National Institute of Advanced Manufacturing Technology
Ranchi, Jharkhand-834003

Department of Environmental Engineering

M.Tech in Environmental Engineering
(Effective from July 2025)

First Semester

Course Type/Code	Core/Elective	Subjects	Contact time per week			Total Credits
			L	T	P	
MTEE-01-01	Core 1	Physico-Chemical Process for water and wastewater treatment	3	0	0	3
MTEE-01-02	Core 2	Air & Noise Pollution Control Technologies	3	0	0	3
MTEE-01-03	Core 3	Environmental Impact Assessment	3	0	0	3
MTEE-01-04*	Department Elective-I	1.Groundwater Flow and Contaminant Transport through Porous Media 2. Air and Water Quality Modelling 3. Indoor Air Quality	3	0	0	3
MTEE-01-05**	Open Elective-I	1. Environmental Health and Safety 2. Regulatory and Legal Framework for Waste Management 3. Hazardous Waste Management	3	0	0	3
MTEE-01-L01	Core Lab 1	Quality and characteristics of water	0	0	2	1
MTEE-01-L02	Core Lab 2	Air and noise quality analysis	0	0	2	1
MTEE -01-06	MLC	Research methodology and IPR	2	0	0	2
MTEE -01-07	Seminar	Seminar I	0	0	2	1
					Total Credits	**20**

Second Semester

Course Type/Code	Core/Elective	Subjects	Contact time per week			Total Credits
			L	T	P	
MTEE -02-01	Core 4	Biological Process Design for Wastewater Treatment	3	0	0	3
MTEE -02-02	Core 5	Solid Waste Management	3	0	0	3
MTEE -02-03	Core 6	Remote Sensing and GIS applications in Environmental Engineering	3	0	0	3
MTEE -02-04*	Department Elective-II	1 Cleaner Production and Environmental Sustainable Management 2.Life Cycle Analysis for Environment 3. Circular Economy and Sustainability	3	0	0	3
MTEE -02-05**	Open Elective-II	1 Membrane Technologies for Water and Wastewater Treatment 2. Geoenvironmental Engineering 3.Biodegradation and Bioremediation Techniques	3	0	0	3
MTEE-02-L01	Core Lab 1	Wastewater characteristics & solid waste analysis	0	0	2	1
MTEE-02-L02	Core Lab 2	RS & GIS and introduction to Environmental software	0	0	2	1
PES-02-06	PES-I*	Professional & Engineering Skill -I	3	0	0	3
					Total Credits	**20**

Third Semester

Course Type/Code	Core/Elective	Subjects	Contact time per week			Total Credits
			L	T	P	
MTEE -03-01		Major project dissertation Phase – I	0	0	24	12
PES-03-02	PES-II**	Professional & Engineering Skill-II	3	1	0	4
PES-03-03	PES-III***	Professional & Engineering Skill -III	3	0	2	4
					Total credits	20

Fourth Semester

Course Type/Code	Core/Elective	Subjects	Contact time per week			Total Credits
			L	T	P	
MTEE-04-01		Major project dissertation Phase – II	0	40	20	
					Total credits	20

Total credit (Semester I to IV): 20+20+20+20 =80

Physico-Chemical Process for water and wastewater treatment

Mass and Energy Transfer: Material Balance, Steady state conservative systems, steadystate systems with non-conservative pollutants, step function response. Water Quality - Physical, Chemical and Biological Parameters of Water - Water Quality Requirement - Potable Water quality Standards, Wastewater Effluent Standards, Water Quality Indices; Water Resources and Water Supply: Introduction; Water quality definition & characteristics, water quality parameters: physical, chemical, biological, water quality standards, water quality index. Aquifers properties and ground water flow; Hydrological characteristics of aquifers, porosity, permeability, transmissivity, specific retention, diffusivity, Laws of ground water movement, Darcy's law, Collection basic, design and distribution of Water. Water Purification in Natural Systems; Primary, Secondary and Tertiary Treatment - Unit Operations - Unit Processes; Particle Separation Processes - Coagulation and Flocculation Processes, Particle Surface Charge, Surface Potential and Stability of Colloidal Dispersions; Sedimentation and Flotation Processes, Gravity Thickeners, Clarifiers and Flotation Systems - Filtration and Ultrafiltration Processes, Modeling Approaches for Rapid Sand Filters - Solute Separation Processes - Gas Transfer Processes, Diffused and Surface Aeration and Air Stripping of Volatile Contaminants in Packed Tower - Adsorption and Ion Exchange Processes, Sorption Isotherm Models and Rates Considerations, Sorption in Completely Mixed and Packed Bed Reactors - Precipitation Processes - Reverse Osmosis and Electro dialysis - Species Transformation Processes - Chemical Oxidation / Reduction Processes, Disinfection using Chlorine and UV, Advanced Oxidation Process.

