Course Structure & Syllabus

Of

M.Tech Programme

In

ENVIRONMENTAL ENGINEERING

(2022 Admission Batch)

(Approved by Academic Council and Board of Studies)

GIFT Autonomous, Bhubaneswar
(Approved by AICTE, New Delhi, Affiliated to BPUT, Odisha)
Recognized under section 2(f) of the UGC act,1956
At. Gramadiha, Po. Gangapada,
Via. Janla, Dist- Khorda,
Pincode:752054

(Specialization: Environmental Engineering)

GIFT Autonomous , Bhubaneswar

1ST SEMESTER				2ND SEMESTER			
CODE	SUBJECTS	L-T-P	CREDITS	Code	SUBJECTS	L-T-P	CREDITS
MT-ME-T-PC-101	Air and Noise pollution	3-1-0	4	MT-ME-T-PC-201	Environmental Impact Assessment	3-1-0	4
MT-ME-T-PC-102	Water Supply Engineering	3-1-0	4	MT-ME-T-PC-202	Waste Water Engineering	3-1-0	4
MT-ME-T-PC-103	Solid And Hazardous Waste Management	3-1-0	4	MT-ME-T-PC-203	Environmental Law and Policy	3-1-0	4
MT-CE-T-PC-103	Project Planning & Management	3-1-0	3	MT-CE-T-PC-204	Computational Methods and Techniques	3-1-0	4
MT-ME-T-PE-105	Advance Green Technology/ Climate Science and Sustainability/ Internet of Things/ Environmental Chemistry and Microbiology	3-1-0	3	MT-ME-T-PE-205	Carbon management for Sustainable Environment/ Industrial pollution and Control/ Remote sensing and GIS/ Environmental Hydraulics	3-1-0	4
CREDIT (THEORY)			18	CREDIT (THEORY)			20
MT-ME-P-PC-101	Environmental Design -1	0-0-2	2	MT-ME-P-PC-201	Water Supply and Waste water Engineering Lab	0-0-2	2
MT-ME-P-PS-102	Report Writing and Seminar - I	0-0-2	4	MT-ME-P-PS-202	Report Writing and Seminar-II	0-0-2	4
MT-ME-P-PC-102	Environment Computation lab	0-0-2	2				
CREDIT (PRACTICAL/SESSIONAL)			**8**	**CREDIT (PRACTICAL/SESSIONAL)**			**6**
TOTAL SEMESTER CREDITS			**26**	**TOTAL SEMESTER CREDITS**			**26**
TOTAL CUMULATIVE CREDITS			**26**	**TOTAL CUMULATIVE CREDITS**			**52**

3RD SEMESTER				4TH SEMESTER			
CODE	SUBJECTS	L-T-P	CREDITS	Code	SUBJECTS	L-T-P	CREDITS
MT-MB-T-ES-301	Research Methodology and Intellectual Property Rights	4-0-0	4	MT-P-PS-401	Dissertation Evaluation and Open Defense.	0-0-4	16
MT-ME-T-PE-302	E- Waste Management/ Energy Conservation and Environment/ Renewable Energy	3-1-0	4	MT-P-PS- 402	Viva Voce.	0-0-4	4
MT-CC-P-PS-303	Pre Dissertation Evaluation	0-0-4	10				
TOTAL SEMESTER CREDITS			**18**	**TOTAL SEMESTER CREDITS**			**20**
TOTAL CUMULATIVE CREDITS			**70**	**TOTAL CUMULATIVE CREDITS**			**90**

1st Semester

Air and Noise pollution			
Course Code	MT-ME-T- PC-101	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	04	Exam Hours	03

Module-1 – (8 Hours)

Sources of Air Pollution: Natural sources (volcanic eruptions, forest fires, dust storms) and anthropogenic sources (industrial emissions, vehicular exhaust, agricultural activities).
Classification of Aerosols: Primary and secondary aerosols; fine (PM2.5) and coarse (PM10) particles; organic and inorganic composition.
Gases and Vapors: Major pollutants including carbon monoxide, sulfur dioxide, nitrogen oxides, ozone, and volatile organic compounds (VOCs).

Module -2 – (8 Hours)

Natural Pollutants: Biological (pollen, spores), physical (dust, volcanic ash), and chemical (methane, sulfur compounds).
Properties of Air Pollutants: Physical (size, optical behavior), chemical (solubility, reactivity), and toxicological (health impacts).
Environmental Impacts: Role in smog, acid rain, climate change, and air quality management.

Module -3 –(6 Hours)

Metrological factors influencing pollutant dispersion: wind speed, atmospheric stability, and temperature inversion.
Fundamentals of the Gaussian plume model for pollutant dispersion. Mathematical formulation and assumptions of the Gaussian plume model. Applications of the Gaussian plume model in air quality management.
Case studies and practical examples of pollutant dispersion analysis.

Module -4 – (10 Hours)

Effects and Impacts of Air Pollution -
Effects of air pollution on human health: respiratory and cardiovascular issues.
Impacts on materials: corrosion, degradation of buildings, and infrastructure damage.
Effects on vegetation: reduced growth, leaf damage, and crop yield reduction.
Damage to art treasures: deterioration of monuments, paintings, and sculptures.
Air pollution disasters: case studies of historical incidents (e.g., Bhopal, London smog).
Economic implications: healthcare costs, loss of productivity, and environmental restoration expenses.

Module -5 – (6 Hours)

Global Effects and Management of Air Pollution - Global effects of air pollution: climate change, ozone layer depletion, and global warming. Contribution of automobiles to air pollution: emission of CO, NOx, PM, and hydrocarbons.
Strategies for controlling automobile emissions: catalytic converters, fuel standards, and alternative fuels.
General concepts of transport planning: promoting public transport, non-motorized transport, and green infrastructure.
Air pollution prevention through sustainable urban design and traffic management.
Role of policies and regulations in mitigating vehicular pollution and promoting cleaner air.

Module -6 - (8 Hours)

Control technology for particulate and gaseous pollutants - Control technologies for particulate pollutants: electrostatic precipitators, fabric filters, and cyclone separators. Control technologies for gaseous pollutants: scrubbers, catalytic converters, and adsorption techniques.
Basics of noise pollution: sources, types, and characteristics of noise in urban and industrial settings.
Methods of measuring noise: decibel scale, sound level meters, and frequency analysis.
Permissible noise levels in different zones: residential, commercial, industrial, and silent zones.
Effects of noise pollution on health: hearing impairment, sleep disturbance, and cardiovascular impacts.

Text Books:

1. Air pollution control theory by Martin Crawford - McGraw-Hill, 1976
2. Air pollution control by A.C. Stern.
3. Air pollution control by H.C. Perkins - McGraw-Hill, 1974
4. Air pollution control by Joe O. Ledbetter- Dekker, 1972
5. Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, 2nd Edition by John H. Seinfeld, Spyros N. Pandis.
6. Fundamentals of air pollution engineering. Environmental Engineering by Seinfeld, John H.

Course Outcomes:

CO1	Identify natural and anthropogenic sources of air pollution.
CO2	Explain the classification and composition of aerosols (PM2.5, PM10).
CO3	Use the Gaussian plume model to analyze pollutant dispersion.
CO4	Assess the environmental and health impacts of air pollutants.
CO5	Design strategies for controlling air pollutants and improving urban transport.
CO6	Evaluate the economic and social impacts of air pollution and propose solutions.

Water Supply Engineering

Course Code	MT-ME-T- PC-102	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	04	Exam Hours	03

Module-1 – (8 Hours)

Types of water supply systems: centralized, decentralized, and combined systems. Water treatment processes: coagulation, filtration, disinfection, and softening. Water requirements: domestic, industrial, and agricultural demands. Sources of water: surface water (rivers, lakes) and groundwater (wells, aquifers).

