pergamon Press), 1st Edition, 2016.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=M1zijCmeXJg
2. https://www.youtube.com/watch?v=FTpMWXMBSyM
3. https://www.youtube.com/watch?v=_T1Au_P5bnQ
4. https://www.youtube.com/watch?v=ENLzwTVjxms
5. https://www.youtube.com/watch?v=7hDyLuFJ0c8
6. https://www.youtube.com/watch?v=lkNIuFkzxBk

WEB RESOURCES:

1 https://drive.google.com/file/d/1rKbsgRMKS1a9SxfDKMnOjucmQDcgIS-e/view

2 https://drive.google.com/file/d/1PEhQ_ZMAzDVhnBdUWdrak5O88S29Mjbi/view

3 https://drive.google.com/file/d/1rH9ibpXqelVMBxreRLlH9DgKgpfPu6FH/view

4 https://drive.google.com/file/d/1cGk0iedOyuEpdmPbvrjFQT6sqU1zoeZz/view

5 https://beeindia.gov.in/sites/default/files/1Ch3.pd

6 https://beeindia.gov.in/content/energy-auditors

7 https://beeindia.gov.in/news-events/energy-conservation-building-code-rules-2018

8 https://nayaenergy.com/difference-between-energy-audit-and-energy-management/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101023	**OPTIMIZATION TECHNIQUES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:

Introduction to optimization; classical optimization techniques; classification of optimization problems; linear programming; Transshipment and Travelling salesman problem; non-linear programming; un-constrained non-linear programming; constrained non-linear programming; dynamic programming; Genetic Algorithm; AntColony Optimization.

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

CO1. Model and solve unconstrained optimization problems.

CO2. Apply LP Techniques and Conduct Sensitivity analysis for real life Problems

CO3. Apply Non-Linear Programming techniques for real life problems

CO4. Analyze various complex problems by using Dynamic programming approaches

CO5. Model and solve complex problems using evolutionary algorithms to optimize the parameters

CO-PO-PSO 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

Module1: CLASSICALOPTIMIZATIONTECHNIQUES (09Periods)

Introduction, Engineering applications of optimization, Statement of an optimization problem, Design vector, Design constraints, Constraint surface, Objective function, Classification of Optimization problems, Single variable optimization, Multivariable optimization without constraints, Multivariable optimization with equality constraints-Lagrange multipliers method; Multivariable optimization with in equality constraint-Kuhn Tucker conditions.

Module2: LINEARPROGRAMMING (09Periods)

Introduction, Formulation, Primal Simplex method, Dual simplex method, Sensitivity Analysis, Goalprogramming

Module3: NONLINEARPROGRAMMING (09Periods)

One dimensional minimization method, classification-Fibonacci method, quadratic interpolation method; classification of unconstrained minimization methods - Powell's method, steepest descent method(Cauchy's method); classification of constrained optimization Techniques – interior and exterior penalty function methods.

Module4: DYNAMICPROGRAMMING (09Periods)

Multistage decision processes, Concept of sub optimization and Principle of optimality,- Calculus method, Tabular method; Linear Programming problem by dynamic programming approach, Applications-reliability problem, shortest path problem, and capital budgeting problem.

Module5: EVALUATIONARYOPTIMIZTIONALGORITHMS (09Periods)

Introduction to Evolutionary optimization, genetic algorithm-Mathematical Modeling of Genetic algorithm, Ant Colony Optimization, particle swarm Optimization and differential evolution techniques.

TotalPeriods:45

EXPERIENTIAL LEARNING:

1. Linear Programming:
   A manufacturing company wants to optimize their production process to reduce costs while meeting the demand for their products. They use linear programming to find the optimal combination of production levels for each product, taking into account the costs of raw materials, labor, and other factors.
2. Non-Linear Programming:
   A tech company wants to optimize the design of a new product by minimizing its weight while maximizing its strength. They use non-linear programming techniques to find the optimal shape and dimensions of the product, taking into account the properties of the materials used.
3. Dynamic Programming:
   A transportation company wants to optimize their delivery routes to reduce travel time and fuel costs. They use dynamic programming to find the shortest path for each delivery, considering traffic conditions, road closures, and other factors.
4. Evolutionary Optimization:
   A financial institution wants to optimize their investment portfolio to maximize returns while minimizing risk. They use evolutionary optimization techniques like genetic algorithms and particle swarm optimization to find the optimal combination of investments, considering market trends, risk factors, and other variables.
5. Optimization in Healthcare:
   A hospital wants to optimize their patient scheduling system to reduce wait times and improve patient satisfaction. They use optimization techniques like linear programming and simulation to find the optimal scheduling algorithms, considering patient flow, staff availability, and other factors.

RESOURCES

TEXTBOOKS:

1. SingiresuS Rao, Engineering Optimization:Theory and Practice, New Age International, 3rd Edition, 2013.
2. A.Ravindran, K.M. Ragsdell, G.V.Reklaitis, Engineering Optimization: Methods and applications, Wiley India Pvt. Ltd., 2nd Edition2006.

REFERENCEBOOKS:

1. C Mohanand Kusum Deep, Optimization Techniques, New Age International Publishers, 1stEdition,2010.
2. HamdyA.Taha, Introduction to Operations Research, PHI, 10thedition, 2017.

VIDEOLECTURES:

1. https://www.youtube.com/watch?v=eo2tOPV3AoE
2. https://archive.nptel.ac.in/courses/111/107/111107104/
3. https://www.youtube.com/watch?v=3Bh_viwz6_0

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101029	**ARCHITECTURE AND TOWN PLANNING**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Architectural design and site planning; Building architecture and services; Town planning and structure; Land use planning; Regional planning and standards.

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

CO1. Analyze architectural design and site planning to solve architectural problems using appropriate tools and techniques following relevant standards and regulations considering society, environment and sustainability.

CO2. Design the building architecture and services to solve complex architectural problems using appropriate tools and techniques following relevant standards, codes and regulations considering safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze town planning and structure to solve urban development problems using appropriate tools and techniques following relevant policies considering society, environment and sustainability.

CO4. Analyzeand use planning to solve complex urban development problems using appropriate techniques following relevant policies considering society, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyze regional planning to solve complex urban and regional problems using appropriate techniques following relevant standards considering society, environment and sustainability besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: ARCHITECTURAL DESIGN AND SITE PLANNING ***(08 Periods)***

Architectural design, analysis, integration of function and aesthetics; Introduction to basic elements and principles of design, Surveys, Site analysis, Development control, Layout regulations, Layout design concepts.

Module 2: BUILDING ARCHITECTURE AND SERVICES ***(09 Periods)***

Residential, Institutional, Commercial and industrial, Application of anthropometry and space standards, Inter relationships of functions, Safety standards, Building rules and regulations, National building code, Integration of building services, Interior design, Man and environment interaction, Factors that determine climate, Characteristics of climate types, Design for various climate types, Passive and active energy controls, Green building concept.

Module 3: TOWN PLANNING AND STRUCTURE ***(10 Periods)***

Planning concepts and processes, Objectives, Levels of planning in India and their interrelationship, Planning administration, Models of planning processes, Components of settlement structures, Models of urban structure; Demand and supply of land for urban use, Means and mechanism, Impact on urban structure, Goals of land policy.

Module 4: LAND USE PLANNING ***(9 Periods)***

Concept of land use, Locational attributes of land use, Land use planning information system, Activity system and choice of space qualities, System approach and physical planning, Approach to land use planning, Introduction to spatial planning at regional level, Choice theory and advocacy planning and their application action plan and its relevance, Development plan types, Scope and objectives, Principles of landscape design.

Module 5: REGIONAL PLANNING AND STANDARDS ***(9 Periods)***

Planning practices in India, Method of identifying urban and regional problem, Setting of goals objectives and priorities, Performance standards, Spatial standards and standard for utilities, Classification of regions, Regionalization and delineation techniques for various types of regions, Cluster and factor analysis method.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a report for any historical building with its architectural description.
2. Prepare a report on architectural services and detailing for buildings.
3. Prepare a draft for small locality considering the town planning concepts and its design.
4. Write and assessment report on land use for any historical city/village.

RESOURCES

TEXT BOOKS:

1. Biswas Hiranmay, *Principles of Town Planning and Architecture*, Vayu Education of India, 2nd Edition, 2019.
2. Satish Chandra Agarwala, *Architecture and Town Planning*, Dhanpat Rai and Company, 2008.

REFERENCE BOOKS:

1. Pratap Rao, M., *Urban Planning Theory and Practice*, CBS Publishers & Distributors Pvt. Ltd., New Delhi, 1st Edition, 2019.
2. Hiraskar, G. K., *Fundamentals of Town Planning*, Dhanpat Rai & Sons, 2018.
3. Rangwala, S. C., *Town Planning*, Charotar Publishing House, 31st Edition, 2021.
4. Muthu Shoba Mohan, G., *Principles of Architecture*, Oxford University Press, New Delhi, 1st Edition, 2006.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=ulyPxhtNEMQ
2. https://archive.nptel.ac.in/courses/124/107/124107158/

WEB RESOURCES:

1. Urban design & urban planning: A critical analysis to the theoretical relationship gap - ScienceDirect
2. https://www.bing.com/search?q=Architectural+town+planning&cvid=cd55c8f1759146879fad56ab2528cfe1&aqs=edge..69i57j0.7615j0j4&FORM=ANAB01&PC=HCTS
3. Architecture and town planning Unit 1 SPPU Principles, elements, Qualities and Role of Architecture by S R Kate (slideshare.net)

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101030	**SMART MATERIALS AND STRUCTURES**	3	-	-	-	3

Pre-Requisite 22CE102002-Civil Engineering Materials and Concrete Technology
22CE101003-Structural Analysis
22CE101005-Reinforced Cement Concrete Structures
22CE101006-Steel Structures

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Smart materials and structures; Measuring techniques and types; Sensing systems; Actuators; Data acquisition and processing.

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

CO1. Analyze smart materials and various components of smart structures to solve problems associated with smart structures for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning.

CO2. Analyze various strain measuring tools to solve problems associated with smart structures for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning.

CO3. Analyze various sensing systems to solve problems associated with smart structures for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning.

CO4. Analyze various materials and techniques used in actuators to solve problems associated with smart structures for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning.

CO5. Analyze the signals from the smart structures and monitor the structural deficiencies prior to failure to solve problems associated with smart structures for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning.

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

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

COURSE CONTENT

Module 1: SMART MATERIALS AND STRUCTURES ***(8 Periods)***

Smart materials and structures, Instrumented structures functions and response Sensing systems, Self-diagnosis, Signal processing consideration, Actuation systems and effectors.

Module 2: MEASURING TECHNIQUES AND TYPES ***(8 Periods)***

Strain measuring techniques using electrical strain gauges- Types, Resistance, Capacitance, Inductance, Wheatstone bridges, Pressure transducers, Load cells, Temperature compensation, Strainrosettes.

Module 3: SENSING SYSTEMS ***(11 Periods)***

Sensing technology, Types of sensors, Physical measurement using piezo electric strain measurement, Inductively read transducers, LVDT, Fiber optic techniques, Chemical and Bio-chemical sensing in structural assessment, Absorptive chemical sensors, Spectroscopes, Fibre optic chemical sensing systems and distributed measurement.

Module 4: ACTUATORS ***(9 Periods)***

Actuator techniques, Actuator and actuator materials, Piezoelectric and electro strictive material, Magneto structure material, Shape memory alloys, Electro rheological fluids, Electromagnetic actuation, Role of actuators and Actuator materials.

Module 5: DATA ACQUISITION AND PROCESSING ***(9 Periods)***

Data acquisition and processing, Signal processing and control for smart structures, Sensors as geometrical processors, Signal processing, Control system- Linear and non-linear.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a detailed report on use of smart materials in buildings and their applications in other civil engineering domains.
2. Assume that a beam contains a strain gauge to determine the deflections. Draw the assumed fluctuations in the deflection curve of the beam (Assume necessary data)
3. Draft a report on use of different smart sensors and actuation systems for a G+15 tall building.
4. Identify and prepare a report on Data processing for a piezoelectric strain gauge.

RESOURCES

TEXT BOOKS:

1. Brain Culshaw, *Smart Structure and Materials*, Artech House – Borton. London, 2004.
2. Srinivasan, A. V. and Michael McFarland, D., *Smart Structures: Analysis and Design*, Cambridge University Press, 2009.

REFERENCE BOOKS:

1. Gandhi, M.V. and Thompson, B.S., *Smart Materials and Structures*, Chapman and Hall, New York, 1992
2. Mel. M Schwartz, *Encyclopedia of Smart Materials*, John Wiley and Sons Inc., 2002.
3. Srinath, L. S., Raghavan, M.R., Lingaiah, K., Gargesa. G., Pant. B., Ramachandra, K., *Experimental Stress Analysis*, Tata McGraw-Hill, 1984.
4. Dally, J. W. and Riley, W. F., *Experimental Stress Analysis*, Tata McGraw-Hill, 3rd Edition, 1991.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc23_ae19/preview
2. https://archive.nptel.ac.in/courses/112/104/112104251/

WEB RESOURCES:

1. (PDF) Smart Materials and Structures (researchgate.net)
2. The Role of Sensors in Construction: Sensing the Future of Building (autodesk.com)
3. Actuation concepts for adaptive high-rise structures subjected to static wind loading - ScienceDirect
4. Strain Gauge: Working Principle & Diagram | Electrical4U

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101031	**INFRASTRUCTURE DEVELOPMENT AND MANAGEMENT**	3	-	-	-	3

Pre-Requisite 22CE102003-Construction, Planning and Project Management

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Infrastructure development; Overview of Indian infrastructure – Tenders, Contracts and specifications; Policies on infrastructure development; Construction and infrastructure; Infrastructure management.

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

CO1. Analyze the impact of infrastructure development on society, economy and environment to solve infrastructure problems ensuring sustainability.

CO2. Analyze the Indian infrastructure to solve infrastructure problems following relevant government policies and regulations considering society, environment, sustainability and finance.

CO3. Analyze the policies on infrastructure development to solve complex infrastructure problems considering society, environment and sustainability.

CO4. Analyze the construction components of various infrastructure sectors to solve complex infrastructure problems following government policies and regulations considering society, environment and sustainability.

CO5. Analyze the infrastructure management in various sectors to solve infrastructure problems using appropriate tools and techniques following relevant guidelines, policies and regulations considering society, environment and sustainability.

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

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

COURSE CONTENT

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

Impact of infrastructure development on economic growth, standard of living and environment; Reasons for rise of public sector and government involvement in infrastructural activities, Changed socio-economic scenario and current problems and related issues.

Module 2: OVERVIEW OF INDIAN INFRASTRUCTURE ***(09 Periods)***

***Indian Infrastructure*:** Energy, Power, Water resources, Dams, Bridges, Canals, Rural Infrastructure, Urban Infrastructure, Housing, Roads, Railways, Ports, Airports, Social Infrastructure, Education, Health care, Infrastructure deficiencies.

***Tenders, Contracts and Specifications*:**Public Private Partnership (PPP) contracts, Turnkey contracts, FIDIC clauses.

Module 3: POLICIES ON INFRASTRUCTURE DEVELOPMENT ***(9 Periods)***

A historical review of the government policies on infrastructure; Current public policies on transportation, power and telecom sectors; Plans for infrastructure development; Legal framework for regulating private participation -Roads and highways, Ports and airports, Power and telecom.

Module 4: CONSTRUCTION AND INFRASTRUCTURE ***(9 Periods)***

Construction component of various infrastructure sectors: Highways, Ports and aviation, Oil and gas, Power, Telecom, Railways, Irrigation; Current scenario, Future needs, Investment needed, Regulatory framework, Government policies and future plans, Technological and methodological demands on construction management in infrastructure development projects.

Module 5: INFRASTRUCTURE MANAGEMENT ***(9 Periods)***

Importance, scope and role in different sectors of construction

- ***Highway Sector:*** Repayment of Funds, Toll Collection Strategy, Shadow tolling, and direct tolls, Maintenance strategy, Review of toll rates & structuring to suit the traffic demand.
- ***Irrigation Projects:*** Large / Small Dams, Instrumentation, Monitoring of water levels, Catchments area, Rainfall data management, Prediction, Land irrigation planning & policies, Processes Barrages, Canals.
- ***Power Projects:*** Power scenario in India, Estimated requirement, Generation of power distribution strategies, National grid, Load calculation & factors, Hydropower, Day to day operations, Management structures, Maintenance, Thermal Power, Nuclear Power.
- ***Airports:*** Requisites of domestic and international airports, Cargo and military airports, Facilities available, Terminal management, ATC.
- ***Railways:*** Mass Rapid Transport System MRTS, LRT, Multi–modal Transport System.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Write a Report on the India's one Lakh Crores of budget in five year plan for the development of National Highways throughout India.
2. Identify BOOT and BOLT Type of PPP contracting system in infrastructure within India.
3. Prepare a detailed informative report on infrastructure development in various sectors post-independence.

4. Write a suggestive report on policies for the development of infrastructure in India.

RESOURCES

TEXT BOOKS:

1. Narindar Jetli, K. and Vishal Sethi, *Infrastructure Development in India Post Liberalization Initiatives and Challenges*, New Century Publications, 2007.
2. Raghuram, G. and Jain, R., *Infrastructure Development and Financing: Towards a Public–Private Partnership*, Macmillan India Ltd., 1999.

REFERENCE BOOKS:

1. Joshi, R. N., *Public Private Partnership in Infrastructure Perspectives, Principles, Practice*, Vision Books, 2000.
2. Prasanna Chandra, *Projects: Planning, Analysis, Selection, Financing, Implementation and Review*, Mc. Graw Hill Education, 8th Edition, 2014.
3. Murty, G. R. K., *Infrastructure Projects: Current Financing Trends,* ICFAI University Press, 2006.
4. Anup Chatterjee, Narinde Jetli, K. and Vishal Sethi*, Industry and Infrastructure Development in India Since 1947*, New Century Publications, 2009.

VIDEO LECTURES:

1. Infrastructure Planning & Management - YouTube
2. Infrastructure Planning and Managements - Course (nptel.ac.in)

WEB RESOURCES:

1. Infrastructure Planning and Management in India: Opportunities and Challenges | SpringerLink
2. Infrastructure Development in India: Market Size, Investments, Govt Initiatives | IBEF
3. Infrastructure Development and Construction Management - 1st Edition - (routledge.com)

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101032	**CIVIL INFRASTRUCTURE FOR SMART CITY DEVELOPMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Smart Cities;Urban Planning for Smart City;Smart City Development; Smart Buildings; Smart City Mobility;Smart City Utilities and Services.

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

CO1. Analyze the various elements of smart city infrastructure using different principles and policies by ensuring safety and sustainability.

CO2. Compare the various levels of urban planning by conserving natural and built heritage environment using RS & GIS.

CO3. Measure the development of smart city and performance of smart buildings with the help of various indices and tools considering environment and sustainability.

CO4. Select a sustainable concept by considering traffic operating policies for the issues related to smart city mobility for the benefit of society.

CO5. Use appropriate tools/techniques for solving various issues related to smart city utility and services by clinching environment sustainability.

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

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

COURSE CONTENT

Module 1: SMART CITIES ***(07 Periods)***

Smart City; Elements of Smart city infrastructure – Buildings, Mobility, Energy, Water, Waste management, Health and Digital layers; Need for an integrated approach; Role of science, technology and innovation in the implementation of smart infrastructure; Smart infrastructure design principles and policies;Case studies: Gujarat International Finance Tech-City in India.

Module 2: URBAN PLANNING FOR SMART CITY ***(09 Periods)***

Introduction to concepts of urban planning; Various levels – Development Plan, Regional Plan, Sub-city Plans; Provision of local needs; Importance of local area and neighbourhood planning; Land use controls and zoning; Housing and slum rehabilitation; Urban patterns; Conservation of Natural and built heritage environment; Elements of urban design; Indian best practices in urban planning; Application of Remote Sensing (RS) for land use/land cover, agriculture and urban planning.

Module 3: SMART CITY DEVELOPMENT AND SMART BUILDINGS ***(11 Periods)***

Smart City Development: Evolution and Concept; Objectives; Contemporary features; Relevance and Importance; Barriers and Drivers;Smart City Governance and Public Institutions; Sustainability and Resilience; Liveability index; Smart city ranking index; Application of BIM in Smart city development.

Smart Buildings: Smart building; Siting the building; Materials; Measuring the Performance of a Building – Financial metrics, Security and life safety, Productivity and satisfaction of building occupants; Essential attributes of a smart building – HVAC, Lighting control, Electric power management, Access control, Video surveillance, Fire alarm and mass notification; Design, Construction, and Renovation process; The Economics of smart buildings; Energy and sustainability; Case studies.

Module 4: SMART CITY MOBILITY ***(09 Periods)***

Introduction; Issues of urban transport; Demand and Supply side solutions; Design concepts (pedestrian friendly/vehicle friendly design, safety considerations); Sustainable transportation; Urban transport planning process; Traffic operation policies; Intelligent Transportation System (ITS) for efficient utilization of resources; Components of ITS; Public transportation systems - Metro rail and Bus Rapid Transit System (BRTS); New trends in urban mobility; Case studies.

Module 5: SMART CITY UTILITIES AND SERVICES ***(09 Periods)***

Sector wise issues in city infrastructure services such as water distribution; waste water collection; waste treatment; Tariff structures; Metering and billing; 24x7 water supply system; Urban sanitation; Integrated Water Resource Management System (IWRM); Smart city applications using RS & Geographic Information System(GIS) for water and waste water utilities; Street lighting system; Case studies.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Visit any nearby town/city and identify various smart features of that location. Also

prepare a detailed flow chart of all available smart features in that town/city.

2. Consider a small town which will be going to expand in coming 10 years. Analyze various parameters using toposheet of that town and prepare a detailed plan for urban land use/land cover.
3. Visit a smart building near your area and prepare a detailed report on how different smart features work in that building.
4. Conduct traffic studies in Tirupati urban and identify the locations of traffic congestion. Suggest some intelligent transportation systems to be implemented.
5. Identify various issues in utility services of Tirupati urban/rural and suggest suitable effective management systems.

RESOURCES

TEXT BOOKS:

1. Anilkumar, P. P., *Introduction to Smart Cities,* First Edition,Pearson, 2019.
2. Joseph M. Sussman, *Perspectives on Intelligent Transportation Systems (ITS),* Springer Science & Business Media, 2008.

REFERENCE BOOKS:

1. Vinod Kumar T. M., *Geographic Information System for Smart Cities*, Copal Publishing, 2014.
2. James Sinopoli, S*mart Buildings Systems for Architects, Owners and Builders*, Butterworth-Heinemann, 2010.
3. James Sinopoli, *Advanced Technology for Smart Buildings*, Artech House, 2016.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=0j7X1w4OXhA&list=RDCMUCY-ANi3wxkUSGhAel7T0TGw&start_radio=1&rv=0j7X1w4OXhA&t=25
2. https://nptel.ac.in/courses/105107210
3. https://nptel.ac.in/courses/105105160

WEB RESOURCES:

1. http://www.inogate.org/documents/Lecture%20Building%20EE%203%20ENG.pdf
2. https://link.springer.com/content/pdf/10.1007/978-3-642-30241-1_16.pdf
3. https://iaeme.com/MasterAdmin/Journal_uploads/IJCIET/VOLUME_8_ISSUE_8/IJCIET_08_08_012.pdf
4. https://www.eltis.org/sites/default/files/ITS_Telematics_6.pdf
5. https://www.civil.iitb.ac.in/tvm/nptel/591_ITS_1/web/web.html
6. https://coeut.iitm.ac.in/ITS_synthesis.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE102013	**ADVANCED CONCRETE TECHNOLOGY**	2	-	2	-	3

Pre-Requisite 22CE102002-Civil Engineering Materials and Concrete Technology

Anti-Requisite

Co-Requisite

COURSE DESCRIPTION: This course provides a detailed discussion oncement, admixtures, aggregates, concrete mix design, mechanical properties of concrete, special concretes, durability of concrete and non-destructive techniques

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

CO1. Evaluate the properties of cement, admixtures and aggregates using different tools and techniques and through continuous learning to solve complex civil engineering construction problems considering codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO2. Design a concrete mix using appropriate methods for solving complex concrete technology problems considering codes of practice, safety, environment and sustainability either individually or in a team.

CO3. Evaluate the mechanical properties of concrete using various tools and techniques to solve complex civil engineering construction problems by following relevant codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO4. Evaluate the properties of special concretes using different tools and techniques and through continuous learning to solve complex civil engineering construction problems considering codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO5. Evaluate the durability of concrete using different tools and techniques and through continuous learning to solve complex civil engineering construction problems considering codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

CO6. Evaluate concrete using different non-destructive tools and techniques tosolve complex civil engineering construction problems considering codes of practice, safety, environment and sustainability either individually or in a team besides communicating effectively in graphical form.

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	2	2	2	2	2	2	-	1	3	-	-
CO2	1	2	3	2	2	2	2	2	2	2	-	-	3	-	-
CO3	3	3	-	2	2	2	2	2	2	2	-	-	3	-	-
CO4	3	3	-	2	2	2	2	2	2	2	-	1	3	-	-
CO5	3	3	-	2	2	2	2	2	2	2	-	1	3	-	-
CO6	3	3	-	2	2	2	2	2	2	2	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**-**	**1**	**3**	-	**-**

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

COURSE CONTENT

Module 1: CEMENT, ADMIXTURES AND AGGREGATES *(09 Periods)*

Cement: Composition of OPC, Manufacture, Modified Portland Cements, Hydration Process of Portland Cements, Structure of Hydrated Cement Pastes.

Admixtures: Mineral Admixtures, Slags, Pozzolanas and Fillers; Chemical Admixtures, Solutes, Retarders, Air Entraining Agents, Water Proofing Compounds, Plasticizers and Super Plasticizers.

Aggregates: Properties and testing of fine and coarse aggregates, combining of aggregates, Substitute material for aggregates, recent advancements.

Module 2: MIX DESIGN AND MECHANICAL PROPERTIES OF CONCRETE *(09 Periods)*

Concrete Mix Design: Mix Proportioning (IS method, British method and ACI method), Mixes incorporating Fly ash, Silica fume, GGBS etc.

Mechanical Properties of Concrete: Interfacial Transition Zone, Fracture Strength, Compressive strength, Tensile strength, Impact strength, Bond strength, Modulus elasticity, Modulus of rupture, Bulking of sand, Deleterious substance in aggregate, Soundness of aggregate, Alkali aggregate reaction, Sieve analysis, Gradation, Maximum aggregate size.

Module 3: SPECIAL CONCRETES *(09 Periods)*

High performance concrete, High strength concrete, Fibre reinforced concrete, Self compacting concrete, Roller compacted concrete, Polymer concrete, High performance concrete, Lightweight concrete, Pervious concrete, Heavy weight aggregate concrete, Bacterial concrete, Recycled aggregate concrete, Reactive powder concrete, Geopolymer concrete, Utilization of industrial wastes in concrete, Special processes and technology - Sprayed concrete, Underwater concrete, Mass concrete, Slip form construction, Prefabrication technology, 3D concrete printing, Recent advancements.

Module 4: DURABILITY OF CONCRETE ***(09 Periods)***

Factors affecting durability, Creep, Shrinkage, Sulphate attack, Acid attack, Permeability, Chloride penetration, Water absorption, Carbonation, Corrosion,Fire resistance, Frost damage, Alkali silica reaction, Concrete in sea water,Service life prediction, Design of Concrete for the required Service Life, Micro structural Characterization (SEM, EDAX, TGA, XRD, FTIX, XRF) and latest developments.

Module 5: NON-DESTRUCTIVE EVALUATION ***(09 Periods)***

Importance; NDT for Quality, Strength and Integrity of concrete; Rebound hammer test, Ultrasonic pulse velocity test, Cover meter test, Carbonation test, Concrete core cutting test, Half-cell potentiometer test,In-situ permeability test, Penetration resistance or Windsor probe test, Radiographic test, Ground penetrating radar (GPR), Impact echo testing methods, Electrical resistivity test, Thermal imaging, Visual investigation, Acoustical emission testing methods, Pullout test.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Tests on Cement
   (a) Fineness of cement
   (b) Standard consistency, initial and final setting time of cement
   (c) Specific gravity and soundness of cement
   (d) Compressive strength of cement
2. Tests on fine aggregate
   (a) Sieve analysis of fine aggregate
   (b) Specific gravity of fine aggregate
   (c) Bulking of fine aggregate
3. Tests on coarse aggregate
   (a) Sieve analysis of aggregates
   (b) specific gravity and water absorption test
4. Concrete mix design – IS method
5. Concrete mix design – British method
6. Concrete mix design – ACI method
7. Determination of workability of fresh concrete by
   (a) Slump cone test
   (b) Compaction factor test
   (c) Vee-Bee consistometer test
8. Determination of workability of self compacting concrete by
   (a) V funnel test
   (b) U box test
   (c) L box test
9. Determination of strength of concrete by
   (a) Compressive strength test
   (b) Split tensile strength test
   (c) Flexural strength test
   (d) Modulus of elasticity of concrete

10. Conduct tests on durability of concrete
    (a) Sulphate attack
    (b) Chloride attack
    (c) Alkali aggregate reaction
    (d) Carbonation
    (e) Acid attack
11. Non-destructive tests on concrete
    (c) Rebound hammer test
    (d) Ultrasound pulse velocity test
    (e) Cover meter test
    (f) Half cell potentiometer test
    (g) Penetration resistance or Windsor probe test
    (h) Radiographic test
    (i) Pull-out test
    (j) Ground penetrating radar (GPR)
    (k) Impact echo testing methods
    (l) Electrical resistivity test
    (m) Acoustical emission testing methods
    (n) Thermal imaging
    (o) Visual investigation
12. Non-destructive tests on underwater concrete
    (a) In-situ permeability test
    (b) Concrete core cutting test
    (c) Corrosion test
    (d) Chloride content test
    (e) Carbonation test

RESOURCES

TEXT BOOKS:

1. Neville A.M., *Properties of Concrete*, 5th Edition, John Wiley and Sons, New Delhi, 2012.
2. Shetty M.S., *Concrete Technology*, S. Chand and Company Ltd., 7th Revised Edition, 2013.

REFERENCE BOOKS:

1. Gupta Y.P., *Concrete Technology and Good Construction Practices*, New Age International Private Limited., New Delhi, 2013.
2. Neville A.M and Brooks J.J., *Concrete Technology*, 2nd Edition, Pearson Education, New Delhi, 2019.
3. Gambhir M.L., *Concrete Technology*, 3rd Edition, Tata McGraw-Hill Publishers, New Delhi, 2008.
4. Santha Kumar A.R., *Concrete Technology*, 7th Edition, Oxford University Press, New Delhi, 2011.

LABORATORY MANUALS

1. *Advanced Concrete Technology Laboratory Manual (MBU22 Regulations)*, Department of Civil Engineering, School of Engineering, Mohan Babu University, Tirupati.

IS CODES

1. IS 10262 – 2000: Concrete Mix design
2. IS 4031 – 1988: Chemical Analysis and Tests on Cement
3. IS 383 – 1970: Coarse and Fine Aggregates
4. IS 10264 – 2009: Mix Design of Concrete
5. IS 1199 – 1959: Methods of Sampling and Analysis of Concrete
6. IS 13311 – 1992: Methods of Non-destructive Testing of Concrete

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105102012
2. https://archive.nptel.ac.in/courses/105/106/105106176/
3. https://www.digimat.in/nptel/courses/video/105106176/L01.html
4. https://www.youtube.com/watch?v=r5IyWOt3WUM

WEB RESOURCES:

1. https://www.sciencedirect.com/book/9780750656863/advanced-concrete-technology
2. https://old.amu.ac.in/emp/studym/1821.pdf
3. https://www.constructioncivil.com/nondestructive-testing-of-concrete/#gsc.tab=0
4. https://housing.com/news/concrete-technology-latest-trends-in-concrete-technology-shaping-the-construction-industry/

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101124	AI AND IOT IN CONSTRUCTION	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on fundamentals of Artificial Intelligence (AI), AI techniques and models, construction engineering management, applications of AI in Civil Engineering, fundamentals of Internet of Things (IoT), machine-to-machine communications, arduino programming, integration of sensors and actuators, virtualization concepts and cloud architecture.

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

CO1. Analyze the applications of AI in the field of civil engineering to solve complex problems appropriate techniques considering society, safety, environment and sustainability besides communicating effectively in graphical form.

CO2. Analyze the AI techniques in construction engineering and management to solve complex problems using advanced tools and techniques considering society, safety, environment and sustainability besides life-long learning by communicating effectively in graphical form.

CO3. Analyze the fundamentals of AI in construction engineering and management to solve complex problems using advanced tools and techniques considering society, safety, environment and sustainability besides life-long learning by communicating effectively in graphical form.

CO4. Analyze IoT designs to solve complex civil engineering problems using appropriate tools and techniques considering society, safety, environment and sustainability besides communicating effectively throughout the life.

CO5. Analyze cloud platforms for IoT in civil engineering filed to solve complex problems using appropriate tools and techniques considering society, safety, environment and sustainability besides life-long learning by communicating effectively.

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

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

COURSE CONTENT

Module 1: INTRODUCTION TO AI (07 Periods)

Importance of AI, Evolution of AI - Applications of AI, Classification of AI Systems with respect to environment, Knowledge inferring systems and planning, Uncertainty and towards learning systems.

Module 2: AI TECHNIQUES (08 Periods)

Expert systems, Fuzzy logic, Statistical model, Machine learning, Process mining, Characteristics , Significance of construction engineering management (CEM), The benefits of AI in CEM, Automation, Risk mitigation, High efficiency, Digitalization, Computer vision.

Module 3: FUNDAMENTALS OF IoT (08 Periods)

Introduction to IoT, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks.

Module 4: IoT DESIGN METHODOLOGY (12 Periods)

Machine-to-Machine Communications, Difference between IoT and M2M, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino. Introduction to Raspberry Pi, Introduction to Software defined Network (SDN).

Module 5: CLOUD PLATFORMS FOR IoT (10 Periods)

Virtualization concepts and Cloud Architecture, Cloud computing, benefits, Cloud services — SaaS, PaaS, IaaS, Cloud providers & offerings, Study of IOT Cloud platforms.

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.
3. Design and implement to capture gas Sensor and send sensor data to cloud from your nodemcu device using Arduino IDE.
4. Design and implementation of humidity and temperature monitoring using Arduino and upload data to cloud using MQTT.
5. Design and implementation of an iot ECG (Electrocardiogram) system to record heart's electrical activity.

RESOURCES

TEXT BOOKS:

1. ArshdeepBahga, Vijay Madisetti, Internet of Things – A Hands-on Approach, Universities Press, 2015.
2. S. Russell, and P. Norvig, Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hal, l2015.

REFERENCE BOOKS:

1. Limao Zhang , Yue Pan , Xianguo Wu , Mirosław J. Skibniewski, Artificial Intelligence in Construction Engineering and Management, Kindle Edition.
2. Adrian McEwen and Hakin Cassimally, *Designing the Internet of Things,* Wiley India.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106105166
2. https://nptel.ac.in/courses/106102220

WEB RESOURCES:

1. https://www.tutorialspoint.com/internet_of_things/internet_of_things_tutorial.pdf
2. https://mite.ac.in/wp-content/uploads/2021/04/iot_module1.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101125	DATA SCIENCE FOR CIVIL ENGINEERS	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Data Science, Python Fundamentals in Construction, Pandas Data Analytics Library and Design Phase Application, Statistics and Visualization Basics and Operations, Machine Learning for the Built Environment.

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

CO1. Analyze portable IoT systems using Arduino/equivalent boards to solve complex construction management problems by using appropriate strategies tools and techniques considering safety and environment besides communicating and managing effectively.