References

1. Weber, W. J. Physicochemical processes for water quality control, John Wiley and sons, Newyork, 2003.
2. Peavy, H. S., Rowe, D. R., Tchobanoglous, G. Environmental Engineering, McGraw Hills, New York, 2013.
3. Metcalf & Eddy, Inc. Wastewater Engineering, Treatment and Reuse, 5th Edition, Tata McGraw-Hill, New Delhi, 2013.

Air and Noise Pollution Control

Air Quality: Definitions, characteristics, and perspectives, Various Sources, Classification of Pollutants, impact of various air pollutants- human, plants and property; Air quality index, Standards, norms, rules and regulations. Ambient and Stack Monitoring: Monitoring Techniques, Continuous ambient air quality monitoring stations (CAAQMS), indoor air pollution. Air pollution metrology and dispersion: Elemental properties of atmosphere, influence of meterological phenomenon on air quality, effects of air pollution on meterological conditions, Dispersion modelling - Box models, Gaussian dispersion model, introduction to few air quality simulation packages. Engineered system for particulate matter control: Air Pollution Control– preventive measures, controls at source methods for gaseous and particulates, Mechanism and design of particulate matter control units– Gravitational Settling chambers, Wet Collectors, Centrifugal Collectors, Fabric filters, Electrostatic precipitators. Engineered system for gaseous contaminants: Adsorption, Absorption, Condensation, Combustion and Automobile emissions control, Catalytic Converter in IC engine. Noise pollution: Basics of acoustics and specification

of sound; sound power, sound intensity and sound pressure levels; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, noise standards and limit values; noise instrumentation and monitoring procedure, Noise indices.

References

1. Wark Kenneth and Warner C.F, Air pollution its origin and control. Harper and Row Publishers, New York, 1997.
2. Rao C.S., Environmental pollution control Engineering, New age international Ltd, New Delhi, 2007.
3. Peavy, H.S., Rowe, D.R., Tchobanoglous, G. Environmental Engineering, McGraw Hills, New York 1985.
4. Arcadio P. Sincero and Gregoria A. Sincero, Environmental Engineering –Prentice Hall of India, 1999.

Environmental Impact Assessment

Introduction: Definitions – Environmental Inventory, Standards, Indices – Environmental attributes—Air, Water Noise, Land Economic; Cultural and detailed discussions of individual parameters of each attributes; methods for Prediction and assessment of impacts air – water – soil – noise – biological – cultural – social – economic environments - Standards and guidelines for evaluation.
EIA - EIA Terminology – Need for EIA – Evolution of EIA – Concepts of EIA – Merits and demerits of EIA – Procedures – Screening, Scoping baseline data, Impact prediction – Stake holders of EIA – Public Participation in Decision making – Projects requiring Environmental Clearance –
EIA methodologies – Criteria for Selection -Impact identification, measurement, interpretation and Evaluation – Impact Communication – Adhoc Methods, Checklists Methods, matrices , Networks and Overlays Methods – Cost-Benefit Analysis – Rapid EIA and Comprehensive EIA – General Framework for Environmental Impact Assessment, Characterization and site assessment.
EMP and Monitoring – Document Planning – Scope and Baseline conditions – Construction Stage Impacts – Environmental Management Plan – Identification of significant or Unacceptable Impacts – Environmental Mitigation Plans – Relief and rehabilitation – Environmental Legislation and Audit – Concept of Environmental Risk Analysis and Life Cycle Assessment – Legal and regulatory Aspects in India.
EIA Case Studies of Developmental Projects: Preparation of EIA for developmental projects - Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Mining, Nuclear fuel complex, Highway project, Sewage treatment plant, CETP, Treatment Storage Disposal Facility, Municipal Solid waste processing plant, Tannery industry. Software for rapid EIA.