Module -2 – (8 Hours)

Water quality parameters: pH, turbidity, dissolved oxygen, and contaminants. Drinking water standards: guidelines for potable water quality and safety regulations. Determination of reservoir capacity: Involves calculating the volume of water a reservoir can store based on inflow, outflow, and storage needs.

Module -3 –(6 Hours)

Transportation and distribution of water: Focuses on designing efficient pipeline networks to ensure reliable delivery to users.
Pumping systems: Includes considerations for pump type, capacity, efficiency, and energy requirements.
Design of pumps: Ensures optimal flow, pressure, and energy consumption in the water supply system.
Water treatment systems: Includes processes like filtration, disinfection, and chemical treatment to ensure safe drinking water.
System planning: Integrates reservoir capacity, distribution networks, and treatment processes for a reliable and efficient water supply.

Module -4 – (10 Hours)

Distribution System Design and Analysis: Involves planning and modeling water or fluid delivery networks for efficient flow, pressure, and coverage.
Optimization of Pipe Network Systems: Focuses on minimizing operational costs by balancing pipe sizes, material choices, and flow requirements.
Distribution Reservoirs: Serve to store water and regulate pressure, ensuring supply during high demand or emergencies.
Service Storage: Refers to the volume required to meet consumer demand, including daily consumption, growth projections, and peak usage.

Module -5 – (6 Hours)

Pipe Network Optimization: Utilizes hydraulic models to adjust parameters like pipe size, flow rate, and pressure for system efficiency.
Long-term Considerations: Design must accommodate future demand growth, maintenance needs, and system sustainability for reliable operation.
Introduction to Physicochemical Processes: Overview of physical and chemical methods used in water treatment for contaminant removal and quality enhancement.

Module -6 - (8 Hours)

Sedimentation: Principles and design of sedimentation tanks, including particle settling and removal of suspended solids.
Coagulation and Flocculation: Study of chemical coagulation agents and the mechanism of floc formation for efficient particle aggregation and removal.
Granular Media Filtration: Principles and operation of filtration systems using sand, gravel, and other media for solid particle removal.
Disinfection Techniques: Methods for microbial control, including chemical disinfection (chlorine, ozone) and physical disinfection (UV light).
Water Softening, Adsorption, and Ion Exchange: Techniques for softening hard water and removing dissolved impurities through adsorption and ion exchange processes.

Text Books :

1. Water Supply Engineering, S.K. Garg, Khana Publishers.
2. Water Supply Engineering, B.C. Punmia, Laxmi Publications.
3. Environmental Engineering: A Design Approach, Sincero& Sincero, PHI.
4. Water and Wastewater Technology, Hammer & Hammer, PHL

CO1	Understand water supply systems (centralized, decentralized, combined) and their applications.
CO2	Apply treatment processes (coagulation, filtration, disinfection, softening) for potable water.
CO3	Analyze water requirements for domestic, industrial, and agricultural use.
CO4	Evaluate surface and groundwater sources for water supply.
CO5	Design efficient water distribution networks and pumping systems.
CO6	Create water treatment solutions using physicochemical methods.

Project Planning & Management			
Course Code	MT-CE-T- PC-103	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	03	Exam Hours	03
Module-1 – (8 Hours)			
Introduction to Project Management , Project Management as a Process, What is a Project, The Project Environment & Ecosystem -- Essential Elements, Kinds of Projects (Examples).			
Module -2 – (8 Hours)			
Project Planning and Scheduling - Bar Charts: Preparation, advantages, and limitations. Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Comparison of CPM and PERT , Processes of project planning, scheduling – progress control - project planning and scheduling techniques.			
Module -3 –(6 Hours)			
Network and Scheduling Techniques –CPM AND PERT, Network diagram, time estimates, activity floats, and determination of the critical path Concept, event and activity times, probability of project completion.			
Module -4 – (10 Hours)			
Use of computer based models - Principles of Project management - Resource Management and Inventory - Implementation of Project Planning Management - Analysis and design of planning and control system.			
Module -5 – (6 Hours)			
The 6 Constraints Of Project Management. The Project Management Cycle, Project Management Processes (Core & Supportive), Project Management Roles & Cultural Differences Project, Management Skills.			
Module -6 - (8 Hours)			
Introduction to Risk Assessment: Contingency planning, A model for adaptive Project management. Disputes and Claims Management - Use of computer based project management tools.			

Text Books:

1. Project Management , Kumar Neeraj Jha
2. Callahan, M. T., Quackenbush, D. G., and Rowings, J. E., Construction Project Scheduling, McGraw- Hill, New York, 1992.
3. Cleland, D. I. and Ireland, L. R., Project Management: Strategic Design and Implementation, 4th Edition, McGraw Hill, New York, 2002

CO1	Define the fundamental concepts of project management, including project processes, environments, and types of projects.
CO2	Explain the techniques of project planning and scheduling, such as bar charts, CPM, and PERT, highlighting their applications and limitations.
CO3	Develop network diagrams, estimate activity times, and determine the critical path using CPM and PERT for effective scheduling.
CO4	Analyze resource management techniques, inventory systems, and project control methods to optimize project implementation.
CO5	Evaluate the constraints, roles, and processes in project management, incorporating cultural and skill-based considerations.
CO6	Design adaptive project management models, including risk assessment, contingency planning, and dispute resolution using software tools.

Solid And Hazardous Waste Management

Course Code	MT-ME-T- PC-103	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	04	Exam Hours	03

Module-1 – (8 Hours)

Solid waste management: Objectives, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, Types, Composition, Quantities, Physical, Chemical and Biological properties.

Module -2 – (8 Hours)

Solid waste generation rate: Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems. Transfer station: Meaning, Necessity, Location,

Module -3 –(6 Hours)

Economic analysis. Transportation of solid waste: Means and methods, Routing of vehicles . Sorting and material recovery: Objectives, Stages of sorting, sorting operations, Guidelines for sorting for material recovery, typical material recovery facility for a commingled solid waste.

Module -4 – (10 Hours)

Composting of solid waste: Principles, Methods, Factors affecting, Properties of compost, Vermicomposting- Introduction to Vermicomposting, Vermicomposting Process, Types of Earthworms, Materials for Vermicomposting, Factors Affecting Composting, Harvesting and Application.

Module -5 – (6 Hours)

Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options. Energy recovery from solid waste: Parameters affecting, Bio methanation.

Module -6 - (8 Hours)

Handling of hazardous waste: handling and segregation of wastes at source - storage and collection hazardous. Wastes -need for transfer and transport - transfer stations optimizing waste. Nuclear waste management.

Text Books:

1. CPHEEO,"Manual on Municipal Solid waste management", Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
2. Micheael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management", Hazardous waste Management, McGraw-Hill International edition, New York, 2001.
3. .Vesilind P.A., Worrell W and Reinhart, "Solid waste engineering", Thomson Learning Inc., Singapore, 2002.References.
4. Manual on municipal solid waste management – Government of India publication.
5. Integrated solid waste management – George Tchobanoglous.
6. Solid waste management – A. D. Bhide.
7. Solid waste management handbook– Pavoni

CO1	Remember the objectives, elements, and environmental impacts of solid waste mismanagement.
CO2	Understand solid waste generation rates, storage, and collection systems.
CO3	Apply economic analysis and transportation methods for solid waste management.
CO4	Analyze composting and vermicomposting methods, evaluating their effectiveness.
CO5	Evaluate thermal processing techniques and energy recovery options.
CO6	Create strategies for hazardous and nuclear waste handling and transportation.