CO2. Analyze and develop a code using python programing to solve complex construction management problems by using appropriate strategies, tools and techniques considering safety and environment besides communicating effectively.

CO3. Apply Panda Data library and design applications in construction managementby using appropriate tools and techniques considering code of ethics, safety and environment besides communicating effectively.

CO4. Analyze basic visualization operations statistics using Pandas in operating buildings by following latest developments to solve problems by using appropriate tools and techniques considering society, safety, environment and sustainability besides communicating effectively in graphical form.

CO5. Apply machine learning to buildings by following latest developments to solve complex construction management problems using appropriate tools and techniques considering safety, environment and sustainability besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: DATA SCIENCE ***(08 Periods)***

About Data Science, Benefits and uses of data science and big data, Facets of data, The Current Landscape of Data Science, Data Science Profile and Thought Experiment Meta-Definition, The big data ecosystem and data science, Overview of Python concepts

Module 2: PYTHON FUNDAMENTALS IN CONSTRUCTION ***(07 Periods)***

Overview of key python concepts, Control Statements, Functions and Libraries; Motivating factors for building industry, Construction professionals to learn to code, The application of python in Net Zero Energy Building (NZEB), Various uses of data science and related technologies in design, construction and operation.

Module 3 PANDAS DATA ANALYTICS LIBRARY AND DESIGN PHASE APPLICATION ***(10 Periods)***

Overview of the design phase of buildings, Pandas data analytics library – Concept, Basics of pandas data structures, Common pandas functions; Applications for designers on Energy Plus, Revit, Rhino, Spatial analytics, Generation design; Construction phase of buildings, Time-series data and its challenges, Applications in project management, and Building Management System (BMS) data analysis.

Module 4 STATISTICS AND VISUALIZATION BASICS AND OPERATIONS ***(11 Periods)***

Overview of operations phase of buildings, Occupant satisfaction in buildings, Pandas statistical aggregations and visualization techniques in pandas, Seaborn visualization library, Applications for operations focused on occupant satisfaction , Spatial optimization and feedback collection.

Module 5 MACHINE LEARNING FOR THE BUILT ENVIRONMENT ***(09 Periods)***

Prediction impact on building industry, Implementation of prediction, classification and clustering using the sci-kit learn library, Application to smart meter and occupant comfort data for prediction and classification of data. Applications on machine learning in construction industry.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Design and implementation of raspberry Pi home security system with camera and PIR sensor with email notifications.
2. Design and implement to upload light sensor (TSL) data to cloud through raspberry Pi.
3. Design and implementation of motion detector with nodemcu and BLYNK.
4. Design and implementation of fire notification IOT system with BLYNK.
5. Predict the 90 Day strength for a compression material with old data of similar material using pandas dairy.

RESOURCES

TEXT BOOKS:

1. Rakesh. K. Jain. Data Science for Civil Engineering _ A beginners Guide, CRC Press, Taylor & Francis Group, London.

REFERENCE BOOKS:

1. Michael Rustell, Innovation in construction, Springer, 2022

SOFTWARE/TOOLS:

1. Pyton
2. Microsoft Power BI

VIDEO LECTURES:

1. Course | Data Science for Construction, Architecture and Engineering | edX
2. Machine Learning Application to Structural Engineering - Part 1 - YouTube

WEB RESOURCES:

1. Data Science in Civil Engineering - Analytics Vidhya
2. Conquer Data Science in Civil Engineering | Data Trained Blogs
3. Artificial Intelligence and Data in Civil Engineering | SpringerLink

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101033	**GEOENVIRONMENTAL ENGINEERING**	3	-	-	-	3

Pre-Requisite 22CE102006-Soil Mechanics
22CE102005-Environmental Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Principles of sustainability; Sustainability metrics and assessment tools; Sustainable engineering practices; Sustainable engineering applications; Sustainable urbanization and industrialization.

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

CO1. Analyze geoenvironmental properties of soil to solve complex problems of geoenvironmental engineering through continuous learning by ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO2. Analyze soil-water-contaminant interaction to solve complex geoenvironmental engineering problems using appropriate tools and techniques ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Design waste containment systems to solve complex geoenvironmental engineering problems using appropriate tools and techniques by following the relevant codes of practice and ensuring cost effectiveness, safety, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze contaminated site characterization and remediation to solve complex geoenvironmental engineering problems using appropriate tools and techniques by following the relevant codes of practice and ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyze advanced soil characterization techniques to solve complex problems of geoenvironmental engineering by following the relevant codes of practice and through continuous learning by ensuring safety, environment and sustainability besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: FUNDAMENTALS OF GEOENVIROMENTAL ENGINEERING ***(09 Periods)***

Scope of geoenvironmental engineering, Multiphase behavior of soil, Role of soil in geoenvironmental applications; Importance of soil physics, soil chemistry, hydrogeology and biological process; Sources and type of ground contamination, Impact of ground contamination on geoenvironmental, Case histories on geoenvironmental problems.

Module 2: SOIL- WATER – CONTAMINANT INTERACTIONS ***(09 Periods)***

Soilmineralogycharacterizationanditssignificanceindeterminingsoilbehavior,Soil–waterinteractionandconceptsof double layer, Forces of interaction between soil particles, Concepts of unsaturated soil, Importance of unsaturated soil in geoenvironmental problems, Measurement of soil suction, Waterretention curves, Water flow in saturated and unsaturated zone, Soil–water–contaminant interactions and its implications, Factors affecting retention and transport of contaminants.

Module 3 WASTE CONTAINMENT SYSTEM ***(09 Periods)***

Evolution of waste containment facilities and disposal practices, Site selection based on environmental impact assessment, Different roles of soil in waste containment, Different components of waste containment system and its stability issues, Property evaluation for checking soil suitability for waste containment, Design of waste containment facilities.

Module 4 CONTAMINANTSITEREMEDIATION ***(09 Periods)***

Site characterization, Risk assessment of contaminated site, Soil remediation technologies– Soil vapour extraction, Soil washing, Stabilization/solidification, Electro-kinetic remediation, Thermal desorption, Vitrification, Bioremediation Phytoremediation; Groundwater remediation technologies – Pump and treat, In–situ flushing, Permeable reactive barriers, In–situ air sparging, Monitored natural attenuation, Bioremediation; Selection and planning of remediation technologies, Some examples of in–situ remediation.

Module 5 ADVANCEDSOILCHARACTERIZATION ***(09 Periods)***

Contaminant analysis, Water content and permeability measurements, Electrical and thermal property evaluation, Use of GPR for site evaluation, Introduction to geotechnical centrifuge modeling, Characterization of contaminated soils by using latest techniques.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Group discussion on contamination of Land resources.
2. Poster presentation on soil - water – contaminant interactions.
3. Submit a case study report on Contaminated sites and their hazardous impacts.
4. Submit a case study report on characterization of (any one site can be taken up as a case study and make a report)
5. Submit a case study report on the effect of environment human life with reflection of Land pollution.
6. Submit a case study report on any one of the Structural failure caused due to soil contamination.
7. Prepare a report on various sources of soil contamination in India.
8. Debate on challenges, limitations and solutions for design and implementation of Contamination free sites.

RESOURCES

TEXT BOOKS:

1. Reddi, L. N. and Inyang, H. I., *Geoenvironmental Engineering Principles and Applications*, Marcel Dekker Inc, 1st Edition, 2000.
2. Sharma, H. D. and Reddy, K. R., *Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies*, John Wiley & Sons, Inc., USA, 1st Edition, 2004.

REFERENCE BOOKS:

1. Rowe, R. K., *Geotechnical and Geoenvironmental Engineering Handbook*, Kluwer Academic, 1st Edition, 2001.
2. Yong, R. N., *Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation*, CRC Press, New York, 1st Edition, 2001.
3. Bedient, P.B., Refai, H. S. and Newell, C. J., *Ground Water Contamination: Transport and Remediation,* Prentice Hall Publications, 2nd Edition, 1999.
4. LaGrega, M. D., Buckingham, P. L. and Evans, J. C., *Hazardous Waste Management*, New Delhi, MedTech, 2nd Edition, 2015.
5. Wise, D.L., Trantolo, D.J., Inyang, H.I. and Cichon, E.J., Remediation *Engineering of Contaminated Soils*, Marcel Dekker Inc, 1st Edition, 2000.
6. Fredlund, D.G. and Rahardjo, H., *Soil Mechanics for Unsaturated Soils*, Wiley-Interscience, USA, 1st Edition, 1993.
7. Hillel, D., *Introduction to Environmental Soil Physics*, Academic Press, New York, 1st Edition, 2003.
8. Sparks, D.L., *Environmental Soil Chemistry*, Academic Press, New York, 2nd Edition, 2002.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105102160
2. https://nptel.ac.in/courses/105103025
3. https://onlinecourses.nptel.ac.in/noc20_ce03/preview

WEB RESOURCES:

1. https://www.ceh.org.in/wp-content/uploads/2019/02/GGHH-Case-Study-Energy_KGMU.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://archive.nptel.ac.in/courses/105/105/105105160/
5. https://archive.nptel.ac.in/courses/105/105/105105157/

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101034	**SOIL DYNAMICS AND MACHINE FOUNDATIONS**	3	-	-	-	3

Pre-Requisite 22CE101004-Foundation Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Courses on fundamentals of vibration and frequency of soil systems; wave propagation and dynamic soil properties; vibration analyses; design of machine foundations; machine foundations on piles and vibration isolation.

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

CO1. Analyze vibration; and frequency of soil systems to solve complex problems of soil dynamics using appropriate techniques through continuous learning by ensuring safety and environment besides communicating effectively in graphical form.

CO2. Analyze wave propagation and dynamic soil properties to solve complex problems of soil dynamics using appropriate tools and techniques by following the relevant codes of practice by ensuring safety and environment besides communicating effectively in graphical form.

CO3. Analyze vibrations in soils to solve complex problems of soil dynamics using appropriate techniques by following the relevant codes of practice by ensuring safety and environment besides communicating effectively in graphical form.

CO4. Design machine foundations to solve complex problems of soil dynamics using appropriate techniques by following the relevant codes of practice by ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyze machine foundations on piles and vibration isolation techniques to solve complex problems of soil dynamics by following the relevant codes of practice by ensuring safety, environment and sustainability besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: FUNDAMENTALS OF VIBRATION AND FREQUENCY OF SOIL SYSTEMS ***(09 Periods)***

Fundamentals of Vibration: Definitions, Simple harmonic motion, Free and forced vibrations with and without viscous damping, Frequency dependent excitation, Systems under transient loads, Rayleigh's method of fundamental frequency, Logarithmic decrement, Latest methods.

Frequency of Soil Systems: Determination of viscous damping, Transmissibility, Systems with two and multiple degrees of freedom, Vibration measuring instruments, Latest methods.

Module 2: WAVE PROPAGATION AND DYNAMIC SOIL PROPERTIES ***(09 Periods)***

Wave Propagation: Propagation of seismic waves in soil deposits, Attenuation of stress waves, Stress–strain behavior of cyclically loaded soils, Strength of cyclically loaded soils.

Dynamic Soil Properties :Dynamic soil properties, Laboratory and field testing techniques, Elastic constants of soils; Correlations for shear modulus and damping ratio in sands, gravels, clays and lightly cemented sand; Liquefaction of soils.

Module 3 VIBRATION ANALYSES ***(09 Periods)***

Types, General requirements, Permissible amplitude, Allowable soil pressure, Modes of vibration of a rigid foundation block, Methods of analyses, Lumped mass models, Elastic half space method, Elasto dynamics, Effect of footing shape on vibratory response, Dynamic response of embedded block foundation.

Module 4 DESIGN OF MACHINE FOUNDATIONS ***(09 Periods)***

Analysis and design of block foundations for reciprocating engines, Dynamic analysis and design procedure for a hammer foundation, IS Code of practice, Design procedure for foundations of reciprocating and impact type machines.

Module 5 MACHINE FOUNDATIONS ON PILES AND VIBRATION ISOLATION ***(09 Periods)***

Machine Foundations on Piles: Introduction, Analysis of piles under vertical vibrations, Analysis of piles under translation and rocking, Analysis of piles under torsion, Design procedure for a pile supported machine foundation.

Vibration Isolation: Types and methods of isolation, Active isolation and passive isolation, Dynamic properties of isolation materials.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Group discussion on Structures Susceptible to Failure under earthquakes.
2. Poster presentation on Vibro Isolation materials.
3. Submit a case study report on the Structures failed due to improper design of machine foundations subjected to vibratory loading.
4. Design sustainable remediation for any of the contaminated sites (any one site can be taken up as a case study and design)
5. Design a Live 3D model for understanding the Dynamics and damping of vibratory forces for various types of machines foundations.

RESOURCES

TEXT BOOKS:

1. Braja M. Das and Ramana, G.V., *Principles of Soil Dynamics,*Cengage Learning, 2nd Edition, 2011.
2. Srinivasalu, P. and Vaidyanathan, C., *Hand Book of Machine Foundations,* Tata McGraw–Hill, 2007.

REFERENCE BOOKS:

1. Suresh C. Arya, Michael O'neill, W. and George Pincus, *Design of Structures and Foundations for Vibrating Machines,* Gulf Publishing Company, 1979.
2. Shamsher Prakash, *Soil Dynamics,* McGraw Hill, 1981.
3. Swami Saran, *Soil Dynamics and Machine Foundations,* Galgotia Publications Pvt. Ltd., 2nd Edition, 2010.
4. Kameswara Rao, N. S. V., *Vibration Analysis and Foundation Dynamics,* Wheeler Publishing, 1998.
5. Richart, Hall and Woods, *Vibration of Soils and Foundations*, Prentice Hall, 1970.
6. Shamsher Prakash and Vijay Kumar Puri, *Foundations for Machines: Analysis and Design,* Wiley, 1988.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/105/105105160/
2. https://archive.nptel.ac.in/courses/105/105/105105157/

WEB RESOURCES:

1. https://www.ceh.org.in/wp-content/uploads/2019/02/GGHH-Case-Study-Energy_KGMU.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

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101035	**GEOTECHNICS FOR UNDERGROUND STRUCTURES**	3	-	-	-	3

Pre-Requisite 22CE101004-Foundation Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provide a detailed discussion on Underground structures and geotechnical investigations, Underground space planning and design, Failure criteria for soil and rock.Also, this course examines a various techniques for Analysis and design of underground structures, Non-destructive testing and health monitoring.

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

CO1. Analyze underground structures and geotechnical investigationsto solve complex problems associated with underground structures using appropriate tools and techniques by following the relevant codes of practice and latest developments considering safety, society, environment, sustainability and project management besides communicating effectively in graphical form.

CO2. Design underground space and planning to solve complex problems associated with underground structures using appropriate techniques by following the relevant codes of practice considering safety, society, environment, sustainability and project management besides communicating effectively in graphical form.

CO3. Analyze the failure criteria for soil and rock to solve complex problems associated with underground structures using appropriate techniques considering safety besides communicating effectively in graphical form.

CO4. Design underground structures to solve complex problems associated with underground structures using appropriate techniques by following the relevant codes of practice considering safety, society, environment, sustainability and project management besides communicating effectively in graphical form.

CO5. Analyze non–destructive testing and health monitoring of underground structures using appropriate techniques to solve complex problems by following the relevant codes of practice and latest developments considering safety, society, environment, sustainability and project management besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: UNDERGROUND STRUCTURES AND GEOTECHNICAL INVESTIGATIONS (09 Periods)

Underground structures - Introduction, Necessity for underground construction, Types and applications of underground structures, Parameters for site selection, Laboratory and field tests of soil, Materials used in underground structures, Geoengineering, Investigations for rock or rock mass characterization - Topographical and geological survey, augering, drilling, soil and rock sampling and testing, Preparing subsurface geological cross section, Georadar use and data analysis for shallow tunnels, Geophysical investigations to identify deeper sub-surface features, Characterization of ground profile.

Module 2: UNDERGROUND SPACE PLANNING AND DESIGN (09 Periods)

Determination of appropriate location, size, shape and alignment; Assessment of behaviour of tunnelling media - Deformation modulus and support pressure measurement, Application of numerical modelling in space design, Earthquake effects on tunnels, Design of underground space in rocks with the help of field data; Design of underground openings - Design based on empirical methods such as RSR, RMR, Q systems, Design based on Rock support interaction analysis; Observational methods - NATM, Convergence - confinement method, Key block analysis; Stability of excavation face and tunnel portals.

Module 3: FAILURE CRITERIA FOR SOIL AND ROCK (09 Periods)

Failure theories - Failure criteria for soil and rock masses, Mohr-Coulomb yield criterion, Hoek-Brown criterion, Tensile yield criterion, Jointed rock yield criterion, Hardening soil criterion, Strength of discontinuities.

Module 4: ANALYSIS AND DESIGN OF UNDERGROUND STRUCTURES (09 Periods)

Beam on elastic foundation method, Stress based analysis, Deformation-based analysis, Soil–structure interaction, Analysis of geotechnical structures using Boundary element method, finite element method, Rankine's and Coulomb's earth pressure theory, Earth pressure for design of excavation, Design of box culvert structures, Design of foundation pit retaining walls.

Module 5: NON-DESTRUCTIVE TESTING AND HEALTH MONITORING (09 Periods)

Strain integrity testing, Cross hole sonic tests, Health monitoring of underground structures, Use of sensors, Vibrating wire displacement sensor, Potentiometric displacement sensor, inclinometer/in place-inclinometer, Wireless tilt meter, Data loggers – Measurement and interpretation of test data.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Task students with analyzing the data to assess soil properties, geological conditions, and potential risks for constructing underground structures.
2. Encourage students on critical thinking and discussion on how different geotechnical factors influenced the project outcomes.
3. Present case studies of past underground construction projects, highlighting challenges faced and lessons learned.
4. Divide students into teams and challenge them to design and build small-scale underground structures using simple materials like cardboard, clay, or foam. Provide them with design criteria, such as depth, length, and load-bearing capacity. Encourage creativity and innovation in their designs while considering geotechnical factors such as soil stability and groundwater pressure.
5. Assign fieldwork projects where students collect geotechnical data from different sites using surveying equipment, ground-penetrating radar, or drones. They can then analyze the collected data to assess soil properties, geological conditions, and potential hazards for underground construction.

RESOURCES

TEXT BOOKS:

1. Zhen-Dong Cui, Zhong-Liang Zhang, Li Yuan, Zhi-Xiang Zhan and Wan-Kai Zhang, *Design of Underground Structures,* Springer, 2020.
2. Pietro Lunardi, *Design and Construction of Tunnels,* Springer, 2008.

REFERENCE BOOKS:

1. Sinha, R.S., *Underground Structures: Design and Instrumentation*, Elsevier Science Publisher, 1989.
2. Bai Yun., *Underground Engineering: Planning, Design, Construction and Operation of the Underground Space*, Academic Press, 2019.
3. Goel, R.K., Singh, B., Zhao, J., *Underground Infrastructures: Planning, Design and Construction*, Elsevier, 2012.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=S-IU_XN1KLk&list=PLZScDy-0gb-UHK6hCwgwfYpA9AwmAfm9n
2. https://www.youtube.com/watch?v=OIhvZcQbvxA
3. https://www.youtube.com/watch?v=0Lk1JAU6b6g
4. https://www.youtube.com/watch?v=dD683t0w0TI

WEB RESOURCES:

1. https://www.researchgate.net/publication/303553027_Geotechnical_design_of_underground_structures/link/574c502508ae78f2d2017eeb/download
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6651343/
3. https://www.researchgate.net/publication/335078633_Design_of_Foundation_Pit_Retaining_Structures
4. https://www.frontiersin.org/articles/10.3389/feart.2022.987294/full

SPECILIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101036	**ROCK MECHANICS AND TUNELLING**	3	-	-	-	3

Pre-Requisite 22CE101001-Engineering Mechanics
22CE105003-Engineering Geology Lab

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onrock mechanics, explorations and classification, rock strength and failure, rock bearing capacity and rock stability, tunnels and engineering applications, design and construction of tunnels.

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

CO1. Analyze rock mechanics, explorations and classification of rocks using appropriate tools and techniques to solve complex geotechnical engineering problems by following the relevant codes of practice and ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO2. Analyze rock strength and failure using appropriate tools and techniques to solve complex soil engineering problems by following the relevant codes of practice and ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Design rock slopes considering bearing capacity stability using appropriate tools and techniques to solve complex soil engineering problems by following the relevant codes of practice and ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze tunnels and engineering applications using appropriate tools and techniques to solve complex soil engineering problems by following the relevant codes of practice and ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO5. Design and construction of tunnels using appropriate tools and techniques to solve complex soil engineering problems by following the relevant codes of practice and ensuring safety, environment and sustainability besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: ROCK MECHANICS, EXPLORATIONS AND CLASSIFICATION ***(09 Periods)***

Basic terminology, Genesis, Rock and Rock mass classification, Geological petro graphic, Index properties of rocks, Physical and mechanical properties, Defects in rock mass, Elastic constants of rock, In-situ stresses in rock, Modes of failures of rocks, Objective of rock exploration, Methods of rock exploration - BY direct penetration, By geophysical processing, In-situ and laboratory tests.

Module 2: ROCK STRENGTH AND FAILURE ***(09 Periods)***

Rock strength, Types of failure, Theories of failure (Coulomb-Navier, Mohr, Griffith), Hoek and Brown strength criteria for rocks with discontinuity sets, Absolute stress by bore hole deformation method, Flat jack method, Propagation velocity method; Bearing capacity of foundations on rocks – Case studies; Testing of rocks - Laboratory and field tests, Assessment of in-situ strength.

Module 3: ROCK BEARING CAPACITY AND ROCK STABILITY ***(09 Periods)***

Rock Foundation - Shallow and deep investigation for foundation design and construction aspect, Slope stability analysis, Mode of failures in rock, Design of slopes, Excavation in rock and stabilization concepts, Bearing capacity of foundations on rocks – Case studies.

Module 4: TUNNELS AND ENGINEERING APPLICATIONS ***(09 Periods)***

Tunnels: Basic terminology, Applications, Types, Site investigations, methods of excavation of tunnels, supports and stabilization, Construction control and maintenance, tunnel ventilation, control of ground water and gas.

Engineering Applications: Reinforcement of fractured and jointed rocks - Shotcreting, Bolting, Anchoring, Installation methods - Case studies. Rock bolting, Reinforcement of laminated rock.

Module 5: DESIGN AND CONSTRUCTION OF TUNNELS ***(09 Periods)***

General Principles, Tunneling in solid rocks, Full face tunneling without supports and with supports, Single stage mining methods and multi-stage classical methods of tunnel construction, shield tunneling, Tunnel Boring Machine (TBM), Analysis and design of horse-shoe shaped tunnels, Design of circular shape tunnels.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Group discussion on tectonic action under a rock profile on a result of rock tunneling.
2. Poster presentation on Critical tunnel projects in hills.
3. Submit a case study report on the failures of a rock tunnels
4. Design a prototype which reflects the mechanism of failures in rock foundations under working loads.
5. Submit a case study report on most successful rock foundations and tunnels.
6. Debate on challenges, limitations and solutions for design and implementation of foundations in rocks.

RESOURCES

TEXT BOOKS:

1. Szechy, K. *Art of Tunnelling*, Akademiai Kiado, Budapest, 2nd Edition, 1973.
2. Obert, L. and Duall, W.I., *Rock Mechanics & Design of Structures in Rock*, John Wiley and Sons Inc., 1967.

REFERENCE BOOKS:

1. Jaeger, J. C., Cook, N. G. W. and Zimmerman, R., *Fundamentals of Rock Mechanics*, Wiley-Blackwell, 4th Edition, 2007.
2. Verma, B. P., *Rock Mechanics Engineers*, Khanna Publishers, New Delhi, 1st Edition, 1985.
3. Hudson, A. and Harrison, P., *Engineering Rock Mechanics – An Introduction to the Principles*, Pergamon Publications, 1st Edition, 1997.
4. Wittke, W., *Rock Mechanics: Theory and Applications with Case Histories*, Springerverlag, Berlin, 1st Edition, 1990.
5. Ramamurthy, T., *Engineering in Rocks for Slopes, Foundations and Tunnels*, PHI Learning Pvt. Ltd., 3rd Edition, 2014.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/105/105105212/
2. https://nptel.ac.in/courses/105106055
3. https://nptel.ac.in/courses/105107208

WEB RESOURCES:

1. https://www.ceh.org.in/wp-content/uploads/2019/02/GGHH-Case-Study-Energy_KGMU.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://archive.nptel.ac.in/courses/105/105/105105160/
5. https://archive.nptel.ac.in/courses/105/105/105105157/

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE103003	**GEOSYNTHETICS AND REINFORCED SOIL STRUCTURES**	2	-	-	4	3

Pre-Requisite 22CE101004-Foundation Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Geosynthetics and Reinforced Soil Structures is an advanced engineering course that delves into the concept, types, properties, functions, installation techniques and applications of geosynthetics. Also, this course emphasizes on the analysis and design of reinforced soil structures (viz. retaining walls, embankments, slopes, and foundations), subsurface drainage systems, landfills, pavement systems and geohazard mitigation systems using geosynthetics. Geosynthetics are synthetic materials that are extensively used in civil engineering to enhance soil properties and provide cost-effective solutions for various geotechnical challenges. This course aims to equip students with a comprehensive understanding of geosynthetics and their role in strengthening soil for sustainable infrastructure development.

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

CO1. Analyze geosynthetics to solve complex problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society and environment besides communicating effectively in graphical form.

CO2. Analyze the strength of reinforced soil to solve complex problems using appropriate techniques following the relevant guidelines considering society and environment besides communicating effectively in graphical form.

CO3. Design reinforced soil with geosynthetics to solve complex problems using appropriate tools and techniques following the relevant codes and guidelines considering safety, society and environment besides communicating effectively in graphical form.

CO4. Design subsurface drainage systems and landfillswith geosynthetics to solve complex problems using appropriate tools and techniques following the relevant codes and guidelines considering safety, society and environment besides communicating effectively in graphical form.

CO5. Designpavement systems and geohazard mitigation systemswithgeosynthetics to solve complex problems using appropriate tools and techniques following the relevant codes and guidelines considering safety, society and environment besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: GEOSYNTHETICS (05 Periods)

Geosynthetics –Significance in civil engineering, Types, Properties, Functions and applications; Properties, types, functions, uses and applications of various geosynthetics - Geotextiles, Geogrids, Geomembranes, Geocells, Geonets, Geosynthetic clay liners, Geocomposites; Manufacturing processes, Testing and Evaluation of geosynthetics; Typical applications, Product range in India, Latest developments.

Module 2: STRENGTH Of REINFORCED SOIL (05 Periods)

Conceptof reinforced soil, Reinforcement effect – Equal confining and pseudo cohesion concepts; Materials; Friction coefficient – Definition, Laboratory determination, Factors affecting fiction coefficient; Application of reinforced earth and its design principles.

Module 3: GEOSYNTHETICS FOR SOIL REINFORCEMENT (07 Periods)

Reinforced soil structures - Overview, Internal stability and external stability of reinforced soil, Types of reinforcement, Design considerations; Analysis and design - Reinforced soil retaining walls, Rienforced soil slopes, Reinforced soil beds, Reinforced pavements; Codes and standards; Applications - Geosynthetic reinforced shallow foundations, Geosynthetic reinforced earth retaining structures, Geosynthetics reinforced embankments,Slope stabilization, Erosion control; Case Studies - Reinforced soil walls, Reinforced soil slopes.

Module4: GEOSYNTHETICS IN SUBSURFACE DRAINAGE SYSTEMSAND LAND FILLS (06 Periods)

Geosynthetics in Sub-Surface Drainage Systems: Geosynthetic applications - Drainage and filtration; Prefabricated vertical drains (PVD, Accelerated consolidation using geosynthetics; Analysis and design.

Geosynthetics inLand Fills: Introduction, Geosynthetic applications for landfill liners; Construction of geosynthetic landfills; Covers and other component; Analysis and design.

Module 5: GEOSYNTHETICS IN PAVEMENT SYSTEMS AND GEOHAZARD MITIGATION (07 Periods)

***Geosynthetics in Pavements*:** Benefitsof placing reinforcement in flexible pavement layers, Design of reinforced pavements by Giroud and Noiray approach and modified CBR *Method.*

Geosynthetics in Geohazard Mitigation:Introduction, Geosynthetic applications for geohazard mitigation, Construction aspects, Limitations.

Total Periods: 30

PROJECT BASED LEARNING:

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

RESOURCES

TEXT BOOKS:

1. Siva Kumar Babu, G. L. *An Introduction to Soil Reinforcement and Geosynthetics,* University Press, 2006.
2. Swami Saran,*Reinforced Soil and Its Engineering Applications,* I. K. International Publishing House Pvt. Limited, 2011.
3. Sarsby, R. W., *Geosynthetics in Civil Engineering*, Elsevier Science Publishers, 2006.

REFERENCE BOOKS:

1. Shukla, S. K. and Jian-Huan-In, *Fundamentals of Geosynthetic Engineering*, Taylors & Francis, 2006.
2. Rao, G. V. and Raju, G. V. S. S. (Eds.), *Advances in Geosynthetics*, Sai Master Geoenvironmental Services Pvt. Ltd., 2012.
3. Koerner, R. M., *Designing with Geosynthetics (Volume 1 and 2),* Xlibris Corporation, 6th Edition, 2012.
4. Colin J.F.P. Jones, *Earth Reinforcement and Soil Structures*, Thomas Telford Ltd., 3rd Edition, 1996.
5. Jonathan T. H. Wu, *Geosynthetic Reinforced Soil (GRS) Walls*, Wiley-Blackwell, 2019.

CODES:

1. IRC:SP:59-2019: Guidelines for Use of Geosynthetics in Road Pavements and Associated Works
2. IRC:SP:102-2014: Guidelines Design and Construction of Reinforced Soil Walls
3. IRC:113-2013: Guidelines for the Design and Construction of Geosynthetic Reinforced Embankments on Soft Subsoils
4. Ministry of Road Trsnport & Highways (MORTH) Specifications for Road and Bridge Works, 5th Revision, 2013.
5. BS 8006-1:2010: Code of Practice for Strengthened/Reinforcesd Soils and Other Fills
6. FHWA NHI-95-038 (1998), Geosynthetic Design and Construction Guidelines, Participant Notebook for Course No. 13213, NHI, FHWA, Virginia.

VIDEO LECTURES:

1. http://nptel.ac.in/courses/105/106/105106052/
2. https://www.digimat. in/nptel/courses/video/105101143/L01.ht ml

WEB RESOURCES:

1. https:// igrip.iitgn.ac. in/geosynthetics-lectures/
2. https://www.btechguru.com/GATE--civil-engineering--soil-mechanics--effective--stress-principle--13412-video-lecture--13420--34--220.html

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101037	**INDUSTRIAL WASTEWATER TREATMENT**	3	-	-	-	3

Pre-Requisite 22CE102005-Environmental Engineering.

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Characteristics ofindustrial wastewater; Primary and secondary treatment; Advanced treatment systems; Typical industrial wastewater treatment; Wastewater minimization.

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

CO1. Analyze the characteristics of industrial wastewater to solve industrial waste water problems following the relevant standards and codes considering society, health, safety and environment besides communicating effectively in graphical form.

CO2. Designprimary and secondary treatment units to provide solutions to the complex problems of industrial wastewater treatment using appropriate techniques following the relevant standards and codes considering society, health, safety and environment besides communicating effectively in graphical form.

CO3. Analyzethe advanced treatment systems to solve complex environmental problems using appropriate techniques following latest developments considering the society, health, safety and environment besides communicating effectively in graphical form.

CO4. Analyze the characteristics and treatment of wastewater from different industries to provide solutions to complex environmental problems using appropriate techniques following the relevant standards and codes considering the society, health, safety and environment besides communicating effectively in graphical form.

CO5. Analyze the wastewater minimization techniques to solve complex environmental problems following latest developments considering society, health, safety, environment and project management besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: CHARACTERISTICS OFINDUSTRIAL WASTEWATER ***(08 Periods)***

Industrial sources of wastewater and characteristics, Significance in determination of characteristics for different industrial effluents, Pattern of pollution and self-purification of rivers, ISI tolerance limits for disposal of effluent into inland surface water and public sewers.

Module 2: PRIMARY AND SECONDARY TREATMENT ***(10 Periods)***

Primary Treatment - Scope, Working principle, Functions and Design of Equalization, Neutralization, Screen chamber, Grit chamber and Primary sedimentation tanks; Secondary Treatment - Microbiological metabolism - Basic kinetic equations, Biological treatment kinetics, Growth kinetics, Oxygen requirement in aerobic process and Design of complete mix conventional biological treatment facilities.

Module 3 ADVANCED TREATMENT SYSTEMS ***(09 Periods)***

Pollution characteristics, Toxic chemicals, Treatments –Oxidation and reduction systems, Thermal reduction, Air stripping, Membrane systems; Nitrogen removal by biological nitrification and denitrification, Phosphate removal by activated sludge process and anaerobic filters.

Module 4 TYPICAL INDUSTRIAL WASTEWATER TREATMENT ***(09 Periods)***

Origin, Characteristics and treatment of wastewater - Paper mills, Sugar mills, Breweries, Wineries, Distilleries, Tanneries, Textile mills and dairy units.

Module 5 WASTEWATER MINIMIZATION ***(09 Periods)***

In-plant survey, Flow measurement, Composition of wastewater generated, Analytical methods recommended for characterization, Waste volume and strength reduction, Water conservation, Factors encouraging the waste minimization, Clean-up and cleaner technologies, Remediation, Hierarchy of waste management options.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Describe self-purification of streams/rivers and observe the nearest stream of river to your place and find practically how much distance the water becoming clear zone from the point of discharge of pollution (wastewater).
2. Visit the nearest sewage treatment plant or effluent treatment plant and explain the operation and performance of the treatment plant with flow sheet and layout of treatment units.
3. Discuss the advanced treatment units including the thermal reduction, ultrafiltration, membrane treatment processes.
4. Visit any one type of industry mentioned in the 4^{th} Unit, collect and compile the characteristics of effluent and also the treated effluent quality.
5. Discuss the wastewater minimization techniques. Do survey nearby industries on implementation of the same and prepare a report.

RESOURCES

TEXT BOOKS:

1. Rao, M. N., and Dutta, A. K., *Waste Water Treatment,* Oxford and IBH Publishers, 3rd Edition, 2009.
2. Metcalf and Eddy, *Wastewater Engineering, Treatment and Reuse,* Mc.Graw Hill Education Private Limited, 4th Edition, 2010.

REFERENCE BOOKS:

1. Newmerow, *Liquid Waste of Industry,* Pearson Education Publishing Co., New Delhi, 1971.
2. Mark J. Hammer and Mark J. Hammer Jr., *Water and Wastewater Technology, ,* Pearson Education Publishing Co., New Delhi, 6th Edition, 2008.
3. Patwardhan, A. D., *Industrial Wastewater Treatment*, PHI Publisher, 2008.
4. Rakesh Kumar and Singh, R. N., *Municipal Water and Wastewater Treatment*, TERI, 2009.
5. Peavy, H.S., Rowe, D.R., Tchobanoglous, G., *Environmental Engineering*, McGraw-Hill Book Co., New Delhi, 1995

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105105178
2. https://nptel.ac.in/courses/105105048

WEB RESOURCES:

1. https://research.iaun.ac.ir/pd/aminsharei/pdfs/UploadFile_1633.pdf
2. https://www.sciencedirect.com/science/article/abs/pii/S0045653521017173
3. https://www.researchgate.net/publication/326586068_Industrial_wastewater_treatment_process
4. https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_6_Ch6_Wastewater.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101038	**ENVIRONMENTAL ECONOMICS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Fundamentals of environmental economics; Economy and the natural environment interaction; Economic development and environment; Valuation of environmental goods and services; Sustainable economic development.