References

1. Canter R. L., Environmental Impact Assessment, Mc Graw Hill International Edition, 1997.
2. John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company, 1980.

3. Barthwal R. R. Environmental Impact Assessment, New Age International Publishers, New Delhi, 2012.

Groundwater flow and Contaminant Transport through Porous Media

Water Movement in the Subsurface - Groundwater Environment - Types of Aquifers - Sources of Contamination - Saturated Flow - Continuity Equation - Darcy's Law - Equation of Flow - Analytical Solutions and Numerical Modeling - Transport of Contaminants - Transport Equation - Dispersion and Diffusion in Porous Media - Reaction Terms - Adsorption and Surface Complexation Models - Soil Chemical Kinetics - Modeling Groundwater Pollution - Coupling of Contaminant - Soil Interactions with Transport - Reaction and Transport of Trace Metals, Ligands and Non-polar Organic Solutes - Model Input Parameters - Initial and Boundary Conditions - Calibration - Sensitivity Analysis - Groundwater Transport Modelling Using VISUAL MODFLOW.

References

1. Zheng, C. and Bennett, G. D., Applied contaminant Transport Modeling, A John wiley& sons, inc, publication, Newyork, 2002.
2. *Freeze, R.A. and Cherry. J.A. Groundwater, Prentice Hall, 1979.*
3. *Sun, N. Z., Mathematical modelling of groundwater Pollution, Springer –Verlac Newyork Inc., and Geological publishing house, 1996.*
4. *Grathwohl, P., Diffusion in Natural Porous Media: Contaminant Transport, Sorption, desorption and Dissolution Kinetics, Kluwer Academic, Boston, 1998*

Air and Water Quality Modeling

Air Quality Modelling: Importance of Air quality Modelling, Components of air quality Modelling, Types of air quality models, Dispersion based models and Receptor based models, Deterministic and Stochastic models. Lagrangian and Eulerian Models.
Water quality modeling: Modelling and Monitoring, Evolution of Water Quality Models, Types of Water Quality Models, Streeter Phelps Model, Non-Point Source Pollution, Modelling. Approaches For Modeling Non-Point Sources, River Water Quality Models and Lake Quality Models, Water quality indices.
Water Quality Management: Overview of Water Quality Management, Water Quality degradation, Flow Augmentation, environmental flows in rivers, water quality restoration, , Regulatory Provisions Pertaining to Water Quality Management, Water quality indices and Legal Aspects of Water quality management, Public and Private Sector Involvement.

References

1. Air Pollution: Measurement, Modeling and Mitigation, Colls, J., CRC Press, 2009
2. Surface Water Quality Modelling, Chapra, S.C. ISBN-13: 978-1577666059; ISBN-10: 1577666054, Waveland Press, 2008
3. Water Quality Modelling for Rivers and Streams, Marcello Benedini, George Tsakiris. Springer Science & Business Media, 2013.
4. Principles of Water Quality Management, Eckenfelder, ISBN 978-94-011-7117-5, Elsevier, 1980

Indoor Air Quality

Indoor Activities of Inhabitants - Levels of Pollutants in Indoor and outdoor Air - Design and Operation of Buildings for Improvements of Public Health - IAQ Policy Issues - Sustainability - Air Pollutants in Indoor Environments - Private Residences, Offices, Schools, Public Buildings - Ventilation - Control of Several Pollutant Classes - Radon - Toxic Organic Gases - Combustion Byproducts - Microorganisms such as Molds and Infectious Bacteria - Concepts and Tools - Exposure - Material Balance Models - Statistical Models - Indoor Air Pollution from Outdoor Sources - Particulate Matter and Ozone - Combustion Byproducts - Radon and its Decay Products - Volatile Organic Compounds - Odors and Sick - Building Syndrome - Humidity - Bio Aerosols - Infectious Disease Transmission - Special Indoor Environments - A/C Units in Indoor - Measurement Methods - Control Technologies - Control Strategies.