Climate Science and Sustainability			
Course Code	MT-ME-T- PE-105	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	03	Exam Hours	03
Module-1 – (8 Hours)			
Climate change – historical perspectives; Carbon cyclone - the Global Carbon Cycle, the Ocean Carbon Cycle, the Terrestrial Carbon Cycle, Modeling the Carbon Cycle; Non-CO2Greenhouse Gases and Aerosols; Greenhouse Effect: Temp, Radiation, & Energy.			
Module -2 – (8 Hours)			
Introduction to Climate Sensitivity - Factors Affecting Climate Sensitivity, Measuring Climate Sensitivity, Impact of Climate Sensitivity on Global Temperature, Climate Sensitivity and Climate Models, Implications for Climate Policy.			
Module -3 –(6 Hours)			
Linking Human Dimension to Climate Change; Econometric Models and GHG Emissions Scenarios, Climate Projections; Strategies to Slow & Stabilize Climate Change.			
Module -4 – (10 Hours)			
Sequestrations of Atmospheric CO2; Impacts of Climate Change; Climate change & Policy options. Photosynthesis – radiation and its parameters, Solar radiation, Spectrum and effects; Energy balance at the level of a leaf and ecosystem			
Module -5 – (6 Hours)			
Crop production – canopy structure, radiation use efficiency, factors determining productivity.			
Module -6 - (8 Hours)			
Sustainability – Ecosystem services, Millennium ecosystem assessment, Ecological foot print, Energy, Gaia, Climate Change and Sustainability – Natural Resources, Energy & Society at various space and time scale.			

Text Books :

1. Climate Change 2013: The Physical Science Basis, IPCC
2. Climate Change 2014: Impacts, Adaptation, and Vulnerability, IPCC.
3. Kevin E. Trenberth: Climate System Modeling, Cambridge University Press.
4. Kendal McGuffie: Ann Henderson-Sellers: A Climate Modeling Premier, Wiley.
5. Climate Change 2014: Impacts, Adaptation, and Vulnerability, IPCC.
6. Stephen Peak and Joe Smith, Climate Change: From science to sustainability, Oxford University Press.

CO1	Remember historical climate change, carbon cycles, and greenhouse gases.
CO2	Understand factors and measurements of climate sensitivity, and its impact on global temperature.
CO3	Apply econometric models and strategies to assess climate change scenarios and mitigation.
CO4	Analyze CO2 sequestration, climate impacts, and policy options.
CO5	Evaluate photosynthesis, radiation, and energy balance for crop productivity.
CO6	Create sustainable strategies for ecosystem services and resource management in relation to climate change.

Advance Green Technology			
Course Code	MT-ME-T- PE-105	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	03	Exam Hours	03

Module-1 – (8 Hours)

Concept of Green Buildings: Green building initiatives, its origin, characteristics of a green building, green buildings in India, certification of green buildings rating systems (BREEAM, USGBC, LEED, IGBC,TERI-GRIHA,) criteria for rating, sustainability.

Module -2 – (8 Hours)

Sources of Energy: Renewable and non-renewable sources of energy; coal, petroleum, nuclear, wind, solar, hydro, geothermal sources; potential of these sources, hazards, pollution; global scenario with reference to demand and supply in India. Energy arises

Module -3 –(6 Hours)

Carbon Emission: Forecasting, control of carbon emission, air quality and its monitoring carbon footprint; environmental issues, minimizing carbon emission.

Module -4 – (10 Hours)

Green Building Materials: Depleting natural resources of building materials; renewable and recyclable resources; energy efficient materials; green cement, biodegradable materials, smart materials, engineering evaluation of these materials.

Module -5 – (6 Hours)

Green Building Planning and Specifications for green buildings .Design of Green Buildings; Sustainable sites, impact of building on environment, life cycle assessment. Design on Bio climatic and solar passive architecture, considerations of energy consumption, water use, and system reliability, indoor air quality, noise level, comfort, cost efficiency in building design.

Module -6 - (8 Hours)

Construction of Green Buildings: Energy efficient construction, practices for thermal efficiency and natural lighting. Eco- friendly water proofing; ECB codes building rating, maintenance of green buildings. Case studies of residential and commercial green buildings.

Text Books :

1. Tropical housing and buildings climate design (1973). By Koenig's Berger Ltd, Ingeesle, T-G Alan mayhew, s zokoloyS.v University press (India) pot-Ltd Hyderabad

CO1	Remember green building concepts, certifications, and characteristics.
CO2	Understand renewable and non-renewable energy sources and their environmental impact.
CO3	Apply carbon emission control and air quality monitoring techniques.
CO4	Analyze green building materials, their impact, and sustainability.
CO5	Evaluate green building design principles and energy-efficient solutions.
CO6	Create eco-friendly construction practices and maintenance strategies for green buildings.

Internet of Things			
Course Code	MT-CE-T- PE-107	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	03	Exam Hours	03
Module-1 – (8 Hours)			
Introduction to Internet of Things Introduction-Definition & Characteristics of IoT , Physical Design of IoT- Things in IoT , IoT Protocols, Logical Design of IoT- IoT Functional Blocks, IoT Communication Models, IoT Communication APIs , IoT Enabling Technologies- Wireless Sensor Networks , Cloud Computing, Big Data Analytics , Communication Protocols , Embedded Systems, IoT Levels & Deployment Templates.			
Module -2 – (8 Hours)			
Domain Specific IoTs Home Automation: Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Cities-Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Emergency Response, Environment-Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection , River Floods Detection , Energy- Smart Grids , Renewable Energy Systems , Prognostics , Retail-Inventory Management			
Module -3 –(6 Hours)			
Smart Payments , Smart Vending Machines , Logistics-Route Generation & Scheduling , Fleet Tracking ,Shipment Monitoring , Remote Vehicle Diagnostics, Agriculture-Smart Irrigation ,Green House Control ,Industry -Machine Diagnosis & Prognosis Indoor Air Quality Monitoring ,Health &Lifestyle - Health & Fitness Monitoring, Wearable Electronics IoT and M2M Introduction, M2M-Difference between IoT and M2M, SDN and NFV for IoT Software ,Defined Networking , Network Function Virtualization.			
Module -4 – (10 Hours)			
IoT Platforms Design Methodology IoT Design Methodology-Purpose & Requirements Specification ,Process Specification, Domain Model Specification, Information Model Specification , Service Specifications , IoT Level Specification,			
Module -5 – (6 Hours)			
Functional View Specification , Operational View Specification , Device & Component Integration , Application Development, Case Study on IoT System for Weather Monitoring, Motivation for Using Python			
Module -6 - (8 Hours)			
IoT Physical Devices & Endpoints What is an IoT Device-Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi , Raspberry Pi Interfaces – Serial, SPI , I2C , Programming Raspberry Pi with Python-Controlling LED with Raspberry Pi , Interfacing an LED and Switch with Raspberry Pi ,Interfacing a Light Sensor (LDR) with Raspberry Pi , Other IoT Devices-pcDuino, Beagle Bone Black , Cubieboard.			

Text Books :

1. Internet of Things, A Hands on Approach, by Arshdeep Bahga& Vijay audisetti, University Press.
2. The Internet of Things, by Michael Millen, Pearson

CO1	Explain IoT concepts, characteristics, functional blocks, communication models, and enabling technologies.
CO2	Analyze domain-specific IoT applications in areas like home automation, smart cities, environment, and energy systems.
CO3	Evaluate IoT and M2M differences, and explore applications in health, logistics, agriculture, and industry.
CO4	Design IoT systems using methodologies for requirements, process, domain, and service specifications.
CO5	Develop IoT applications by integrating devices, components, and operational specifications, demonstrated through case studies.
CO6	Implement IoT physical devices, such as Raspberry Pi, by interfacing sensors and programming with Python.