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

CO1. Analyze fundamentals of environmental economics to solve environmental economics challenges associated with sustainable design of technology systems considering latest developments, society, environment, economic, and sustainability besides communicating effectively in graphical form.

CO2. Analyze economy and the natural environment interaction to solve ecological limits and scarcity of eco-services approaches using different tools and techniques considering latest developments, relevant guidelines, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze economic development and environment to solve environmental cost-benefit challenges using different tools and techniques considering latest developments, relevant guidelines, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze valuation of environmental goods and services to solve methodical challenges using different tools and techniques considering latest developments, relevant guidelines, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyze sustainable economic development to solve environmental economics challenges using different tools and techniques considering latest developments, relevant guidelines, environment and sustainability besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: FUNDAMENTALS OF ENVIRONMENTAL ECONOMICS ***(10 Periods)***

Fundamentals of environmental economics, Review of microeconomics and welfare economics, Ecology-economy interaction, Perspective of economic modelling- the concept and conditions of sustainability of the human economy, Classification and characterization of resources and pollution as a public good or bad, Role of Externalities as the fundamental determinants, Property Rights, Market, Spatial-temporal dimensions of externality- command and control, Market approaches, Green tax, Taxes in controlling externalities.

Module 2: ECONOMY AND THE NATURAL ENVIRONMENT INTERACTION ***(08 Periods)***

An overview of the economy and the natural environment; Interaction using an input- output based general equilibrium approach to show how ecological limits and scarcity of eco-services would affect the resource allocation and prices; Regimes of natural resources, Types of goods, Provision of public goods.

Module 3 ECONOMIC DEVELOPMENT AND ENVIRONMENT ***(09 Periods)***

The relation between development environmental Quality - Environmental Kuznets curve; Development vs conservation of environmental resources - Ecosystem flips and irreversibility - Krutilla-Fisher equation; Environmental cost-benefit analysis under strong and weak conditions of sustainability; Choice of time discount rate for evaluation - Sustainability premium.

Module 4 VALUATION OF ENVIRONMENTAL GOODS AND SERVICES ***(10 Periods)***

Theory of environmental valuation and conceptual basis of its methods - Compensating variations and surplus, Equivalent variations and surplus, Willingness to pay or accept for improvement or loss of environmental goods and services; Empirical approaches in environmental valuation; Indirect methods of environmental valuation, Non-demand function methods of valuation, Revealed preference methods - (a) Hedonic Pricing, (b) Household production function approach, Defensive cost, Health cost and travel cost methods; The direct method of environmental valuation - Stated preference - Contingent valuation method.

Module 5 SUSTAINABLE ECONOMIC DEVELOPMENT ***(08 Periods)***

Capital theoretic basis of the notion of sustainable development - Sustainable Development as non-declining inter-temporal utility or that of the value of the wealth. Concepts of Genuine investment or savings, Green National Income, Natural capital stock and sustainable resource accounting, Strong and weak sustainability, Environmental adjustment of national income.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Relate the pollution and economics and describe the relationship by considering any some case studies.
2. Discuss the relationship between economy and natural environment with examples.
3. Discuss the cost - benefit analysis of environmental sustainability by considering any two case studies.
4. Explain the environmental services for wellbeing of all.
5. Illustrate the environmental evaluation of natural built environment with that of artificial one with few case studies.

RESOURCES

TEXT BOOKS:

1. Siebert, H. and Siebert, H., Economics of the Environment. Massachusetts: Lexington Books, 9th Edition, 1981.
2. Pearce, David W., and Kerry Turner R., Economics of Natural Resources and The Environment, JHU Press, Revised and Enlarged Edition, 1990.
3. Barry Field and Martha K Field: Environmental Economics, McGraw Hill International Edition, 2017.

REFERENCE BOOKS:

1. Charles Kolstad: Environmental Economics, Oxford University Press, New York, 2000.
2. Nick Hanley, Jason F Shorgen and Ben White, Environmental Economics Theory and Practice, MacMillan, 2nd Edition, 2006
3. Kumar, P., The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations, Routledge, 2012.
4. Tietenberg, Tom and Lynne Lewis, Environmental and Natural Resource Economics, Routledge, 11th Edition, 2018.
5. Bennear, Lori Snyder, and Cary Coglianese (2004), Evaluating Environmental Policies, KSG Faculty Research Working Paper series RWP04-049, USA.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=_VShdCUG3yU
2. https://www.youtube.com/watch?v=vUF7s4Bp_ok
3. https://www.youtube.com/watch?v=d05jEprJxtE

WEB RESOURCES:

1. https://www.researchgate.net/publication/324978698_Environmental_Economics
2. https://www.sfu.ca/~wainwrig/Econ400/documents/Lecture-Notes-part_One-10-3.pdf
3. https://vdoc.pub/download/environmental-economics-an-introduction-7l5mfmrasri0
4. http://econdse.org/wp-content/uploads/2016/08/chapter_3.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101039	**ENVIRONMENTAL SUSTAINABILITY**	3	-	-	-	3

Pre-Requisite 22CE102005-Environmental Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Environmental measurements from different disciplines and sustainability concepts; Environmental chemistry and physical process in environment; Environmental risk assessments with concepts of EIA and LCA; Sustainability assessment of water and wastewater treatment; Sustainability assessment of solid waste management and air pollution issues.

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

CO1. Analyze environmental measurements and sustainability concepts to solve environmental sustainability challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO2. Analyze environmental chemistry and physical processes to solve environmental sustainability challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO3. Analyze environmental risk assessment with concepts of EIA and LCA to solve environmental sustainability problems using appropriate tools and techniques following relevant codes and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO4. Analyze water and wastewater treatment to solve environmental sustainability problems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering health, society, environment, sustainability and economics besides communicating effectively in graphical form.

CO5. Analyze sustainable assessment of solid waste management and air pollution issue to solve complex problems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering health, society, environment, sustainability and economics besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: ENVIRONMENTAL MEASUREMENTS FROM DIFFERENT DISCIPLINES AND SUSTAINABILITY CONCEPTS ***(09 Periods)***

Environmental measurements - Mass concentration units, Partial pressure units, Other types of units, Qualitative and quantitative measurements; Sustainability concepts and evolution, Engineering for sustainability.

Module 2: ENVIRONMENTAL CHEMISTRY AND PHYSICAL PROCESS IN ENVIRONMENT ***(09 Periods)***

Environmental chemistry, Mass balance and reactor systems; Mass balance in continuous reactor, continuous stirred tank reactor (CSTR) and Plug flow reactor; Plug flow reactor and energy flow, Energy balance and earth overshot day, Mass transport processes.

Module 3 ENVIRONMENTAL RISK ASSESSMENT WITH CONCEPTS OF EIA AND LCA ***(09 Periods)***

Life Cycle Assessment (LCA); Environmental Impact Assessment (EIA) - Fundamentals, Evolution of EIA (Global and Indian Scenario), Elements of EIA– Screening, Scoping, Public consultation, Environmental clearance process in India - Key elements in 2006 EIA (Govt. of India) notification; Environmental risk, Environmental impact calculation by using LCA technique, Risk assessments with concepts of EIA and LCA, Case studies.

Module 4 SUSTAINABILITY ASSESSMENT OF WATER AND WASTEWATER TREATMENT ***(08 Periods)***

Sustainability assessment in Water purification – Processes, Engineered systems – Aeration, Solids separation, Settling operations, Coagulation, Softening, Filtration, Disinfection; Sustainability assessment in wastewater treatment process and disposal – Primary, Secondary and Tertiary.

Module 5 SUSTAINABILITY ASSESSMENT OF SOLID WASTE MANAGEMENT AND AIR POLLUTION ISSUES ***(10 Periods)***

Sustainability assessment of solid waste management –Need and scope; 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; Sustainability assessment of air pollution issues –Need and scope, Classification, Sources – Line, Area, Stationary, Mobile; Effects of air pollutants on man, Material and vegetation; Global effects of air pollution.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Write different units related to mass concentrations of various parameters in water, atmosphere and soil pollutions.
2. Analyze mass balance of various parameters such as flow and pollutant characteristics in the given waste stream as per the standard equations.
3. Visit the polluted site(s) (at least one) and do analyze impact on environment through EIA and LCA techniques and suggest remedial measures.
4. Visit any water and wastewater treatment plants nearby your residence and write report on treatment of water and wastewater including its performance from the data collected from the site.
5. Visit nearby solid waste disposal site, observe and explain method of collection, transportation, processing and final disposal of it at the site and follow up after disposal to avoid environmental pollution including air, water and soil pollutions.

RESOURCES

TEXT BOOKS:

1. Davis, M. L. and Cornwell, D. A., *Introduction to Environmental Engineering,* McGraw-Hill, 5th Edition, 2008.
2. Keong, Choy Yee, *Global Environmental Sustainability: Case Studies and Analysis of the United Nations' Journey toward Sustainable Development*, Elsevier, 2020.
3. R.L Rag and Lakshmi Dinachandran Ramesh, Introduction to SUSTAINABLE ENGINEERING, 2nd Edition, PHI Learning, 2015.

REFERENCE BOOKS:

1. Singh, Ritu, and Sanjeev Kumar, *Green Technologies and Environmental Sustainability*, Springer, 2nd Edition, 2017.
2. Joumard, Robert, and Henrik Gudmundsson, *Indicators of Environmental Sustainability in Transport: An Interdisciplinary Approach to Methods,* European Commission, 2nd Edition, *2010*.
3. Smith, Fraser, *Environmental Sustainability: Practical Global Applications*, CRC Press, 1st Edition, 2020.
4. Bradley. A.S; Adebayo, A. O., Maria, P., *Engineering Applications in Sustainable Design and Developmen*t, Cengage Learning, 1st Edition, 2016.
5. Purohit, S. S., *Green Technology: An Approach for Sustainable Environment*, Agrobios Publication, 1st Edition, 2016.
6. Mathew Hampshire-Waugh, CLIMATE CHANGE and the road to NET-ZERO: Science - Technology - Economics – Politics, Crowstone Publishing, 2021.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=k6jUaaQNY28
2. https://www.youtube.com/watch?v=5lrn4CDQZzo
3. https://youtu.be/Mw9b0UHMSDs
4. https://youtu.be/GnYHFRq7-5s
5. https://youtu.be/QQYgCxu988s

WEB RESOURCES:

1. https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/2015wess_ch5_en.pdf
2. ttps://www.researchgate.net/publication/277340208_Environmental_Sustainability_Research_Growth_and_Trends
3. ttps://www.researchgate.net/publication/309619897_Sustainability_Theory_and_Conceptual_Considerations_A_Review_of_Key_Ideas_for_Sustainability_and_the_Rural_Context
4. ttps://www.oecd.org/dac/environment-development/FINAL%20POST-2015%20global%20and%20local%20environmental%20sustainability.pdf
5. https://www.oecd.org/dac/environment-development/50559116.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101040	INTEGRATED WASTE MANAGEMENT FOR A SMART CITY	3	-	-	-	3

Pre-Requisite 22CE102005-Environmental Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on municipal solid waste management - Waste characteristics and quantities; Waste segregation, collection, transportation, processing, storage and disposal; Principles of smart cities; Sustainable engineering practices – 5Rs principle; Hierarchy of Waste management; Waste management rules.

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

CO1. Classify the municipal solid waste and apply principles of solid waste sustainable management for collection, transportation, processing, storage and recycling to solve complex environmental problems following relevant standards/protocols considering society, health, safety and environment.

CO2. Analyze disposal methods of municipal solid waste to solve complex environmental problems following relevant standards and emerging trends considering society, health, safety, environment and economics besides communicating effectively in graphical form.

CO3. Analyze current issues in management of solid waste in smart cities including challenges of segregation at source of waste generation, collection, transportation, segregation at transfer station and processing with sustainable engineering practices to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO4. Analyze construction and demolition waste with sustainable engineering applications to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management.

CO5. Analyze electronic waste with sustainable urbanization and industrialization principles to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and 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	2	2	2	3	2	1	-	-	-	-	-	3
CO2	3	3	3	2	2	2	3	2	1	1	2	1	-	-	3
CO3	3	3	3	2	2	2	3	2	1	1	2	1	-	-	3
CO4	3	3	3	2	2	2	3	2	1	1	2	1	-	-	3
CO5	3	3	3	2	2	2	3	2	1	-	2	1	-	-	3
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	1	**1**	**2**	**1**	**-**	-	**3**

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

COURSE CONTENT

Module 1: MUNICIPAL SOLID WASTE COLLECTION AND PROCESSING ***(09 Periods)***

Municipal solid waste characteristics and quantities; Municipal Solid Waste Collection, Transportation, Segregation and Processing; MSW Rules 2016; Swachh Bharat Mission and Smart Cities Program.

Module 2: DISPOSAL OF MUNICIPAL SOLID WASTE ***(09 Periods)***

Methods of disposal – Sanitary landfill, biochemical processes and composting, incineration, pyrolysis, biogas generation; Energy recovery; Materials recovery, reuse and recycling.

Module 3 CURRENT ISSUES – CASE STUDIES ***(09 Periods)***

Review of MSW Management Status in Smart Cities in the Country; Current Issues in Solid Waste Management – Types of collection, transportation, vehicles, processing, recovery and disposal; Case studies.

Module 4 CONSTRUCTION AND DEMOLITION WASTE ***(09 Periods)***

Construction and Demolition (C&D) Waste Management in India – Overview; C&D Waste – Regulation, Beneficial Reuse of C&D Waste Materials – Reinforcement, Aggregates, Metals, Glass, Doors and Windows; Case studies.

Module 5 ELECTRONIC WASTE ***(09 Periods)***

Electronic Waste (E-Waste) Management – Issues and Status in India and Globally; E-Waste Management Rules 2016 and Management Challenges; Basel convention.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Visit any one of the solid waste dump site near to your locality, observe and note the different types of waste present over there and analyze its characteristics and pollution levels.
2. Visit municipality or panchayat and collect the data regarding solid waste generation, collection and disposal for the past 1 year and analyze the changes that during this one period and present it in graphical form.
3. Visit smart city nearest to your place and observe the types of bins and vehicles used for management of solid waste, and then compare with your place with necessary photographs of both cases.
4. Study the construction and demolition activities of any site near to your locality (probably minimum 3 and above story building) for atleast a week and prepare a detailed report on wastage.
5. List out the waste of electronic components/gadgets that normally come in the E-waste and prepare a report on hazardous substances present in the e-waste and disposal methods followed and compare with the e-waste rules.

RESOURCES

TEXT BOOKS:

1. William A Worrell and P. Aarne Veslind., Solid Waste Engineering, 2nd Edition (SI Edition) Cengage Learning, 2012 (ISBN-13: 978-1-4390-6217-3).
2. George Tchobanoglous, Hilary Theisen and Samuel A Vigil, Integrated Solid Waste management, Tata McGraw Hill.

REFERENCE BOOKS:

1. Manual on Solid Waste Management, prepared by The Central Public Health and Environmental Engineering Organization (CPHEEO), India.
2. MSW Management Rules 2016, Govt. of India, available online at CPCB website.
3. Electronic Waste Management Rules 2016, Govt. of India, available online at CPCB website.
4. Bhide, A. D. and Sundaresan, B. B., Solid Waste Management in Developing Countries, INSDOC, 1st Edition, 2010.
5. Asnani, P. U., and Chris Zurbrugg, Improving Municipal Solid Waste Management in India: A Sourcebook for Policymakers and Practitioners, World Bank Publications, 1st Edition, 2007.
6. Ramachandra, T. V., Management of Municipal Solid Waste, The Energy and Resources Institute (TERI), 1st Edition, 2011.

VIDEO LECTURES:

1. https://www.envacgroup.com/?gclid=EAIaIQobChMI0MP-3pjE_wIVBEgrCh1DMAY5EAAYASABEgLLXPD_BwE
2. https://www.youtube.com/watch?v=STcFSthSJWo&list=PL3MO67NH2XxIYo-UFN8csPPnEiYVyR0TO
3. https://www.youtube.com/watch?v=IBlFQgBX5ZQ
4. https://www.youtube.com/watch?v=yptJmqatnK0
5. https://www.youtube.com/watch?v=a7gfg-wZgzE
6. https://www.youtube.com/watch?v=MTgentcfzgg
7. https://www.youtube.com/watch?v=4fkbQynfSyY
8. https://www.youtube.com/watch?v=WB-yxJNf-pE

WEB RESOURCES:

1. https://www.researchgate.net/publication/349605617_Smart_Waste_Management_for_Smart_City_Impact_on_Industrialization
2. https://www.researchgate.net/publication/356395797_An_ICT-based_solid_waste_management_system_for_smart_cities_a_case_of_municipality_in_India
3. https://www.academia.edu/24286208/The_Role_of_the_Professional_Engineer_and_Scientist_in_Sustainable_Development
4. NPTEL Course ID 105105160 Integrated Waste Management for a Smart City
5. NPTEL Course ID 105105157 Sustainable Engineering Concepts and Life Cycle Analysis
6. tps://www.researchgate.net/publication/283805590_A_framework_for_sustainable_waste_management_challenges_and_opportunities

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101041	**WASTE TO ENERGY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on the Waste to energy concept; Municipal solid waste; Thermochemical waste to energy technologies; Biological waste to energy technologies. This course also examines Waste to energy plants and the environment.

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

CO1. Analyze waste to energy process to solve waste management challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO2. Analyze municipal solid waste characteristics and sampling techniques to solve solid waste management challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO3. Analyze thermochemical waste to energy technologies to solve solid waste management challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO4. Analyze traditional and advanced biological technologies for converting waste to energy using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO5. Analyze energy plants and the environment to solve waste to energy challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: WASTE TO ENERGY CONCEPT *(09 Periods)*

Waste to energy- A historical perspective, Waste as a renewable resource, Global production of power from waste; The politics of waste - Waste management hierarchy, Circular economy/zero Waste, Energy from waste with the circular economy concept.

Module 2: MUNICIPAL SOLID WASTE *(08 Periods)*

Sources and types of solid waste, Quantity, Factors affecting the generation of solid waste, Characteristics, Waste Classification, Methods of sampling and characterization, and Energy content of the waste.

Module 3 THERMOCHEMICAL WASTE TO ENERGY TECHNOLOGIES *(10 Periods)*

Traditional waste combustion technologies - Waste processing and treatment facility, Rotary combustors, Fluidized bed combustors; Energy production from waste through advanced thermochemical techniques - Incineration, Gasification and Pyrolysis.

Module 4 BIOLOGICAL WASTE TO ENERGY TECHNOLOGIES *(10 Periods)*

Energy production from waste through biological techniques - Anaerobic digestion, Fermentation, Transesterification, Advanced microbial fuel cells; Cultivation of algal biomass from wastewater and energy production from algae.

Module 5 WASTE TO ENERGY PLANTS AND THE ENVIRONMENT *(08 Periods)*

Emission limits for waste combustion, Environmental politics and science, Waste to energy plant cost, Latest developments in waste to energy, Case Studies.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Do-It-Yourself: Biogas plant working model: https://www.youtube.com/watch?v=msuck0vxbLc&ab_channel=howtofunda
2. Do-It-Yourself: Anaerobic Digester Experiment: https://paksc.org/pk/diy-projects/764-biogas-plant-experiment

3. Do-It-Yourself: How to Make Generator using Waste Materials | Do-It-Yourself Hydroelectric Generator - https://www.youtube.com/watch?v=v8t2HJnM1sE
4. Do-It-Yourself: Generating energy from waste: how it works - https://energysavingtrust.org.uk/generating-energy-waste-how-it-works/
5. Do-It-Yourself: Generate Electricity by Plastic and Waste Materials Project - https://www.youtube.com/watch?v=c6QqzC0rzgc&ab_channel=TheRSIndustries

RESOURCES

TEXTBOOKS:

1. Breeze, Paul, *Energy from Waste*, Academic Press, 1st Edition, 2017.
2. Singh, R. P., Prasad, V. and Vaish, B., *Advances in Waste-to-Energy Technologies*, CRC Press, 1st Edition, 2019.

REFERENCE BOOKS:

1. Maczulak, A. E., *Environmental Engineering: Designing a Sustainable Future,* Infobase Publishing, 4th Edition, 2010.
2. Kalogirou, E. N., *Waste-to-Energy Technologies and Global Applications*, CRC Press, 1st Edition, 2017.
3. Klinghoffer, N. B., &Castaldi, M. J., *Waste to Energy Conversion Technology*, Elsevier, 3rd Edition, 2013.
4. Rogoff, M. J., &Screve, F., *Waste-to-energy: Technologies and Project Implementation*, Academic Press, 1st Edition, 2019.
5. Trabold, T., and Babbitt, C. W., *Sustainable Food Waste-to-Energy Systems*, Academic Press, 1st Edition, 2018.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/103107125
2. https://nptel.ac.in/courses/105103205
3. Energy from Garbage - https://www.coursera.org/lecture/energy-environment-life/energy-from-garbage-iIhxi
4. Renewable Waste-to-Energy - https://www.covanta.com/what-we-do/waste-to-energy
5. In My Backyard: Waste and Energy in a Circular Economy - https://unhabitat.org/in-my-backyard-angelique-chettiparamb

WEB RESOURCES:

1. Waste-to-Energy: https://www.energy.gov/eere/bioenergy/waste-energy
2. Energy Recovery from the Combustion of Municipal Solid Waste (MSW): https://www.epa.gov/smm/energy-recovery-combustion-municipal-solid-waste-msw
3. Biomass explained-Waste-to-energy (Municipal Solid Waste): https://www.eia.gov/energyexplained/biomass/waste-to-energy-in-depth.php
4. How a waste-to-energy plant works - https://www.youtube.com/watch?v=lmtOuAed5nM&ab_channel=EngineeringTimelines
5. Waste to Energy Facility (Case study) - https://my.spokanecity.org/solidwaste/waste-to-energy/
6. Best Out of Waste - Gujarat Cleaner Production Centre - http://www.gcpcenvis.nic.in/Kids-Student/Best_out_of_Waste_for_Students.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101042	**EARTHQUAKE RESISTANT DESIGN OF STRUCTURES**	3	-	-	-	3

Pre-Requisite 22CE101005-Reinforced Cement Concrete Structures

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Earthquake engineering, Earthquake analysis, Codal design and detailing provisions, Seismic planning, Shear walls and base isolation techniques.

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

CO1. Analyze earthquakes to solve earthquake engineering problems using appropriate tools and techniques following relevant IS codes considering society and environment besides communicating effectively in graphical form.

CO2. Analyze earthquakes and seismic planning of buildings to solve complex earthquake engineering problems using appropriate techniques besides communicating effectively in graphical form.

CO3. Design earthquake resistant structures to solve complex earthquake engineering problems using appropriate techniques and following IS codes considering safety, stability, environment and sustainability besides communicating effectively in graphical form.

CO4. Design earthquake resistant structures to solve complex earthquake engineering problems using capacity based method and following IS codes considering safety, stability, environment and sustainability besides communicating effectively in graphical form.

CO5. Design shear walls to solve complex earthquake engineering problems using appropriate techniques and following IS codes considering safety, stability, environment and sustainability besides communicating effectively in graphical form.

CO6. Analyze base isolation techniques to solve earthquake engineering problems following latest developments considering safety and environment besides communicating effectively in graphical form.

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	-	-	1	2	2	1	-	1	-	-	3	-	-
CO2	2	3	3	3	2	1	1	2	-	2	-	-	3	-	-
CO3	1	2	3	3	2	1	1	2	-	1	-	-	3	-	-
CO4	1	2	3	3	2	1	1	2	-	1	-	-	3	-	-
CO5	1	2	3	3	2	1	1	2	-	1	-	-	3	-	-
CO6	1	3	-	3	1	2	1	2	-	1	-	2	3	-	-
Course Correlation Mapping	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	-	**2**	-	**2**	**3**	-	-

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

COURSE CONTENT

Module 1: EARTHQUAKE ENGINEERING ***(08 Periods)***

Engineering seismology, Earthquake phenomenon, Causes and effects of earthquakes, Faults, Structure of earth, Plate tectonics, Elastic rebound theory, Earthquake terminology - Source, Focus, Epicenter, Earthquake size, Magnitude and intensity of earthquakes; Classification of earthquakes, Seismic waves, Seismic zones, Seismic zoning map of India.

Module 2: SEISMIC ANALYSIS AND PLANNING ***(10 Periods)***

Seismic Analysis - Rigid base excitation, Formulation of equations of motion for SDOF and MDOF Systems, Earthquake response analysis of single and multi-storied buildings, Use of response spectra.

Seismic Planning- Plan configurations, Torsion irregularities, Re-entrant corners, Non-parallel systems, Diaphragm discontinuity, Vertical discontinuities in load path, Irregularity in strength and stiffness, Mass irregularities, Vertical geometric irregularity, Proximity of adjacent buildings, Displacement requirements, drift requirements, Provisions for torsion.

Module 3: DESIGN OF EARTHQUAKE RESISTANT STRUCTURES ***(10 Periods)***

Codal design& detailing provisions –Review of IS: 1893 – 2016 (Part–I), IS: 4326, IS: 13920 and SP – 34, Earthquake design philosophy – Assumptions, Design by seismic coefficient and response spectrum methods; Design of flexure members, Design of exterior columns, Design of interior columns, column subjected to bending and axial load, joint of frames, detailing of reinforcements, soft storey.

Module 4: CAPACITY BASED DESIGN ***(09 Periods)***

Preliminary data for plane frame, Determination of loads, Procedure for capacity-based design, Determination of moment magnification factors for column, Capacity design for shear in beams, Capacity design for shear in columns and detailing of reinforcement.

Module 5: SHEAR WALL AND BASE ISOLATION TECHNIQUES ***(08 Periods)***

Shear Wall: Types, Design of shear walls as per IS: 13920 – Detailing of reinforcements.

Base Isolation Techniques: Seismic base isolation – Concept, Types; Variousdamper systems and their importance, Latest developments in earthquake resistant design.

Total Periods: 45

EXPERIENTIAL LEARNING

1. ASeismic zoning map of India Prototype Model: In this assignment, students will be able to understand the seismic zoning map of India and make a detailed report on it.
2. A Multistorey building Prototype Model: In this assignment, students will be able to understand the concept of earthquake response analysis of single and multi-storied buildings and make a report on it.
3. A shear wall Prototype Model: In this assignment, students will be able to understand the concept and design of shear wall and make detailed design report on it.
4. Practical Visual Learning of slab: In this assignment, students will be able to understand the concept and design earthquake response analysis of single and multi-storied buildings by visiting nearby site.
5. Practical Visual Learning of footing: In this assignment, students will be able to understand the concept and design of capacity design for shear in beams, Capacity design for shear in columns and detailing of reinforcement by visiting nearby site.

RESOURCES

TEXT BOOKS:

1. Pankaj Agarwal and Manish Shrikhande, *Earthquake Resistant Design of Structures,* Prentice Hall of India, 2006.
2. Duggal, S.K., *Earthquake Resistant Design of Structures*, Oxford University Press, 2010.

REFERENCE BOOKS:

1. Anil Chopra, K., *Dynamics of Structures*, Pearson Education, 3rd Edition, 2007.
2. Clough and Penzien*, Dynamics of Structures*, McGraw–Hill, 3rd Edition, 2008.
3. Mario Paz, *Structural Dynamics - Theory and Computation*, Kluwer Academic Publication 2004.
4. Murty, C.V.R., *Earthquake Tips*, NICEE (www.nicee.org), IIT, Kanpur.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105107204
2. https://www.digimat.in/nptel/courses/video/105107204/L01.html
3. https://www.digimat.in/nptel/courses/video/105102016/L03.html
4. https://www.youtube.com/watch?v=fL06uRR7MnU

WEB RESOURCES:

1. https://pdfexist.com/download/1716403-Earthquake-Resistant-Design-Of-Structures-Nptel.pdf
2. http://ndl.ethernet.edu.et/bitstream/123456789/9201/1/Earthquake%20Resistant%20Design%20of%20Structures.pdf
3. https://sjce.ac.in/wp-content/uploads/2018/01/EQ4-Earthquake-Resistant.pdf
4. https://www.researchgate.net/publication/295812449_Earthquake_resistant_design_of_structures

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101043	**ANALYSIS AND DESIGN OF COMPOSITE STRUCTURES**	3	-	-	-	3

Pre-Requisite 22CE101005-Reinforced Cement Concrete Structures
22CE101006-Steel Structures

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Steel-concrete composite construction, Design of composite members, Design of shear connectors, Design of composite box girder bridges, Case studies and seismic behaviour of composite structures.

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

CO1. Analyze steel-concrete composite construction to solve composite structures using appropriate techniques considering safety, serviceability and code of practice besides communicating effectively in graphical form.
CO2. Design composite members to solve complex problems using appropriate techniques considering safety, serviceability and code of practice besides communicating effectively in graphical form.
CO3. Design the shear connectors to solve complex problems using appropriate techniques considering safety, serviceability and code of practice besides communicating effectively in graphical form.
CO4. Design composite box girder bridges to solve complex problems using appropriate techniques considering safety, serviceability and code of practice besides communicating effectively in graphical form.
CO5. Analyze the seismic behaviour of composite structures to solve complex problems using appropriate techniques considering safety, society, environment and code of practice.

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

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

COURSE CONTENT

Module 1: STEEL-CONCRETE COMPOSITE CONSTRUCTION ***(09 Periods)***

Introduction to steel-concrete composite construction, Codes, Composite action, Serviceability and construction issues in design.

Module 2: DESIGN OF COMPOSITE MEMBERS ***(09 Periods)***

Design of composite beams, slabs, columns and beam–columns; Design of composite trusses.

Module 3: DESIGN OF SHEAR CONNECTORS ***(09 Periods)***

Shear connectors, Types, Design of connections in composite structures, Design of shear connectors, Partial shear interaction.

Module 4: DESIGN OF COMPOSITE BOX GIRDER BRIDGES ***(09 Periods)***

Introduction, Behaviour of box girder bridges, Design of composite box girder bridges.

Module 5: CASE STUDIES AND SEISMIC BEHAVIOR OF COMPOSITE STRUCTURES ***(09 Periods)***

Case studies on steel-concrete composite construction in buildings, seismic behavior of composite structures.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Acomposite beam Prototype Model: In this assignment, students will be able to understand the design of composite beam and make a detailed report on it.
2. Acomposite column Prototype Model: In this assignment, students will be able to understand the design of composite column and make a report on it.
3. A composite truss Prototype Model: In this assignment, students will be able to understand the the design of composite trusses and make detailed design report on it.
4. Practical Visual Learning of slab: In this assignment, students will be able to understand the concept and behaviour of box girder bridges by visiting nearby site.
5. Practical Visual Learning of footing: In this assignment, students will be able to understand the concept and design of composite box girder bridges by visiting nearby site.

RESOURCES

TEXT BOOKS:

1. Johnson R.P., *Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings*, Vol.I, Blackwell Scientific Publications, 2004.
2. Oehlers D.J. and Bradford M.A., *Composite Steel and Concrete Structural Members*, Fundamental behaviour, Pergamon press, Oxford, 1995.

REFERENCE BOOKS:

1. Qing Quan Liang, *Analysis and Design of Steel and Composite Structures*, CRC Press, 2015.
2. Owens, G.W. and Knowles, P., *Steel Designers Manual*, Steel Concrete Institute(UK) Oxford Blackwell Scientific Publications, 1992.
3. Narayanan, R., *Steel-Concrete Composite Structures*, CRC Press, 1st Edition, 1988.

CODES

1. 1. IS: 3935 - 1966 : Code of Practice for Composite Construction.
2. 2. IS: 11384 – 1985 : Code of Practice for Composite Construction in Structural Steel and Concrete.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=jPFqDWD3-Os
2. https://www.youtube.com/watch?v=6pC6hl3E5Ko
3. https://www.youtube.com/watch?v=1S5MsvelG4I
4. https://www.youtube.com/watch?v=DJsqj4AhScc

WEB RESOURCES:

1. https://structures.dhu.edu.cn/_upload/article/files/f6/62/f5c6159f4c86ae7a86fbd6b48811/0d2d816a-f260-44c9-914d-84728d1a3f0c.pdf
2. https://download.e-bookshelf.de/download/0003/7273/33/L-G-0003727333-0002367315.pdf
3. https://ntrs.nasa.gov/api/citations/19830025689/downloads/19830025689.pdf
4. https://learnengineering.in/design-and-analysis-of-composite-structures-by-christos-kassapoglou/

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101044	**BRIDGE ENGINEERING**	3	-	-	-	3

Pre-Requisite 22CE101005-Reinforced Cement Concrete Structures
22CE101006-Steel Structures

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on bridge loading standards, deck slab bridge, box culver, beam and slab bridge, bridge bearings, piers and abutments.

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

CO1 Analyze bridge loading standards to solve bridge engineering problems following relevant codes ensuring safety besides communicating effectively in graphical form.
CO2 Design deck slab bridge and box culvert to solve complex bridge engineering problems using appropriate techniques considering safety, serviceability, environment and IRC codes of practice besides communicating effectively in graphical form.
CO3 Design beam and slab bridge to solve complex bridge engineering problems using appropriate techniques considering safety, serviceability, environment and IRC codes of practice besides communicating effectively in graphical form.
CO4 Design bridge bearings to solve complex bridge engineering problems using appropriate techniques considering safety, serviceability, environment and IRC codes of practice besides communicating effectively in graphical form.
CO5 Analyze piers, abutments and bridge foundations to solve bridge engineering problems considering safety, serviceability, environment and IRC codes of practice.

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

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

COURSE CONTENT

Module 1: BRIDGE LOADING STANDARDS ***(09 Periods)***

Importance of site investigation in bridge design, Various loads in bridges, Highway bridge loading standards, Impact factor, Railway bridge loading standards.

Module 2: DECK SLAB BRIDGEAND BOX CULVERT ***(09 Periods)***

Deck Slab Bridge: Effective width method of analysis and design of deck slab bridge (simply supported) subjected to Class AA tracked vehicle only.

Box Culvert: General aspects, Design loads, Design of box culvert subjected to class AA tracked vehicle only.

Module 3: BEAM AND SLAB BRIDGE (T–BEAM BRIDGE) ***(09 Periods)***

General features, Design of interior panel of slab, Pigeauds method, Design of a T–beam bridge subjected to Class AA tracked vehicle only.

Module 4: BRIDGE BEARINGS ***(09 Periods)***

General features, Types of bearings, Design principles of steel rocker and roller bearings, Design of a steel rocker bearing, Design of elastometric pad bearing.

Module 5: PIERS AND ABUTMENTS ***(09 Periods)***

General features, Bed block, Materials of piers and abutments, Types of piers, Forces acting on piers, Stability analysis of piers, General features of abutments, Forces acting on abutments, Stability analysis of abutments, Types of wing walls, Approaches, Types of bridge foundations (excluding design).

Total Periods: 45

EXPERIENTIAL LEARNING

1. Field study report on site investigation in bridge design.
2. Field study report on deck slab bridge and box culvert.
3. Field study report on T-beam bridge.
4. Field study report on bridge bearings.
5. Field study report on piers and abutments.

RESOURCES

TEXT BOOKS:

1. Krishna Raju, N., *Design of Bridges*, CBS Publishers and Distributors Pvt Ltd, 5th Edition, 2019.
2. Ponnuswamy, S., *Bridge Engineering,* Tata Mcgraw–Hill Company, 3rd Edition, 2017.

