National Institute of Advanced Manufacturing Technology

Hatia, Ranchi-834003

(Formerly National Institute of Foundry and Forge Technology)

(Centrally Funded Technical Institute, Under MHRD, Govt of India)

(Affiliated under Jharkhand Technical University)

Syllabus

M.Tech (Environmental Engineering)

Department of Applied Science and Humanities

2021

Master of Technology (M. Tech) in Environmental Engineering

National Institute of Advanced Manufacturing Technology (NIAMT)
Ranchi, Jharkhand
Department of Applied Sciences and Humanities
M.Tech in Environmental Engineering
July 2020 onwards

First Semester

Course Code	Core/ Elective	Subjects	Contact time per week			Total Credits
			L	T	P	
EE1101	Core 1	Environmental Chemistry	3	0	0	3
EE1102	Core 2	Water Treatment and Supply System	3	0	0	3
EE113*	Elective I	**EE1131** Solid & Hazardous Waste Management **EE1132** Waste Management	3	0	0	3
EE114*	Elective II	**EE1141** Remote Sensing and GIS **EE1142** Geoinformatics	3	0	0	3
EE115*	Open Elective	**EE1151** Instrumental Techniques in Science and Technology	3	0	0	3
EE1111	Core Lab I	Env. Engg lab I (Env Chemistry)	0	0	4	2
EE1112	Core Lab II	Env Engg Lab II (Water, Air & Noise parameters analysis)	0	0	4	2
EE1103	MLC	Research Methodology and IPR	2	0	0	2
EE112*	Audit 1	Audit course 1	2	0	0	0
					Total	**21**

Second Semester

Course Code	Core/ Elective	Subjects	Contact time per week			Total Credits
			L	T	P	
EE1201	Core 3	Air and Noise Pollution Control	3	0	0	3
EE1202	Core 4	Wastewater Engineering	3	0	0	3
EE125*	Elective IV	**EE1251** Environmental Policies, Laws and Impact Assessment **EE1252** Environmental Management	3	0	0	3
EE126*	Elective V	**EE1261** Thermodynamics and Atmosphere **EE1262** Environmental Fluid Mechanics	3	0	0	3
EE127*	Elective VI	**EE1271** Renewable Energy System and Generation **EE1272** Green Technology and Alternative Energy	3	0	0	3
EE1211	Core Lab III	Env Engg Lab III (Wastewater parameter analysis)	0	0	4	2
EE1212	Core Lab IV	Env. Engg Lab IV (Introduction to RS & GIS)	0	0	4	2
EE1229	Core	Mini Project	0	0	4	2
EE122*	Audit 2	Audit course 2	2	0	0	0
					Total	**21**

Third Semester

Course Code	Core/Elective	Subjects	Contact time per week			Total Credits
			L	T	P	
EE2128		Industrial training (4 weeks)	0	0	0	0
EE2129	Dissertation	Dissertation Phase I	0	0	20	10
					Total	**10**

Fourth Semester

Course Code	Core/Elective	Subjects	Contact time per week			Total Credits
			L	T	P	
EE 2229	Dissertation	Dissertation Phase – II	0	0	32	16
					Total	**16**

Total Credit for the programme = 21+21+10+16 = 68

Audit course 1 & 2

EE1*21 English for Research Paper Writing
EE1*22 Disaster Management
EE1*23 Sanskrit for Technical Knowledge
EE1*24 Value Addition
EE1*25 Constitution of India
EE1*26 Pedagogy Studies
EE1*27 Stress Management by Yoga and aerobics
EE1*28 Personality Development through Life Enlightenment Skills.

EE1101: Environmental Chemistry (3-0-0: 3 credits)

Unit – I

Basic Concepts of Chemistry: Atomic weight, Valency, Oxidation state, Oxidation reduction equation, Vapour pressure, Surface tension, Acids-Bases, Buffer, Solubility of salts, introduction to organic chemistry Langelier saturation Index, E_H-pH diagram.

(6 lectures)

Unit - II

Environmental Chemistry of Water: The principles and application of aqueous chemistry to the environmental systems. Unique properties of water, Water quality criteria and standards, water quality monitoring and management aspects. Membrane processes: Osmosis & Dialysis, electrochemistry, Chemical kinetics, catalysis, and adsorption. (7 lectures)

Unit - III

Atmospheric Chemistry: Structure and properties of atmosphere, Classification and chemistry of major air pollutants and their control, Types and sources of air pollution-natural, combustion and other combustion sources, Atmospheric photochemistry, chemical and photochemical reactions in atmosphere. Thermodynamics and kinetics of air pollutants, atmospheric pollution due to automobile emissions and its control, smogs, PAH, VOCs, Acid rain, Depletion of stratospheric ozone. (12 lectures)

Unit - IV

Soil Chemistry: soil properties, Acid-Base and Ion-exchange reactions in soils. Macro- and micro-nutrients, Fertilizers and other soil amendments, Waste and pollutants in soil, Heavy metals and radionuclides in soil, Colloidal chemistry of inorganic constituents, clays, Organic matter and soil humus, absorption in soils - forces and isotherms, soil as cation and anion exchanger; degradation of natural substances; remediation of metal contaminated soil.