Environmental Chemistry and Microbiology

Course Code	MT-ME-T- PE-105	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	03	Exam Hours	03

Module-1 – (8 Hours)

Introduction, Review of basic concepts in chemistry, chemical thermodynamics, concept of chemical equilibrium, Equilibrium constants and activity.

Module -2 – (8 Hours)

Reaction kinetics, acid and basis, polyprotic acids and bases, acidity, alkalinity, carbonate system, pH-CT, buffers, and solubility reactions.

Module -3 –(6 Hours)

Electrochemistry and electrochemical cells, nuclear chemistry, nitrogen chemistry and chlorination.

Module -4 – (10 Hours)

Introduction, the bacteria, the fungi, the algae, protozoa and other higher forms, viruses, pathogens and disease, microbial growth and enumeration, environmental influences, control of microorganisms.

Module -5 – (6 Hours)

Reaction kinetics, acid and basis, polyprotic acids and bases, acidity, alkalinity, carbonate system, pH-CT, buffers, and solubility reactions

Module -6 - (8 Hours)

Introduction, Review of basic concepts in chemistry, chemical thermodynamics, concept of chemical equilibrium, Equilibrium constants and activity.

Text Books :

1. Environmental Chemistry, Sawer and Mccarty, TMH.
2. Microbiology for Environmental Scientists and Engineers, A.F. Gaudy, McGraw-Hill Int Edition.
3. Environmental Chemistry, Benerjee, PHI
4. Microbiology Demystified, Betsy, Tom, Keogh and James, TMH

CO1	Identify and analyze risk events using probability distributions and lifecycle stages in project investments.
CO2	Evaluate risk assessment methods such as sensitivity analysis, decision trees, and certainty equivalent approaches.
CO3	Develop risk mitigation strategies through techniques like elimination, transfer, and pooling, including coverage through risk policies.
CO4	Explain the concept of value and factors contributing to value, identifying unnecessary costs in project scenarios.
CO5	Apply principles of value analysis and elements of job planning to enhance project efficiency and effectiveness.
CO6	Assess the benefits and applications of value analysis, measuring its impact on project outcomes.

Environmental Design - I

Course Code	MT-ME-P- PC-101	IE Marks	100
Teaching Hours/Week (L:T:P)	0:0:2		
Credits	02		

Experiment 1: Basics of environmental design principles, focusing on sustainable and energy-efficient building designs.

Experiment 2: Techniques for analyzing the environmental, climatic, and geographical aspects of a site to influence design decisions.

Experiment 3: Practical exercises on optimizing building orientation for natural lighting, ventilation, and passive solar heating.

Experiment 4: Use of natural light and ventilation in design, including calculations for light levels and airflow.

Experiment 5: Hands-on projects to incorporate energy-saving techniques, such as insulation, passive solar design, and green building materials.

Experiment 6: Practical application of bioclimatic and solar passive design principles to reduce energy consumption and enhance comfort.

Experiment 7: Exploration of renewable, recyclable, and low-impact materials for construction and finishes.

Experiment 8: Design techniques for efficient water management, including rainwater harvesting, greywater reuse, and water-efficient fixtures.

Experiment 9: Performing environmental impact analysis to evaluate the sustainability and ecological footprint of design choices.

Experiment 10: Using software tools to simulate energy performance, thermal comfort, and indoor air quality in building designs.

CO1	Understand sustainable and energy-efficient building design principles.
CO2	Analyze site factors (environmental, climatic, geographical) for design decisions.
CO3	Apply techniques to optimize building orientation for natural lighting and ventilation.
CO4	Evaluate energy-saving strategies like insulation and passive solar design.
CO5	Design buildings using bioclimatic principles and efficient water management.
CO6	Create simulations to assess energy performance and indoor comfort.

Report Writing and Seminar- I			
Course Code	MT-ME-P- PS-102	IE Marks	100
Teaching Hours/Week (L:T:P)	0:0:4		
Credits	02		

CO1	Identify and gather relevant information from credible sources to support seminar topics.
CO2	Organize and structure content effectively for seminar presentations and written reports.
CO3	Analyze audience needs to tailor presentation styles and content for effective communication.
CO4	Develop and deliver impactful seminar presentations using appropriate visual aids and technology.
CO5	Evaluate the quality of reports and presentations through peer review and self-assessment.
CO6	Demonstrate professional writing skills by producing clear, concise, and well-formatted reports.

Environment Computation lab			
Course Code	MT-ME-P- PC-102	IE Marks	100
Teaching Hours/Week (L:T:P)	0:0:2		
Credits	02		
Experiment 1: Introduction on environmental data			
Experiment 2: Environmental statistics estimation (concentration, frequency of detection, minimum detection limit, sample size)			
Experiment 3: Frequency and probability distributions			
Experiment 4: Inferences concerning mean and variance, confidence Interval estimation.			
Experiment 5: Hypotheses test,			
Experiment 6: ANOVA, regression, goodness of fit			
Experiment 7: Factoral experimentation			
Experiment 8: Exceedance factor			
Experiment 9: Intervention model			
Experiment 10: Case studies.			

CO1	Understand environmental data and statistical concepts.
CO2	Apply statistical estimation techniques for environmental data.
CO3	Analyze frequency and probability distributions in data.
CO4	Evaluate mean, variance, and confidence intervals in environmental data.
CO5	Apply hypothesis testing, ANOVA, and regression analysis.
CO6	Create intervention models and analyze case studies for solutions.

2nd Semester

Environmental Impact Assessment			
Course Code	MT-ME-T- PC-201	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	04	Exam Hours	03

Module-1 – (8 Hours)

Introduction Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA – Cross sectoral issues and terms of reference in EIA – Public Participation in EIA. EIA process- screening – scoping - setting – analysis – mitigation.

Module -2 – (8 Hours)

Components And Methods For Eia Matrices – Networks – Checklists – Connections and combinations of processes - Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA.

Module -3 –(6 Hours)

Prediction tools for EIA – Mathematical modelling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment – Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation. EIA methods in other countries.

Module -4 – (10 Hours)

Socio-Economic Impact Assessment Definition of social impact assessment. Social impact assessment model and the planning process. Rationale and measurement for SIA variables. Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition - neighbourhood and community impacts.

Module -5 – (6 Hours)

Selecting, testing and understanding significant social impacts. Mitigation and enhancement in social assessment. Environmental costing of projects.
Environmental Management Plan Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes

Module -6 - (8 Hours)

Post project audit – Ethical and Quality aspects of Environmental Impact Assessment. Sectoral EIA. EIA related to the following sectors - Infrastructure –construction and housing Mining – Industrial - Thermal Power - River valley and Hydroelectric – coastal projects-Nuclear Power. EIA for coastal projects.

Text Books :

1. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey, 2003.
2. World Bank –Source book on EIA.
3. Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science, London, 1999.
4. Canter, L.W., Environmental Impact Assessment and McGraw Hill, New York. 1996.

Course Outcomes:

CO1	Explain the historical development and role of EIA in project cycles.
CO2	Analyze legal frameworks and regulatory aspects of EIA in India.
CO3	Apply EIA tools like matrices, checklists, and networks for impact evaluation.
CO4	Develop predictive models and prepare EIA reports for environmental impacts.
CO5	Evaluate socio-economic impacts and their effect on communities.
CO6	Design Environmental Management Plans and propose mitigation strategies.