REFERENCE BOOKS:

1. Jagadish, T. R. and Jayaram, M. A., *Design of BridgesStructures*, Prentice Hall of India Pvt. Ltd., 2nd Edition, 2009.
2. Bindra, S. P., *Principles and Practice of Bridge Engineering*, Dhanpat Rai Publishing Co Pvt Ltd, 2012.
3. Victor D. Johnson, *Essentials of Bridge Engineering,* Oxford & IBH Publishing Co Pvt. Ltd., 6th Edition, 2019.
4. Rangwala, *Bridge Engineering*, Charotar Publishing House Pvt. Ltd, 16th Edition, 2015

CODES:

1. IRC: 6:2017: Loads and Load Combinations.
2. IRC: 112-2011: Concrete Road Bridges.
3. IRC: 83(Part I) 1999: Bearings, Part I: Metallic Bearings.
4. IRC: 83(Part II) 1987: Bearings, Part II: Elastomeric Bearings.
5. Pigeauds Curves

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/105/105105216/
2. https://nptel.ac.in/courses/105105165
3. https://www.youtube.com/watch?v=hc9Vj_wuQlg
4. https://www.youtube.com/watch?v=DtpckvIBrqo

WEB RESOURCES:

1. https://www.teachengineering.org/lessons/view/cub_brid_lesson02
2. https://www.britannica.com/technology/bridge-engineering
3. https://shorturl.at/doCIZ
4. https://ascelibrary.org/journal/jbenf2

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE102014	**FINITE ELEMENT METHODS IN STRUCTURAL ENGINEERING**	3	-	2	-	4

Pre-Requisite 22MM101402-Multivariable Calculus and Differential Equations
22CE101003-Structural Analysis

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of FEM; One Dimensional & Two Dimensional Elements; Element stiffness matrix; ISO-parametric Formulation and Solution techniques.

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

CO1. Evaluate the fundamentals of FEM to solve complex structural analysis problems using different tools and techniques considering safety, either individually or in a team besides communicating effectively in graphical form.

CO2. Evaluate the one dimensional and two dimensional elements to solve complex structural analysis problems using different tools and techniques considering safety, either individually or in a team besides communicating effectively in graphical form.

CO3. Evaluate the element stiffness matrix to solve complex structural analysis problems using different tools and techniques considering safety, either individually or in a team besides communicating effectively in graphical form.

CO4. Evaluate the Iso-parametric formulation and Axi-symmetric analysis to solve complex structural analysis problems using different tools and techniques considering safety, either individually or in a team besides communicating effectively in graphical form.

CO5. Evaluate the solution techniques to solve complex structural analysis problems using different tools and techniques considering safety, either individually or in a team besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: FUNDAMENTALS OF FEM ***(09 Periods)***

Concepts of FEM, Steps involved, Merits anddemerits, energy principles, Discretization, Rayleigh, Ritz method of functional approximation, Principles of Elasticity: Equilibrium equations, strain displacement relationships in matrix form, Constitutive relationships for plane stress, plane strain and Axi-symmetric bodies of revolution with axi-symmetric loading.

Module 2: ONE DIMENSIONAL AND TWO DIMENSIONAL ELEMENTS ***(09 Periods)***

Stiffness matrix for bar element, shape functions, 1D and 2D elements, types of elements for plane stress and plane strain analysis, Displacement models, generalized coordinates, shape functions, convergent and compatibility requirements, Geometric invariance, Natural coordinate system, area and volume coordinates.

Module 3: ELEMENT STIFFNESS MATRIX ***(09 Periods)***

Generation of element stiffness and nodal load matrices for 3-node triangular element and four-node rectangular elements.

Module 4: ISO-PARAMETRIC FORMULATION AND AXI-SYMMETRIC ANALYSIS ***(09Periods)***

Iso-Parametric Formulation:Iso-parametric elements for 2D analysis, formulation of CST element, 4–noded and 8-noded iso-parametric quadrilateral elements, Lagrangian and Serendipity elements.

Axi-Symmetric Analysis: Basic principles, Formulation of 4-noded iso-parametric axi-symmetric element.

Module 5: SOLUTION TECHNIQUES ***(09 Periods)***

Numerical Integration, Static condensation, assembly of elements and solution techniques for static loads.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:
SOFTWARE: ANSYS

1. Introduction to ANSYS and static structural procedure.
2. Analysis of bar element by finite element analysis using ANSYS.
3. Analysis of beam by applying various mesh controls.
4. Analysis of Non Linear Plastic Deformation Cantilever I-Beam with uniform varying load using ANSYS.
5. Analysis of Shear and Deflection Behaviour of CRC Beam using ANSYS.
6. Bulking analysis of beam, critical loading, mode shapes and factor of safety.
7. Analysis of truss for shear moment diagram and reaction forces.
8. Analysis for structural model for stress, deflection and factor of safety.
9. Bridge finite element analysis using ANSYS.
10. Dynamic analysis of a bride by finite element analysis using ANSYS.

RESOURCES

TEXT BOOKS:

1. Tirupathi R Chandraputla, *Finite Element Analysis for Engineering and Technology*, Universities Press Pvt Ltd, Hyderabad, 2003.
2. Bhavikatti S. S, *Finite Element Analysis*, New age International Publishers, 03rd Edition, 2015.

REFERENCE BOOKS:

1. Lakshminaryana H. V, *Finite Element Analysisand Procedures in Engineering*, 3rd edition, Universities press, Hyderabad, 2004.
2. Robert D. Cook, Michael E Plesha, *Concepts and applications of Finite Element Analysis,*, John Wiley & sons Publications, 4th edition, 2001.
3. Rajasekharan. S, *Finite element analysis in Engineering Design*, S. Chand Publications, New Delhi, 2000.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=UOp6JEiJctA&list=PLSGws_74K018SmggufD-pbzG3thPIpF94
2. https://www.youtube.com/watch?v=0VNIEfX0m4A&list=PLSGws_74K018SmggufD-pbzG3thPIpF94&index=3
3. https://www.youtube.com/watch?v=C7gEY9sNXhg&list=PLSGws_74K018SmggufD-pbzG3thPIpF94&index=17

WEB RESOURCES:

1. https://www.studocu.com/row/document/nfc-institute-of-engineering-and-technology/auto-cad-mechanical-engineeering/fea-lab-manual/26786439
2. https://www.iitg.ac.in/mech/documents/128/introfem.pdf
3. https://www.iist.ac.in/sites/default/files/people/IN08026/FEM.pdf
4. https://www.engr.uvic.ca/~mech410/lectures/FEA_Theory.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101045	**PREFABRICATED STRUCTURES**	3	-	-	-	3

Pre-Requisite 22CE101005-Reinforced Cement Concrete Structures
22CE101006-Steel Structures

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:

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

CO1. Analyze the prefabricated structures using different tools and techniques to solve complex civil engineering construction problems considering codes of practice, safety, environment and sustainability.

CO2. Analyze the prefabricated components using different tools and techniques to solve complex civil engineering construction problems considering codes of practice, considering safety, environment and sustainabilitybesides communicating effectively in graphical form.

CO3. Analyze the precast concrete and erection using different tools and techniques to solve complex civil engineering construction problems considering codes of practice, safety, environment and sustainabilitybesides manage and communicating effectively in graphical form.

CO4. Design the prefabricated structures using different tools and techniques to solve complex civil engineering construction problems considering codes of practice, safety, environment and sustainabilitybesides communicating effectively in graphical form.

CO5. Analyze the joints and connections in prefabricated structures using different tools and techniques to solve complex civil engineering construction problems considering codes of practice, safety, environment and sustainabilitybesides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: PREFABRICATED STRUCTURES ***(09 Periods)***

Prefabrication - Concept, Need, principles, Materials; Modular coordination, Standardization systems, production, transportation, erection, applications

Module 2: PREFABRICATED COMPONENTS ***(09 Periods)***

Behavior of structural components, roof and floor slabs, floor systems, wall panels, columns, shear walls, hipped plate and shell structures.

Module 3 PRECAST CONCRETE AND ERECTION ***(09 Periods)***

Precast Concrete: Materials and moulds, Admixtures, pigments, production – general considerations & Specific considerations, accelerated curing, properties and performance, quality assurance, repairs.
Erection: Transportation and erection, organizing of production, storing and erection equipment, shuttering and mould design, dimensional tolerances, erection R.C. structures***.***

Module 4 DESIGN OF PREFABRICATE STRUCTURES ***(09 Periods)***

Design Principles: Disuniting of structures, design of cross section based on efficiency of material used, problems in design, joint flexibility, allowance for joint deformation.
Design of Abnormal Loads: progressive collapse, code provisions, equivalent design loads, considerations for earthquake loads, wind loads, cyclone effects, importance of progressive collapse.

Module 5 JOINTS AND CONNECTIONS IN STRUCTURAL MEMBERS ***(09 Periods)***

Joints: Types, based on action of forces – compression joints, shear joints, tension joints; based on function – construction, contraction joints, expansion joints; design of expansion joints, dimensions and detailing, types of sealants.
Connections: Types of structural connections, beam to column, column to column, beam to beam, column to foundation.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Write a report on precast concrete for an industrial building.
2. Detail a report on Indoor Stadium – Mohan Babu University.
3. Prepare a perceptive report on modular structures and their functions.
4. Container homes – a future ready building, write a case study report on container homes.

RESOURCES

TEXT BOOKS:

1. M. Levitt, "Precast Buildings – Materials, Manufacture, Properties and usage", Applied science publishers, London, 2004
2. B. Lewicki, "Building with Large Prefabricates", Elsevier publishing company, Amsterdam/London/New York, 1966
3. "Structural design manual", precast concrete connection details, society for the studies in the use of precast concrete, Netherland bettor verlag, 2009
4. T. Koncz, Manual of precast concrete construction, Volume I, II & III, Bauverlag, GHBH, 1971.

REFERENCE BOOKS:

1. Lasslo Mokk, "Prefabricated concrete for industrial and public sector, Akademiai Kiado, Budapest, 1964
2. CBRI, Building Materials and Components, India, 1990.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=sM4SjL5jTUg
2. https://www.youtube.com/watch?v=d7o6qAQ7pTc
3. https://www.youtube.com/watch?v=d0i6SPLBkGM

WEB RESOURCES:

1. Prefabricated structures (slideshare.net)
2. Container Homes | Container house in Bangalore | Prefab Container Home (championprefabs.com)
3. Prefab Homes | Prefabricated Houses in India | Modular Homes (championprefabs.com)

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE103004	LAND SURVEYING AND REAL ESTATE DEVELOPMENT	3	-	-	4	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Land survey and layouts; Building bye–laws and regulations; Real estate development; Retail real estate; Portfolio and real estate management.

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

CO1. Analyze land survey and layouts to solve real estate problems using appropriate techniques by following relevant standards and codes considering society, environment besides communicating effectively in graphical form.

CO2. Analyze building bye-laws and regulations to solve real estate problems by following latest developments considering society, environment besides communicating effectively in graphical form.

CO3. Analyze real estate development to solve real estate problems following relevant standards, regulations and latest developments considering society, finance and project management.

CO4. Analyze retail real estate to solve real estate problems following relevant standards, regulations and latest developments considering society, finance and project management.

CO5. Analyze portfolio and real estate management to solve the real estate problems using appropriate techniques following relevant standards, regulations and latest developments considering society, finance and project 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	-	-	1	2	1	2	-	1	-	-	-	-	3
CO2	3	3	-	-	1	2	1	2	-	1	-	1	-	-	3
CO3	3	3	-	-	2	2	-	2	-	-	1	1	-	-	3
CO4	3	3	-	-	2	2	-	2	-	-	1	1	-	-	3
CO5	3	3	-	-	2	2	-	2	-	-	1	1	-	-	3
Course Correlation Mapping	**3**	**3**	**-**	**-**	**2**	**2**	**1**	**2**	**-**	**1**	**1**	**1**	**-**	**-**	**3**

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

COURSE CONTENT

Module 1: LAND SURVEY AND LAYOUTS *(08 Periods)*

Field surveying - Definition and objectives; Concept of geoid and reference spheroids, Coordinate systems, Plane and geodetic surveys; Maps - Types, Importance, Scales or centre line, Conventional symbols and generalization; Topographic maps, Map projection systems, Sheet numbering systems, Map layout; Engineering project surveys - Requirements and specifications.

Module 2: BUILDING BYE–LAWS AND REGULATIONS *(10 Periods)*

Meaning of terms of law, legislation, ordinance, bill, act, regulation and bye-laws; Significance of law and its relationship to urban planning, Benefits of statutory backing of schemes, Law of eminent domain and police powers, Evolution of planning legislation – A brief history of planning legislation in India and abroad, Town and country planning act 1957, Improvement trust act 1961, Development authorities act 1957, State housing board act, Land acquisition act 1986, Urban land (ceiling and regulation) act 1976, Slum areas (improvement and clearance) act 1956, Rent control act 1946, Apartment ownership act 1983; Significance of land development controls – Zoning, Subdivision regulations, Building regulation and bye-laws; Land layout development.

Module 3: REAL ESTATE DEVELOPMENT *(09 Periods)*

Organizational set up and its functions, General procedure for development permission, Authorities and discretionary powers, Duties of staff, Policy decisions; Documents from owner, architect or surveyor; Permissions by corporation, Finance for investment in real properties, FDI, Method of valuation - Open lands, Rental method, Capital value, Outgoings, Depreciation, Valuation of licensed premises.

Module 4: RETAIL REAL ESTATE *(09 Periods)*

Merchandising, Warehousing, Franchising, Shopping malls, General free and unfree tenure, Land system in India, Concept of term value, Different forms of value, Supply and demand forces, Occupation value and investment value, Factors affecting changes in market value, Classification of values, Building redevelopment proposal, Slum rehabilitation and development schemes, Latest developments.

Module 5: PORTFOLIO AND REAL ESTATE MANAGEMENT *(09 Periods)*

Risk management in real estate, Strategic business risks and corporate real estate, Competitive risks; Managing portfolio - Property assets, Contracts and relationships, Workplace and infrastructure; Risk management - Financial risks, Property market risks, Business risks, Understanding risks and informing decision making; Business ethics - Normative ethics, Prescriptive ethics, Applied ethics, Concept of right and duty, Definition and scope relevance in social changes, Corporate code of conduct.

Total Periods: 45

PROJECT BASED LEARNING

The faculty will allocate the project-based learning during the course work period.

RESOURCES

TEXT BOOKS:

1. Mike E. Miles, Laurence M. Netherton and Adrienne Schmitz, *Real Estate Development: Principles and Process*, Urban Land Institute, 5th Edition, 2015.
2. Rena Mourouzi-Sivitanidou and Petros Sivitanides, *Market Analysis for Real Estate*, Routledge, 1st Edition, 2020.

REFERENCE BOOKS:

1. Charles D. Ghilani, Elementary Surveying - An Introduction to Geomatics, Pearson India Education Services Pvt. Ltd, 13th Edition, 2018.
2. David L. Cleland and Lewis R. Ireland, Project Management: Strategic Design and Implementation, McGraw-Hill Education; 5th Edition, 2006.
3. Downs, J.C., Principles of Real Estate Management, Institute of Real Estate Management, 1980.
4. Dutta, B.N., Estimating and Costing in Civil Engineering, CBS Publishers & Distributors Private Limited, 28th Edition, 2020

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=tt5UKISiQs0
2. http://nptel.ac.in/courses/105107158

WEB RESOURCES:

1. https:// www.youtube.com/watch?v=cAXa2Tc5sbk&list=PL3MO67NH2XxL_jS8K-gyg_Yo8lWITwQQd

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE102015	**DIGITAL LAND SURVEY AND MAPPING**	1	-	2	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on land surveying and mapping, uses of global positioning system (GPS), total station and contouring. This course also describe about different type of digital surveying instruments and various techniques used in digital mapping.

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

CO1. Evaluate the land surveying and mapping to solve complex surveying problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society and environment either individually or in a team besides communicating effectively in graphical form.

CO2. Evaluate the global positioning system to solve complex surveying problems using appropriate tools and techniques following the relevant guidelines considering society and environment either individually or in a team besides communicating effectively in graphical form.

CO3. Evaluate the total station and contouring to solve complex surveying problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society and environment either individually or in a team besides communicating effectively in graphical form.

CO4. Evaluate the digital surveying instruments to solve complex surveying problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society and environment either individually or in a team besides communicating effectively in graphical form.

CO5. Evaluate the digital mapping to solve complex surveying problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society and environment either individually or in a team besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: LAND SURVEYING AND MAPPING (03 Periods)

Introduction and applications, Fundamentals and operations, Overview of digital land surveying, Understanding surveying data, Data conversion from distance, Direction and angles to mapping coordinates, Map numbering systems, Map scale and classification of maps, Datum and coordinate systems, Map projection systems, National map policy and instructions by Survey of India (SOI) for publication.

Module 2: GLOBAL POSITIONING SYSTEM (GPS) (02 Periods)

Introduction of GPS,GPS Signal (Civilian Perspective), GPS User segment, GPS Positioning of control point, Demonstration of GPS Receivers, Principle of GPS Positioning and GPS Observables, Errors in GPS Observables.

Module 3: TOTAL STATION AND CONTOURING (03 Periods)

Total Station: Introduction to total station, Parts and accessories, Handling and operation, Measurement of distance, Measurement of horizontal angle, Measurement of vertical angle and height, Errors in total station.

Contouring*:* Introduction of contouring, Purpose of contouring/Contour map, Methods of contouring - Squares or grid method, Cross section.

Module4: DIGITAL SURVEYING INSTRUMENTS (02 Periods)

Surveying measurements using Electromagnetic Distance Measurement Instrument (EDMI), Digital level, Digital theodolite, Global Navigation Satellite System (GNSS), Data format conversion for mapping coordinates, Map preparation in software.

Module 5: DIGITAL TECHNIQUES USED IN MAPPING (05 Periods)

Mapping fundamentals, Mapping basics, Mapping software, Automated mapping, Mapping from photographs collected by potogrammetry, Working steps, High resolution remote sensing, Geographical Information System (GIS), Digitization of objects from paper maps or images, Attribute data input and map preparation.

Total Periods: 15

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Creation of geo–database in GIS
2. Preparation of thematic maps using Arc GIS
3. Editing Map Elements in ArcMap
4. GPS Positioning Accuracy Assessment
5. Determination of area using total station
6. Determination of remote height, distance, gradient and differential height between two inaccessible points using total station.
7. Contour plan of given area
8. GNSS Topographic mapping
9. Developing digital elevation model in road design
10. Simple applications of GIS in watershed analysis
11. Simple applications of GIS in transportation engineering

RESOURCES

TEXT BOOKS:

1. Garg, P .K.,*A Text Book of Digital Land Surveying and Mapping*, New Age International Publication, 2021.
2. Christian Tiberius, Hans van der Marel, René Reudink and Freek van Leijen., *A Text Book of Surveying and Mapping*, Delft University of Technology, 2021.

REFERENCE BOOKS:

1. Satheesh Gopi, Sathikumar, R. and Madhu, N., *Advanced Surveying: Total Station, GIS and Remote Sensing*,Pearson Publications, 1st Edition, 2003.
2. Arora Manoj K. and Badjatia, R. C., *Geomatics Engineering*, Nem Chand and BrosPublications, 1st Edition, 2011.
3. Yuhong He Qihao Weng, *High Spatial Resolution Remote Sensing: Data, Analysis, and Applications*, CRC Press, 1st Edition, 2018.
4. Survey of India, *Instructions for Publishing Map by Central/State Government Departments/Offices and Private Publishers*, 2015. http://surveyofindia.gov.in/

LABORATORY MANUAL:

1. *Digital Land Survey and Mapping Laboratory Manual (MBU22 Regulations)*, Department of Civil Engineering, School of Engineering, Mohan Babu University, Tirupati.

VIDEO LECTURES:

1. http://nptel.ac.in/courses/105/107/105107158/
2. https://freevideolectures.com/course/4731/nptel-digital-land-surveying-and-mapping-dls-m/37
3. https://www.youtube.com/watch?v=6EsbHPpQQcw
4. https://www.youtube.com/watch?v=GYvKB1wg5hs

WEB RESOURCES:

1. Digital Audio Signal Processing: https://www.udemy.com/course/surveying/
2. https://www.youtube.com/channel/UCxQyIna2BQSlfdOsgp34n4g?app=desktop
3. https://ucsd.libguides.com/c.php?g=90732&p=584251
4. https://www.studocu.com/en-us/document/university-of-wisconsin-madison/our-digital-globe-an-overview-of-giscience-and-its-technology/lecture-1-notes/14024942
5. Sutton, T., Dassau, O., Sutton, M. (2009). A gentle introduction to GIS. Chief Directorate: Spatial Planning & Information, Eastern Cape
6. Tutorial data can be downloaded from the link IGET_GIS_005
7. http://dst-iget.in/tutorials/IGET_GIS_005/IGET_GIS_005_Digitization.pdf
8. http://www.geo.utexas.edu/courses/371c/Labs/lab1_11.htm#slick_tricks

SOFTWARE/Tools: ArcGIS

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE102016	**DRONE SURVEYING AND MAPPING**	1	-	2	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experienceon drones, survey with drones, image processing and photogrammetry, mapping and modelling, applications of drone surveying.

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

CO1. Evaluate drones and their specifications to solve complex surveying problems following ethics, latest developments and considering society besides communicating effectively in graphical form as an individual or in a team.

CO2. Evaluate drone survey to solve complex surveying problems following ethics and considering society besides communicating effectively in graphical form as an individual or in a team.

CO3. Develop images and models using image processing and photogrammetry of drone data to solve complex surveying problems following ethics and considering society besides communicating effectively in graphical form as an individual or in a team.

CO4. Develop maps and models using data acquired from drone surveying solve complex surveying problems following ethics and considering society besides communicating effectively in graphical form as an individual or in a team.

CO5. Develop maps using drone surveying for various applications in civil engineering to solve complex surveying problems following ethics and considering society ensuring safety, environment and sustainability besides communicating effectively in graphical form as an individual or in a team.

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

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

COURSE CONTENT

Module 1: DRONES ***(03 Periods)***

Introduction to Drones, History of Drone/UAS/UAVs, Payload, Battery life, Specifications for good results, Regulations of DGCA and Drone license, Pre and Post Flight planning- Flight execution and photography, Data collection- Image Format, GSD, Scale and Resolution, Latest developments.

Module 2: SURVEYING WITH DRONE ***(03 Periods)***

Consideration for hardware selections, comparison on surveying drone and its accuracy, Techniques of controlling errors, Consideration of Ground Control Point (GCP) in vertical and horizontal accuracies, Planning and estimation of drone surveying jobs, Autonomous flight vs. manual and hybrid flight profiles.

Module 3: IMAGE PROCESSING AND PHOTOGRAMMETRY ***(03 Periods)***

Aerial Triangulation, Post processing softwares, Analyzing Data, Contouring, DEM, DSM, Cut, Fill, and Volumetric measurement calculation and orthophoto generation.

Module 4: MAPPING AND MODELING ***(03 Periods)***

Introduction to mapping and modeling concepts, Understanding Real-Time Kinematic (RTK),Post-Processed Kinematic (PPK) and GCPs, Overview of popular data processing software platforms and functions.

Module 5: APPLICATIONS OF DRONE SURVEYING ***(03 Periods)***

Applications of drone for surveying and mapping- Construction, Irrigation and Agricultural, Engineering Land Survey and Transportation.

Total Periods: 15

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Introduction to professional drone
2. Flying the professional drone in the field
3. Downloading survey data from the drone
4. Geo-referencing the drone images
5. Processing drone survey data to create orthomosaic maps (3D Maps) using data processing software tools
6. Determination of area using drone
7. Determination of volume using drone
8. Contouring using drone
9. Digital Surface Modelling (DSM) and Digital Terrain Modelling (DTM) using drone
10. Topography mapping using drone
11. Route mapping using drone
12. Aerial mapping using drone
13. Infrastructure quality inspection using drone
14. Construction site monitoring using drone
15. Land surveying and mapping using drone
16. Road surveying and mapping using drone

RESOURCES

TEXT BOOKS:

1. Lillesand and Kiefer, *Remote Sensing and Image Interpretation*, John Wiley and Sons, 5th Edition, 2008.
2. John E. Jackson, *One Nation Under Drones: Legality, Morality, and Utility of Unmanned Combat Systems*, Naval Institute Press, Illustrated Edition, 2018.

REFERENCE BOOKS:

1. Chandra, A. M. and Ghosh, S. K., *Remote Sensing and Geographical Information System*, Narosa Publishing House, 1st Edition, 2007.
2. David P Paine, *Aerial Photography and Image Interpretation*, Wiley Higher Education, 2nd Edition, 2006.
3. James Igoe Walsh and Marcus Schulzke, *Drones and Support for the Use of Force*, University of Michigan Press, USA, 2018.
4. Kike Calvo, *So You Want to Create Maps Using Drones?,* Blurb Publishers, 2015.
5. Armenakis, C. and Patias, P., *Unmanned Vehicle Systems for Geomatics: Towards Robotic Mapping*, Whittles Publishing, 2019.
6. Garvit Pandya, *Basics of Unmanned Aerial Vehicles: Time to Start Working on Drone Technology*, Notion Press, 2021.
7. Garg, P. K., *Introduction To Unmanned Aerial Vehicles*, New Age International Publishers, 1st Edition, 2020.

LAB MANUAL:

1. *Drone Surveying and Mapping Laboratory Manual (MBU22 Regulations)*, School of Engineering, Department of Civil Engineering, Mohan Babu University, Tirupati.

SOFTWARE/TOOLS:

1. STADD Pro
2. AutoCAD
3. SurvCE
4. Access
5. Drone

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc22_ce05/preview
2. https://nptel.ac.in/courses/101104073
3. https://archive.nptel.ac.in/courses/105/107/105107218/

WEB RESOURCES:

1. https://theconstructor.org/surveying/drone-surveying-features-and-applications/562424/
2. https://dreamcivil.com/drone-surveying/
3. https://civilsnapshot.com/applications-surveying-civil-engineering/
4. https://www.auav.com.au/articles/drone-types/

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE102017	**UTILITY SURVEYING AND MAPPING**	1	-	2	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provide a detailed discussion on subsurface utilities and underground mapping, understanding of utility surveying drawings and images. Also, this course examines a various techniques for utility surveying, utility information systems, and knowledge structure for AUSM profession.

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

CO1. Evaluate the subsurface utilities to solve complex surveying problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society and environment either individually or in a team besides communicating effectively in graphical form.

CO2. Evaluate the utility surveying to solve complex surveying problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society and environment either individually or in a team besides communicating effectively in graphical form.

CO3. Evaluate the techniques for utility surveying to solve complex surveying problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society and environment either individually or in a team besides communicating effectively in graphical form.

CO4. Evaluate the Utility management to solve complex surveying problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society and environment either individually or in a team besides communicating effectively in graphical form.

CO5. Understand the utility surveying and management (USM) profession to solve utility surveying problems following the relevant guidelines and latest developments.

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

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

COURSE CONTENT

Module 1: SUBSURFACE UTILITIES (04 Periods)

Introduction, Types of underground utilities, Construction and attributes of each type of utility, Utility quality level attributes, Roles of utility owner and surveyor in underground utility mapping, Mapping of subsurface utilities and its importance, Underground utility tunnel.

Module 2: UTILITY SURVEYING (03 Periods)

Positioning and condition survey, Understanding of record drawings,Electromagnetic detection (active and passive systems), Ground Penetrating Radar (GPR), Interpretations of GPR images.

Module 3: TECHNIQUES FOR UTILITY SURVEYING (03 Periods)

Sonar techniques for underwater utilities, Acoustic techniques for leak positioning, CCTV inspection, Utility health monitoring, Stepped approach for different levels of tasks.

Module 4: UTILITY MANAGEMENT (02 Periods)

Database for subsurface utilities, Utility information systems; Utility operation and maintenance.

Module 5: UTILITY SURVEYING AND MANAGEMENT (USM) PROFESSION (03 Periods)

Academic and professional position of USM, Knowledge structure for a USM profession, International utility surveying associations, International perspective of USM.

Total Periods: 15

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Field study of subsurface utilities
2. Study on underground utility tunnel
3. Positioning and condition survey
4. Understanding record drawings
5. Study report on Ground Penetrating Radar(GPR)
6. Surveying and mapping the location of water pipes, gas lines, electrical cables, and telecommunication lines using Ground Penetrating Radar
7. Surveying and mapping the location of water utilities using sonar techniques
8. Surveying and mapping of leak positioning using acoustic techniques
9. Surveying and mapping of utilities using CCTV inspection
10. Study report on utility health monitoring
11. Study report on utility management

RESOURCES

TEXT BOOKS:

1. *Standard Guideline for Underground Utility Mapping,* National Committee for Mapping and Spatial Data (Link: https://www.scribd.com/document/266105218/Standard-Guidelines-for-Underground-Utility-Mapping#)
2. Wong, K. and Allan, R. J., *Hong Kong Conduit Condition Evaluation Codes*, Utility Training Institute, 2009.

REFERENCE BOOKS:

1. Jeong, H., Arboleda, C., Abraham, D., Halpin, D. and Bernold, L., *Imaging and Locating Buried Utilities*, Report No. FHWA/IN/JTRP2003/12 Purdue University, 2003.
2. Everett, M. E., *Near-surface Applied Geophysics*, Cambridge University Press, 2013.

LABORATORY MANUAL:

1. *Utility Surveying and Mapping Laboratory Manual (MBU22 Regulations)*, Department of Civil Engineering, School of Engineering, Mohan Babu University, Tirupati.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=18eTnwyqPIQ
2. https://www.youtube.com/watch?v=37P5YVOjpE4
3. https://www.youtube.com/watch?v=gcei79J5ym0
4. https://www.youtube.com/watch?v=pGreWWpDIwg

WEB RESOURCES:

1. https://www.youtube.com/watch?v=msx1XFUH-bs
2. https://geoscopelocating.com.au/utility-surveying-and-mapping/
3. https://www.softdig.com/blog/what-are-quality-levels-sue/
4. https://www.fig.net/resources/proceedings/fig_proceedings/fig2012/papers/ts05j/TS05J_jamil_nomanbhoy_et_al_5636.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE102018	**HYDROGRAPHIC SURVEYING**	1	-	2	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on tides and datums, soundings,navigation and position fixing,planning and data processing,marine environmental measurements and case studies.

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

CO1. Evaluate tides and datums using appropriate tools and techniques to solve complex surveying problems of hydrographic surveying following ethics and considering society, environment and sustainability besides communicating effectively in graphical form as an individual or in a team.

CO2. Evaluate soundings using appropriate tools and techniques to solve complex surveying problems of hydrographic surveying following ethics and considering society, environment and sustainability besides communicating effectively in graphical form as an individual or in a team.

CO3. Evaluate navigation and position fixing using appropriate tools and techniques to solve complex surveying problems of hydrographic surveying following ethics and considering society, environment and sustainability besides communicating effectively in graphical form as an individual or in a team.

CO4. Develop plots using appropriate planning and data processing tools and techniques to solve complex surveying problems of hydrographic surveying following ethics and considering society, environment and sustainability besides communicating effectively in graphical form as an individual or in a team.

CO5. Analyze marine environment measurements using appropriate tools and techniques to solve complex surveying problems of hydrographic surveying following ethics and considering society, environment and sustainability besides communicating effectively in graphical form as an individual or in a team.

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

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

COURSE CONTENT

Module 1: TIDES AND DATUMS ***(03 Periods)***

Overview of hydrographic surveying concepts, Bathymetric and nautical charts, Basic tidal theory, Tidal observations and predictions, Common types of recording tide gauge, Different vertical datums, Hong Kong tides.

Module 2: SOUNDINGS ***(03 Periods)***

Overview of depth data types. Working principle of echo sounders, Characteristics and nature of underwater acoustic signals, Transducers, Error sources and calibrations, Advanced instrumentation.

Module 3: NAVIGATION AND POSITION FIXING ***(03 Periods)***

Horizontal positioning methods and requirements, Concept of line and surface of position, Positioning and navigation using satellite positioning systems, Differential GPS and Real-time Kinematic (RTK)

Module 4: PLANNING AND DATA PROCESSING ***(03 Periods)***

General considerations for planning of an inshore hydrographic survey, Ground and track control, Practical soundings in inshore and coastal surveys, Data processing and chart compilation; Hydrographic software packages for data collection, processing and plotting.

Module 5: MARINE ENVIRONMENTAL MEASUREMENTS AND CASE STUDIES ***(03 Periods)***

Marine Environmental Measurements: Methods of measuring and recording of currents, Composition of theseabed, and Solids in suspension.
Case Studies: The role of the hydrographic surveyor on different marine projects.

Total Periods: 15

EXPERIENTIAL LEARNING

1. Study of tides and datums
2. Bathymetric survey using Singlebeam Echo Sounder (SBES)
3. Side Scan Sonar survey
4. Multibeam Echo Sounder (MBES) survey
5. Hydrographic data processing and analysis
6. Hydrographic survey planning and execution
7. Tide and current measurements
8. Differential GPS (DGPS) survey
9. GIS Data collection
10. Integration of hydrographic data with Geographic Information Systems (GIS)
11. Study on planning and data processing
12. Study on few case studies on marine projects

RESOURCES

TEXT BOOKS:

1. U.S. Army Corps of Engineers, *Hydrographic Surveying*, Document No. EM 1110-2-1003, 2002.
2. de Jong, C. D., Lachapelle, G., Skone, S. and Elema, I. A., *Hydrography*, Delft University Press, The Netherlands, 2nd Editions, E Book, 2010.

REFERENCE BOOKS:

1. Ingham, A. E., *Hydrography for the Surveyor and Engineer*, Revised by Abbott V. J., Wiley-Blackwell, 3rd Revised Edition, 1992,
2. International Hydrographic Organization, *IHO Standards for Hydrographic Surveying*, Special Publication No. 44, IHB Monaco, 5th Edition, 2008.
3. Loweth, R. P., *Manual of Offshore Surveying for Geoscientists and Engineers*, Springer Dordrecht, 1st Edition, 1997.
4. Pugh, D., *Changing Sea Levels – Effects of Tides, Weather and Climate*, Cambridge University Press. 2004.
5. Sonnenberg, G. J., Radar and Electronic Navigation, Butterworths, 6th Edition, 1988.

LABORATORY MANUAL:

1. *Hydrographic Surveying Laboratory Manual (MBU22 Regulations)*, Department of Civil Engineering, School of Engineering, Mohan Babu University, Tirupati.

SOFTWARE/TOOLS:

1. HYPACK
2. AutoCAD
3. SurvCE
4. Access
5. GIS/QGIS

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105103176
2. https://www.youtube.com/watch?v=rzUgqf7ulrY
3. https://www.youtube.com/watch?v=85AtxerDGbE

WEB RESOURCES:

1. https://jbpro.com/what-is-hydrographic-surveying/#:~:text=Hydrographic%20surveying%20is%20an%20important,water%20to%20support%20marine%20construction
2. https://www.aboutcivil.org/hydrographic-surveying.html
3. https://www.marineinsight.com/tech/a-guide-to-hydrographic-surveys/
4. http://www.khoa.go.kr/eng/kcom/cnt/selectContentsPage.do?cntId=21030100

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101046	**TRANSPORTATION PLANNING AND MANAGEMENT**	3	-	-	-	3

Pre-Requisite 22CE102008-Transportation Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on transportation planning process, transportation surveys, trip generation, trip distribution, mode choice, trip assignment, transport economics, land use transportation models, mass transit systems.

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

CO1. Analyze transportation planning process and surveys to solve transportation problems using appropriate techniques considering society and environment.

CO2. Analyze trip generation and trip distribution to solve complex transportation problems using appropriate techniques considering safety besides communicating effectively in graphical form.

CO3. Analyze mode choice and trip assignment to solve complex transportation problems using appropriate techniques following relevant guidelines considering safety besides communicating effectively in graphical form.

CO4. Analyze transportation economics and land use transport models to solve transportation planning and management problems using appropriate techniques considering society besides communicating effectively in graphical form.

CO5. Analyze mass transit systems to solve complex transportation problems using appropriate techniques following relevant codes and latest developments considering society and environment besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: TRANSPORTATION PLANNING PROCESS AND SURVEYS *(09 Periods)*

Transportation Planning Process: System approach to transportation planning, Stages in transportation planning and difficulties in transportation planning process.