References

1. Thaddes Godish, Indoor air and Environmental Quality, CRC press, 2000.
2. Nazaroff W.W. and L. Alvarez-Cohen, Environmental Engineering Science, Wiley sons, Newyork, 2001.
3. Indoor Air Quality Handbook, John D. pengler, John F. McCarthy, and Jonathan M. Same, McGraw Hill, 2000.

Environment Health and Safety

EHS Management System: Purpose and responsibility, EHS Program Goals and Objectives, EHS Program, EHS Committees, Workplace Inspections, EHS Self-Inspection Checklists, Introduction to Environmental Compliance Injury, Illness, and Near Miss: Reporting Incidents, Personal Injuries, and Near Misses, Incident Investigation of Injuries, Illnesses, and Near Misses Workers, Lost-Time Injuries and Illnesses, Return to Work Program, First Aid, Travel Immunization Program Fire Safety: Emergency Planning and Evacuation, Fire Emergency Procedure, Reporting Fires, Life Safety: Exitways, Life Safety Policy, Life Safety: Public Assemblies, Portable Fire Extinguishers, Storage and Use of Flammable and Combustible Liquids, Sign and Tag Requirements for Accident Prevention, Fire and Life Safety Coordination, Managing Fire Alarms, Life Safety: Electrical Equipment, Exterior Open Flame, Policy on Fire Protection System Impairments, False Alarm Ordinance, Building Emergency Coordinators Occupational Safety Policies: Industrial Hygiene Program Requirements, Medical Surveillance, Hearing Conservation Program, Use of Chemical Carcinogens, Chemical Waste Disposal, OSHA Bloodborne Pathogens Standard, OSHA Laboratory Standard, Use of Biohazardous Agents, Product or Device Alert/Recall, Personal Protective Equipment, Eye and Face Protection, Eye Protection for Chemistry Lab Courses, Foot Protection, Compliance with Laboratory Safety Standards, Respiratory Protection Program, Laboratory Ventilation Policy, Clearance of Laboratories Where Hazardous Materials Have Been Used, Indoor Air Quality Policy

References

1. National Research Council (US), Committee on Prudent Practices in the Laboratory (2011). Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, updated version, National Academies Press, USA.

2. Environment, Health and Safety Manual (2020), The university of North Carolina at chapel hill, North Carolina, USA.
3. Tortora GJ, Funke BR, and Case CL, Microbiology: An Introduction, Pearson Education, 2019, 4th Edition

Regulatory and Legal framework for Waste Management

Introduction: Overview of waste management in India, importance of legal and regulatory frameworks, Difference between Regulatory and Legal frameworks, Legal Landmarks in the History of Waste management in India, Institutional framework on solid waste management in India.
Waste Management Laws in India: The Environmental Protection Act, The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, The Plastic Waste (Management and Handling) Rules, 2011, Bio-Medical Waste (Management and Handling) Rules, 1998, The E- Waste (Management and Handling) Rules, 2011, The Batteries (Management and Handling) Rules, 2001.
Solid waste management rules 2016: Source segregation of waste and Duties of waste generator, Introduction of the concept of partnership in Swachh Bharat, Collection and disposal of sanitary waste, Collect back scheme for packaging waste, User fee and spot fine, Promotion of marketing and utilization of compost, Promotion of waste to energy, Criteria and standards for waste treatment facility and pollution control, Management of waste in hilly areas, Duties of constitutional bodies and Ministries.
Regulatory and Legal policy making in Waste Management: Waste management protocol during epidemics, Circular economy in waste management, Role of global economy, Stake holder engagement, Best practices in India and Abroad- Case studies

References

1. "National Environment Policy, 2006", Ministry of Environment and Forests, Government of India, Approved by the Union Cabinet on 18 May, 2006
2. 'Municipal solid waste management Manual Part 1,2 & 3"(2016), Central public health and environmental engineering organization, Ministry of Urban Development, Government of India.