Waste Water Engineering			
Course Code	MT-ME-T- PC-202	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	04	Exam Hours	03
Module-1 – (8 Hours)			
Waste waters-Sources, nature and characteristics, Estimation of quantities of waste water flow rate and fluctuations, Determination of quantities of storm water by various methods.			
Module -2 – (8 Hours)			
Waste Water collection systems - Combined and separate sewerage systems, their relative merits, Design of combined and separate system.			
Module -3 –(6 Hours)			
Sewer materials, Sewer appurtenances, Construction and maintenance of sewers and pumping of sewage, different types of pumps used for pumping, their working advantages and disadvantages.			
Module -4 – (10 Hours)			
Methods of analysis - Analysis of waste water-determination of BOD, COD, Solids and volatile solids and their significance, BOD progression and its formulations.			
Module -5 – (6 Hours)			
Design of waste water treatment systems-Primary, secondary and tertiary treatments, screens, grit chambers, sedimentation tanks, chemical precipitation, Biological treatment-objectives.			
Module -6 - (8 Hours)			
Methods and design of activated sludge and trickling filter units, Sewage sludge-its treatment, disposal and reuse, Effluent standards and its disposal.			

Text Books :

1. Sewage Disposal and Air Pollution Engineering, S.K. Garg, Khana Publishers.
2. Wastewater Engineering, B.C. Punmia, Laxmi Publications.
3. Wastewater, Treatment, Disposal and Reuse, Mtcalf& Eddy
4. Water and Wastewater Technology, Hammer & Hammer, PHL

CO1	Describe the sources, characteristics, and estimation of wastewater and stormwater flow.
CO2	Compare combined and separate sewerage systems and their design merits.
CO3	Explain sewer materials, appurtenances, and pumping systems for wastewater.
CO4	Analyze wastewater using BOD, COD, and solid content tests.
CO5	Design primary, secondary, and tertiary wastewater treatment systems.
CO6	Develop activated sludge and trickling filter units and ensure compliance with effluent standards.

Environmental Law and Policy

Course Code	MT-MET- PC-203	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	04	Exam Hours	03

Module-1 – (8 Hours)

Introduction to Environmental Policies, including the significance, objectives, and evolution of environmental regulations at global, national, and local levels.role of governments, NGOs, and case studies of policy successes and failures. **Economics and Environmental Policies** - economic principles like cost-benefit analysis, externalities, green taxes, subsidies, market-based instruments, and sustainable development models, with case studies on effective policy implementation.

Module -2 – (8 Hours)

Industries and Environmental Policies examines industrial pollution, environmental compliance, clean technologies, global standards like ISO 14001, and corporate environmental responsibility, supported by case studies of industrial best practices and challenges. Agriculture and environmental policies; Ecosystem and environmental policies;

Module -3 –(6 Hours)

Environmental policy instruments (EPI); Environmental Policies and Programs in India; Forest conservation activities; NGO movements for environmental protection in India; Environmental Laws and Legislations

Module -4 – (10 Hours)

Private and Public Law
Definition, scope, and distinction between private and public law., Key elements of private law: property, contract, tort, and family law. Public law: constitutional, administrative, and criminal law.Case studies and comparative legal systems.
Principles of International Law
Nature, sources, and subjects of international law., Key principles: sovereignty, jurisdiction, and state equality. Laws of treaties, diplomacy, and use of force. Landmark cases and contemporary issues in international law.

Module -5 – (6 Hours)

Indian Environmental Laws
Constitutional provisions and evolution of environmental laws in India. Key acts: Environment Protection Act, Air and Water Pollution Acts, Forest Conservation Act, Wildlife Protection Act. Environmental Impact Assessment (EIA) framework. Role of judiciary and National Green Tribunal (NGT).
International Institutions
Role of UN bodies: UNEP, UNFCCC, and SDGs. Major treaties: Paris Agreement, Montreal Protocol. World Bank, WTO, and environmental funding. Regional organizations and NGOs in environmental governance. Case studies on international cooperation.

Module -6 - (8 Hours)

Key international treaties; Objectives and principles of legislation; Environmental Legislations in India; Evolution of Indian Legislations; Constitution of India; Union Government initiatives.

Text Books :

1. The Limits of Growth by D. H. Meadows, D. L. Meadow, J. Randers and W. W. Behren, Earth Island Ltd., London.
2. World Commission on Environment and Development, Our Common Future. Oxford University Press, Oxford.
3. Environmental Policies in India by Surendra Kumar, Northan Book Centre, New Delhi.

CO1	Explain the evolution and significance of environmental policies.
CO2	Analyze economic tools like green taxes and subsidies in policy-making.
CO3	Evaluate industrial and agricultural environmental practices and standards.
CO4	Apply policy instruments and assess NGO roles in conservation.
CO5	Interpret key Indian environmental laws and the judiciary's role.
CO6	Assess global treaties and international cooperation in governance.

Computational Methods and Techniques			
Course Code	MT-CE-T- PC-204	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	04	Exam Hours	03
Module-1 – (8 Hours)			
Neural Networks: Artificial Neural Network and Introduction, Learning Rules, Knowledge Representation and Acquisition, Different Methods of Learning.			
Module -2 – (8 Hours)			
Algorithms of Neural Network: Feed-forward Error Back Propagation, Hopfield Model, Kohonen's Featrure Map, K-Means Clustering, ART Networks, RBFN, Application of Neural Network to the relevant field.			
Module -3 –(6 Hours)			
Fuzzy Logic: Basic Concepts of Fuzzy Logic, Fuzzy vs Crisp Set, Linguistic variables ,Membership Functions, Operations of Fuzzy Sets, Fuzzy If-Then Rules, Variable Inference Techniques, Defuzzification, Basic Fuzzy Inference Algorithm, Fuzzy System Design, FKBC and PID Control, Antilock Breaking System(ABS), Industrial Applications.			
Module -4 – (10 Hours)			
Optimization Fundamentals: Definition, Classification of Optimization Problems, Unconstrained and Constrained Optimization, Optimality Conditions. LINEAR Programming: Simplex Method, Duality, Sensitivity Methods.			
Module -5 – (6 Hours)			
NON-LINEAR Programming: Newton's Method, GRG Method, Penalty Function Method, Augmented Langrange Multiplier Method, Dynamic Programming and Integer Programming, Interior Point Methods, Karmakar's Algorithm, Dual Affine, Primal Affine.			
Module -6 - (8 Hours)			
Genetic Algorithm: GA and Genetic Engineering, Finite Element based Optimization, PSO,BFO, Hybridization of Optimization Technique, Application of Optimization Technique for Solving Projects(Project solutions). Implementation of Branch Relevant Industrial Applications by Mat lab Code.			

Text Books :

1. Neural Networks- by Simon Haykin
2. Fuzzy Logic with Engineering Application- by ROSS J.T (Tata Mc)
3. Neural Networks and Fuzzy Logic – by Bart Kosko
4. An introduction Fuzzy Control – by D.Driankor, H. Hellendorn, M.Reinfrank (Narosa Pub)
5. Fuzzy Neural Control – by Junhong NIE & Derek Linkers (PHI) Related IEEE/IEE Publications.
6. Fuzzy System Design Principles, Building Fuzzy IF-THEN Rule Bases – by Riza C. Berikiu and Trubatch, IEEE Press
7. Ashok D. Begundu & chandrapatla T.R "Optimization concept and application in engineering", Prentice Hall,1999
8. Rao S.S "Engineering Optimization"
9. Gill,Murray and Wright ,"Practical Optimization"
10. James A.Memoh. "Electric Power System Application Of Optimization".
11. Song Y.,"Modern Optimization Techniques In Power System"
12. Optimization Research;Prabhakar Pai,Oxford University Press.