Transportation Surveys: Study area zoning, Types of surveys – Home interview survey, Commercial vehicle survey, Intermediate public transport survey, Cordon line survey, Post card questionnaire survey, Registration number survey, Tag-on-vehicle survey.

Module 2: TRIP GENERATION AND TRIP DISTRIBUTION *(09 Periods)*

Trip Generation*:* Factors governing trip generation and attraction, Multiple linear regression analysis.

Trip Distribution: Presentation of trip distribution data, Uniform and average factor method of trip distribution, Fratar method of trip distribution, Furness method of trip distribution, Gravity model of trip distribution**.**

Module 3: MODE CHOICE AND TRIP ASSIGNMENT *(09 Periods)*

Mode Choice: Influencing factors, Trip-end type modal split model, Trip-interchange modal split model, Disaggregate mode-choice model, Logit model of mode-Choice.

Trip Assignment: Description of transport network, Route choice behaviour, The minimum path, Minimum path algorithm, Route assignment techniques, All-or-nothing assignment, Multipath traffic assignment, Capacity-restrained traffic assignment.

Module 4: TRANSPORTATION ECONOMICS AND LAND USE TRANSPORT MODELS *(09 Periods)*

Transportation Economics: Economic evaluation of highway schemes - Necessity, Cost and benefits of transportation projects, Basic principles of economic evaluation - Net present value method, Benefit/Cost ratio method, Internal rate of return method, Vehicle operating costs, Value of travel time saving, Accident costs.

Land Use Transport Models: Selection of land, Lowry model, Grain-Lowry model, Applications of Lowry model.

Module 5: MASS TRANSIT SYSTEMS *(09 Periods)*

Urban passenger transport modes and classifications, System Performance - Capacity and quality of service, Planning issues - Route determination, Network design, Service policy and schedule development, Scheduling - Trip generation, Blocking, Runcutting and rostering, Priority measures and their implementations, Improvements in mass transportation system - Issues and challenges.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Conduct transportation survey using any of the methods and prepare a detailed report on transportation planning.

2. Carryout the trip assignment studies for a particular route and identify the suitable path with maximum benefits.
3. Prepare a detailed report on cost-benefit analysis of a highway project using any of the methods.
4. Visit any mass transit system in nearby city and prepare a detailed report on the planning, operation and maintenance of mass transit system.

RESOURCES

TEXT BOOKS:

1. Kadiyali, L. R., *Traffic Engineering and Transport Planning*, Khanna Publishers, New Delhi, 9th Edition, 1999.
2. Jotin Khisty, C. and Kent Lall, B., *Transportation Engineering – An Introduction*, Prentice Hall of India Pvt. Ltd., 3rd Edition, 2006.

REFERENCE BOOKS:

1. Hutchinson, B. G., *Principles of Urban Transport Systems Planning*, McGraw-Hill Book Co., New York, 1974.
2. Vuchic Vukan, R., *Urban Transit: Operations, Planning and Economics*, Prentice Hall, 2005.
3. Gray, G. E. and Hoel, L. A., *Public Transportation*, Prentice Hall, 2nd Edition, 1992.
4. Ortuzar, J. D. and Willumsen, L. G., *Modelling Transport*, Wiley, 4th Edition, 2011.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/106/105106058/
2. https://www.youtube.com/watch?v=qFzbStLr9Bo
3. https://archive.nptel.ac.in/courses/105/105/105105204/

WEB RESOURCES:

1. https://www.civil.iitb.ac.in/~dhingra/ce751/Module4.pdf
2. https://www.civil.iitb.ac.in/tvm/nptel/203_lnTse/web/web.html
3. https://www.slideshare.net/EddyAnkitGangani/urban-transportation-system-mass-transit-system
4. https://www.slideshare.net/Dhwani7887/traffic-transportation-surveys

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101047	**INTELLIGENT TRANSPORTATION SYSTEMS**	3	-	-	-	3

Pre-Requisite 22CE102008-Transportation Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on intelligent transportation systems (ITS), telecommunications in ITS, ITS functional areas, ITS user needs and services, automated highway systems.

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

CO1. Analyze intelligent transport systems to solve complex transportation problems using appropriate techniques following relevant guidelines and latest developments considering society and environment besides communicating effectively in graphical form.

CO2. Analyze telecommunications in ITS to solve complex transportation problems using appropriate techniques considering society and environment besides communicating effectively in graphical form.

CO3. Analyze ITS functional areas to solve complex transportation problems using appropriate techniques following relevant guidelines and latest developments considering society and environment.

CO4. Analyze ITS user needs and services to solve complex transportation problems using appropriate techniques following relevant guidelines and latest developments considering safety and environment.

CO5. Analyze automated highway systems to solve transportation problems following relevant guidelines and latest developments considering society and environment.

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

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

COURSE CONTENT

Module 1: INTELLIGENT TRANSPORTATION SYSTEMS (ITS) ***(09 Periods)***

Intelligent Transportation Systems (ITS) – Definition of ITS and identification of ITS objectives, Historical background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), Video data collection**.**

Module 2: TELECOMMUNICATIONS IN ITS ***(09 Periods)***

Importance of telecommunications in the ITS system, Information management, Traffic Management Centres (TMC); Vehicle – Road side communication, Vehicle positioning system**.**

Module 3: ITS FUNCTIONAL AREAS ***(09 Periods)***

Advanced Traffic Management Systems (ATMS), Advanced Traveller Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

Module 4: ITS USER NEEDS AND SERVICES ***(09 Periods)***

Travel and traffic management, Public transportation management, Electronic payment, commercial vehicle operations, Emergency management, Advanced vehicle safety systems, Information management.

Module 5: AUTOMATED HIGHWAY SYSTEMS ***(09 Periods)***

Vehicles in platoons – Integration of automated highway systems; ITS Programs in the world – Overview of ITS implementations in developed countries, ITS in developing countries.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Prepare a report on the principles of ITS and their applications.
2. Visit a highway nearby and identify the telecommunication facilities provided on road side. Also prepare a detailed report on how these telecommunications will help the road users at emergency situations.
3. Make a detailed report on the working of advanced traffic management system and advanced traveller information system.
4. Prepare a report on the working of electronic payment systems at toll plazas and their uses in easing the movement of road users.
5. Compare and contrast the ITS implementations in developed and developing countries.

RESOURCES

TEXT BOOKS:

1. Pradip Kumar Sarkar and Amit Kumar Jain, *Intelligent Transport Systems*, PHI Learning, 2018.
2. Sussman, J. M., *Perspective on ITS*, Artech House Publishers, 2005.

REFERENCE BOOKS:

1. Jotin Khisty, C. and Kent Lall, B., *Transportation Engineering – An Introduction*, Prentice Hall of India Pvt. Ltd., 2006.
2. Chakroborthy, P. and Das, A., *Principles of Transportation Engineering*, Prentice Hall of India Pvt. Ltd, New Delhi, 2nd Edition, 2017.
3. Papacostas, C. S. and Prevedouros, P. D., *Transportation Engineering and Planning* PearsonIN, 3rd Edition, 2015.
4. Mannering, Fred L., Walter P. Kilareski., Scott S. Washburn, *Principles ofHighway Engineering and Traffic Analysis*, John Wiley & Sons, 3rd Edition, 2004.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105105204
2. https://www.youtube.com/watch?v=OnjX0O9dPMc
3. https://www.youtube.com/watch?v=Jd7hG_P8z_Y

WEB RESOURCES:

1. https://ocw.mit.edu/courses/1-212j-an-introduction-to-intelligent-transportation-systems-spring-2005/pages/lecture-notes/
2. https://www.civil.iitb.ac.in/tvm/nptel/591_ITS_1/web/web.html
3. https://edurev.in/t/101472/Intelligent-Transportation-System-I
4. https://www.studocu.com/in/document/kurukshetra-university/human-resource-management/intelligent-transport-systems-its/33373830

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101048	**TRAFFIC ENGINEERING AND MANAGEMENT**	3	-	-	-	3

Pre-Requisite 22CE102008-Transportation Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on traffic engineering, traffic characteristics, traffic studies, parking studies, highway capacity, highway safety, traffic signs and road markings, traffic and environment, traffic control, regulation and traffic management.

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

CO1. Analyze traffic and traffic characteristics to solve complex traffic engineering problems using appropriate techniques following relevant codes considering society and environment besides communicating effectively in graphical form.

CO2. Analyze traffic measurements to solve complex traffic engineering problems using appropriate techniques following relevant codes considering society and environment besides communicating effectively in graphical form.

CO3. Analyze highway capacity and safety to solve complex traffic engineering problems using appropriate techniques following relevant codes considering environment besides communicating effectively in graphical form.

CO4. Analyze traffic signs, road markings; traffic and environment to solve complex traffic engineering problems using appropriate techniques following relevant standards considering safety besides communicating effectively in graphical form.

CO5. Analyze traffic control, regulation and management to solve complex traffic engineering problems using appropriate techniques following relevant standards and latest developments considering society and environment besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: TRAFFIC ENGINEERING AND TRAFFIC CHARACTERISTICS *(09 Periods)*

Traffic Engineering: Significance and scope, Characteristics of vehicles and road users, Skid resistance and braking efficiency (Problems), Components of traffic engineering - Road, traffic and land use characteristics.

Traffic Characteristics: Basic characteristics of traffic - volume, speed and density, Relationship among traffic parameters, Temporal headway and spatial headway,Vehicular speed trajectories, Car-following and lane change theories - Macroscopic flow models, Microscopic flow models, Shockwave analysis with examples**.**

Module 2: TRAFFIC MEASUREMENTS *(09 Periods)*

Traffic Studies: Traffic volume studies - Objectives, Types of volume studies, Concept of PCU, Data collection and presentation, Speed studies - Types of speeds, Objectives of speed studies, Methods of conducting speed studies, Data collection and presentation, Statistical methods for analysis of speed data, Origin and destination studies, Pedestrian studies, Basic principles of traffic flow.

Parking Studies: Types of parking facilities, On-street and off-street parking facilities, Parking inventory study, Parking survey by patrolling method, Analysis of parking data and parking characteristics, Multi storey car parking facility, Design standards**.**

Module 3: HIGHWAY CAPACITY AND SAFETY *(09 Periods)*

Highway Capacity: Definition of capacity, Importance of capacity, Factors affecting capacity, Concept of level of service, Different levels of service, Concept of service volume, Peak hour factor.

Highway Safety: Problem of highway safety, Types of road accidents, Causes, Engineering measures to reduce accidents, Enforcement measures, Educational measures, Road safety audit, Principles of road safety audit.

Module 4: TRAFFIC SIGNS, ROAD MARKINGS, TRAFFIC AND ENVIRONMENT *(09 Periods)*

Traffic Signs and Road Markings: Types of traffic signs, Cautionary, regulatory and informative signs, Specifications, Pavement markings, Types of markings, Lane markings and object markings, Standards and specifications for road markings.

Traffic and Environment: Detrimental effect of traffic on environment, Air pollution, Pollutants due to traffic, Measures to reduce air pollution due to traffic, Noise pollution, Measures to reduce noise pollution.

Module 5: TRAFFIC CONTROL, REGULATION AND MANAGEMENT *(09 Periods)*

Traffic Control and Regulation: Traffic problems in urban areas, Importance of traffic control and regulation, Traffic regulatory measures, Channelization, Principle and design of intersections, grade separations and interchanges, Traffic signals, Saturation flow, Design of traffic signals and signal co-ordination (Problems), Signal phasing and timing diagrams, Traffic control aids and street furniture, Street lighting, Computer applications in signal design.

Traffic Management: Transportation system management (TSM), Travel demand management (TDM), Traffic forecasting techniques, restrictions on turning movements, One-way Streets, Traffic segregation, Traffic calming, Tidal flow operations, Exclusive bus lanes, Introduction to intelligent transportation system (ITS)s.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Conduct traffic volume studies for a duration of one hour and determine the peak hour volume and peak hour factor for a particular road.
2. Conduct spot speed studies for a duration of one hour and determine design speed, safe speed and mean speed at a section of road.
3. Carryout the parking studies on a particular stretch of road and design a suitable parking facility.
4. Prepare a report on various causes of road accidents and suggest suitable safety measures for curtailing the accidents.
5. Visit a highway nearby and identify various traffic signs and road markings, and prepare a report on their significance.
6. Prepare a report on the latest developments in traffic control and management system.

RESOURCES

TEXT BOOKS:

1. Kadiyali, L. R., *Traffic Engineering and Transport Planning*, Khanna Publishers, NewDelhi, 9th Edition, 1999.
2. Khanna, K. and Justo, C. E. G., *Highway Engineering,* Nem Chand & Bros, 8th Edition*,* 2009.

REFERENCE BOOKS:

1. Roger Roess, P. Elena, S. Prassas and William, R. Shane, M. C., *Traffic Engineering*, Prentice Hall, 4th Edition, 2010.
2. Chakroborthy, P. and Das, A., *Principles of Transportation Engineering*, Prentice Hall of India Pvt. Ltd, 2nd Edition, 2017.
3. Subhash, C. and Saxena, A.,*Course in Traffic Planning and Design*, DhanpatRai Publications, 2010.
4. JotinKhisty, C. and KentLall, B., *Transportation Engineering – An Introduction*, Prentice Hall of India Pvt. Ltd., 3rd Edition, 2002.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/105/105105215/
2. https://www.youtube.com/watch?v=0yzgMc110po
3. https://www.youtube.com/watch?v=uCPlvu-bzDw

WEB RESOURCES:

1. https://vssut.ac.in/doc/Transportation-1_Lecture-Note.pdf
2. https://www.civil.iitb.ac.in/~vmtom/ce740/ce740.html
3. https://www.civil.iitb.ac.in/tvm/1100_LnTse/504_lnTse/plain/plain.html
4. https://www.studocu.com/en-us/document/university-of-memphis/traffic-engineering/l5-volume-studies-v1-lecture-notes-5/1168747

SPECILIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE102019	**PAVEMENT MATERIALS**	3	-	2	-	4

Pre-Requisite 22CE102008-Transportation Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on subgrade soil, aggregates, bitumen, cement and cement concrete and advanced pavement materials.

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

CO1. Evaluate subgrade soil to solve complex pavement problems using appropriate tools and techniques following relevant codes considering safety, environment and sustainability besides communicating effectively in graphical formas an individual or in a team.

CO2. Evaluate aggregates to solve complex pavement problems using appropriate tools and techniques following relevant codes considering safety, environment and sustainability besides communicating effectively in graphical form as an individual or in a team

CO3. Design bitumen mixes to solve complex pavement problems using appropriate tools and techniques following relevant codes considering safety, environment and sustainability besides communicating effectively in graphical form as an individual or in a team

CO4. Evaluate cement and cement concrete to solve complex pavement problems using appropriate tools and techniques following relevant codes considering safety, environment and sustainability besides communicating effectively in graphical form as an individual or in a team

CO5. Identify advanced pavement materials to solve pavement problems following relevant codes and latest developments considering safety, environment and sustainability besides communicating effectively in graphical form as an individual or in a team

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

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

COURSE CONTENT

Module 1: SUBGRADE SOIL ***(09 Periods)***

Subgrade soil characterization - Soil classification, Index and engineering properties of soil, Properties of subgrade; Mechanical response of soil, A critical look at the different laboratory and in-situ procedures for evaluating the mechanical properties of soils viz. CBR, Plate load test, Resilient modulus, DCPT; Suitability of different types of soil for the construction of highway embankments and pavement layers, Field compaction and control, Soil stabilization.

Module 2: AGGREGATES ***(09 Periods)***

Aggregate characterization - Origin, Classification, Types of aggregates, Sampling of aggregates, Mechanical and shape properties of aggregates, Aggregate texture and skid resistance, Polishing of aggregates; Proportioning and blending of aggregates - Super pave gradation, Fuller and Thompson's Equation, 0.45 Power maximum density graph; Use of locally available materials in lieu of aggregates**.**

Module 3: BITUMEN ***(09 Periods)***

Bitumen Characterization -Sources, Composition of bitumen, Rheology of bitumen, Types of bituminous material, Properties of bitumen; Properties of Bituminous Mixes - Elastic modulus, Dynamic modulus; Modified bitumen - Crumb rubber modified bitumen, Natural rubber modified bitumen, Polymer modified bitumen; Long term and short term ageing and its effect on bitumen performance, Tests to simulate ageing of bitumen viz. RTFO and PAV; Design of bituminous mixes - Marshall's specifications, Introduction to super pave mix design procedure.

Module 4: CEMENT AND CEMENT CONCRETE ***(09 Periods)***

Cement and cement concrete mix characterization - Types of cements and basic properties, Quality tests on cement, Tests on cement concrete including compressive strength, flexural strength, modulus of elasticity and fatigue properties.

Module 5: ADVANCED PAVEMENT MATERIALS ***(09 Periods)***

Alternate Materials for durable pavements -Artificial aggregates, Industrial waste materials – Fly ash, Pond ash, Marble dust, GGBS, Geopolymer coated aggregates, Waste plastics, Fibers, recycled aggregate and reclaimed asphalt pavement aggregate (RAP); Nanomaterial for pavements - Nano clay, Nano silica, Carbon Nano Tube (CNT) and other nanomaterial; Warm mix technologies - Additives and modifiers, Design guidelines and practices; Cold mix technologies - Materials, Additives, Guidelines and practice.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

(A) INDEX AND ENGINEERING PROPERTIES OF SOIL

1. Grain size analysis – Sieve analysis and hydrometer analysis
2. Determination of field density – Core cutter method and sand replacement method
3. Relative density test
4. CBR Test (Field/Lab)
5. Standard Proctor's compaction test
6. Plate load test

(B) TESTS ON AGGREGATE

7. Sieve analysis of aggregates
8. Shape test and angularity number test for coarse aggregate
9. Aggregate crushing value test and 10% fines value
10. Aggregate impact test
11. Attrition test for coarse aggregate
12. Abrasion test for coarse aggregate
13. Specific gravity and water absorption test

(C) TESTS ON BITUMEN

14. Penetration test
15. Ductility test
16. Softening point test
17. Flash and fire point test
18. Viscosity test
19. Specific gravity test
20. Marshall stability test on Marshall bituminous mix design
21. Stripping value test of coated bituminous mix

(D) TESTS ON CEMENT CONCRETE

22. Compressive strength test on cement
23. Slump cone test on fresh concrete
24. Compressive strength test on concrete
25. Flexural strength test on concrete
26. Modulus of elasticity on concrete

(E) ADVANCED PAVEMENT MATERIALS

27. Study on advanced pavement materials

RESOURCES

TEXT BOOKS:

1. Khanna, K. and Justo, C. E. G., *Highway Engineering,* Nem Chand & Bros, Roorkee, 10th Edition, 2014.
2. Kadiyali, L. R., *Traffic Engineering and Transport Planning*, Khanna Technical Publications, 7th Edition, 2010.

REFERENCE BOOKS:

1. Jotin Khisty, C. and Kent Lall, B., *Transportation Engineering – An Introduction,* Prentice Hall of India Pvt. Ltd., 3rd Edition, 2016.
2. Partha Chakroborthy and Animesh Das, *Principles of Transportation Engineering,* Prentice Hall of India Pvt. Ltd., 2005.
3. Papacostas, C. S. and Prevedouros, P. D., *Transportation Engineering and Planning,* Prentice Hall of India Pvt. Ltd., 3rd Edition, 2009.
4. Mannering, F. L. And Washburn, S. S., *Principles of Highway Engineering and Traffic Analysis*, John Wiley & Sons, Inc., 5th Edition, 2013.

LABORATORY MANUAL:

1. *Pavement Materials Laboratory Manual (MBU22 Regulations)*, Department of Civil Engineering, School of Engineering, Mohan Babu University, Tirupati.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=aUL4nsdfeYA
2. https://www.youtube.com/watch?v=BxgSlTTqriQ
3. https://www.youtube.com/watch?v=47TNhLl0owg&list=PL3MO67NH2XxKuZwStwfy3GZkKRou_q9Yp&index=4

WEB RESOURCES:

1. https://theconstructor.org/transportation/processes-in-bituminous-road-construction/5316/
2. http://nebula.wsimg.com/85f3e6b05f31d5484c66e147027adc14?AccessKeyId=5887AD44AEE58F1FD65A&disposition=0&alloworigin=1
3. https://abhashacharya.com.np/wp-content/uploads/2019/02/Highway-Drainage.pdf
4. https://www.srividyaengg.ac.in/coursematerial/Civil/103565.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101049	**SUSTAINABLE URBAN MOBILITY**	3	-	-	-	3

Pre-Requisite 22CE102008-Transportation Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on introducing the concepts of transportation, accessibility and mobility planning, transport economics, externalities and pricing, behaviour analysis and travel demand models, strategies and regulations for sustainable transport, traffic control devices and environmental control.

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

CO1. Analyze transportation and its accessibility and mobility to solve complex urban mobility problems using appropriate tools and techniques following relevant codes considering society, environment and economy besides communicating effectively in graphical form.

CO2. Analyze transport economics and pricing to solve complex urban mobility problems using appropriate techniques and following relevant codes considering society, environment and economy besides communicating effectively in graphical form.

CO3. Analyze travel demand models to solve complex transport problems using appropriate techniques and following relevant codes considering society, environment and sustainability besides communicating effectively in graphical form.

CO4. Develop strategies for sustainable transport to solve complex urban mobility problems using appropriate tools and techniques following relevant codes, guidelines and latest developments considering society, environment and economy besides communicating effectively in graphical form.

CO5. Design traffic control and environmental control systems to solve complex traffic problems using appropriate tools and techniques following relevant codes and latest developments considering society, environment and economy besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: INTRODUCING THE CONCEPTS OF TRANSPORTATION, ACCESSIBILITY AND MOBILITY PLANNING ***(09 Periods)***

Terminology - Transport, Transport systems, Travel behaviour, Infrastructure and users/commuters; Sustainable transport concepts – Society, Environment and economy, Indicators based approach; Policy initiatives and programs on sustainable transport - Global perspectives(SUMP, KYOTO Protocol), National policies (NUTP, CMP and NAPCC) and local initiatives; Transport system effectiveness and efficiency – Service level benchmarks.

Module 2: TRANSPORT ECONOMICS, EXTERNALITIES AND PRICING ***(09 Periods)***

Demand – supply elasticity, Factors influencing demand;Externalities of transport, quantification and value association -Energy consumption, emissions and air quality (Lifecycle assessment), Safety and security, Land consumption and waste production, Equity and inclusiveness, Mobility and accessibility;Transport pricing and user costs - Internalizing externalities.

Module 3: BEHAVIOUR ANALYSIS AND TRAVEL DEMAND MODELS ***(09 Periods)***

GIS-T, Four-step travel demand model, Data collection and travel surveys; User and their choices – Variables that influence travel behaviour.

Module 4: STRATEGIES AND REGULATIONS FOR SUSTAINABLE TRANSPORT ***(09 Periods)***

Integrated land use and transport planning and neighbourhood designs, Planning and designing for pedestrians and bicycles, Planning and design of a public transport systems, Integrated multi-modal transport networks; Regulations and enforcements - Parking policy, Congestion pricing.

Module 5: TRAFFIC CONTROL AND ENVIRONMENTAL CONTROL ***(09 Periods)***

Different methods of signal design, Redesign of existing signals including case studies, Signal coordination, Air and noise pollution of different transport models, Visual impacts, Impacts on land development, Technological approaches to improving environment.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a detailed report on various parameters to be considered during transportation, accessibility and mobility planning.
2. Make an assessment on transport pricing and users costs and prepare a detailed report on it.
3. Conduct travel surveys and collect the data using four-step travel demand model.
4. Prepare a detailed report on integrated multi-modal transport networks and their role in achieving objectives of sustainable urban mobility.
5. Study the existing traffic control devices in nearby city and redesign the existing signals if required.

RESOURCES

TEXT BOOKS:

1. Jain A.K., *Planning, Design & Engineering of Sustainable Urban Transport & Systems*, First edition, Khanna Publishers, 1st Edition, 2005.
2. Preston L Schiller, Jeffrey R Kenworthy, *An Introduction to Sustainable Transportation: Policy, Planning and Implementation,* Routledge, 1st Edition, 2010.
3. Dinesh Mohan, Geetam Tiwari, *Sustainable Approaches to Urban Transport*, Taylor & Francis Ltd., 1st Edition, 2021.

REFERENCE BOOKS:

1. Hensher, D. A., Button, K. J., Handbooks in Transport - Volume 1: *Handbook of Transport Modelling*, Pergamon Press, 2nd Edition, 2000.
2. Michele Finck, Matthias Lamping, Valentina Moscon, Heiko Richter, *Smart Urban Mobility: Law, Regulation, and Policy*, Springer, 1st Edition, 2020.
3. Dr. Sanal Kumar K.P., Dr. Anu H Nair, *Role/Impact of Artificial Intelligence in Sustainable Smart Cities and Urban Mobilities*, Scientific International Publishing House, 1st Edition, 2020.
4. Alaa Khamis, *Smart Mobility: Exploring Foundational Technologies and Wider Impacts*, Apress, 1st Edition, 2021.
5. Evangelos Simoudis, *Transportation Transformation*, Corporate Innovators LLC, 1st Edition, 2020.
6. Ortuzar, J. D. and Willumsen, L. G., *Modelling Transport*, John Wiley, 4th Edition, 2011.
7. National Urban Transport Policy (2014), Govt. of India, 2014.
8. Tiwari, G., Jain, D. and Ramachandra Rao, K., *Impact of public transport and non-motorized transport infrastructure on travel mode shares, energy, emissions and safety: Case of Indian cities.* Transportation Research Part D: Transport and Environment, 44, 277-291, 2016.

VIDEO LECTURES:

1. http://www.digimat.in/nptel/courses/video/105107210/L01.html
2. https://www.youtube.com/watch?v=wepKtAyPkwk
3. https://www.youtube.com/watch?v=IJdfoqeOw88

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/105/107/105107210/
2. https://sdgs.un.org/sites/default/files/2021-10/Transportation%20Report%202021_FullReport_Digital.pdf
3. https://www.studocu.com/en-au/document/swinburne-university-of-technology/principles-of-sustainability/cve80010-lecture-8-sustainable-transport/9996784
4. https://www.vtpi.org/mohan.pdf
5. https://www.teriin.org/sites/default/files/completed_es/ES2012UD01.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101050	**SUSTAINABLE WATER RESOURCES DEVELOPMENT**	3	-	-	-	3

Pre-Requisite 22CE101002-Hydrology and Water Resources Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Challenge of water sustainability; Water Economics; Sustainable Planning Approaches; Sustainable Practicesfor water resources management; Integrated Management of Water Supply.

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

CO1. Analyze global water issues and challenges to solve water resource problems considering latest developments, relevant guidelines, society, environment, and sustainability besides communicating effectively in graphical form.

CO2. Analyze water resource economics as linked to hydrology, ecology, pollution, consumptive and non-consumptive uses for solving complex problems considering latest developments, relevant guidelines, society, environment, and sustainability besides communicating effectively in graphical form.

CO3. Analyze sustainable planning approaches of water resources to solve complex problems considering relevant guidelines, latest developments and society besides communicating effectively in graphical form

CO4. Analyze sustainable practices to solve complex water resources problems using best management practices considering latest developments, relevant guidelines, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyze integrated management of water supply methods to solve complex water resources problems considering latest developments, relevant guidelines, environment and sustainability besides communicating effectively in graphical form

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

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

COURSE CONTENT

Module 1: CHALLENGES OF WATER SUSTAINABILITY ***(09 Periods)***

Water as a global issue - Key challenges, Need and importance of water resources; Ecosystem services, Water security, Sustainable water use; Overview of water resources – rivers, streams, groundwater and aquifers, lakes and reservoirs, wetlands and coastal zones; Global warming, Climate change and its impacts.

Module 2: WATER ECONOMICS ***(09 Periods)***

Economic view of water issues, Economic characteristics of watergoods and services, International funding organizations, Non-market monetary valuation methods, Water economic instruments, Policy options for water conservation and sustainable use – Case studies; Pricing -Distinctionbetween values and charges; Private sector involvement in water resources management - PPP Objectives, Options, Processes, Experiences through case studies, Linksbetween PPP and IWRM.

Module 3 SUSTAINABLE PLANNING APPROACHES ***(09 Periods)***

National laws, Acts and Policies; Watershed planning, Tools for water resource analysis, Stormwater management and erosion control, Land use planning and management, Urban hydrology -Existing systems, Impervious cover model,Trees in urban watersheds; Groundwater protection - A Sustainable approach, Data at the local and national levels.

Module 4 SUSTAINABLE PRACTICES FOR WATER RESOURCES MANAGEMENT ***(09 Periods)***

River, Lake and Wetland restoration; Low-impact development and smart growth, Recreational use, Wildlife management and habitat restoration, New lakes, Reservoirs and dams,Land acquisition, Best management practices - Structural and nonstructural, Vegetative Practices, Runoff and sediment control, Wetlands; Rainwater harvesting.

Module 5 INTEGRATED MANAGEMENT OF WATER SUPPLY ***(09 Periods)***

Integrated management of water supply for large cities, Managing water supply using groundwater recharge, Assessment of surface storage requirement, Using flood water for artificial recharge and space irrigation, Optimal usage of irrigation water, Watershed approach for controlling erosion and non-point source pollutants to water bodies, Environment impact assessment of water resources – Objectives, Advantages and limitations.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Assign activities where students can calculate and compare the water footprints of different products, processes, or lifestyles.
2. Facilitate and prepare a document on discussions on the trade-offs and decision-making processes involved in evaluating the economic viability and sustainability of water projects
3. Engage students in designing sustainable building projects, integrating innovative technologies and sustainable practices.
4. Assign activities where students can analyze irrigation methods and practices in agricultural settings.
5. Conduct activities where students can assess water pollution risks in their local area, such as industrial discharges, agricultural runoff, or improper waste disposal.

RESOURCES

TEXT BOOKS:

1. Sipes, J., Sustainable Solutions for Water Resources Policies, Planning and Implementation, John Wiley & Sons, Inc., 1st Edition, 2010.
2. MaysL, W., *Water Resources Sustainability*, McGraw-Hill Education, 1st Edition, 2007

REFERENCE BOOKS:

1. Setegn, S.G., and Donoso, M.C., Sustainability of Integrated Water Resources Management, Springer International Publishing Switzerland, 1st Edition, 2015.
2. Grigg, N.S., Integrated Water Resources Management, Macmillan Publishers Ltd.,1st Edition, 2016.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=ph3JcY8c1Oo
2. https://www.youtube.com/watch?v=qDJXwjl8YoY
3. https://archive.nptel.ac.in/courses/105/106/105106145/

WEB RESOURCES:

1. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.un.org/waterforlifedecade/pdf/wm-iii-eng.pdf
2. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://web.engr.oregonstate.edu/~istokj/Water%20reources%20syllabi/ENVE456-556.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101051	**RIVER ENGINEERING AND RIVER BASIN MANAGEMENT**	3	-	-	-	3

Pre-Requisite 22CE101002-Hydrology and Water Resources Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: River functions; river hydraulics; river flow mechanism and social aspects; river training works; river basin management.

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

CO1. Analyze river systems for solving river engineering problems considering society, environment, and sustainability besides communicating effectively in graphical form.

CO2. Analyze behavior of river hydraulics for solving complex river engineering problems using different techniques considering relevant guidelines, society, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze mechanism of river flow for solving complex river engineering problems using different tools and techniques, relevant guidelines, environment and sustainability besides communicating effectively in graphical form.

CO4. Design river training works for solving complex river engineering problems using different tools and techniques considering relevant guidelines, safety, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyze integrated river basin management practices for solving complex river basin management problems using different tools and techniques considering latest developments, relevant guidelines, safety, environment and sustainability besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: RIVER FUNCTIONS ***(09 Periods)***

Rivers – Origin and evolution of river systems, Classification of rivers, Alluvial river channel and flood plainfeatures, Sediment transport, River morphology and various classification schemes

Module 2: RIVER HYDRAULICS ***(09 Periods)***

Behavior of rivers - Introduction, River channel patterns, Straight river channels, Causes;River meandering –Causes, Characteristics, Shapes of meanders and control; Instability of rivers, Hydraulic geometry, Delta formation and control.

Module 3 RIVER FLOW MECHANISM AND SOCIAL ASPECTS ***(09 Periods)***

Mechanics of alluvial rivers, Rivers and restoration structures, Socio-cultural influences and ethics of stream restoration.

Module 4 RIVER TRAINING WORKS ***(09 Periods)***

River training works and river regulation works, Classification, Protection for bridges with reduced waterways, Floodplain management, Waves and tides in estuaries, Interlinking of rivers, River stabilization.

Module 5 RIVER BASIN MANAGEMENT ***(09 Periods)***

Basic concepts of River Basin Management (RBM) - Integrated River Basin Management (IRBM), River Basin Organizations (RBOs); Theories and principles of IRBM - Need for IRBM, Irrigation-objectives and benefits of IRBM; Key Activities and Challenges in IRBM - Various Guiding Principles of IRBM, Scenarios in Developed and Developing Countries, Case studies.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Organize a field trip to a nearby river or stream and observe the river's features, such as its channel, banks, bed, and flood plain. Engage students in activities to study and document the physical characteristics of the river, such as width, depth, and flow velocity
2. Engage students in activities such as measuring water velocity, depth, and channel cross-sections using flow meters, current meters, and surveying equipment.
3. Observe and document the flow patterns, water velocities, and channel features of Swarnamukhi river.
4. Engage students in activities to study and analyze the purpose, design, and effectiveness of these structures in managing river flow and erosion of nearby river.
5. Observe and document the physical features, land use patterns, water resources, and ecological characteristics of the basin of nearby river.

RESOURCES

TEXT BOOKS:

1. Garg,S. K., *River Engineering*, Khanna Publishing House, 1st Edition, 2019
2. Gupta, K. D., *River Engineering,* Vayu Education of India, 1st Edition, 2014

REFERENCE BOOKS:

1. Janson, PL., Ph., Lvan Bendegam Jvanden Berg, Mdevries A. Zanen (Editors), Principles of River Engineering – The non tidal alluvial rivers – Pitman, 1st Edition, 1979.
2. Bucu, D., River Basin Management, INTECH Publication, 2nd Edition, 2017.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/103/105103204/
2. https://www.digimat.in/nptel/courses/video/105103021/L01.html

WEB RESOURCES:

1. https://docplayer.net/49477604-Module-8-lecture-notes-1-river-basin-planning-and-management.html
2. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.iwmi.cgiar.org/assessment/Water%20for%20Food%20Water%20for%20Life/Chapters/Chapter%2016%20River%20Basins.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101052	**PIPELINE ENGINEERING**	3	-	-	-	3

Pre-Requisite 22CE102001-Fluid Mechanics and Hydraulic Machinery

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Elements of pipeline design and route selection; Pressure drop calculations; Gas compression and coolers; Pumps and transient flow in liquid; Pipeline design.

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

CO1. Analyze elements of pipeline design and route selection to solve pipeline engineering problems using appropriate techniques by following relevant codes and standards considering society, environment and economics besides communicating effectively in graphical form.

CO2. Analyze pressure drop calculations to solve complex pipeline engineering problems using appropriate techniques by following relevant codes for the benefit of the society considering environment besides communicating effectively in graphical form.

CO3. Analyze gas compressors and coolers to solve complex pipeline engineering problems using appropriate techniques by following relevant codes considering safety and environment besides communicating effectively in graphical form.

CO4. Design pump station piping for the fluid flow to solve complex pipeline engineering problems using appropriate techniques by following relevant codes considering safety and environment besides communicating effectively in graphical form

CO5. Analyze transient flow in liquid to solve complex pipeline engineering problems using appropriate techniques considering safety and environment besides communicating effectively in graphical form.

CO6. Design a pipeline to solve complex pipeline engineering problems using appropriate techniques by following relevant codes considering safety and environment besides communicating effectively in graphical form.