Hazardous Waste Management

Introduction to Hazardous Waste: Definition and sources; Identification and classification; Management in developing countries; Collection, handling, storage and transport; TSDF concept; Rules and regulations. Steps in Risk Assessment, Risk Assessment in Siting of a Hazardous Waste Disposal Facility-Case study.
Hazardous Waste Treatment and Disposal: Treatment technologies – physical treatment, chemical treatment, physico-chemical treatment, thermal treatment; Specific techniques – solidification and chemical fixation, encapsulation, pyrolysis and incineration; Disposal - hazardous waste landfills, waste reduction, recycling and reuse, remediation of contaminated sites
Plastic Waste: Overview – sources and production, global and Indian Context; Management practices - recycling, energy production, landfilling, other applications.

Battery Waste: Overview – sources and production, global and Indian Context; Management practices – recycling.
E-Waste: Introduction - E-waste characteristics; Generation and management – collection and transport, recycling and disposal; Effects on society and environment; E-waste management rules
Biomedical Waste: Introduction – definition and sources of biomedical waste; Classification and management – collection and segregation, treatment and disposal; Management rules
Nuclear Waste: Characteristics and types; Sources - uranium mining and processing, Power reactors, refinery and fuel fabrication, spent fuel; Management – waste management techniques, decommissioning of reactors; Health and environmental effects

References

John Pichtel, Waste Management Practices: Municipal, Hazardous and Industrial, CRC Press, 2014, 2nd Edition
2. LaGrega M.D., Buckingham P.L. and Evans J.C.,Hazardous Waste Management, Waveland Pr Inc., 2010, Reissue Edition.
3. Tchobanoglous G, Theisen H and Vigil SA, Integrated Solid Waste Management, Engineering Principles and Management Issues, McGraw Hill Education, 2014, Indian Edition
4. Richard J. Watts, Hazardous Wastes - Sources, Pathways, Receptors, John Wiley and Sons, 1998, 1st Edition.

Research Methodology and IPR

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 instrumentations. Effective literature studies approaches, analysis Plagiarism and 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.
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property, Procedure for grants of patents, Patenting under PCT.
Patent Rights: Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications.
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.

References

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques, New Age International publishers, Third Edition.
2. Ranjit Kumar, Research Methodology: A Step by Step Guide for Beginners, 2nd Edition, SAGE, 2005.
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition

4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approach. Sage publications, 2013.

Seminar I

There is no specific syllabus for this course. However, student can choose any topic, of his choice, pertaining to Environmental Engineering. Topic should be a relevant and currently researched one. Students are advised to refer articles published in current journals in Environmental Engineering for choosing their seminar topics. Student should review minimum of 5 to 6 research papers relevant to the topic chosen, in addition to standard textbooks, handbooks, etc. Students are required to prepare a seminar report, in the standard format and give presentation to the Seminar Assessment Committee (SAC) in the presence of their classmates. It is mandatory for all the students to attend the presentations of their classmates.

References

1. Research Articles / Reports available on Internet
2. Environmental Engineering Journals
3. Environmental Engineering Textbooks and Handbooks

Online Resources:
1. Guidelines for the Preparation and Delivery of a Seminar Presentation:
http://www2.cs.uregina.ca/~hilder/cs499-900/Presentation%20Guidelines.pdf

2. Guidelines on Seminar
Presentation:http://foodsci.rutgers.edu/gsa/SeminarGaudelines.pdf

3. http://onlinepubs.trb.org/onlinepubs/circulars/ec194.pdf

4. Instructor Resources: Seminar Proposal Guidelines, SAE International;
http://www.sae.org/training/seminars/instructorzone/proposalguidelines.pdf

Biological Process Design for Wastewater Treatment

Constituents of Wastewaters - Sources - Significant Parameter - Fundamentals of Process Kinetics, Zero Order, First Order, Second Order Reactions, Enzyme Reactions - Bio Reactors - Types, Classification, Design Principles - Design of Wastewater Treatment Systems -Primary, Secondary and Tertiary Treatments - Evaluation of Biokinetic Parameters - Activated Sludge and its Process - Modifications, Biological Nitrification and Denitrification - Attached Growth Biological Treatment Systems -Trickling Filters - Rotating Biological Contactors - Waste Stabilization Ponds and Lagoons - Aerobic Pond, Facultative Pond, Reed beds/Root Zone, Anaerobic Ponds- Polishing Ponds, Aerated Lagoons – Anaerobic Processes - Process Fundamentals - Standard, High Rate and Hybrid Reactors, Anaerobic Filters-Expanded / Fluidized Bed Reactors - Upflow Anaerobic Sludge Blanket Reactors - Expanded Granular Bed Reactors - Two Stage/Phase Anaerobic Reactors - Sludge Digestion, Sludge Disposal.