CO1	Understand the fundamentals of neural networks, including their learning rules, knowledge representation, and acquisition methods.
CO2	Apply neural network algorithms, such as feed-forward error back propagation and K-means clustering, to solve real-world problems.
CO3	Analyze fuzzy logic concepts, including fuzzy sets, membership functions, and fuzzy inference techniques for designing fuzzy systems.
CO4	Evaluate optimization problems using linear programming techniques, such as the Simplex method and sensitivity analysis.
CO5	Solve non-linear programming problems using methods like Newton's method, dynamic programming, and integer programming.
CO6	Create solutions using genetic algorithms, particle swarm optimization, and other hybrid optimization techniques for industrial applications.

Carbon management for Sustainable Environment

Course Code	**MT-MET- PE-205**	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	04	Exam Hours	03

Module-1 – (8 Hours)

Climate Change Basics - distinction between weather and climate, natural and human-induced causes of climate change, and scientific evidence such as IPCC reports and global climate models.

Greenhouse Basics, focusing on the natural and enhanced greenhouse effect, types and sources of greenhouse gases, and their role in the global energy balance.

Module -2 – (8 Hours)

Climate Change Consequences - environmental impacts like rising sea levels, biodiversity loss, and extreme weather, alongside socio-economic effects on agriculture, health, and global inequalities.

Low Carbon Transition - shift to a low-carbon economy through renewable energy, energy efficiency, sustainable industrial practices, and policy frameworks like carbon pricing.

Module -3 –(6 Hours)

Carbon Footprint Concept - definition, methods of calculation, strategies for reduction, global initiatives, and the role of education in promoting low-carbon lifestyles.

Module -4 – (10 Hours)

Carbon Footprint Measurement - International and Local Standards, Quantifying the Emissions, Carbon Audit Process, Carbon Measurement and Reporting Tools

Module -5 – (6 Hours)

Carbon Trading and Offsetting - Carbon as an asset, Emission Trading Benefits, Current Carbon Market, Carbon Offsetting, Carbon Credits

Module -6 - (8 Hours)

International Protocols and Indian Commitment - towards Sustainable Environment and Development International Protocols like Kyoto Protocol, Paris Agreement, Conference of Parties (CoP), Sustainable Development Goals (SDG), Panchamrit etc., Indian Bills and Acts, Case Studies in Indian Concept, Future Plannings for Carbon Neutrality, Total Carbon Management Model

Text Books :

1. Carbon Management for Sustainable Environment- Shelley W. W. Zhou
2. Carbon Management for Sustainable Environment- Osama Schacht

CO1	Explain the basics of climate change and the greenhouse effect.
CO2	Analyze the environmental and socio-economic impacts of climate change.
CO3	Evaluate strategies for transitioning to a low-carbon economy.
CO4	Apply methods to calculate and reduce carbon footprints.
CO5	Interpret carbon trading, offsetting, and market mechanisms.
CO6	Assess international protocols and India's commitments toward carbon neutrality.

Remote sensing and GIS			
Course Code	**MT-MET- PE-205**	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	04	Exam Hours	03

Module-1 – (8 Hours)

Remote Sensing: Introduction to Remote Sensing: Principles of Remote sensing, Types of Remote Sensing, Advantages of Remote Sensing, Physical basis of Remote Sensing, Applications of Remote Sensing ; History of Remote Sensing; The Electromagnetic spectrum; The nature and generation of Electromagnetic radiation (EMR) Spectral Reflectance Curves.

Module -2 – (8 Hours)

Interaction of EMR with the atmosphere and earth's surface features. Spectral signatures and characteristics, spectral reflectance curves for rocks, soil, vegetation and water features within near and near Infrared. Spectral signatures, Resolution. Remote Sensing observations and platforms: Ground, airborne and satellite based platforms; Some important Remote Sensing Satellites. Aerial Stereo coverage and Remote Sensing Satellites.

Module -3 –(6 Hours)

Sensors: Passive and Active Sensors; Major Remote Sensing Sensors; single and multi band scanners Satellite band designations and principal applications; Colour / False Colour; Aerial Photography/ Aerial Photo Interpretation. USS sensor and other type of sensors. Details of sensors on BOARD LATEST EARTH RESOURCES SATELLITES VIZ.; LANDSAT 6/7/8, SPOT, IKONOS, IRS AND ERS.

Module -4 – (10 Hours)

Digital Image Processing: Pixels and Digital Number; Digital Image Structure; Format of Remote Sensing Data; Image Processing functions: Image Restoration, Image Enhancement, Image Transformation, Image Classification and Analysis; Image interpretation strategies. Visual Photo- Interpretation Techniques based on 'Photo elements' and 'Terrain elements'.

Module -5 – (6 Hours)

Geographic Information System: Introduction, Definition, Preparation of thematic map from remote sensing data, Map Projection and Coordinate system , GIS components: Hardware, software and infrastructures, GIS data types, Data acquisition ,Data Input and Data Processing, and management including topology DEM/ DTM generation.

Module -6 - (8 Hours)

Integration of Remote Sensing and GIS techniques and its applications in Environmental Impact Assessment and Management including some case studies.

Text Books :

1. Remote Sensing and GIS - Anji Reddy M., The Book Syndicate, Hyderabad, 2000.
2. Principles of Geographical Information Systems - P A Burrough and R. A. McDonnell, OUP, Oxford, 1998.
3. Remote Sensing for Earth Resource- Rao, L.P., AEG Publication, Hyderabad, 1987.
4. Geographic Information System- Kang Tsung Chang, Tata Mc Graw Hill, Publication Edition, 2002.
5. Remote Sensing And Image Interpretation Thomas M. Lillesand, Ralph W. Kiefer, Jonatha W. Chipman, Wiley,2003
6. Journal by Insurance company surveyors and loss assessors – Mumbai – published by Insurance companies.

CO1	Explain the principles, types, and applications of remote sensing.
CO2	Analyze the interaction of electromagnetic radiation with the atmosphere and earth's surface.
CO3	Compare passive and active sensors and their applications in remote sensing.
CO4	Apply digital image processing techniques for remote sensing data analysis.
CO5	Interpret GIS components and prepare thematic maps from remote sensing data.
CO6	Integrate remote sensing and GIS for environmental impact assessment and management.

Industrial pollution and Control			
Course Code	**MT-MET- PE-205**	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	04	Exam Hours	03
Module-1 – (8 Hours)			
Introduction: Need of HRD in the context of globalization, Organization Policies various HRD parameters viz. Elements of the ICDP i.e. integrated construction development paradigm.			
Module -2 – (8 Hours)			
Key elements37of HRD such as basic literacy, functional skills, supervisory skills, entrepreneurship skills. Database concept & application in Human Resource Information System.			
Module -3 –(6 Hours)			
Challenges of managing people in construction; organization and management theory; HRM theory; Strategic. HRM approaches; operational HRM approaches; employee relations; employee empowerment; diversity			
Module -4 – (10 Hours)			
Work/life balance; employee welfare; strategic human resource development; employment legislation.			
Module -5 – (6 Hours)			
Recruitment policies, Pre requisites skills- Soft and technical skills. Employee testing & selection Personal Management .			
Module -6 - (8 Hours)			
.Training: –Training of multi-skilled workforce, quality, productivity and employee relations in construction, contractors & sub-contractors – selection, training & development, performance appraisal, potential appraisal, training rewards and recognition etc.			

Reference Books:

1. Neville A.M., 'Properties of concrete', 3rd ed., 1985, ELBS Lea F.M.,
2. 'Chemistry of cement and concrete', 3rd ed., 1970, Edward Arnold Proceedings of recent seminars etc. and journals.