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	-	2	1	1	1	1	-	1	-	-	-	-	3
CO2	2	3	-	2	1	1	1	1	-	1	-	-	-	-	3
CO3	2	3	-	2	1	1	1	1	-	1	-	-	-	-	3
CO4	1	2	3	2	1	1	1	1	-	1	-	-	-	-	3
CO5	2	3		2	1	1	1	1	-	1	-	-	-	-	3
CO6	1	2	3	2	1	1	1	1	-	1	-	-	-	-	3
Course Correlation Mapping	**2**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**3**

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

COURSE CONTENT

Module 1: ELEMENTS OF PIPELINE DESIGN AND ROUTE SELECTION *(09 Periods)*

Elements of Pipeline Design: Scope of Pipeline Engineering; History of Pipelines in India, Fluid properties; Environment - Effects of pressure and temperature; Supply/Demand scenario; Codes and standards – Environmental and hydrological considerations; Economics - Materials/Construction – Operation; Pipeline protection - Pipeline integrity monitoring.
Pipeline Route Selection: Introduction - Preliminary route selection - Key factors for route selection; Engineering survey - Legal survey - Construction /As-built survey - Geotechnical design.

Module 2: PRESSURE DROP CALCULATIONS *(09 Periods)*

General flow equation – Weymouth Equation, Panhandle A equation, Panhandle B Equation, Steady state; Transmission Factor, Effect of Pipeline Elevation (Single Slope, Multiple Slope), Pressure drop calculation for pipeline in series and parallel; Pipeline gas velocity –Erosional velocity, Friction Factor Calculations.; Optimum pressure drop for design purposes; Pipeline packing –Determining gas leakage using pressure drop method; Wall thickness/pipe grade; Temperature profile – Optimization process – Gas transmission solved problems.

Module 3 GAS COMPRESSION AND COOLERS *(09 Periods)*

Gas Compression: Types of compressors; Compressor drivers; Compressor station configuration; Thermodynamics of isothermal and adiabatic gas compression; Temperature change in adiabatic gas compression; Thermodynamics of poly tropic gas compression; Gas compressors in series; Centrifugal compressor horsepower; Enthalpy / Entropy charts (Mollier diagram); Centrifugal compressor performance curve; Reciprocation compressors.

Coolers: Gas coolers – Aircooled heat exchangers; Heat transfer equations for coolers; Fanair mass flow rate; Required fan power; Gas pressure drop in coolers; Iterative procedure for calculations based on unknown T_2.

Module 4 PUMPS AND TRANSIENT FLOW IN LIQUID *(08 Periods)*

Pumps: Fully developed laminar flow in a pipe; Turbulent flow; Centrifugal pumps – Retrofitting for centrifugal pumps (Radial-flow); Pump station control – Pump station piping design.

Transient Flow in Liquid: Purpose of transient analysis; Theoretical fundamentals and transient solution technique; Applications – Computer applications

Module 5 PIPELINE DESIGN *(10 Periods)*

Pipeline Mechanical Design: Codes and standards, Location classification; Pipeline design formula, Expansion and flexibility, Joint design for pipes of unequal wall thickness; Value assemblies, Scraper traps, Buoyancy control; Crossings – Depth of cover – Aerial markings – Warning signs; Pipeline Construction and Commissioning.

Materials Selection: Elements of design – Materials designation standards.

Pipeline Protection*:* Pipeline coating; Cathodic protection –Cathodic protection calculations for land pipelines; Internal corrosion; Flow meters and their calibration – Sensors – Pigs.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Present case studies of existing pipeline projects, highlighting their design features and route selection processes.
2. Engage students in practical exercises to measure flow rates and understand the principles behind different flow measurement devices.
3. Encourage students to connect their practical experiences with theoretical knowledge of gas compression and cooling processes.
4. Provide an overview of pumps and their role in fluid transport and circulation systems.
5. Discuss the different types of pipelines, such as oil and gas pipelines, water pipelines, and industrial pipelines.

RESOURCES

TEXT BOOKS:

1. Mahitpour, M., Golshan, H. and Murray, M.A., Pipeline Design and Construction: A Practical Approach, ASME Press, 3rd Edition, 2010.
2. Henry Liu, Pipeline Engineering, Lewis Publishers (CRC Press), 2003.

REFERENCE BOOKS:

1. George, A., Antaki, Piping and Pipeline Engineering-Design, Construction, Maintenance Integrity and Repair, CRC Press, 2003.
2. Alkazraji, D., A Quick Guide to Pipeline Engineering, Woodhead Publishing, 2008.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=R2K3mwjdJrs
2. https://www.youtube.com/watch?v=Vm_5JTm8Els
3. https://www.digimat.in/nptel/courses/video/112106300/L25.html
4. https://www.youtube.com/watch?v=3nDAQ0D3e34
5. https://www.youtube.com/watch?v=AXgfeV568c8

WEB RESOURCES:

1. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.wermac.org/pdf/piping_engineering.pdf
2. https://www.studocu.com/row/document/rajshahi-university-of-engineering-and-technology/mechanical-engineering/piping-design-lecture-notes-1/3004002

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101053	COMPUTATIONAL AND STATICAL METHODS IN HYDRAULICS AND HYDROLOGY	3	-	-	-	3

Pre-Requisite 22CE101002-Hydrology and Water Resources Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on numerical solutions for ordinary differential equations and partial differential equations, finite difference method, finite element method and statistical data, probability distributions and regression analysis.

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

CO1. Analyze ordinary and partial differential equations to solve complex hydraulics and hydrology problems using appropriate techniques.

CO2. Analyze finite difference method to solve complex hydraulics and hydrology problems besides communicating effectively in graphical form.

CO3. Analyze finite element method and statistical data using appropriate techniques to solve complex hydraulics and hydrology problems besides communicating effectively in graphical form.

CO4. Analyze probability distributions using appropriate techniques to solve complex hydraulics and hydrology problems besides communicating effectively in graphical form.

CO5. Evaluate regression using appropriate techniques to solve complex hydraulics and hydrology problems besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: NUMERICAL SOLUTIONS FOR ORDINARY DIFFERENTIAL EQUATIONS AND PARTIAL DIFFERENTIAL EQUATIONS ***(09 Periods)***

Numerical solution of ordinary differential equations – Taylor's series, Euler's method, Runge-Kutta methods, Simultaneous and higher order equations, Boundary value problems, Applications, Classification of quasi-linear partial differential equations; Solution methods for parabolic, elliptical and hyperbolic equations.

Module 2: FINITE DIFFERENCE METHOD ***(09 Periods)***

Finite difference method, Finite difference, Representation of differential equations, Stability-Consistency and convergence of partial differential equations, Time integration, Finite difference methods in solution of steady and unsteady problem - Jacobi's method, Gauss Seidel method, Successive over relaxation method, Method of characteristics, Application and examples.

Module 3: FINITE ELEMENT METHOD AND STATISTICAL DATA ***(09 Periods)***

Finite Element Method: Finite element method, Basic Concepts, Solution of discrete problems, Steady state and time dependent continuous problems, Application of finite element method through illustrative examples.

Statistical Data: Classification and presentation of data, Basic Concepts of probability, Probability axioms, Analysis and treatment of data, Population and samples, Measures of central tendency, Measures of dispersion, Measures of symmetry, Measures of peakedness.

Module 4: PROBABILITY DISTRIBUTIONS ***(09 Periods)***

Probability distributions; Discrete and continuous Probability distribution functions – Binomial, Poisson, Normal, Lognormal, Exponential, Gamma distributions, Extreme value distributions; Transformations to normal distributions, Selecting a probability distribution; Parameter estimation – Method of moments, Method of maximum likelihood, Probability weighted moments and least square method; Joint probability distributions.

Module 5: REGRESSION ANALYSIS ***(09 Periods)***

Regression analysis, Simple linear regression, Evaluation of regression, Confidence intervals and tests of hypotheses, Multiple linear regression, Correlation and regression analysis.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Engage students and explore numerical methods such as Euler's method, Runge-Kutta methods, and others commonly used for solving ODEs and prepare a document based on the advanced methods.
2. Prepare a document on advanced methods like higher-order methods (e.g., adaptive step-size methods like the Dormand-Prince method
3. Prepare a report on development of FEM models, solve them using appropriate techniques, and analyze the results in the context of the application.
4. Prepare a document on various distributions such as the t-distribution, chi-square distribution, or F-distribution to assess the statistical significance of the results
5. Explore and prepare a report on model selection techniques like backward elimination, forward selection, or stepwise regression to determine the most relevant predictors for your model.

RESOURCES

TEXT BOOKS:

1. Hoffman, J.D., *Numerical Methods for Engineers and Scientists*, CRC Press, Special Indian Edition, 2011.
2. Akai, T. J, *Applied Numerical Methods for Engineers*, John Wiley Inc., New York, 1994

REFERENCE BOOKS:

1. Huyorkon, P.S. and Pinder, G.F.,*Computational Methods in Subsurface Flow*, Academic Press, 1983.
2. Schilling, R. J., and Harris, S. L., *Applied Numerical Methods for Engineering*, Cengage Learning, India Edition, 2007.
3. Haan, C.T.,*Statistical Methods in Hydrology*, East West Press, New Delhi, 1995.
4. Ioana Popescu, *Computational Hydraulics: Numerical Methods and Modelling*, IWA Publishing, 1st Edition, 2014.
5. Abbot, M. A. and Vervey, *Computational Hydraulics*, Elsevier Publications, 1996.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/105/105105161/
2. https://www.digimat.in/nptel/courses/video/105105161/L13.html

WEB RESOURCES:

1. Chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://johndfenton.com/Lectures/Computations+Hydraulics/Computational-Hydraulics.pdf

SPECILIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101054	**ADVANCED HYDRAULICS**	3	-	-	-	3

Pre-Requisite 22CE102001-Fluid Mechanics and Hydraulic Machinery

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Kinematics of flow, Ideal fluid flow, Laminar flow, Boundary layers, Turbulent flows.

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

CO1. Analyze the fluids in motion condition to solve complex problems using appropriate tools and techniques considering stability besides communicating effectively in graphical form.

CO2. Analyze the principles of ideal fluid and real fluid flow to solve complex fluid flow problems using appropriate tools and techniques besides communicating effectively in graphical form.

CO3. Analyze the principles of viscous flow of fluids to solve complex fluid flow problems using appropriate tools and techniques besides communicating effectively in graphical form.

CO4. Analyze and able to find out different layers of boundary layer and identifying the separation and control studies to solve complex fluid mechanics problems using appropriate techniques besides communicating effectively in graphical form.

CO5. Analyze the fluids in turbulent flow conditions to solve complex fluid flow problems using appropriate tools and techniques besides communicating effectively in graphical form.

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

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

COURSE CONTENT

Module 1: KINEMATICS OF FLOW ***(09 Periods)***

Equation of continuity in Cartesian, polar and cylindrical coordinates, Standard 2D flow pattern: Source, Sink, Doublet and their combinations, Construction of flows by superposition, D'Alemebert's paradox

Module 2: IDEAL FLUID FLOW ***(09 Periods)***

Simple patterns of 2-dimensional flow- Uniform flow, Source, Sink, Vortex flow, Superposition of elementary flows – Doublet – Rankine half body – Rankine oval, flow about a circular cylinder and flow about a rotating cylinder.

Module 3 LAMINAR FLOW ***(09 Periods)***

Derivation of Navier-Stokes equation – exact solutions for flow between parallel plats, Couette flow, flow near a suddenly accelerated plate and an oscillating plate

Module 4 BOUNDARY LAYERS ***(09 Periods)***

Similarity solutions of boundary layer equations, Falkner-Skan Wedge flows, Karman's momentum integral equations, Karman-Puhlhausen approximate solution. Separation in boundary layer under adverse pressure gradient, turbulent boundary layer.

Module 5 TURBULENT FLOWS ***(09 Periods)***

Reynolds equation of motion, Semi-empirical theories of turbulence, Velocity profiles of inner, outer and overlap layers, Equilibrium boundary layers

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Encourage students to prepare a document and analyze fluid flow patterns, velocity profiles, and the effects of changes in pipe diameter or flow rate in a given pipe line
2. Perform an experiment to illustrate the conservation of mass principle in ideal fluid flow and measure the flow rate of pipe and compare it with the corresponding cross-sectional area. Prepare a report based on the flow rate remains constant across the different pipe sections, validating the principle of conservation of mass.
3. Demonstrate laminar flow using pipes of different sizes. Students can observe how the flow behavior changes with the diameter of pipe. As the pipe diameter decreases, the flow becomes more laminar due to increased viscous effects and prepare a document based on the observations.
4. Engage students in designing and implementing boundary layer control techniques and make a report on different techniques used in boundary layer control.
5. Engage students can observe the random fluctuations, vortices, and mixing effects associated with turbulent flow and can compare it with laminar flow and prepare a note the differences in flow behavior.

RESOURCES

TEXT BOOKS:

1. Som Biswas.,*Advanced Fluid Mechanics,*McGraw Hill, 3rd Edition, 2011.
2. Rajput, R. K., A Textbook of Fluid Mechanics and Hydraulic Machines, S. Chand Publishers, 6th Edition, 2016

REFERENCE BOOKS:

1. White F.M., *Fluid Mechanics*, McGraw Hill, 1979
2. Rouse, H., Advanced Mechanics of Fluids, John Wiley and Sons, 1959
3. Fox, R.W., Pitchard, P.J., and Mcdonald, A.T., Fluid Mechanics, Wiley India Pvt. Ltd., 2009.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc22_me102/preview
2. https://archive.nptel.ac.in/courses/112/105/112105287/

WEB RESOURCES:

1. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.vssut.ac.in/lecture_notes/lecture1525136058.pdf
2. https://web.iitd.ac.in/~pmvs/course_mcl702.php

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101701	**AI IN HEALTHCARE**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of Artificial Intelligence (AI) in Healthcare; The Present State and Future of AI in Healthcare Specialties; The Role of Major Corporations in AI in Healthcare; Applications of AI in Healthcare.

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

CO1 Understand the fundamental concepts of AI in Healthcare sector.

CO2 Analyse the present state and future of AI in Healthcare specialties for different scenarios.

CO3 Apply design concepts and metrics for AI in Healthcare.

CO4 Demonstrate basic concepts and terminologies of future applications of Healthcare in AI.

CO5 Develop AI applications through AI techniques for healthcare

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: INTRODUCTION TO ARTIFICIAL INTELLIGENCE IN HEALTHCARE ***(08 Periods)***

Introduction to AI in Healthcare, Benefits & Risks, AI in the health sector, AI versus human intelligence, The future of AI in health sector, AI & Neural networks.

Module 2: THE PRESENT STATE & FUTURE OF AI IN HEALTHCARE SPECIALTIES ***(10 Periods)***

Artificial Intelligence in: preventive healthcare, Radiology, Pathology, Surgery, Anesthesiology, Psychiatry, Cardiology, Pharmacy, Dermatology, Dentistry, Orthopedics, Ophthalmology.

Module 3: THE ROLE OF MAJOR CORPORATIONS IN AI IN HEALTHCARE ***(08 Periods)***

IBM Watson, The role of Google & Deep mind in AI in Healthcare, Baidu, Facebook & AI in Healthcare, Microsoft & AI in Healthcare.

Module 4: FUTURE OF HEALTHCARE IN AI ***(10 Periods)***

Evidence-based medicine, personalized medicine, Connected medicine, Virtual Assistants, Remote Monitoring, Medication Adherence, Accessible Diagnostic Tests, Smart Implantables, Digital Health and Therapeutics, Incentivized Wellness, Block chain, Robots, Robot-Assisted Surgery, Exoskeletons, Inpatient Care, Companions, Drones, Smart Places, Smart Homes, Smart Hospitals.

Module 5: APPLICATIONS OF AI IN HEALTHCARE ***(09 Periods)***

Case Study 1: AI for Imaging of Diabetic Foot Concerns and Prioritization of Referral for Improvements in Morbidity and Mortality.

Case Study 2: Outcomes of a Digitally Delivered, Low-Carbohydrate, Type 2 Diabetes Self-Management.

Case Study 3: Delivering A Scalable and Engaging Digital Therapy.

Case Study 4: Improving Learning Outcomes for Junior Doctors through the Novel Use of Augmented and Virtual Reality for Epilepsy.

Case Study 5: Big Data, Big Impact, Big Ethics: Diagnosing Disease Risk from Patient Data.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Analyze how the artificial intelligence is used to predict the disease result and Prognosis Assessment of a patient.
2. How does drug discovery happen and how does AI is helping in drug discovery and Labs.
3. Justify that artificial intelligence provide engineering solutions for early detection and Diagnosis of diseases.
4. Demonstrate the prediction of bladder volume of a patient.

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

RESOURCES

TEXT BOOKS:

1. Dr. Parag Mahajan, *Artificial Intelligence in Healthcare*, MedManthra Publications, First Edition 2019.
2. Arjun Panesar, *Machine Learning and AI for Healthcare Big Data for Improved Health*, Apress Publications, 2019.

REFERENCE BOOKS:

1. Michael Matheny, Sonoo Thadaney Israni, Mahnoor Ahmed, and Danielle Whicher, *Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril*, National Academy of Medicine Publication, First Edition 2019.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=-aHBwTQQyNU
2. https://intellipaat.com/blog/artificial-intelligence-in-healthcare/

WEB RESOURCES:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/
2. https://www.ibm.com/topics/artificial-intelligence-healthcare
3. https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CM101701	**BANKING AND INSURANCE**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Introduction to Banking; Bank-Customer Relationship; Electronic Payment System and Business Models; Introduction to Risk and Insurance; Insurance Overview.

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

CO1 Demonstrate the importance of Banking and functions of the Reserve Bank of India and its role in the country's sustainable development.

CO2 Demonstrate the role, relationships, and operations between Banker and Customer.

CO3 Demonstrate the Online Banking system, various types of Electronic Payments, and Business models.

CO4 Demonstrate the concept of risk and principles, functions, and, types of Insurance companies.

CO5 Understand the principles of insurance and its functions.

CO-PO Mapping Table

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

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

COURSE CONTENT

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

Meaning - Importance of banking- Functions of banking - Reserve Bank of India: Functions – Role of RBI in sustainable development.

Module 2: BANK-CUSTOMER RELATIONSHIP (09 Periods)

Debtor-creditor relationship, deposit products or services, payment, and collection of cheques. Accounts – Types of accounts, the procedure for opening and closing an account - Loans and Advances- principles of lending.

Module 3 ELECTRONIC PAYMENT SYSTEM&BUSINESS MODELS (09 Periods)

Introduction to Online Banking - types of e-payment system, e-cash, NEFT, RTGS, Credit cards, Electronic Wallet and Debit cards. **Business models**- B2B, B2C, C2C, and B2G.

Module 4 INTRODUCTION TO RISK AND INSURANCE (09 Periods)

Insurance: Definition, Insurance as risk mitigation mechanism, elements of insurance. Concept of risk, risk *Vs* uncertainty.

Module 5 INSURANCE OVERVIEW ***(09 Periods)***

Principles of insurance - insurance types - LIC & GIC – insurance functions, IRDA - Insurance Players in India.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Make a PowerPoint presentation on the banking system in India.
2. Submit a report on the working of insurance companies.
3. Prepare a report on the functions of RBI & IRDA in India.
4. Submit a report on electronic banking facilities provided by Indian banks.

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

RESOURCES

TEXT BOOKS:

1. RanganadhaChary, A.V. and Paul, R.R., *Banking and Financial system*, 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

REFERENCES BOOKS:

1. *Indian Institute of Banking & Finance, Digital Banking*, Taxman Publications Pvt. Ltd., 2016 edition, 2016.
2. Jyotsna Sethi and Nishwan Bhatia, *Elements of Banking and Insurance*, PHI Learning Pvt. Ltd., 2nd edition, 2012.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=a1_p8zhbAfE
2. https://www.youtube.com/watch?v=bxNw9VB5Y_0

WEB RESOURCES:

1. https://unacademy.com/content/railway-exam/study material/economics/importance-of-banking-sector-in-the-country/
2. https://www.geeksforgeeks.org/ life-insurance-meaning-elements-and-types-of-life-insurance-policies/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS101701	**BIOINFORMATICS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course focus on Biological Data Acquisition, Databases, Data Processing, Methods of Analysis, Applications of Bio-informatics.

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

CO1 Understand basic biological data acquisition in bioinformatics.

CO2 Identify the proper databases for the information search by choosing the biological databases and also submission and retrieval of data from databases.

CO3 Analyze the results of bioinformatics data using text and sequence-based searching techniques.

CO4 Analyze the secondary and tertiary structures of proteins by applying 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 of proteins.

Module 5: APPLICATIONS ***(09 Periods)***

Genome Annotation and Gene Prediction; ORF finding; Phylogenetic Analysis, Genomics, Proteomics, Genome analysis – Genome annotation, DNA Microarray, computer aided drug design (CADD).

Total Periods: 45

EXPERIENTIAL LEARNING

1. Calculate the dynamic programming matrix and one or more optimal alignment(s) for the sequences GAATTC and GATTA, scoring +2 for a match, −1 for a mismatch and with a linear gap penalty of d = 2.
2. Determine whether the RNA string GGACCACCAGG should be folded into two substructures.
3. Discuss how to carry out the multiple sequence alignment of the following three sequences: TTTTAAAA, AAAACCCC, CCCCTTTT.

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

RESOURCES

TEXT BOOKS:

1. Lesk, A. K., *Introduction to Bioinformatics*, Oxford University Press, 4th Edition, 2013
2. Dan Gusfield, *Algorithms on Strings, Trees and Sequences: Computer Science and Computational Biology*, Cambridge University Press, 1997.

REFERENCE BOOKS:

1. Baldi, P. and Brunak, S., *Bioinformatics: The Machine Learning Approach*, MIT Press, 2nd Edition, 2001.
2. Mount, D.W., *Bioinformatics Sequence and Genome Analysis*, Cold Spring Harbor Laboratory Press, 2nd Edition, 2004.
3. Tindall, J., *Beginning Perl for Bioinformatics: An introduction to Perl for Biologists*, O'Reilly Media, 1st Edition, 2001.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=liNblw4x50E
2. https://www.youtube.com/watch?v=eZfyWdHnzR0

WEB RESOURCES:

1. https://www.britannica.com/science/bioinformatics
2. https://www.ebi.ac.uk/training/online/courses/bioinformatics-terrified/what-bioinformatics/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS101701	**BIOLOGY FOR ENGINEERS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to living organisms, Proteins, Nucleic acids and enzymes, Genetics and Molecular biology, Recombinant DNA technology, Human physiology and applied biology.

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

CO1 Identify difference between cells, Cellular components and their functions.

CO2 Understand Proteins, Nucleic acids structure and function and also Mechanism of enzyme action.

CO3 Identify Central dogma of Molecular biology and processes of Molecular Biology.

CO4 Understand Recombinant DNA technology and its importance in creating new 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 same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Rajiv Singal, Gaurav Agarwal, *Biology for Engineers*, CBS, 2019.
2. S. Sing and T. Allen, *Biology for Engineers*, Vayu Education of India, 2014.

REFERENCE BOOKS:

1. B. Alberts, A. Johnson et al., *The molecular biology of the cell*, Garland Science, 6th edition, 2014.
2. A. T. Johnson, *Biology for Engineers*, CRC press, 2011.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=N0Y386SVGN8
2. https://www.youtube.com/watch?v=1Pzk-UqiIW4
3. https://www.youtube.com/watch?v=208pMhKoQeo

WEB RESOURCES:

1. Structure and function of Proteins: https://nptel.ac.in/courses/104102016/16
2. Enzyme catalysis: https://nptel.ac.in/courses/103103026/module3/lec35/4.html
3. Biochips: https://nptel.ac.in/courses/112104029/3

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22LG101701	**BUSINESS COMMUNICATION AND CAREER SKILLS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Nature and Scope of Communication, Corporate Communication, Writing Business Messages & Documents, Careers & Résumés, and Interviews.

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

CO1. Demonstrate knowledge of professional communication by analyzing and applying the styles and strategies of business communication in Communication Networks, Interpersonal, and Informal communication.

CO2. Analyze the limitations of communication by applying and demonstrating corporate and cross-cultural communication strategies effectively in a business context and Crisis Management situations.

CO3. Apply appropriate strategies and techniques in writing business messages, business letters, and résumé for effective professional communication and career building.

CO4. Demonstrate appropriate communication techniques and answering strategies by analyzing the expectations during presentations and interviews.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: NATURE AND SCOPE OF COMMUNICATION ***(9 Periods)***

Introduction – Communication Basics – Functions of Communication – Communication Networks – Interpersonal Communication – Informal Communication – Communication Barriers – Roles of a Manager.

Module 2: CORPORATE COMMUNICATION ***(9 Periods)***

Introduction – Corporate Communication – Cross-Cultural Communication; Concept & Styles – Corporate Communication Strategy – Corporate Citizenship – Crisis Communication: Case Study.

Module 3: WRITING BUSINESS MESSAGES & DOCUMENTS ***(9 Periods)***

Introduction – Importance of Written Business Communication – Types of Business Messages – Five Main Stages of Writing Business Messages – Business Letter Writing – Kinds of Business Letters – Common Components of Business Letters – Strategies for Writing the Body of a Letter.

Module 4: CAREERS AND RÉSUMÉS ***(9 Periods)***

Introduction – Career Building – Résumé Formats: Traditional, Electronic and Video Résumé – Sending Résumés – Follow-up Letters – Business Presentations and Speeches: Planning – Structuring – Organizing – Delivery.

Module 5: INTERVIEWS ***(9 Periods)***

Introduction – General Preparation for an Interview – Success in an Interview – Important Non-verbal Aspects – Types of Interviews – Styles of Interviewing – Types of Interviewing – Online Recruitment Process.

Total Periods: 45

EXPERIENTIAL LEARNING

1. People often get confused in identifying or using English vocabulary on most occasions. Prepare a list of confusing words and find methods to overcome the difficulties in using those words to uplift the career of professionals.
2. Organizations and institutions use modern technology in communicating with their colleagues, clients, and stakeholders. Make a PowerPoint presentation on the modern communication system of any organization and its role in the success of the organization and its career.
3. As a student in the modern technological world, organizing or attending webinars is inevitable. Analyze the pros and cons of video conferencing by organizing webinars and preparing a report.
4. Form a team and act as a team leader. Prepare a performance appraisal report of the team using visual aids to support the presentation.
5. Make a detailed study on social networking and its impact on modern business and Career.

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

RESOURCES

TEXT BOOKS:

1. Meenakshi Raman, Prakash Singh, *Business Communication*, Oxford University Press, New Delhi, 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 CIVIL ENGINEERING ***(09 Periods)***

Unpredictable nature, Examples of unpredictable natural disasters - Earthquakes, Floods, Landslides, Hurricanes, Tsunamis, Impacts of unpredictable natural events on infrastructure; Role of civil engineering; Resilience in civil engineering - Strategies for building resilient structures, Risk assessment and analysis, Incorporating safety factors, Using robust construction materials, Implementing redundancy and backup systems, Sustainable design practices; Case studies of successful resilient designs.

Module 4 CIVIL ENGINEERING SOLUTIONS FOR THE PROBLEMS OF TRAFFIC, POLLUTION, WATER AND WASTE MANAGEMENT ***(11 Periods)***

Introduction to urban challenges and sustainable development; Traffic management solutions - Causes and impacts of traffic congestion, Intelligent transportation systems; Pollution control and environmental engineering, Sources and types of urban pollution, Air quality monitoring and control strategies, Water pollution control, Noise pollution management, Sustainable construction practices to reduce pollution; Water resource management, Water demand and supply management in urban areas, Rainwater harvesting techniques, Water conservation and wastewater treatment technologies; Waste management strategies, Solid waste generation and disposal challenges, Waste-to-energy conversion technologies, Case studies of successful waste management initiatives; Integration and synergies among Solutions, Multi-disciplinary approach for holistic solutions.

Module 5 BUILDING SUSTAINABLE SMART CITIES ***(09 Periods)***

Smart city; Elements of smart city infrastructure – Buildings, Mobility, Energy, Water, Waste management, Health and digital layers; Need for an integrated approach; Role of science, technology and innovation in the implementation of smart infrastructure; Smart infrastructure design principles and policies; Case studies: Gujarat International Finance Tech-City in India.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Group discussion on compatibility of modern construction materials compared to that of traditional civil engineering materials
2. Poster presentation on historic and modern civil engineering structures.
3. Submit a case study report on Life Cycle Analysis (LCA) of any one of the historic civil engineering structure.
4. Submit a case study report on the theme of severity of the natural disasters on the Civil engineering structures.

5. Debate on challenges, limitations and solutions for design and implementation of smart city.

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

RESOURCES

TEXT BOOKS:

1. David Muir Wood., *Civil Engineering: A Very Short Introduction*, Oxford University Press, 1st Edition, 2012.
2. Roger Scruton, *The Aesthetics of Architecture*, Princeton University Press, 2nd Edition, 2013.

REFERENCE BOOKS:

1. Anubha Kaushik and C. P. Kaushik, *Perspectives in Environmental Studies*, New Age International (P) Ltd Publications, 6th Edition, 2018.
2. Sang Lee (Editor), *Aesthetics of Sustainable Architecture*, 010 publishers, 1st Edition, 2013.
3. Marc Kushner, *The Future of Architecture in 100 Buildings*, Simon and Schuster, 1st Edition, 2015.
4. Nicholas J. Garber and Lester A. Hoel, *Traffic and Highway Engineering*,Nelson Engineering, 1st Edition, 2008.
5. Stephen M. Wheeler and Timothy Beatley, *Sustainable Urban Development*, Reader Routledge Urban Reader Series, 3rd Edition, 2014.
6. Larry W. Mays, *Water Resources Engineering*, Wiley India Private Limited, 3rd Edition, 2011.
7. Hans Straub, *A History of Civil Engineering: An Outline from Ancient to Modern Times*, The MIT Press, 4th Edition, 1964.
8. Brian Vanden Brink, *Iconic: Perspectives on the Man-Made World*, Down East Books, Illustrated Edition, 2012.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/123/105/123105001/
2. https://onlinecourses.nptel.ac.in/noc22_ce42/preview
3. https://onlinecourses.nptel.ac.in/noc19_ce31/preview
4. https://onlinecourses.nptel.ac.in/noc20_ce07/preview

WEB RESOURCES:

1. https://bregroup.com/insights/aesthetics-in-architecture-how-beauty-and-design-are-inspiring-each-other/
2. https://keckwood.com/news-updates/how-civil-engineers-help-during-disaster-recovery/#:~:text=Civil%20engineers%20provide%20humanitarian%20and,shortages%20to%20hard%2Dhit%20communities
3. https://smartcities.gov.in/
4. https://www.twi-global.com/technical-knowledge/faqs/what-is-civil-engineering
5. https://www.ice.org.uk/engineering-resources/knowledge-resources/water-and-waste-water-management

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101701	**CONSTITUTION OF INDIA**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides and in-depth knowledge about Constitution of India's Preamble and its Philosophy; Union Legislature; Federalism in India; Judiciary and Public Services; Nation Building. The students can gain first-hand information and knowledge about these dynamics and accordingly act based on these sources in their professional and routine activities.

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

CO1: Demonstrate knowledge in the Parliamentary proceedings, Election Commission, Public Services and Foreign Policy of India.

CO2: Apply the reasoning informed by the various aspects of the Constitution and its provisions to assess societal issues and the consequent responsibilities relevant to the professional engineering practice.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: PREAMBLE AND ITS PHILOSOPHY *(9 Periods)*

Introduction to Indian Constitution; Evolution of Indian Constitution; preamble and its philosophy

Module 2: UNION LEGISLATURE *(9 Periods)*

The Parliament, Parliamentary Structure, Process of Legislation; President of India – Powers and Functions; Prime Minister and Council of Ministers; Constitution Amendment Procedure.

Module 3: FEDERALISM IN INDIA *(9 Periods)*

Centre-State Administrative Relationship; Governors – Powers and Functions; State Legislature - Composition and powers; Chief Ministers - Powers and Functions; The Election Commission – Powers and Functions.

Module 4: JUDICIARY AND PUBLIC SERVICES ***(9 Periods)***

The Union Judiciary - Supreme Court and High Court; Fundamental Rights and Duties All India Services - Central Civil Services -State Services - Local Services.

Module 5: INTERNATIONAL PARTICIPATION ***(9 Periods)***

Foreign Policy of India; International Institutions Influence: UNO, WTO, WHO, SAARC, International Summits: BRICS, NSS, UNEP – India's Role in International Negotiations; Environmentalism in India.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Review newspapers and submit a report on critical analysis of Indian Civil Servants exercise of powers, in the 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 Minister of India as delivered on these two occasions.
    b) Compare these two events relevance in terms of Indian Armed Forces presence.
    c) Observe, compare and analyse 'flag code' relevance as marked in these two events.
4. Watch a few videos on recent 'proceedings' of any state Legislative Assembly session and submit a detailed report.

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

RESOURCES

TEXT BOOKS:

1. 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 the elements of costing.

CO2 Determine the Cost of Production for pricing decisions.

CO3 Apply the Standard Costing and Variance techniques for the control of the cost of production

CO4 Analyze the Profitability and financial condition of an organization using Ratios.

CO5 Apply Capital Budgeting techniques for making investment decisions in an organization.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: COST ACCOUNTING *(09 Periods)*

Meaning of Cost and Cost Accounting, Objectives, Scope, Advantages, and Disadvantages – Cost Accounting *Vs* Management Accounting – Elements of Costing – Installation of costing system – Material Control, Labor Control, Overhead Control.

Module 2: COST SHEET & PREPARATION OF COST SHEET (09 Periods)

Analysis of Cost – Preparation of cost sheet, estimate, tender, and quotation (Simple problems) – Importance of Costing while pricing the products

Module 3 STANDARD COSTING & VARIANCE ANALYSIS (09 Periods)

Introduction to Standard Costing & Variances – Variance Analysis: Material variances, Labor variances (Simple Problems).

Module 4 FINANCIAL MANAGEMENT & RATIO ANALYSIS (09 Periods)

Meaning, Objectives - Nature and Scope, Importance of FM – Ratio Analysis**:** Types of Ratios: Solvency Ratios, Liquidity Ratios, Turnover Ratios, and Profitability Ratios - Financial Statement Analysis through Ratios (Simple Problems).

Module 5 INTRODUCTION TO INVESTMENT *(09 Periods)*

Investment - Meaning and Definition- concept of risk and returns - Capital budgeting techniques – Security Analysis and Portfolio Management (Basic concepts).

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a report on the role of cost accountants in the growth of a company.
2. To visit the manufacturing unit to observe how they used various techniques for analyzing the financial health of a company.
3. Prepare a report on factors influencing the form of business organization.
4. Prepare the cost sheet with practical examples of any two manufacturing companies.

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

RESOURCES

TEXT BOOKS:

1. S.P. Jain and K.L. Narang: *Cost Accounting*, Kalyani Publishers, Ludhiana, 10th edition, 2016.
2. I.M. Pandey, *Financial Management*, Vikas Publishing House Pvt. Ltd., 14th edition, 2016.

REFERENCE BOOKS:

1. The Institute of Company Secretaries of India, *Cost and Management Study Material*, New Delhi.
2. CA Saravana Prasath, *Cost Accounting and Financial management*, Wolters Kluwer India Pvt. Ltd., New Delhi, 2018.

VIDEO LECTURES:

1 https://www.youtube.com/ watch?v=ESqO8sFgQa0&list=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 minimize the impact of cyber threats.

CO5. Apply security standards for the implementation of Cyber Security and laws.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: INTRODUCTION TO CYBER CRIMES AND OFFENSES ***(09 Periods)***

Cyber Crimes: Introduction, Definition, Origin, Cybercrime and information security, Cyber criminals, Classifications of cybercrimes, The legal perspectives and Indian perspective, Cybercrime and Indian ITA 2000, Global perspective on cybercrimes.