References

1. *Benefield, L.D. and Randall C.W. Biological Processes Design for wastewaters, Prentice-Hall, Inc. Eaglewood Cliffs, 1989.*
2. *Grady Jr. C.P.L and Lin H.C. Biological wastewater treatment: Theory and Applications, Marcel Dekker, Inc New York, 1980.*
3. *Metcalf & Eddy, Inc. Wastewater Engineering, Treatment and Reuse. 3rd Edition, Tata McGraw-Hill, New Delhi, 2003.*
4. *Arceivala, S. J. and Asolekar, S. R., Wastewater Treatment for Pollution Control, 3rd Edition, McGraw-Hill Education (India) Pvt. Ltd., New Delhi, 2006.*

Solid Waste Management

Introduction: Impacts on Environment, sources and types of waste, characteristics, Legislation, management and handing rules, collection and processing, transfer stations, materials separation, material handling, recycling of components.
Processing and disposal: Thermal conversion, incineration, pyrolysis, gasification, pelletization, biological processing, composting, vermiculture, chemical processing, disposal of solid waste on landfill, types of landfill, components of landfill, landfill operation, management of landfill sites.
Leachate management and landfill gas control: Characteristics, management system, landfill liners, collection system, detection and remediation, recirculation, treatment, composition, gas generation estimation, gas migration, collection, monitoring.
Industrial waste management and site remediation: waste management- properties, classification, generation of industrial waste; industrial waste characteristics - TCLP tests; transportation; labeling of industrial waste: physical, chemical and biological treatment of industrial waste and disposal of industrial waste; remediation of contaminated sites, case studies (domestic waste, flyash, construction waste, foundry waste etc.).

References

1. *Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, Environmental Engineering, McGraw Hill Inc., N.York, 1985*
2. Tchobanoglous G, Theisen H and Vigil SA, Integrated Solid Waste Management, Engineering Principles and Management Issues' McGraw-Hill, 1993
3. Khan I.H, and Ahsan N, Text book of Solid Wastes Management, CBC Publishers & Distributors, New Delhi, 2003

Remote Sensing and GIS applications in Environmental Engineering

Introduction: Types, Application and Importance of Remote Sensing; Physics of Remote Sensing; The Electromagnetic spectrum; Spectal Reflectance Curves; Spectral Signatures; Resolution, Remote Sensing Platforms: Ground, airborne and satellite based platforms; Some important Remote Sensing Satellites.
Sensors: Passive and Active Sensors; Major Remote Sensing Sensors; Satellite band designations and principal applications; Colour/False Colour, Aerial Photography/Aerial Photo Interpretation.

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.
Geographic Information System: Introduction; Preparation of thematic map from remote sensing data; Co-ordinate systems; GIS components; Hardware, software and infrastructures; GIS data types: Data input and Data Processing; DEM/DT, generation.
Integration of GIS and Remote Sensing: Application of Remote Sensing and GIS in Water resources, Urban Analysis, Watershed Management Resources Information Systems. Global Positioning System an introduction.

References

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, D.P., AEG Publication, Hyderabad, 1987.
4. Geographic Information System- Kang Tsung Chang, Tata Mc Graw Hill, Publication Edition, 2002.