CO1	Understand the need for Human Resource Development (HRD) in the context of globalization and organizational policies, focusing on the Integrated Construction Development Paradigm (ICDP).
CO2	Analyze the key elements of HRD, such as literacy, functional, supervisory, and entrepreneurship skills, and their application in Human Resource Information Systems.
CO3	Evaluate the challenges of managing people in construction, including HRM theory, strategic and operational HRM approaches, employee relations, and empowerment.
CO4	Assess the importance of work-life balance, employee welfare, and strategic HRD, including the impact of employment legislation.
CO5	Apply recruitment policies and evaluate the skills needed for effective employee testing, selection, and personal management in construction organizations.
CO6	Design training programs for a multi-skilled workforce, focusing on quality, productivity, employee relations, performance, potential appraisal, and rewards.

Environmental Hydraulics.			
Course Code	**MT-MET- PE-205**	IE Marks	100
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	100
Credits	04	Exam Hours	03

Module-1 – (8 Hours)
Fluid Properties - key characteristics like density, viscosity, surface tension, and their variation with temperature and pressure, along with measurement techniques. **Flow Formulation** - types of flow (steady, uniform, compressible), the continuity equation, and flow analysis methods, **Turbulent and Viscous Flow**- laminar and turbulent regimes, Reynolds number, boundary layer theory, and practical applications like drag reduction.
Module -2 – (8 Hours)
Energy and Momentum Equations - Bernoulli's and momentum equations, with applications in fluid machinery. **Transition Flow** - shift between laminar and turbulent states, critical Reynolds numbers, and real-world examples. **Uniform and Non-Uniform Flow** - flow profiles, governing equations, and their role in designing hydraulic structures and flow management systems.
Module -3 –(6 Hours)
Open channel flow, gradually varied flow, channel control, critical flow, hydraulic jump. Flow through orifices, gates, flow measurement through Venturimeter, flow through channels, sewer pipes, pressure flow
Module -4 – (10 Hours)
Design and analysis of water distribution network, Hardy Cross and other method of analysis, Head loss computation.
Module -5 – (6 Hours)
Three reservoir problem, reactor hydraulics, concept of plug flow, mixed and turbulent flow through reactor, dispersion number, flow profile
Module -6 - (8 Hours)
Pump hydraulics, measurement of suction head, NPSH, Losses through valves, energy computation, and plumbing hydraulics.

Text Books :

1. Peavy, Rowe, Techobanoglous- Environmental Engg.
2. V.L. Streeter- Fluid Mechanics..

CO1	**Explain** fluid properties and their measurement techniques. *(Understanding)*
CO2	**Analyze** types of flow and apply the continuity equation in flow analysis. *(Analyzing)*
CO3	**Apply** energy and momentum equations to fluid machinery and hydraulic systems. *(Applying)*
CO4	**Evaluate** flow profiles and design hydraulic structures using open channel flow principles. *(Evaluating)*
CO5	**Solve** water distribution problems using methods like Hardy Cross and compute head losses. *(Applying)*
CO6	**Design** pump and plumbing systems considering losses, NPSH, and energy computations. *(Creating)*

Water Supply and Waste water Engineering Lab

Course Code	MT-MEP- PC-201	IE Marks	100
Teaching Hours/Week (L:T:P)	0:0:2		
Credits	02		

Experiment 1: Physical Analysis of Water
Experiment 2: Physical Analysis of Waste Water
Experiment 3: Chemical Analysis of Water
Experiment 4: Chemical Analysis of Waste Water
Experiment 5: Bacteriological Analysis of Water
Experiment 6: Bacteriological Analysis of Waste Water

CO1	Conduct physical analysis of water samples to evaluate quality parameters.
CO2	Perform physical analysis of wastewater to assess its characteristics.
CO3	Carry out chemical analysis of water to determine key constituents.
CO4	Analyze wastewater chemically to identify pollutants and contaminants.
CO5	Examine water for bacteriological content to ensure safety standards.
CO6	Evaluate wastewater bacteriologically to assess treatment needs.

Report Writing and Seminar - II			
Course Code	MT-MEP- PS-202	IE Marks	100
Teaching Hours/Week (L:T:P)	0:0:2		
Credits	04		

CO1	Understand the basics of project planning, including task creation, milestones, and dependencies.
CO2	Apply resource allocation techniques to effectively assign and manage project resources.
CO3	Develop a structured Work Breakdown Structure (WBS) to organize and visualize project tasks.
CO4	Analyze the project schedule using tools like critical path and resource leveling to optimize timelines.
CO5	Evaluate project progress by setting baselines and comparing actual performance against planned schedules.
CO6	Generate and interpret project reports to monitor performance and communicate project status.

3RD Semester

Research Methodology and Intellectual Property Rights			
Course Code	MT-MB-T- ES-301	IE Marks	100
Teaching Hours/Week (L:T:P)	4:0:0	ESE Marks	100
Credits	04	Exam Hours	03

Module-1 – (8 Hours)

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentation.

Module -2 – (8 Hours)

Effective literature studies approaches, analysis, Plagiarism, Research ethics. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Module -3 –(6 Hours)

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

Module -4 – (10 Hours)

International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

Module -5 – (6 Hours)

PATENT RIGHTS Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Module -6 - (8 Hours)

NEW DEVELOPMENTS IN IPR New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text Books :

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.

Course Outcomes:

CO1	Identify and formulate research problems and objectives using systematic approaches.
CO2	Analyze literature, ensure ethical practices, and develop research proposals and reports.
CO3	Explain the nature and process of intellectual property rights, including patents and copyrights.
CO4	Apply international patenting procedures, including PCT processes.
CO5	Evaluate patent rights, licensing, and the use of patent information databases.
CO6	Examine new developments in IPR, including biological systems and traditional knowledge.

E- Waste Management

MT-CE-P- PC -301	MT-ME-TPE-302	IE Marks	100
3:0:0	3:1:0	ESE Marks	100
04	04	Exam Hours	03

Module-1 – (8 Hours)

Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspect of Inspection Assessment procedure for evaluating a damage structure, causes of deterioration.

Module -2 – (8 Hours)

An overview of treatment technologies of E-waste – Introduction, Types of contaminants in E-waste , Treatment strategies of E-waste, Recycling, Landfill disposal , Biological treatment , Advanced methods.

Urban mining of E-waste: treasure hunting for precious nanometals- Introduction, Urban mining E-waste for metals, Extraction of nanometals from E-waste.

Module -3 –(6 Hours)

Policy issues for efficient management of E-waste in developing countries - E-waste and its management, Current practices of E-waste management, Policy comparison between developed and developing countries, Proposed sustainable E-waste management in developing countries.

Module -4 – (10 Hours)

E-waste as a challenge for public and ecosystem health - The composition, fate, and toxic compounds in E-waste, Impacts of E-waste on ecosystem health, Impacts and associated risks of E-waste on public health, Safety measures for final disposal and future perspectives.

Module -5 – (6 Hours)

Electrochemical enhanced metal extraction from E-waste – Introduction, Waste electronic and electrical equipment types, Metallic components in E-waste, Hydrometallurgical recovery methods, Electrowinning and electrorefining processes, Electrochemical enhancement methods for metal recovery, Copper recovery, Gold recovery, Silver recovery, Rare earth elements recovery, Ionic liquids for enhanced electrodeposition, Process summary of the recovery of major elements present in waste electronic and electrical equipment, Process flow chart, Future outlook.