Cyber Offenses: Introduction, Criminals planning on attacks, Social engineering, Cyber stalking, Cyber cafe and crimes, Botnets.

Module 2: TOOLS AND METHODS USED IN CYBER CRIME AND PHISHING AND IDENTITY THEFT ***(09 Periods)***

Introduction, Proxy servers and Anonymizers, Phishing, Password cracking, Key loggers and Spywares, Virus, Worms and Ransomware, Trojan horses and Backdoors, Steganography, DoS and DDoS attacks.

Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).

Module 3 CYBER CRIMES AND CYBER SECURITY-LEGAL PERSPECTIVES ***(08 Periods)***

Introduction, Cyber laws in Indian context, The Indian IT act, Challenges to Indian law and Cybercrime scenario in India, Consequences of not addressing the weakness in IT act, Digital signatures and the Indian IT Act, Cyber Crime and Punishment, Cyber law, Technology and Students in India scenario.

Module 4 CYBER SECURITY-ORGANIZATIONAL IMPLICATIONS ***(10 Periods)***

Introduction, Web threats for organizations – evils and perils, Security and privacy implications from cloud computing, Social Media Marketing-Security risks and Perils for organizations, Social computing and associated challenges for organizations, Protecting people's privacy in organization, Organizational guidelines for internet usage, Safe computing and Usage policy, Incident handling and Best practices.

Module 5 CYBER CRIME AND TERRORISMAND ILLUSTRATIONS ***(09 Periods)***

Cyber Crime & Terrorism: Introduction, Intellectual property in the cyber space, The ethical dimension of cybercrimes, The psychology, Mindset and skills of hackers and cyber criminals, Sociology of cyber criminals, Information warfare.

Cyber Crime Illustrations: Indian banks lose millions of rupees, Justice vs. Justice, Parliament attack, The Indian case of online gambling, Bank and credit card related frauds, Purchasing goods and services scam, Nigerian 419 scam.

Total Periods: 45

EXPERIENTIAL LEARNING

1. The Cyber Security Risks on Social Media – Learn from Case Studies: https://www.rswebsols.com/tutorials/internet/cyber-security-risks-social-media
2. SIX automates key cybersecurity tasks to actively protect itself against social media threats: https://www.hootsuite.com/resources/six-group-case-study
3. Important Cyber Law Case Studies : https://www.cyberralegalservices.com/detail-casestudies.php

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

RESOURCES

TEXT BOOKS:

1. Nina Gobole, 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 India 2018

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

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

COURSE CONTENT

Module 1: INDIAN ELECTRICITY RULES AND ACTS, AND THEIR SIGNIFICANCE ***(10 Periods)***

OSHA standards of electrical safety, Basic electrical safety rules as per OSHA; Objectives and scope of IE acts and IE rules, Ground clearance and Section Clearances, Clearance in transmission and distribution lines, Significance of Equipment Earthing, Earthing of equipment bodies, structures and non-current carrying metallic parts, Earthing of system neutral; Rules regarding first aid and firefighting facility, Electrical safety general requirements as per IE rules.

Module 2: INTRODUCTION TO ELECTRICAL SAFETY AND SAFETY MANAGEMENT ***(10 Periods)***

Electric Safety: Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, Protection against electrical hazards and types, Effect of current on the human body, Principles of electrical safety and approach to prevent accidents.

Electric shocks and its prevention: Primary and secondary electrical shocks, possibilities of getting an electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, Safety precautions in LV installations and electric plant.

Module 3: ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL, AND AGRICULTURAL INSTALLATIONS ***(08 Periods)***

Introduction—Wiring and fitting; Domestic appliances—water tap giving a shock, shock from wet wall, fan firing shock; Multi-storied building, Temporary installations, Agricultural pump installation; Do's and Don'ts for safety in the use of domestic electrical appliances; Principles of safety management in electrical plants, safety auditing, and economic aspects.

Module 4: ELECTRICAL SAFETY IN HAZARDOUS AREAS ***(07 Periods)***

Hazardous zones—class 0, 1 and 2; Sparks, flashovers and corona discharge in electrical plants; equipment for hazardous locations; scope for live line work, principles of live line maintenance, special tools for live line maintenance, safety instructions for working on HV lines/apparatus.

Module 5: SAFETY DURING INSTALLATION TESTING AND MAINTENANCE ***(10 Periods)***

Safety during installations: Preliminary preparations, preconditions for the start of installation work and safe sequence, safety aspects during installations of Transformers and Rotating machines.

Safety during testing: Purpose of commissioning checks and tests, equipment tests, high voltage energization tests, performance and acceptance tests, and safety aspects during commissioning.

Safety during maintenance: Operators' safety, Types of safety maintenance, Safety procedures, safety precautions during maintenance, and planning of maintenance.

Total Periods: *45*

EXPERIENTIAL LEARNING

1. Study and submit a report on various electrical safety standards followed in abroad countries.
2. Visit a nearby industry and submit a report on various safety measures followed in the industry.
3. Study and submit a report on standard practices followed during the maintenance/commissioning of the electrical apparatus in any industry.
4. Collect information about various safety/alert sign boards and the relative measures for a particular situation.
5. Should practice preliminary first aid assistance such as Cardiopulmonary resuscitation (CPR) and shall demonstrate.

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

RESOURCES

TEXT BOOKS:

1. Rao, Prof. H.L. Saluja, *Electrical Safety, Fire Safety Engineering and Safety Management*, Khanna Publishers. New Delhi, 2nd Edition, 2018 Reprint.

REFERENCE BOOKS:

1. Cadick, John, Mary Capelli-Schellpfeffer, and Dennis K. Neitzel, *Electrical safety Handbook,* McGraw-Hill Education, 2012.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=g-ofq7i_u48

WEB RESOURCES:

1. https://cercind.gov.in/Act-with-amendment.pdf
2. https://www.edapp.com/blog/electrical-safety-training-topics/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22MG101701	ENTREPRENEURSHIP FOR MICRO, SMALL AND MEDIUM ENTERPRISES	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: To understand the setting up and management of MSMEs and initiatives of Government and other institutions support for growth and development of MSMEs

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

CO1. Understand the basic of SME and challenges of MSMEs

CO2. Explain the opportunities to Set-Up SSI/SME Units and role of rural & women entrepreneurship.

CO3. Illustrate roles of various institutions supporting MSMEs.

CO4. Understand Management of MSME, NPA & sickness units

CO5. Evaluate role of Government in Promoting Entrepreneurship

CO-PO Mapping Table:

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

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

COURSE CONTENT

Module 1: INTRODUCTION2 ***(07 Periods)***

Concept & Definition, Role of Business in the modern Indian Economy SMEs in India, Employment and export opportunities in MSMEs. Issues and challenges of MSMEs

Module 2: MSME SETTING ***(09 Periods)***

Identifying the Business opportunity, Business opportunities in various sectors, formalities for setting up an enterprise - Location of Enterprise – steps in setting up an enterprise – Environmental aspects in setting up, Incentives and subsidies.

Module 3: MSMES SUPPORTING INSTITUTIONS ***(09 Periods)***

Forms of Financial support, Long term and Short term financial support, Sources of Financial support, Development Financial Institutions, Investment Institutions, Central level institutions, State level institutions, Other agencies, Commercial Bank – Appraisal of Bank for loans

Module 4: MANAGEMENT OF MSME ***(10 Periods)***

Management of Product Line; Communication with clients – Credit Monitoring System - Management of NPAs - Restructuring, Revival and Rehabilitation of MSME, Problems of entrepreneurs – sickness in SMI – Reasons and remedies –– Evaluating entrepreneurial performance

Module 5: ENTREPRENEURSHIP PROMOTION ***(10 Periods)***

MSME policy in India, Agencies for Policy Formulation and Implementation: District Industries Centers (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship & Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB)

Total Periods: 45

EXPERIENTIAL LEARNING

1. Present a case study on MSMEs Business Strategies.
2. Collect the data about nearby MSMEs and Present their structures in a PPT
3. Discuss in the group MSMEs opportunities in terms of Orientation and Develop mentation.

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

RESOURCES

TEXT BOOKS:

1. Vasant Desai, *Small Scale Industries and Entrepreneurship*, Himalaya Publishing House, 2003..
2. Poornima M Charanthimath, *Entrepreneurship Development Small Business Enterprises*, Pearson, 2006.

REFERENCE BOOKS:

1. Suman Kalyan Chaudhury, *Micro Small and Medium Enterprises in India Hardcover*, Raj Publications, 2013.
2. Aneet Monika Agarwal, *Small and medium enterprises in transitional economies, challenges and opportunities*, DEEP and DEEP Publications
3. Paul Burns & Jim Dew Hunt, *Small Business Entrepreneurship*, Palgrave Macmillan publishers, 2010.

VIDEO LECTURES:

1. https://sdgs.un.org/topics/capacity-development/msmes
2. https://blog.tatanexarc.com/msme/msme-schemes-in-india-for-new-entrepreneurs-and-start-ups/

WEB RESOURCES:

1. ncert.nic.in/textbook/pdf/kebs109.pdf
2. https://www.jetir.org/papers/JETIR1805251.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101702	**ENVIRONMENTAL POLLUTION AND CONTROL**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on fundamentals of air pollution, dispersion of pollutants, effects and control of air pollution, water pollution, soil pollution and control, and municipal solid waste management.

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

CO1 Analyze air and noise pollution using appropriate tools and techniques to solve complex environmental issues following relevant standards considering society, environment and sustainability besides communicating effectively in graphical form.

CO2 Analyze air and noise pollution control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO3 Analyze water pollution and its control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO4 Analyze soil pollution and its control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO5 Analyze solid waste and its management measures using appropriate tools and techniques to solve solid waste disposal issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: AIR AND NOISE POLLUTION *(08 Periods)*

Air Pollution: Scope, Significance, Classification, Sources – Line, Area, Stationary, Mobile; Effects of air pollutants on man, material and vegetation; Global effects of air pollution; Air pollution meteorology - Lapse rate, Inversion, Plume pattern; Dispersion of air pollutants - Dispersion models and applications; Ambient air quality standards.

Noise Pollution: Sound pressure, Power and intensity, Impacts of noise, permissible limits of noise pollution, measurement of noise, Noise standards.

Module 2: AIR AND NOISE POLLUTION CONTROL *(10 Periods)*

Self-cleansing properties of the environment, Dilution method, Control at source, Process changes and equipment modifications, Control of particulates – Types of equipment, Design and operation - Settling chambers, Centrifugal separators, Bag house filters, Wet scrubbers, Electrostatic precipitators; Control of gaseous pollutants – Adsorption, Absorption, Condensation, Combustion; Control of air pollution from automobiles, Control of noise pollution, Case studies, Latest developments in the air and noise pollution control.

Module 3: WATER POLLUTION AND CONTROL *(10 Periods)*

Water pollution – Sources, Causes, Effects; Surface and groundwater quality – Physical, Chemical, Biological; Drinking water quality standards, Water purification – Processes, Engineered systems – Aeration, Solids separation, Settling operations, Coagulation, Softening, Filtration, Disinfection; Wastewater – Sources, Causes, Effects, Treatment process and disposal – Primary, Secondary, Tertiary; Case studies, Latest developments in the water pollution control.

Module 4: SOIL POLLUTION AND CONTROL *(08 Periods)*

Soil pollutants, Sources of soil pollution, Causes, Effects and control of soil pollution, Diseases caused by soil pollution, Methods to minimize soil pollution, Effective measures to control soil pollution, Soil quality standards, Case studies, Latest developments in the soil pollution control.

Module 5: MUNICIPAL SOLID WASTE MANAGEMENT *(09 Periods)*

Municipal solid waste – Types, Composition and characteristics; Methods of collection and transportation; Methods of disposal – Open dumping, Sanitary landfill, Composting and Incineration; Utilization - 6R Concept, Recovery and recycling and Energy Recovery; Latest developments in solid waste management.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Explain plume patterns due to air pollution and meteorology effects and draw a neat sketch of plume pattern from any chimney that you have observed in recent times.
2. Compare the different air pollution control equipment used in India and draw a neat sketch line diagram of equipment you have seen in any of your industrial visit.
3. Submit a study report on Coagulation, Flocculation, Sedimentation, Filtration and Disinfection in your own words after watching a YouTube video on water treatment.
4. Enumerate the effective measures to control soil pollution with any two case studies.

5. Submit a report on case studies on the use of 6Rs concept of Municipal Solid Waste Management.

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

RESOURCES

TEXT BOOKS:

1. Peavy, H. S, Rowe, D. R., and Tchobanoglous, G., *Environmental Engineering*, 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 be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Michael L. Bushnell, Vishwani D. Agrawal*, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits,* Kluwer Academic 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.McIntyre, *Introduction to VLSI Testing*, Prentice Hall, 1st Illustrated Edition, 1998.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/117105137
2. https://nptel.ac.in/courses/117103125
3. https://nptel.ac.in/courses/106103016
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/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101702	**INTRODUCTION TO ETHICAL HACKING**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on ethical hacking overview, role of security and penetration testers, foot printing, reconnaissance and scanning networks, enumeration and vulnerability analysis, system hacking, network protection systems.

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

CO1. Understand and recognize role of security and penetration testers to protect the system from malware attacks.

CO2. Apply the foot printing tools to find the vulnerabilities in the system.

CO3. Analyze vulnerabilities to find the system security loopholes or flaws in networked systems within a given range of IP

CO4. Apply the web attackers tools to assess the website's security

CO5. Identify the possible incidents and threats, alert administrators, and prevent potential attacks using IDS

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: INTRODUCTION ***(10 Periods)***

Ethical Hacking Overview, Role of Security and Penetration Testers .Penetration, Testing Methodologies, Laws of the Land, Overview of TCP/IP, The Application Layer, The Transport Layer, The Internet Layer, IP Addressing, Network and Computer Attacks, Malware, Protecting Against Malware Attacks, Intruder Attacks, Addressing Physical Security.

Module 2: FOOT PRINTING, RECONNAISSANCE AND SCANNING *(09 Periods)* NETWORKS

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 usedto 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

EXPERIENCIAL 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 image file/ 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 issues and topics within global environmental politics in environmental decision-making.

CO2 Demonstrate knowledge of the concepts of gender and sustainable development through debates and policy documents.

CO3 Analyze the concept of environmental security and justice by identifying the sources of insecurity.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: GENDER AND ENVIRONMENT RELATIONSHIP *(09 Periods)*

Introduction – Gender and Environment – Development of gender roles – Society, gender & environment – Understanding environmental politics – Gender-environment connections–Eco-feminism – Cultural eco-feminism – Social eco-feminism – Feminist political ecology

Module 2: GENDERED ROLES IN THE FAMILY & COMMUNITY *(09 Periods)*

Organization of the household – Domestic division of labour – Food: growing, harvesting, shopping, preparing, and cooking

Gender & Power – Planning – Politics – NGO – Gendering of environmental protest – Environmental decision-making

Module 3: GENDER AND SUSTAINABLE DEVELOPMENT ***(09 Periods)***

Concept of sustainability & its achievement – Concept of sustainable development – Ecological Modernization – Gender & sustainability debates – Gender & sustainable development debates - Gender in policy documents – Gender, poverty & equity in sustainable development

Module 4: GENDER IN ENVIRONMENTAL JUSTICE ***(09 Periods)***

Normative Concerns (Fairness, Inequality & Justice) –Making sense of Environmental justice – Ecological debt, Transnational harm, & human rights – Ecological justice – Gender &Environmental Justice – Gender, Vulnerability & risk – Women in environmental justice movements – Knowledge & participation – Gender, sustainability & justice as guiding concepts.

Module 5: GENDER AND ENVIRONMENTAL SECURITY ***(09 Periods)***

Connections between security & the environment – **Gender, environment & security:** Sustainability as security – poverty & insecurity – Insecurity as injustice – Competing ways of thinking security – Reflecting on sources of insecurity – **Case Study** – Food Security -**Case Study** – The impacts of natural disasters

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a poster presentation on the impact of globalization on family structure and society.
2. Prepare a presentation on the family setup of different countries and their peculiar customs.
3. Prepare poster presentation on "Ancient hominin walked like a human but climbed like an ape."
4. Find out the problems of present society and being part of future generations how you may help to strengthen environmental security.

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

RESOURCES

TEXT BOOKS:

1. Nicole Detraz, *Gender and the Environment,* Polity Press, Cambridge, UK. 2017
2. Susan Buckingham- Hatfield, *Gender and Environment*, Routledge, London. 2000

REFERENCE BOOKS:

1. Promillakapur ed., *Empowering Indian Women*, Publication Division, Government of India, New Delhi. 2000.
2. Ronnie Vernooy, Ed., *Social and Gender Analysis Natural Resource Management: Learning Studies and Lessons from Asia,* Sage, New Delhi. 2006
3. Swarup Hemlata and Rajput, Pam, *Gender Dimensions of Environmental and Development Debate: The Indian Experience,* In Sturat S. Nagel, (ed). *India's Development and Public Policy*. Ashgate, Burlington. 2000

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101701	GLOBAL STRATEGY AND TECHNOLOGY	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:
Introduction to strategic management; Strategic management process; Principles of good strategy; Globalization strategies; Research and Development strategies; Technology Management and Transfer; Elements of Transfer Process; Corporate Governance in the Indian scenario.

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

CO1 Demonstrate the knowledge on strategic management, its approaches, and tools through ethical decision making.

CO2 Analyse the globalization challenges for scrupulous selection of globalization strategies.

CO3 Apply the R&D strategies and trends to enhance the technological breakthroughs for new products and applications.

CO4 Demonstrate the knowledge on technology management and transfer that strengthen the economy and accelerate the application of technology and resources.

CO5 Analyze the challenges of corporate governance in Indian scenario for the effective development of value-oriented organizations.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: STRATEGIC MANAGEMENT (09 Periods)

Introduction, Classes of decisions, Levels of strategy, Core competence, Strategic intent and stretch, Approaches to strategy making, Roles of different strategists, Strategic Management-Process, Benefits, Limitations; Ethics in strategic decision making, Principles of good strategy, Strategic Management in India; Common managerial strategy formulation tools.

Module 2: GLOBALIZATION (09 Periods)

Definition, Stages, Essential conditions for globalization, Globalization strategies, Competitive advantage of Nations and regions, Factors affecting Globalization, Globalization of Indian business.

Module 3: RESEARCH & DEVELOPMENT STRATEGIES (09 Periods)

Concept, Evolution of R and D Management, R and D as a business, R and D as competitive advantage, Elements of R and D strategies, Integration of R and D, Selection and implementation of R and D strategies, R and D trends and challenges.

Module 4: TECHNOLOGY MANAGEMENT AND TRANSFER (09 Periods)

Technology Management: Introduction, Technology-Definition, Components, Classification Features; Technology Management-Concept, Nature; Drivers of Management of Technology-Significance, Scope, Responding to technology challenges.

Technology Transfer: Introduction, Definition, Classification, Significance, Elements of process, Types of Technology Transfer, Package, Modes of Transfer, Routes, Channels and Effectiveness of Technology Transfer.

Module 5: CORPORATE GOVERNANCE: THE INDIAN SCENARIO (09 Periods)

Emergence of corporate governance in India-Landmarks, Models, Codes and status in India, Role and Responsibilities of Regulators, The Board of Directors; Corporate Governance- Specific issues in India, Family-owned Business, Corporate Governance and the Indian ethos.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Case studies: Using real-world examples of global businesses and their technological strategies, students can examine the challenges and opportunities presented by different markets and technologies. This can involve analyzing data, conducting market research, and making decisions based on their findings.
2. Simulation games: Students can participate in simulation games that allow them to make decisions about global strategy and technology in a virtual environment. This can help them understand the complexities of international business, such as navigating different cultures, regulations, and economic systems.
3. Industry partnerships: Partnerships with technology companies and global businesses can provide students with hands-on experience in global strategy and technology. This can include internships, shadowing, or working on real projects with industry professionals.
4. Project-based learning: Students can work on real-world projects that require them to apply their knowledge of global strategy and technology. This can include developing a business plan for a new product or service, designing a marketing campaign for a global audience, or analyzing the impact of a new technology on a specific industry.

5. Field trips: Visiting international businesses or attending technology conferences can provide students with a first-hand look at global strategy and technology in action. This can help them understand the challenges and opportunities of different markets and technologies, as well as connect with industry professionals.

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

CASE STUDIES:

1. Tesla: Can Elon Musk's electric car company succeed globally?
2. Uber: How the ride-sharing giant is expanding its global footprint.
3. Alibaba: How China's e-commerce giant is competing on the global stage.
4. Airbnb: How the home-sharing platform is disrupting the global hotel industry.
5. Netflix: How the streaming service is expanding globally and adapting to local markets.

ARTICLES:

1. "Digital Transformation: Why it Matters for Global Business" by Forbes
2. "How AI is Changing Global Business Strategy" by Harvard Business Review
3. "The Future of Globalization: Exploring the Role of Technology" by World Economic Forum
4. "Globalization 4.0: What it Means for Technology and Strategy" by McKinsey & Company
5. "How Technology is Transforming Global Supply Chains" by MIT Sloan Management Review

RESOURCES

TEXT BOOKS:

1. Francis Cherunilam, *Strategic Management*, Himalaya Publishing House, 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 Strategic Approach*, 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 of re-use of materials, and the oxidation technology for wastewater.

CO3. Go beyond energy-efficient machinery, biofuels, and environmentally friendly materials.

CO4. Acquire basic knowledge on man-made ecosystems, sources, and control of pollution.

CO5. Understand the concepts and requirements for green buildings.

CO-PO Mapping Table

Course Outcome	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 AND COMPENSATION ***(09 Periods)***

Orientation - Orientation programme, Requisites of an effective programme, Evaluation of orientation programme, Problems of orientation; Training and development – Nature, Inputs, Training process, Methods, Impediments to effective training, Management development, Career development, Talent management; Performance Appraisal - Nature, Appraisal process, Challenges of performance appraisal; Merit rating; Compensation - Philosophy, Components, Theories, Factors influencing employee compensation, Challenges, Wage and salary administration.

Module 4: INDUSTRIAL RELATIONS AND TRADE UNIONS ***(09 Periods)***

Industrial Relations (IR): Nature of IR, Importance of Peaceful IR; Approaches to IR - Unitary Approach, Pluralistic approach, Marxist approach; Parties to IR; IR strategy; Industrial Disputes - Nature, Causes, and Settlement.

Trade unions: Nature of trade unions, Strategic choices before unions, Union tactics, Trade union movement in India, Trends in trade union movement, Managing unions; Indian Factories Act; Employee's compensation Act; Industrial disputes Act.

Module 5: ETHICAL ISSUES AND SAFETY ADMINISTRATION ***(09 Periods)***

Managing Ethical Issues in HRM: Nature of ethics, Sources of business ethics, Myths about ethics, Ethical dilemmas, HR ethical issues, Managing ethics, Improving ethical decision making.

Employee Safety: Safety, Need for safety, Types of accidents, Safety programme, ISO safety standards.

Total Periods: 45

EXPERIENTIAL LEARNING

1. What are the challenges that are faced by HR in effective performance management including performance appraisal in MNCs? Discuss in detail in the contemporary of HRM.
2. Evaluate employee relations in a comparative perspective across few countries of your choice. Describe in brief by taking a case study.
3. Visit an organization or industry and Evaluate HRM related social, cultural, ethical and environmental responsibilities and issues in a global context.

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

RESOURCES

TEXT BOOKS:

1. Aswathappa K, *Human Resource Management,* Tata McGraw Hill Private Limited, 8th edition, 2017.
2. Garry Dessler and Biju Varkkey, *Human Resource Management,* Pearson India, 16th Edition, 2020.

REFERENCE BOOKS:

1. Raymond A. Noe, John R. Hollenbeck, *HRM: Gaining a Competitive Advantage*, TMH, 7th edition, 2010.
2. Bohlander George W, Snell Scott, *Principles of Human Resource Management,* Cengage Learning, 16th edition, 2016.
3. Edwin B. Flippo, *Personnel Management,* McGraw-Hill International editions, 6th edition, 1984.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/122105020
2. https://onlinecourses.nptel.ac.in/noc20_mg15/preview
3. https://www.digimat.in/nptel/courses/video/122105020/L01.html

UNIVERSITY ELECTIVE

Course Code	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.

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 family setups of different countries and their peculiar customs if any.
3. Prepare a poster presentation on "Ancient hominin walked like a human but climbed like an ape."
4. Find out the problems of present society and being part of future generations and how you may help to strengthen environmental security.

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

RESOURCES

TEXT BOOKS:

1. Panneerselvam. R., *Engineering Economics*, PHI Learning Private Limited, New Delhi, 2nd edition, 2013.
2. Jain. T. R., V. K. Ohri, O. P. Khanna., *Economics for Engineers*, VK Publication, 1st edition, 2015.

REFERENCE BOOKS:

1. DuttRudar & Sundhram K. P. M., *Indian Economy*, S. Chand, New Delhi, 62nd revised edition, 2010.
2. Misra, S. K. & V. K. Puri., *Indian Economy*: *Its Development Experience*, Himalaya Publishing House, Mumbai, 32nd edition, 2010.

UNIVERSITY ELECTIVE

Course Code	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 and communalism, Nature of development, Processes of social exclusion and Inclusion, Changing Nature of Work and Organization.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a write-up on how to safeguard ancient monuments.
2. Analyze the most famous historically important place you visited.
3. Prepare a presentation on the ancient Seven Wonders of the World with their significance and how they are destroyed.
4. Prepare a presentation on "Wars of the past not only destroyed people and their livelihood but also the people's tradition and culture."
5. Prepare a poster on " Continents that No Longer Exist" with causes

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

RESOURCES

TEXT BOOKS:

1. K. Krishna Reddy, *Indian History,* Tata McGraw-Hill, 21st reprint, 2017.

REFERENCE BOOKS:

1. Guha, Ramachandra, *India after Gandhi*, Pan Macmillan, 2007.
2. Romila Thapar, *Early India***,** Penguin India, New Delhi 2002.

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101705	**INDIAN TRADITION AND CULTURE**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Basic traits of Indian Culture; Humanistic Reforms under Jainism and Buddhism; Culture in the medieval period; Socio Religious reforms in Indian Culture; Reform movements for harmonious relations.

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

CO1 Demonstrate knowledge of Vedic and Upanishadic culture and society to consider human aspirations, values and theories.

CO2 Understand the contributions of Buddhism and Jainism to Indian culture.

CO3 Examine the cultural conditions and achievements of India under Mouryas and Guptas.

CO4 Analyze social religious reforms and reform movements.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: BASIC TRAITS OF INDIAN CULTURE ***(08 Periods)***

Meaning and definition and various interpretations of culture - Culture and its features - The Vedic and Upanishad culture and society - Human aspirations and values in these societies - Chaturvidha purushardhas, Chaturashrma and Chaturvarna theory.

Module 2: HUMANISTIC REFORMS UNDER JAINISM AND BUDDHISM ***(09 Periods)***

Salient features of Jainism - contributions of Jainism to Indian culture - Contributions of 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 be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Valluru Prabhakaraiah, *Indian Heritage and Culture*, Neelkamal Publications Pvt. Ltd. Delhi, 1/e, reprint 2015.

REFERENCE BOOKS:

1. L. P. Sharma, *History of Ancient India*, Konark Publishers, Pvt. Ltd. New Delhi, 2010.
2. L. P. Sharma, *History of Medieval India*, Konark Publishers, Pvt. Ltd. New Delhi, 2010.
3. The Cultural Heritage of India Vol-I, II, III, IV, V, The Ramakrishna Mission Institute of Culture, Calcutta

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101703	**INSTRUMENTATION IN INDUSTRIES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on measurement of various parameters like displacement, force, torque, acceleration, velocity, density, viscometer, hygrometers, temperature, pressure, level and flow.

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

CO1 Select appropriate displacement, force and torque measuring devices for specific measurement application.

CO2 Identify suitable acceleration, velocity and density measuring devices for specific measurement application.

CO3 Apply suitable viscometer and hygrometer for measurement of viscosity, humidity and moisture for a specific application.

CO4 Select appropriate temperature and pressure transducer for an industrial requirement.

CO5 Identify appropriate level and flow transducer for measurement of level and flow for a specific application.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: DISPLACEMENT, FORCE & TORQUE MEASUREMENT ***(08 Periods)***

Displacement Measurement: Introduction, Strain gauge, LVDT, Capacitive Gauges and applications.

Force Measurement: Introduction, Analytical Balance, Spring Balance, Load cells.

Torque Measurement: Introduction, Strain gauge, Relative angular twist and applications.

Module 2: ACCELERATION, VELOCITY & DENSITY MEASUREMENT ***(08 Periods)***

Acceleration Measurement: Introduction, LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers and applications.

Velocity Measurement: Introduction, Revolution Counter, Capacitive Tacho, Drag-cup Type, Tacho and Stroboscope and applications.

Density Measurement: Introduction, Pressure type densitometers, Float type densitometers, Ultrasonic densitometer and gas densitometer.

Module 3: VISOCITY, HUMIDITY & MOISTURE MEASUREMENT ***(09 Periods)***

Viscosity Measurement: Introduction, friction tube viscometer, say bolt's viscometer, rotameter viscometer, Searle's rotating cylinder, cone and plate viscometer.

Humidity Measurement: Introduction, Dry and wet bulb psychrometers, Resistive and capacitive type hygrometers

Moisture Measurement: Introduction, Thermal Conductivity and Capacitive sensors, Applications of moisture measurement, Moisture measurement in solids.

Module 4: TEMPERATURE & PRESSURE MEASUREMENT ***(10 Periods)***

Temperature Measurement: Definitions and standards, RTD, Thermistor, Thermocouples: Laws of thermocouple, Reference junctions compensation, Radiation fundamentals, Radiation methods of temperature measurement, Total radiation pyrometers, Optical pyrometers, Applications.

Pressure Measurement: Introduction, manometer and its types, elastic transducers Bourdon tube, diaphragm, bellows, electrical types, resistive, inductive and capacitive, Thermal conductivity gage, Ionization gage, Sound level meter, Microphone, Applications.

Module 5: LEVEL & FLOW MEASUREMENT ***(10 Periods)***

Level Measurement: Introduction, Gauge Glass technique, Float Types – Float–and– tape method, Float–and–shaft method, Magnetic float types. Electrical types – Resistance switch type, Inductive and Capacitance type. Ultrasonic methods. Applications

Flow Measurement: Introduction, Head types – Orifice, Venturi, Flow Nozzle. Rotameter & types. Coriolis flow meter, Gyroscopic flow meter, Liquid bridge mass flow meter, Calorimetric flow meter. Electromagnetic flow meter, Ultrasonic flow meter, Hotwire anemometer type. Applications.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Record temperature from RTD and convert temperature in to voltage.
2. Measure the speed of rotating shaft using stroboscope.
3. Record level of the tank using suitable device.
4. Measure the flow rate of water in boiler plant.
5. Measure the displacement using LVDT.

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

RESOURCES

TEXT BOOKS:

1. K. Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and Sons, New Delhi, 19th Revised Edition, 2013
2. D. Patranabis, *Principles of Industrial Instrumentation*, TMH, 3rd Edition, 2010.

REFERENCE BOOKS:

1. Ernest Doebelin & Dhanesh Manik, *Measurement Systems*, McGraw Hill International, 6th Edition, 2011.

VIDEO LECTURES:

1. https://www.vlab.co.in/
2. https://archive.nptel.ac.in/courses/103/103/103103135/
3. https://nptel.ac.in/courses/103103135

WEB RESOURCES:

1. https://www.tutorialspoint.com/electronic_measuring_instruments/index.htm
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/108105064/lec1.pdf
3. https://www.ibiblio.org/kuphaldt/socratic/sinst/book/liii.pdf.

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101704	**INTRODUCTION TO NANOTECHNOLOGY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The fundamental principles of nanoelectronics and the utilization of nanostructures as nano electronic devices.

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

CO1. Demonstrate the basic knowledge in nanoelectronics, crystal structure of semiconducting 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 nano devices.

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

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 Periods: 45

EXPERIENTIAL LEARNING

1. Submission of report on specifications of Clean room.
2. Submission of report on specifications of Clean bench.

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

RESOURCES

TEXT BOOKS:

1. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, *Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications,* Cambridge University Press, 2012.
2. George W. Hanson, *Fundamentals of Nanoelectronics*, Prentice Hall, 2007

REFERENCE BOOKS:

1. Mitin.V, Kochelap.V and Stroscio.M, *Introduction to Nanoelectronics*, Cambridge University Press, 2008
2. Karl Goser et.al, *Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum devices*, Springer, 2005.

VIDEO LECTURES:

1. Introduction to Nanotechnology, nanohub.org
2. https://nptel.ac.in/courses/103103033

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101702	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Introduction to Artificial Intelligence, Designing intelligent agents, Solving general purpose problems, Search in complex environments, Represent knowledge, Robotics, Ethics.

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

CO1 Analyze and Architect intelligent agents using Artificial Intelligence Techniques and principles

CO2 Analyze the usage of Knowledge representation techniques in Artificial Intelligence

CO3 Analyze and interpret the problem, identify suitable solutions using heuristic functions and search algorithms

CO4 Investigate robot hardware and frameworks for intelligent robotic perception.

CO5 Demonstrate knowledge on ethical implications of intelligent machines for providing privacy, trust, security and safety.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1 INTRODUCTION TO ARTIFICIAL INTELLIGENCE ***(09 Periods)***

Foundations of artificial intelligence, History of artificial intelligence, State of the art, Risks and benefits of AI, Intelligent agents – Agents and environments, The concept of rationality, Structure of agents.

Module 2 KNOWLEDGE & REASONING ***(09 Periods)***

Logic, Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses.

First-Order Logic - Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution.

Module 3 PROBLEM SOLVING BY SEARCHING ***(09 Periods)***

Problem solving agents, Search algorithms, Uninformed search strategies, Informed search strategies – Greedy best-first search, A* search; Heuristic functions.

Module 4 SEARCH IN COMPLEX ENVIRONMENTS ***(09 Periods)***

Local search algorithms and optimization problems – Hill-climbing search, Simulated annealing, Local beam search, Evolutionary algorithms; Optimal decisions in games – The minimax search algorithm, Optimal decisions in multiplayer games, Alpha-Beta pruning, Move ordering; Monte Carlo tree search.

Module 5: ROBOTICS ***(09 Periods)***

Robots, Robot hardware, Robotic perception, Alternative robotic frameworks, Application domains.

Limits of AI, Ethics of AI – Surveillance, security and privacy, Fairness and bias, Trust and transparency, AI safety

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Design and implement agent programs for Table-driven agents using the agent function of vacuum-cleaner world. The agent cleans the current square if it is dirty, otherwise it moves to the other square.
2. Implement agent programs for Simple reflex agents and Model-based reflex agents using the agent function of vacuum-cleaner world.
3. Solve the travelling sales man problem using Hill Climbing search algorithm

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

RESOURCES

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, *Artificial Intelligence: A Modern Approach*, Prentice Hall, 4th Edition, 2020.

REFERENCE BOOKS:

1. Stephen Lucci, Danny Kopec, *Artificial Intelligence in the 21st Century*, Mercury Learning and Information, 3rd Edition,2018
2. Rich, Knight, Nair*, Artificial intelligence*, Tata McGraw Hill, Third Edition, 2009.
3. Deepak Khemani, *A First Course in Artificial Intelligence*, McGraw Hill Education, 2017.
4. Saroj Kaushik, *Artificial Intelligence*, Cengage Learning, 2011.