Cleaner Production and Environmental Sustainable Management

Concepts of Sustainable Development - Indicators of Sustainability - Sustainability Strategies, Barriers to Sustainability - Resource Degradation - Industrialization and Sustainable Development - Industrial Ecology - Socio Economic Policies for Sustainable Development - Clean Development Mechanism, - Principles and Concepts of Cleaner Production - Definition - Importance - Historical Evolution - Benefits - Promotion - Barriers - Regulatory versus Market Based Approaches - Environmental Management Hierarchy - Source Reduction Techniques - Process and Equipment Optimization, Reuse, Recovery, Recycle, Raw Material Substitution - Overview of CP Assessment Steps and Skills - Process Flow Diagram - Material Balance - CP Option Generation - Technical and Environmental Feasibility Analysis - Economic Valuation of Alternatives - Total Cost Analysis - Pollution Prevention and Cleaner Production Awareness Plan - Waste Audit -Environmental Statement - Green House Gases and Carbon Credit - Carbon Sequestration- Sustainable Development through Trade - Carbon Trading - Ecotoxicology - Hazards by Industry and its Environmental Effects - Relationship of Occupational Hygiene / Safety and Disease - Overview, Planning, Hazard Identification and Risk Assessment - Pesticides and Environment - Response to Toxic Exposures - Dose Response, Frequency Response and Cumulative Response - Lethal and Sub-Lethal Doses - Dose - Response Relationships between Chemical and Biological Reactions - Detoxification in Human Body - Detoxification Mechanisms, Organs of Detoxification - Green Energy and Green Process Management in Pharmaceutical, Construction, Textiles, Petroleum Refineries, Iron and Steel Industries.

References

1. J. Kirkby, P. O'Keefe and Timberlake, Sustainable Development, Earthscan Publication, London, 1999.

2. P.L. Bishop, Pollution Prevention: Fundamentals and Practice, McGraw Hill International, 2004.
3. P. Modak, C. Visvanathan and M. Parasnis, Cleaner Production Audit, Environmental System Reviews, Asian Institute of Technology, Bangkok, 1995.
4. H. Koren, Handbook of Environmental Health and Safety -principle and practices, Lewis Publishers, 3rd Edition, 1995.
5. I. C. Shaw and J. Chadwick, Principles of Environmental Toxicology, Taylor & Francis ltd, 2000.

Life Cycle Analysis for Environment

A brief history of Life-cycle Inventory analysis: overview of methodology, three components, Identifying and setting boundaries for life-cycle stages, issues that apply to all stages, Applications of inventory analysis. Procedural framework of Life-cycle inventory: Introduction, define the purpose and scope of inventory. General issues in Inventory analysis: Introduction, Using Templates, Data issues, special case boundary issues. Issues Applicable to specific life cycle stages: Introduction, Raw Material acquisition stage, Manufacturing stage, Use/Reuse/Maintenance stage, Recycle/Waste Management stage.
Term Project Proposal, Process Based LCA, Software Demo: SimaPro Part-1, LCA Software Demo: SimaPro Part 2, LCA Software Demo: GREET, LCA Software Demo: BEES (Construction Materials).

References

1. Ciambrone , D.F, Environmental Life Cycle Analysis,., (2019)., Taylor and Francis Group, UK.
2. Jeroen Guinee, Handbook on Life Cycle Assessment: Operational guide to the ISO standards, , (2014).,Springer, USA.
3. Hauschild, M. Z., Rosenbaum, R. K., & Olsen, S. I, Life Cycle Assessment - Theory and Practice, (Eds.) (2018). . Springer. https://doi.org/10.1007/978-3-319-56475-3

Circular Economy and Sustainability

Introduction to circular economy: Purpose of circular economy, Circular sustainability, Challenges for circular economy. Concept of sustainable development: Sustainable processes technologies and Critical assessment on current sustainable technologies. Circular bioeconomy, Circular Business Models. Circular business models to create economic and social value.
Circular economy policy framework: universal circular economy policy gals, role of governments and networks and how policies and sharing best practices can enable the circular economy. Circular economy towards zero waste: circular economy and waste sector, waste management in the context of circular economy

References

1. Walter R Stahe, The Circular Economy A User's Guide, Taylor & Francis, 2019, First edition
2. Peter Lacy, The Circular Economy Handbook: Realizing the Circular Advantage, Palgrave Mac-millan, 2020, first edition

3. Lacy P, Rutqvist J, Waste to wealth: The circular economy advantage, Palgrave Macmillan, 2015, first edition
4. Franco-García, María-Laura, Jorge Carlos Carpio-Aguilar, and Hans Bressers, Towards Zero Waste: Circular Economy Boost, Waste to Resources, Springer International, 2019.