Module -6 - (8 Hours)

Socio-technological challenges in formalization of E-waste recycling in India – Introduction, Review of literature: recycling of E-waste in India, Methodology, Formal recycling technologies used in India, Formalization of E-waste recycling in India, Initiatives for formalization of E-waste recycling in India, Challenges faced by formal recyclers in Delhi-NCR.

Text Books :

1. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi
2. Handbook of Electronic Waste Management - International Best Practices and Case Studies , Elsevier.
3. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009
4. Fowler B, Electronic Waste – 1 st Edition (Toxicology and Public Health Issues), 2017Elsevier
5. E-Resource : https://news.mit.edu/2013/ewaste-mit

Course Outcomes:

CO1	Explain the importance of maintenance and procedures for assessing structural damage.
CO2	Describe treatment technologies and urban mining for E-waste management.
CO3	Analyze policy issues and sustainable E-waste management practices in developing countries.
CO4	Evaluate the health and environmental risks associated with E-waste.
CO5	Apply electrochemical methods for metal recovery from E-waste.
CO6	Assess the socio-technological challenges in formalizing E-waste recycling in India.

Energy Conservation and Environment

MT-CE-P- PC -301	MT-ME-TPE-302	IE Marks	100
3:0:0	3:1:0	ESE Marks	100
04	04	Exam Hours	03

Module-1 – (8 Hours)

Energy Scenario: Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security,

Module -2 – (8 Hours)

Energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change, Energy Conservation Act2001 and its features.

Module -3 –(6 Hours)

Electrical Billing, Power Factor & Capacitors, Load Management, Energy Conservation in Motors & Transformers (Types, Characteristics), Pumps, Compressors, Blowers, Fan Cooling Towers.

Module -4 – (10 Hours)

Energy Conservation Opportunities in Compressed Air Distribution System, Lighting System, Energy Conservation through: Variable Speed Drives.

Module -5 – (6 Hours)

Energy Audit, Need, Types of Energy Audit, Energy Management Audit Approach, - Understanding Energy Costs, Matching Energy Use to Requirement, Maximizing System Efficiencies, Optimizing the Input Energy Requirements, Energy Audit Instruments.

Module -6 - (8 Hours)

Investment Need, Appraisal and Criteria, Financial Analysis Techniques-Simple Payback Period, Return on Investment, Net Present Value, Internal Rate of Return, Cash Flows, Risk and Sensitivity Analysis; Financing Options, Energy Performance Contracts and Role of ESCOs.

Text Books :

1. Energy Conservation in Process Industry, Kenny W.F.
2. Energy Conservation & Utilization, Krenz H. Jerrold
3. Waste Energy Utilization Technology, Kiang, Yen Hsiung
4. Waste less Chemical Processing, Kafarov, V.V.
5. Electrical Energy Utilization & Conservation, Tripathy, S.C.
6. Efficient Electrical use by C.B. Smith
7. Savings Electricity in Utility Systems of Industrial Plants by B. G. Desai, B.S. Vaidya

Course Outcomes:

CO1	Explain energy scenarios, resources, and environmental impacts of energy consumption.
CO2	Evaluate energy conservation strategies and policies for a sustainable future.
CO3	Analyze electrical billing, power factors, and energy conservation in electrical systems.
CO4	Identify energy conservation opportunities in compressed air, lighting, and drive systems.
CO5	Conduct energy audits and apply management approaches to optimize energy use.
CO6	Assess financial analysis techniques for energy projects, including investment and risk analysis.

Renewable Energy

MT-CE-P- PC -301	MT-ME-TPE-302	IE Marks	100
3:0:0	3:1:0	ESE Marks	100
04	04	Exam Hours	03

Module-1 – (8 Hours)

Need of sources of renewable energy: Introduction to different sources of renewable energy, e.g., Solar Energy, Wind Energy, Bio-mass, Geothermal Energy, Ocean energy, Solar Energy and Applications.
Basic concepts of radiations: Solar radiation, Direct and Indirect radiation, Radiation measuring instrument, applications etc.

Module -2 – (8 Hours)

Solar Energy: Basics of solar thermal applications both low and high temperature ranges such as water heating, air heating, steam generation, desalination of water, crop drying and power generation, Principle of photovoltaics including introduction to various components of a photovoltaic systems for standalone/hybrid/grid connected systems

Module -3 –(6 Hours)

Wind Energy: Wind Resource assessment including instrumentation used in resource assessment, basic theory of wind, wind power generators both for decentralized applications and grid connected systems.
Bioenergy: Types and availability of biomass resources, various methods of biomass utilisation for energy generation: gasification, briquette, palatization, syn-gas, Anaerobic/Aerobic digestion, ethanol and biodiesel production, types of Bio-gas digesters, Combustion characteristics of biogas and its different utilizations,

Module -4 – (10 Hours)

Geothermal Energy: availability and methods of utilisation of geothermal resource for thermal applications and electricity generation
Hydro Energy: Basic principle of hydroelectric power generation, classification of hydropower projects (pico, micro, mini, small hydro sand large hydro projects), types of hydro turbine, various components of hydropower projects.

Module -5 – (6 Hours)

Ocean Energy: Principles utilization, thermodynamic cycles, tidal and wave energy, potential and conversion technique, Principle of ocean thermal energy conversion system.

Module -6 - (8 Hours)

Fuel Cells and Hydrogen Energy: Introduction, principle of fuel cells, thermodynamic analysis of fuel cells, types of fuel cells, fuel cell batteries, applications of fuel cells. Hydrogen as a renewable energy source, sources of hydrogen, fuel for vehicles, hydrogen production-direct electrolysis of water, thermal decomposition of water, biological and biochemical methods of hydrogen production.

Text Books :

1.

Course Outcomes:

CO1	To provide knowledge of solar energy concept and applications.
CO2	To impart knowledge of geothermal, ocean and tidal energy and their applications.
CO3	To understand the design of wind mills and applications.
CO4	To understand the turbines and generators for small scale hydroelectric generation.
CO5	To understand the important parts of a biogas plant, design and principle of bio-diesel.
CO6	To provide knowledge of solar energy concept and applications.

Pre Dissertation Evaluation			
Course Code	MT-CC-PPS-303	IE Marks	100
Teaching Hours/Week (L:T:P)	0:0:4		
Credits	10		

CO1	Identify and analyze a well-defined research problem.
CO2	Develop a suitable research methodology.
CO3	Conduct and evaluate a detailed literature review.
CO4	Apply advanced concepts to propose solutions.
CO5	Present interim findings effectively.
CO6	Improve research through critical feedback.

4th Semester

Dissertation Evaluation and Open Defense.			
Course Code	MT-P-PS-401	IE Marks	100
Teaching Hours/Week (L:T:P)	0:0:4		
Credits	16		

CO1	Identify and analyze a well-defined research problem.
CO2	Develop a suitable research methodology.
CO3	Conduct and evaluate a detailed literature review.
CO4	Apply advanced concepts to propose solutions.
CO5	Present interim findings effectively.
CO6	Improve research through critical feedback.

Viva Voce.			
Course Code	MT-P-PS-402	IE Marks	100
Teaching Hours/Week (L:T:P)	0:0:4		
Credits	04		

CO1	Demonstrate a comprehensive understanding of core concepts and principles related to the research or subject matter.
CO2	Apply theoretical knowledge and methodologies to justify the research approach and findings.
CO3	Analyze and critically evaluate questions posed during the viva to provide logical and evidence-based responses.
CO4	Synthesize information from various sources to present coherent and well-structured answers.
CO5	Effectively communicate research objectives, methodology, and conclusions to the examiners.
CO6	Reflect on the feedback and questions received to identify areas for further improvement.