SOFTWARE/TOOLS:

1. Python
2. pandas, matplotlib

VIDEO LECTURES:

1. https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence
2. http://aima.cs.berkeley.edu/
3. https://ai.google/education/
4. https://www.coursera.org/courses?query=artificial%20intelligence
5. https://www.edureka.co/blog/artificial-intelligence-with-python/

WEB RESOURCES:

1. http://www.airesources.org/
2. https://allthingsai.com/
3. https://designmodo.com/ai-tools-designers/
4. https://www.ulethbridge.ca/teachingcentre/chatgpt-ai-resources

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS101702	**INTRODUCTION TO DATA SCIENCE**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Data Science; Data Collection and Data Pre-Processing, Exploratory Data Analytics, Model Development, and Model Evaluation**.**

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

CO1 Demonstrate knowledge on Data science concepts.

CO2 Perform data collection and pre-processing.

CO3 Perform exploratory data analytics.

CO4 Design and develop data visualization models.

CO5 Evaluate performance of data models.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	3	2	2	-	-	-	-	-	-	-
CO3	2	2	2	3	2	-	-	-	-	-	-	-
CO4	2	3	2	2	2	-	-	-	-	-	-	-
CO5	3	2	2	2	2	-	-	-	-	-	-	-
Level of correlation of the course	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

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

COURSE CONTENT

Module 1 INTRODUCTION *(09 Periods)*

Introduction to Data Science, Evolution of Data Science, Data Science Roles, Stages in a Data Science Project, Applications of Data Science in various fields, Data Security Issues.

Module 2 DATA COLLECTION AND DATA PRE-PROCESSING *(09 Periods)*

Data Collection Strategies, Data Pre-Processing- Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization.

Module 3 EXPLORATORY DATA ANALYTICS *(09 Periods)*

Descriptive Statistics, Mean, Standard Deviation, Skewness and Kurtosis, Box Plots, 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 important role in applications such as chatbots, customer support forum, customer reviews etc. So you have to train a machine learning model that can identify the emotion of a text by presenting the most relevant emoji according to the input text.

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 based on its target customers from different types of customer segments. For example, instead of spending money to market a new product to every customer in the company's database, a company can analyze which customer segment is most likely to buy the product and then market the product only on that particular segment.

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

RESOURCES

TEXT BOOK:

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*, EMC 2013.
2. Davy cielen, *Introducing Data Science*, Manning Publications, 2022.
3. Chirag Shah, *A Hands-on Introduction to Data Science*, Cambridge University Press, 2020

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=JL_grPUnXzY&list=PLeo1K3hjS3us_ELKYSj_Fth2tIEkdKXvV

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, compile and debug programs in Python programming language.

CO2. Use appropriate data type for handling user data and write optimized programs using the functions, and statements.

CO3. Manage the exceptions raised during the program execution and avoid abrupt termination of the program execution.

CO4. Process files and solve real world problems using classes and objects in the Python programming environment.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: DATA TYPES AND INPUT/OUTPUT ***(09 Periods)***

Internal working of Python, Python character set, Tokens, Python Core Data Types (list, set, tuple, and 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 in a function, The local and global scope of a variable, The return statement, Recursive functions, The lambda function; Lists-Creating Lists, Accessing the elements of a List, List slicing, Python in-built functions for lists, List Comprehension, List Methods, Passing list to a function, Returning a list to function.

Module 4: TUPLES, SETS AND DICTIONARIES ***(09 Periods)***

Tuples - Creating tuples, tuple() function, Inbuilt functions for tuples, Indexing and Slicing, Operations on tuples, Passing variable length arguments to tuples, Sort tuples, Traverse 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 lines in a given text file. You can also include additional features like finding the most common words or displaying statistics about the text.
5. Tic-Tac-Toe: Implement a two-player tic-tac-toe game where users take turns marking Xs and Os on a 3x3 grid. Determine the winner or detect a tie by checking the board after each move.
6. Dice Rolling Simulator: Create a program that simulates rolling dice. Allow the user to specify the number of dice to roll and display the results. You can also add features like keeping track of the roll history or calculating the probability of certain outcomes.

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

RESOURCES

TEXTBOOKS:

1. Ashok Namdev kamthane and Amit Ashok Kamthane, *Programming and Problem solving 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 and use cases*, CRC Press.

VIDEO LECTURES:

1. https://www.digimat.in/nptel/courses/video/106105166/L01.html
2. https://www.youtube.com/watch?v=oBZnySDgst8

WEB RESOURCES:

1. https://www.arduino
2. https://www.raspberrypi.org/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101703	**MANAGEMENT SCIENCE**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:
Concepts of Management; Concepts Related to ethics and social responsibility; Human Resource Management; Operations Management; Statistical Process Control; Inventory Management; Marketing; Project Management; Project Crashing.

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

CO1 Demonstrate the concepts of management, its functions and processes used in optimum resource utilization within the context of ethics and social responsibility.

CO2 Apply the concepts of HRM for selection and management of human resources.

CO3 Analyze different operations management problems using quality management tools to produce effective, efficient and adoptable products/services

CO4 Identify different marketing strategies to maximize enterprise profitability and customer satisfaction within the realistic constraints

CO5 Develop network models in time-cost trade-off for effective project management.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: MANAGERIAL FUNCTION AND PROCESS ***(10 Periods)***

Concept and foundations of management, Evolution of management thought; Managerial functions – Planning, Organizing, Directing and Controlling; Decision-making; Role of manager, managerial skills; Managing in a global environment, Flexible systems management; Social responsibility and managerial ethics; Process and customer orientation; Managerial processes on direct and indirect value chain.

Module 2: HUMAN RESOURCE MANAGEMENT ***(08 Periods)***

Human Resource challenges; Human Resource Management functions; Human Resource Planning; Job analysis; Job evaluation, Recruitment and selection; Training and Development; Promotion and transfer; Performance management; Compensation management and benefits; Employee morale and productivity; Human Resource Information System.

Module 3: OPERATIONS MANAGEMENT ***(10 Periods)***

Fundamentals of Operations Management, Services as a part of operations management; Facilities location and layout; Line balancing; Quality management – Statistical Process Control, Total Quality Management, Six sigma; Role and importance of materials management, Value analysis, Make or Buy decision, Inventory control, Materials Requirement Planning, Enterprise Resource Planning, Supply Chain Management.

Module 4: MARKETING MANAGEMENT ***(08 Periods)***

Concept, evolution and scope; Marketing strategy formulation and components of marketing plan; Segmenting and targeting the market; Positioning and differentiating the market offering, Analyzing competition; Product strategy; Pricing strategies; Designing and managing marketing channels; Integrated marketing communications.

Module 5: PROJECT MANAGEMENT ***(09 Periods)***

Project management concepts; Project planning – Work Breakdown Structure, Gantt chart; Project scheduling – Critical Path Method, Program Evaluation and Review Technique, Crashing the project for time-cost trade off; Resource Levelling.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Find the social responsibilities in the context of management theoretically and practically in an organization? Explain them by taking a real case study in any organization (preferably in your organization).
2. Gaining market share should be one of management's primary goals because of its effect on operations and profitability. Comment. What Strategies Do Companies Employ to Increase Market Share?
3. A Gantt chart is a visualization that helps in scheduling, managing, and monitoring specific tasks and resources in a project. Prepare a gantt chart for Online food ordering system.

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

RESOURCES

TEXT BOOKS:

1. 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 establishing Industrial ventures.
CO2. Identify and analyze the gaps in an organization for innovation in the context of developed economies
CO3. Develop a comprehensive and well-planned business structure for a new venture.
CO4. Demonstrate knowledge on intellectual property rights, patents, trademarks, copyrights, trade secrets and commercialization of intellectual property.
CO5. Apply ethics in constructive innovation framework and problem solving.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: CREATIVITY AND INNOVATION ***(09 Periods)***

Introduction, Levels of innovation, Purposeful innovation and the sources of innovative opportunity, The innovation process, Innovative strategies, Strategies that aim at introducing and innovation, Dynamics of ideation and creativity – Inbound, Outbound; Context and process of new product development, Theories of outsourcing.

Module 2: PARADIGMS OF INNOVATION ***(09 Periods)***

Systems approach to innovation, Innovation in the context of developed economies and Emerging economies, Examining reverse innovation and its application, Performance gap, Infrastructure gap, Sustainability gap, Regulatory gap, Preference gap, organizational factors effecting innovation at firm level.

Module 3: 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 &PROBLEM SOLVING ***(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 OF ALLOYS *(09 Periods)*

Materials Structure: Space lattice, Unit cells and Metallic crystal structures (SC, BCC, FCC and HCP), Crystal defects: Point, Line, Interstitial and Volume, Primary and secondary bonding in materials.

Constitution of Alloys: Necessity of Alloying, Gibbs's phase and Hume Rothery rule, Iron Iron-carbide diagram and its microstructural aspects.

Module 2: HEAT TREATMENT OF STEELS ***(09 Periods)***

Annealing, Normalizing, Tempering, Carburization and Hardening- Austempering, Martempering, Carburizing, Nitriding, Cyaniding, Carbo-Nitriding, Flame and Induction Hardening, Vacuum and Plasma Hardening, Time-Temperature-Transformation Diagrams and Continuous Cooling Transformation Diagrams.

Module 3: FERROUS MATERIALS AND ALLOYS ***(09 Periods)***

Steels: Structure, properties, classifications and applications of plain steels, Specifications of steels, Structure, properties, classifications and applications of low alloy steels, Hadfield manganese steels, Stainless steel and Tool steels.
Cast iron: Structure, properties and applications of Gray cast iron, White cast iron, Malleable cast iron, Nodular cast iron and Alloy cast iron.

Module 4: NON-FERROUS MATERIALS AND ALLOYS ***(09 Periods)***

Structure, properties and applications of Copper and its alloys, Aluminium and its alloys, Titanium and its alloys, Nickel and its alloys, Magnesium and its alloys, Refractory and Precious metals.

Module 5: CERAMICS, POLYMERS AND COMPOSITES MATERIALS ***(09 Periods)***

Ceramics: Classifications, Properties and Applications, Glass-ceramics, Polymers: Classification, Properties and Applications, Polymerization Reaction,
Composites: Classifications, Properties and Applications of Polymer matrix composites, Ceramic matrix composites, Metal matrix composites and Nanocomposites.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Laboratory experiments allow students to apply theoretical concepts and learn how to conduct experiments safely and effectively. Some examples of laboratory experiments include mechanical testing of materials, heat treatment of metals, and microscopy analysis of materials.
2. Materials characterization techniques such as X-ray diffraction, scanning electron microscopy, and transmission electron microscopy can provide valuable insights into the structure and properties of materials. Students can gain hands-on experience with these techniques by conducting experiments and analyzing the results.

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

RESOURCES

TEXT BOOKS:

1. V. Raghavan, *Materials Science & Engineering*, Prentice Hall of India, 5th edition,2004.
2. R. Balasubramaniam, Callister's, *Materials Science & Engineering*, John Wiley and sons, 2nd edition, 2014.

REFERENCE BOOKS:

1. Sidney H. Avner, *Introduction to Physical Metallurgy*, Tata McGraw Hill, 2nd edition,1997.
2. George E Dieter, *Mechanical Metallurgy*, Tata McGraw Hill, 3rd edition, 2013.
3. Kodigre V D, *Material Science and Metallurgy*, Everest Publishing House, 31st edition, 2011.

VIDEO LECTURES:

1. https://ocw.mit.edu/courses/materials-science-and-engineering/3-012-fundamentals-of-materials-science-fall-2005/lecture-notes/
2. https://nptel.ac.in/courses/116/104/116104045/
3. https://www.youtube.com/watch?v=tsX-VYvkiJ8&list=PLJV_OG0NLkV8VRNFk-0AyDZz1pZym6V8j
4. https://www.khanacademy.org/science/materials-science

WEB RESOURCES:

1. https://www.doitpoms.ac.uk/tlplib/teachers.php
2. https://www.springer.com/journal/10853
3. http://dmse.mit.edu/
4. http://dmse.mit.edu/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22LG101702	**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.

CO1. Demonstrate knowledge in Self-Management and Planning Career
CO2. Analyze the functional knowledge in attitudes and thinking strategies
CO3. Learn and apply soft skills for professional success.
CO4. Function effectively as an individual and as a member in diverse teams
CO5. Communicate effectively in public speaking in formal and informal situations.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: **SELF-ESTEEM & SELF-IMPROVEMENT** ***(09 Periods)***

Know Yourself – Accept Yourself; Self-Improvement: Plan to Improve - Actively Working to Improve Yourself- Exercises- case studies

Module 2: **DEVELOPING POSITIVE ATTITUDES** ***(09 Periods)***

How Attitudes Develop – Attitudes are Catching – Improve Your Attitudes – Exercises- case studies

Module 3 **SELF-MOTIVATION & SELF-MANAGEMENT** ***(09 Periods)***

Show Initiative – Be Responsible Self-Management; Efficient Work Habits – Stress Management – Employers Want People Who can Think – Thinking Strategies- Exercises- case studies

Module 4 GETTING ALONG WITH THE SUPERVISOR ***(09 Periods)***

Know your Supervisor – Communicating with your Supervisor – Special Communication with your Supervisor – What Should you Expect of Your Supervisor? – What your Supervisor expects of you - Moving Ahead Getting Along with your Supervisor- Exercises- case studies

Module 5 WORKPLACE SUCCESS ***(09 Periods)***

First Day on the Job – Keeping Your Job – Planning Your Career – Moving Ahead- Exercises- case studies

Total Periods: 45

EXPERIENTIAL LEARNING

1. List out the self-improvements in you on the charts and explain in detail.
2. Discuss different famous personalities and their attitudes.
3. Describe different personalities with respect to self-motivation and self-management.
4. Imagine you are a supervisor and illustrate different special communications.
5. Assume and Interpret different experiences on the first day of your job.

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

RESOURCES

TEXTBOOK:

1. Harold R. Wallace and L. Ann Masters, *Personal Development for Life and Work*, Cengage Learning, Delhi, 10th edition Indian Reprint, 2011. (6th Indian Reprint 2015)
2. Barun K. Mitra, *Personality Development and Soft Skills,* Oxford University Press, 2011.

REFERENCE BOOKS:

1. K. Alex, *Soft Skills*, S. Chand & Company Ltd, New Delhi, 2nd Revised Edition, 2011.
2. Stephen P. Robbins and Timothy A. Judge*, Organizational Behaviour*, Prentice Hall, Delhi, 16th edition, 2014

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=6Y5VWBLi1es
2. https://www.youtube.com/watch?v=H9qA3inVMrA

WEB RESOURCES:

1. https://www.universalclass.com/.../the-process-of-perso...
2. https://www.ncbi.nlm.nih.gov/pubmed/25545842
3. https://www.youtube.com/watch?v=Tuw8hxrFBH8

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101703	**PLANNING FOR SUSTAINABLE DEVELOPMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on sustainable development, environmental impact, sustainable policies, governance, theories and strategies, media and education for sustainability.

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

CO1 Compare sustainable development theories in national and global context to protect the society and environment.

CO2 Analyze the unforeseen environmental impacts on sustainable development to protect the society and environment.

CO3 Analyze policies and governance for sustainable development considering ethics, economics, society and environment.

CO4 Analyze systems and strategies for sustainable development using appropriate tools and techniques considering ethics, economics, society and environment.

CO5 Analyze the role of media and education in sustainable development using appropriate tools and techniques considering ethics, society and environment besides communicating effectively.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: SUSTAINABLE DEVELOPMENT ***(09 Periods)***

Definition and concepts of sustainable development, Capitalization of sustainability- National and global context; Sustainable development goals, Emergence and evolution of sustainability and sustainable development, Theories of sustainability, Case studies.

Module 2: ENVIRONMENTAL IMPACT ***(09 Periods)***

Climate change – Science, Knowledge and sustainability; Unforeseen environmental impacts on development, Challenges of sustainable development, Centrality of resources in sustainable development, Case studies.

Module 3: SUSTAINABLE POLICIES AND GOVERNANCE ***(09 Periods)***

Governance - Democracy and Eco–welfare; Global civil society and world civil politics, Civic environmentalism, Policy responses to sustainable development, Economics of sustainability, Social responsibility in sustainability, National action, ISO 14001: Environmental management system.

Module 4: SUSTAINABLE SYSTEMS AND 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, Case studies.

Module 5: MEDIA AND EDUCATION FOR SUSTAINABILITY ***(09 Periods)***

Role of emerging media, Remarkable design and communication art, Activism and the public interest, Education for sustainability, Participation in decision making, Critical thinking and reflection, Case studies.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Submit a study report on the importance and implementation of United 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 Strategies of 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 Base band Signal, PWM and PPM, Time Division Multiplexing, Frequency Division Multiplexing.

Module 3: BASE BAND DIGITAL TRANSMISSION ***(07 Periods)***

Pulse Code Modulation- Advantages, Block diagram of PCM, Quantization, effect of Quantization, Quantization error. DM, ADM and Comparison of PCM,DM & ADM.

Module 4: PASS BAND DIGITAL TRANSMISSION ***(10 Periods)***

Digital Binary Schemes-ASK, FSK, PSK, DPSK, QPSK, Modulation and Demodulation - Coherent and Non-coherent techniques.

Module 5: INFORMATION THEORY AND CODING ***(08 Periods)***

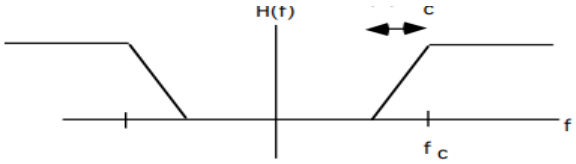
Concept of Information, Entropy and Rate of Information, Coding efficiency, Shannon-Fano and Huffman Coding.
Error Correction and Detection Codes- Linear Block Codes, Cyclic Codes, Convolution Codes.

Total Periods: 45

EXPERIENTIAL LEARNING

1 Suppose that a non-linear device is available for which the output current i0 and the input 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 edition 2007.
2. Simon Haykin, *Communication Systems*, John Wiley, 2nd edition 2007.

REFERENCE BOOKS:

1. Herbert Taub & Donald L Schilling, *Principles of Communication Systems*, Tata McGraw-Hill, 3rd Edition, 2009.
2. Sham Shanmugam, *Digital and Analog Communication Systems*, Wiley-India edition, 2006.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/108/104/108104091/
2. https://onlinecourses.nptel.ac.in/noc19_ee47/preview

WEB RESOURCES:

1. https://studiousguy.com/basic-principles-of-communication/
2. https://www.tutorialspoint.com/principles_of_communication/principles_of_communication_modulation.htm

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EE101702	**RELIABILITY AND SAFETY ENGINEERING**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on the fundamentals of reliability and safety engineering. The course emphasizes on various reliability measures used in assessing the performance of the system, evaluating the critical parameters of the network, and the techniques to assess the reliability of the system. The course also deals with safety management and measures in industrial and other hazardous environments.

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

CO1. apply the various probability and statistics fundamentals into engineering systems to evaluate performance.
CO2. develop mathematical models for engineering networks/systems to evaluate the critical parameters for the reliability of a network/system.
CO3. analyze the time-dependent/independent characteristics of a repairable system and frequency durations techniques to assess the reliability
CO4. understand various safety management, policy, and planning strategies for personal and industrial safety.
CO5. understand various safety and hazard identification techniques and follow appropriate safety measures in industry and society.

CO-PO Mapping Table

Course Outcome	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 Level	**3**	**2**	**-**	**2**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**3**

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

COURSE CONTENT

Module 1: FUNDAMENTALS OF RELIABILITY ENGINEERING ***(09 Periods)***

Random variables, probability concepts, rules for probabilities of events. Probability density and distribution functions. Binomial distribution - Expected value and standard deviation for binomial distribution. Reliability functions, f(t), F(t), h(t) - Relationship between these functions, Exponential density and distribution functions, expected value and standard deviation of exponential distribution. Measures of reliability - MTTF, MTTR, MTBF. Bathtub curve.

Module 2: NETWORK MODELING AND RELIABILITY EVALUATION ***(09 Periods)***

Basic concepts - Evaluation of network reliability/unreliability, series systems, parallel systems, series - Parallel configuration systems. Redundant systems and its types. Evaluation of network reliability/unreliability using conditional probability method, tie-set and cut-set based approach, complete event tree and reduced event tree methods.

Module 3: MARKOV CHAIN AND MARKOV PROCESSES ***(09 Periods)***

Basic concepts, stochastic transitional Probability matrix, time dependent probability evaluation, Limiting State Probability, Absorbing states. Modelling concepts – State space diagrams, time dependent reliability evaluation of single component repairable model, two component repairable model. Frequency and duration techniques.

Module 4: BASICS OF SAFETY CONCEPTS ***(08 Periods)***

Introduction, goals, need for safety, history of safety movement – the evolution of modern safety concept, general concepts of safety management. Planning for safety- productivity, quality and safety, line and staff functions, budgeting for safety, safety policy.

Module 5: SAFETY TECHNIQUES AND APPLICATIONS ***(10 Periods)***

Introduction to safety techniques, Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of the performance of supervisors on safety. Hazard identification techniques, components of safety audit, types of audit, audit methodology, and process of safety reporting. Applications of industrial Safety, environmental safety, health safety, electrical safety, fire safety.

Total Periods: 45

EXPERIENTIAL LEARNING

1. The students shall understand various IEEE reliability standards to be followed in the engineering systems for the evaluation of reliability and 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 problems using appropriate tools and techniques following the relevant guidelines and latest 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 appropriate 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, Visual interpretation techniques.

Module 2: GEOGRAPHIC INFORMATION SYSTEM (09 Periods)

GIS categories, Components of GIS, Fundamental operations of GIS, Spatial and non spatial data, Raster data and vector data, File management, Layer based GIS, Feature based GIS, Map projections, Latest developments.

Module 3: GIS SPATIAL ANALYSIS (08 Periods)

Database models, Data storage, Vector data storage, Attribute data storage, Data manipulation and analysis, Integrated analysis of the spatial and attribute data - DTM/DEM, Softwares – Arc GIS, QGIS and Global mapper, Latest developments in GIS software.

Module 4: REMOTE SENSING AND GIS APPLICATIONS (09 Periods)

Land use/Land cover classification, Rainfall-runoff studies, Flood and drought impact assessment and monitoring, Drainage morphometry, Watershed management for sustainable development, GIS based precision farming, GIS based natural resources management, Inland water quality survey and management, Regional and urban planning and management, GIS based highway alignment, GIS based traffic congestion analysis, GIS for public health – Case Studies.

Module 5: GLOBAL POSITIONING SYSTEM (09 Periods)

Global Positioning System (GPS) – Fundamental concepts, Components of GPS – Space segment, Control segment, User segment, Reference systems, Satellite orbits; Classification of GPS receivers, GPS observations, GPS measurements and accuracy of GPS, Applications.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Sound composing project: In this assignment, Select area and collect the geometry of aerial photographs and analyze the views.
2. Visit any meteorological department and understand about rain gauges and collect, analyse the data
3. Visit Geographical Information Systems Laboratory and understand about GIS and GPS Systems

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

RESOURCES

TEXT BOOKS:

1. Shivam, P. and Shashikanth, T., *A Text Book of Basic Concept of Remote Sensing*, *GPS and GIS*, Sankalp Publication, 2020.
2. Anji Reddi, M., *A Text Book of Remote Sensing and Geographical Information Systems*, B. S. Publications, 2nd Edition, 2012.

REFERENCE BOOKS:

1. Bhatta, B., *Remote Sensing and GIS*, Oxford University Press, 2nd Edition, 2011.
2. Lillesand, T. M., Kiefer, R. W. and Chipman, J. W., *Remote Sensing and Image Interpretation*, John 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 -

COURSE DESCRIPTION: This course provides a discussion onsmart city and infrastructure, smart governance, smart mobility, smart economy, smart environment, smart buildings, smart energy, smart water, smart living, smart people and case studies.

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

CO1 Understand the concept of smart cities and its infrastructure for ensuring safety and sustainability using appropriate techniques and management principles in India besides lifelong learning.

CO2 Analyse smart cities to solve problems associated with mobility and governance for the growing population by ensuring safety and sustainability, management using appropriate standards in India besides lifelong learning.

CO3 Analyse smart cities to solve problems associated with economy and environment for ensuring safety and sustainability, management using appropriate techniques and standards in India besides lifelong learning.

CO4 Analyse buildings, energy and water resource systems in smart cities to solve problems associated with the growing population for ensuring safety and sustainability, management using appropriate standards in India besides lifelong learning.

CO5 Analyse the smart cities to solve complex problems associated with people and living systems for ensuring safety and sustainability, management using appropriate techniques in India besides lifelong learning.

CO-PO Mapping Table

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

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

COURSE CONTENT

Module 1: SMART CITY AND INFRASTRUCTURE ***(09 Periods)***

Smart city - Concept, Objectives, History, Need; Key trends in smart city development, Government of India – Policy for smart city.

Infrastructure: Smart city infrastructure – Components, Challenges; Managing - Principle stake holders, Infrastructure in India and World, Dimensions of smart cities, Global standards and performance benchmarks, Practice codes, Infrastructure development, Integrated infrastructure management systems for smart city, Infrastructure management system applications for existing smart city, Various types of infrastructure systems, Infrastructure assessment.

Module 2: SMART GOVERNANCE AND SMART MOBILITY ***(09 Periods)***

Smart Governance: Definition, smart governance to citizens, Industries and commerce, Smart governance within government, Emerging trends in smart governance, Future of smart governance, Guidelines and standards for smart governance; IOT and ICT Application – Broadband city, Use of sensors, Intelligent city governance.

Smart Mobility: Intelligent transportation systems, Accessibility, Smart vehicles and fuels, GIS, GPS, Navigation system, Public transport, Traffic safety management, Logistics flows in cities, Mobility services, E-ticketing.

Module 3: SMART ECONOMY AND SMART ENVIRONMENT ***(09 Periods)***

Smart Economy: City branding, Market places and crowd funding, Innovation, entrepreneurship – E-business, E-commerce, Online integrated business platforms and networks; Local and global interconnectedness, Productivity, Flexibility of labour market.

Smart Environment: Network and environmental monitoring, Energy efficiency, Urban planning and urban refurbishment, Smart buildings and building renovation, Resource management, Environmental protection.

Module 4: SMART BUILDINGS, SMART ENERGY AND SMART WATER ***(09 Periods)***

Smart Buildings: Definition,Sustainable city – A green approach, Housing, Sustainable green building - Solar energy for smart city, Waste water management, solid waste management, 3Rs Policy, Green ratings.

Smart Energy: Current energy demand, Alternate energy sources, Renewable energy, Production, Solar energy, Wind energy, Energy from solid waste, Applications, Challenges in smart energy

Smart Water:Storage and conveyance system of water, Sustainable water and sanitation, Sewage systems, Flood management, Conservation system.

Module 5: SMART LIVING, SMART PEOPLE AND CASE STUDIES ***(09 Periods)***

Smart Living: Definition, Cultural facilities, World-class education, Tourist attractions, World-class hospitals, Latest technologies, Quality housing, Community and urban life management, Social cohesion.

Smart People: Definition, Human development index, Level of qualification, Graduate enrolment ratio, Lifelong learning, ICT Skills, Quality of smart people – Flexibility, Creativity to contribute to education, Democratic nature; Personality dimensions – Extroversion, Agreeableness, Consciousness, Emotional Stability, Open to experience.

Case Studies: Helsinki – Finland; Zurich - Switzerland; Oslo - Norway; Amsterdam - The Netherlands; New York - United States; Seoul (World's first Smart City) - South Korea.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Prepare a report on smart city infrastructure for south Indian cities.
2. Prepare a review on need for changes in transportation and governing policies in India.
3. Write a report on energy conservation and economy stability in world's first smart city.
4. Write a report on need and technologies to be adopted for green buildings in a smart city.
5. Prepare a case study report on Hyderabad, Telangana.

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

RESOURCES

TEXT BOOKS:

1. Li Xian Yi, *Smart City on Future Life - Scientific Planning and Construction*, Posts and Telecom Press, 2012.
2. Arpan Kumar Kar, Manmohan Prasad Gupta, P. Vigneswara Ilavarasan and Yogesh K. Dwivedi, *Advances in Smart Cities*, CRC Press, Taylor & Francis Group, Boca Raton, 2017.

REFERENCE BOOKS:

1. Nicos Komninos, *The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities)*, Routledge Taylor & Francis Group, London, 2015.
2. Eleonora Riva Sanseverino, *Smart Rules for Smart Cities – Managing Efficient Cities in Euro-Mediterranean Countries*, springer for innovation, Springer, Italy, 2014.
3. smart Cities Mission: A Step Towards Smart India, National Portal of India
4. Anthony M. Townsend, *Smart Cities – Big Data, Civic Hackers and The Quest for a New 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-PSO Mapping Table:

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

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

COURSE CONTENT

Module 1: CONCEPTS OF SENSORS ***(08 Periods)***

Introduction to sensors and transducers. Need for sensors in the modern world. Different fields of sensors based on the stimuli, various schematics for active and passive sensors. Static and dynamic characteristics of sensors. ***zero, I and II order sensors:*** Response to impulse, step, ramp and sinusoidal inputs. Environmental factors and reliability of sensors.

Module 2: SENSORS IN ENGINEERING ***(07 Periods)***

Physical principles of sensors, Electric Sensors: Resistive, Capacitive, Inductive. Piezoelectric sensor. Photo elastic sensors, Fluid Mechanic sensors.

Module 3: HUMAN AND BIOMIMETIC SENSORS ***(10 Periods)***

Human sensors: vision, Taste and smell, Hearing, Somatic, Biomimetic Sensors, Electrochemical, Thermoelectric sensors, Optic sensors.

Module 4: APPLICATIONS OF SMART SENSORS ***(11 Periods)***

WSN Based Physiological Parameters Monitoring System:Measurement of Human Body Temperature. Intelligent Sensing System for Emotion Recognition: Aim of the Emotion Recognition System, Development of Intelligent Sensing System for Emotion Recognition.WSN Based Smart Power Monitoring System.

Module 5: ADVANCEMENTS IN SENSING TECHNOLOGY ***(09 Periods)***

Ecological Monitoring Using Wireless Sensor Networks:Overview, Challenges, and Opportunities.Development of an Embedded System-Based Gateway for Environmental Monitoring in Wild Fields. Advancements in Structural Health Monitoring.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Build a wireless sensor system for Environmental pollution monitoring.
2. Design a smart temperature measurement system using required accessories.

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

RESOURCES

TEXT BOOKS:

1. Patrick F Dunn, *Fundamentals of sensors For engineering and science*, CRC Press,2012.
2. Subhas C. Mukhopadhyay, Krishanthi P. Jayasundera, and Anton Fuchs, *Smart Sensors, Measurement and Instrumentation*, Springer,2013.

REFERENCE BOOKS:

1. Subhas Chandra Mukhopadhyay*, Intelligent Sensing, Instrumentation and Measurements*, Springer, Kluwer Academic Publishers,2013.
2. Henry Bolte, *Sensors – A Comprehensive Sensors,* John Wiley.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=oRydUfgMdgA
2. https://onlinecourses.nptel.ac.in/noc22_ee36/

WEB RESOURCES:

1. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1199&context=nasapub#:~:text=The%20smart%20materials%20examined%20include,%2C%20magneto%2Doptical%20materials%2C%20and
2. https://www.youtube.com/watch?v=q8UuRkOQ9A0
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8433768/
4. https://www.mdpi.com/1424-8220/21/17/5890

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EE101703	**SUSTAINABLE ENERGY SYSTEMS**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course designed emphasizes the operating principle of a range of non-conventional energy resources, energy harvesting and conversion principles and key performance characteristics. The energy conversion technologies will include energy conversion from, Solar, Wind, Ocean, Biomass, Geothermal and Fuel cells. The course also emphasizes on various types of hybrid energy storage systems with their relative advantages and disadvantages.

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

CO1 Understand the fundamental concepts of renewable energy sources and their endurance for sustainability.

CO2 Understand the various methods of harvesting solar energy, energy conversion principles, and operational aspects and environmental impacts of solar technologies.

CO3 Understand the various methods of harvesting wind energy, conversion principles, operational aspects, and environmental impacts of wind energy systems.

CO4 Understand the various methods of harvesting ocean energy, Biomass energy and geothermal energy, energy conversion technologies, operational aspects, and their impacts on the environment.

CO5 Understand the principle of harvesting energy from fuel cells and the operational aspects of hybrid energy storage systems.

CO-PO Mapping Table:

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

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

COURSE CONTENT

Module 1: INTRODUCTION TO SUSTAINABLE ENERGY SOURCES *(07 Periods)*

Impact of conventional sources on Environment—acid rain, ozone layer depletion, Global warming, greenhouse effect and nuclear waste; Limitation of fossil fuels; Renewable energy sources; Renewable sources and their sustainable development.

Module 2: ENERGY FROM SOLAR ***(10 Periods)***

Introduction, solar radiation, Measurement of solar radiation—Pyranometer; Solar energy collectors; Flat plate collectors— Liquid and air (non-porous) types; Focusing type— Parabolic and Point types; Solar photovoltaic system— PV cell and its types, Configuration of solar panel, PV system; Applications:Solar pump, Solar water heater

Module 3: ENERGY FROM WIND ***(08 Periods)***

Introduction, power extraction from the wind, Wind turbines— Horizontal axis wind turbine— Propeller type and Vertical axis wind turbine— Darrieus rotor type; Basic components of wind energy conversion systems, Applications: Energy storage, Water pumping; Environmental impacts.

Module 4: ENERGY FROM OCEAN, BIOMASS AND GEOTHERMAL RESOURCES ***(12 Periods)***

Energy from ocean: Introduction, ocean thermal energy conversion (OTEC): Open and closed cycle power plants; Tidal energy: Schematic diagram of tidal power plant; Advantages and disadvantages.

Energy from Biomass: Introduction, biomass conversion technologies-direct, Thermochemical and Biochemical conversions; Biogas generation—Anaerobic digestion process.

Geothermal energy: Introduction, Geothermal resources, Geothermal power plants— Vapour dominated and liquid dominated; Environmental issues.

Module 5: FUEL CELLS AND HYBRID ENERGY SYSTEMS ***(08 Periods)***

Fuel Cells: Introduction, principle and operation of fuel cell, classification of fuel cells, advantages and disadvantages of fuel cells.

Hybrid energy systems: Need for hybrid systems, configuration and coordination, Block diagram approach of Stand-alone PV-wind system, PV-Diesel and Wind-diesel; energy storage systems — Ultra capacitors, SMES, Battery.

Total Periods: *45*

EXPERIENTIAL LEARNING

1. The students shall visit a solar power plant, understand the operational aspects and should prepare a technical report on the plant visited.

2. The students shall visit a wind farm, understand the operational aspects, and should prepare a technical report on the plant visited.

3. The students shall visit a bio-mass energy conversion plant, understand the operational aspects and should prepare a technical report on the plant visited.

4. The students shall prepare a technical report on the need of a hybrid plant and find new avenues for a new hybrid system.

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

RESOURCES

TEXT BOOKS:

1. Rai, G.D., *Non-conventional Energy Sources*, Khanna Publishers, New Delhi, 2017.
2. G.N. Tiwari and M.K. Ghosal, *Renewable energy resources: Basic principles and applications*, Alpha Science International Ltd., 2005.

REFERENCE BOOKS:

1. 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 - Table Layouts - : Effects, Frames, and Controls in CSS

Module 5: ADVANCED FEATURES OF HTML5 ***(09 Periods)***

Creating Editable Content - Checking Spelling Mistakes - Custom Data Attributes - Client-Side Storage - Drag and Drop Feature - Web Communication –**jQuery -** Fundamentals of jQuery - Callback Functions - jQuery Selectors - jQuery Methods to Access HTML Attributes.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Design a blog layout that includes header, navigation menu, content area, sidebar. Apply appropriate styling to each section.
2. Develop a java script based quiz that presents MCQs to the user and provides immediate feedback on their answers. Keep track of the score and display the final results at the end.
3. Build a web page that displays and image gallery. Each image should be a clickable link that opens the image in a larger view when clicked.

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

RESOURCES

TEXTBOOKS

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 RESOURCES

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