Membrane Technologies for Water and Wastewater Treatment

Principles of Membrane Processes - Types and Classification - Theory of Membrane Separation - Types and Choice of Membranes - Liquid Membranes - Characterization of Membranes - Recent Development in Membranes - Modules and Washing Process - Electrodialysis - Principles, Electrodialysis Stack and its Various Components - Ion Exchange Capacity - Electrical Resistance of Ion Exchange Membrane - Donnon Dialysis - Reverse Osmosis - Theory and Principle - Membrane Materials - Design Considerations - Filtration- Theory - Nanofiltration - Ultrafiltration -Microfiltration - Membrane Module/Element Designs - Design of Membrane Systems - Membrane Bioreactors - Bio treatment Fundamentals - Biomass Separation - Principles - MBR Design Principles - Submerged Anaerobic Membrane Bioreactors - Fouling - Pretreatment Methods and Strategies - Langlier and Silt Indexes - Cleaning Methods - Foulants Analysis - Disposal of RO Concentrate - Rejects in Membranes - Synthetic Membranes - Preparation Methods - Composite Membranes - Preparation Methods and Applications - Immersion Precipitation Preparation Techniques - Phase Inversion Membranes - Introduction to Module and Process Design.

References

1. R.D. Noble and S.A. Stern, Membrane Separations Technology: Principles and Applications, Elservier, 1995.
2. E.D. Schroeder, Water & Wastewater Treatment, McGraw Hill, 1977.
3. J.G. Crespo and K.W. Boddekes, Membrane Processes in Separation and Purification, Kluwer Academic Publications, 1994.
4. R. Rautanbach and R. Albrecht, Membrane Process, John Wiley & Sons, 1989.

Geoenvironmental Engineering

Basic concepts related to soil pollution; Sources of pollution- industrial, mining, agricultural, and municipal; types of contaminants; Impact of contamination- physical and chemical properties of soil; Retention behavior- governing factors, sorption characteristics, isotherms; Contaminant transport- saturated and unsaturated flow, pore size distribution characteristics; Site investigation- Soil sampling, sample handling, transportation, characterization, preservation and storage; Non-destructive techniques- electromagnetic, thermal and seismic, Soil remediation- need and approach, Techniques- soil washing, permeable reactive barriers, solidification, vacuum extraction, electro kinetic remediation, thermal desorption; Bioremediation, phytoremediation, soil fracturing; Case studies on polluted sites and issues related to environment. Containment systems and basic principles – carbon dioxide sequestration, Grout curtains, Ground freezing, Compacted soil liners, Geosynthetic clay liners.

References:

1. Rowe R.K., "Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
2. Reddi L.N. and Inyang, H. I., "Geoenvironmental Engineering, Principles and Applications" Marcel Dekker Inc. New York, 2000.
3. Yong, R. N., "Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation" CRC Press, New York, 2001.
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Biodegradation and Bioremediation Techniques

Environmental Biotechnology - Principles and Concepts - Usefulness to Mankind - Degradation of High Concentrated Toxic Pollutants - Halogenated, Non Halogenated, Petroleum Hydrocarbons, Metals - Mechanisms of Detoxification -Oxidation - Dehalogenation - Biotransformation of Metals - Biodegradation of Solid Wastes - Biotechnological Remedies for Environmental Pollution - Decontamination of Groundwater - Bioremediation - Production of Proteins - Biofertilizers - Physical, Chemical and Microbiological Factors of Composting - Health Risk - Pathogens -Odor Management - Microbial Cell/Enzyme Technology - Adapted Microorganisms -Biological Removal of Nutrients - Algal Biotechnology - Extra Cellular Polymers - Biogas Technology - Concept of rDNA Technology - Expression Vectors - Cloning of DNA - Mutation - Construction of Microbial Strains - Radioactive Probes - Protoplast Fusion Technology - Applications - Environmental Effects and Ethics of Microbial Technology - Genetically Engineered Organisms - Microbial Containment - Risk Assessment. Bioremediation and Biodegradation - Microbial Catabolism of Organic Pollutant - Catabolic Enzymes - Biodegradation Detoxication Reactions - Biodegradation Kinetics - Requirements of Biodegradation – Nutritional, Environmental and Biological Factors - Monitoring and Assessment Methods - Soil Enzyme Assay - Bacterial Biosensors - Toxicological Risk Assessments - Improved Bioremediation by Engineering Microbes - Bioadsorbents - Metal Precipitation - Enzymatic Transformation of Metals.

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