(7 lectures)

Unit - V

Environmental Biochemistry: Biosphere in stabilizing the earth system, metabolism and control in organisms, Biomolecules – Proteins, carbohydrates, lipids, enzymes, nucleic acids, metabolic process, metabolism of xenobiotic compounds, toxicological chemistry, effects, toxicological chemistry of inorganic and organic substances. (6 lectures)

Books and references

1. Environmental Chemistry - Stanley E. Manahan, 5th Ed., Lewis Publishers, 1995.
2. Chemistry for Environmental Engineering and Sciences (5th Ed) - CN Sawyer, PL McCarty and GF Parkin, Tata McGraw-Hill ed., New Delhi, 2003.
3. Aquatic Chemistry -W.Stumm& JJ Morgan, John Wiley & Sons, Inc, 3rd Ed., NY-1995.
4. Environmental Soil Chemistry (2nd Ed) - Donald Sparks, Academic press, Elsevier, 2003.
5. Environmental Biochemistry - Erik Hamilton, Larsen and Keller Education, 2017.

EE1102: Water Treatment and Supply System (3-0-0: 3 credits)

Unit – I

Mass and Energy Transfer: Material Balance, Steady state conservative systems, steady-state systems with non-conservative pollutants, step function response. (5 lectures)

Unit- II

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. (8 lectures)

Unit-III

Water Purification in Natural Systems: Physical, chemical, biochemical processes, responses of streams to biodegradable organic waste, application of natural processes in engineering system. (5 lectures)

Unit- IV

Engineered Systems for Water Purification: Water treatment plant layout and processes: Aeration, solid separation, coagulation, softening, filtration, disinfection, dissolved solid removal. (12 lectures)

Unit-V

Advanced Water Purification Processes: Membrane separation processes, electrodialysis, distillation, adsorption, ion-exchange, emerging pollutants (EDCs, NPs, Pharmaceutical compounds, PCPs) and its removal technologies. (8 lectures)

Books and references

1. Peavy, H.S., Rowe, D.R., Tchobanoglous, G. Environmental Engineering, McGraw Hills, New York 1985.
2. Masters G.M., Introduction to Environmental Engineering and Science, Princtice-Hall of India Pvt Ltd. New Delhi 2001
3. Weber, W. J., Physiochemical process for water quality control, John Wiley & Sons
4. Water and Wastewater Technology by Hammer Mark J., Hammer Mark J. - Prentice-Hall New Arrivals.

EE1131: Solid & Hazardous Waste Management (3-0-0: 3 credits)

Unit -I

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. (4 lectures)

Unit -II

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. (8 lectures)

Unit –III

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. (6 lectures)

Unit-IV

Hazardous waste management and site remediation: Hazardous waste management-properties, classification, generation of hazardous waste; hazardous characteristics - TCLP tests; transportation; labeling of hazardous waste: physical, chemical and biological treatment of hazardous waste and disposal of hazardous waste; remediation of contaminated sites, Biomedical waste categorization, generation, collection, transport, autoclaving, microwaving, Radioactive wastes: detection and analysis, classification and disposal, flyash disposal, E-Waste: source and recovery processes, Site remediation, Battery waste. (16 lectures)

Unit-V

Environmental Impact Assessment: Legal framework, purpose of EIA, Methodology, Management plan, Case studies, Environmental audit, Risk analysis, lifecycle assessment, sustainable development. (4 lectures)

Books and 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
4. Barthwal R. R. Environmental Impact Assessment, New Age International Publishers, New Delhi, 2012.

EE1132: Waste Management (3-0-0: 3 credits)

Unit-I

Introduction: Definition of solid waste-waste generation in a technological society major legislation, sources and types of solid waste- sampling and characterization- Determination of composition of MSW- storage and handling of solid waste Collection and transport of solid waste: Collection of Solid waste: type of waste collection systems, analysis of collection system. (4 lectures)

Unit-II

Separation and Processing: Separation, processing and transformation of solid waste: unit operations used for separation and processing, materials recovery, Waste transformation through combustion and anaerobic composting, anaerobic methods for materials recovery and treatment- recycling of plastic materials and metals. Energy recovery: incinerators. Transfer and Transport: methods, transfer station types and design requirements. (8 lectures)

Unit- III

Landfills and Leachate Management: Landfills: Site selection, design and operation, drainage and leachate collection systems Integrated waste management facilities. Leachate management and landfill gas control. (6 lectures)

Unit- IV

Hazardous waste management: Definition and identification of hazardous wastes- sources and characteristics- hazardous wastes in Municipal Waste- Hazardous waste regulations – minimization of Hazardous Waste – compatibility, handling and storage of hazardous waste-collection and transport. Hazardous waste treatment and design: Hazardous waste treatment technologies – Design and operation of facilities for physical, chemical and thermal treatment

of hazardous waste –Biomedical waste disposal. Biomedical waste categorization, generation, collection, transport, autoclaving, microwaving, radioactive wastes: detection and analysis, classification and disposal, flyash disposal Solidification, chemical fixation and encapsulation, incineration, E-Waste, Battery Waste. (16 lectures)

Unit-V

Environmental Management plan: EIA, Methodology, Management plan, Case studies, Environmental audit, lifecycle assessment, sustainable development Risk analysis, Rules & Regulations. (4 lectures)

Books and references

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil "Integrated Solid Waste Management, McGraw-Hill International edition, New York, 1993.
2. CPHEEO "Manual on Municipal Solid Waste Management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
3. Micheael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous Waste Management, McGraw-Hill International edition, New York, 2001.
4. Vesilind P A, Worrell W and Reinhart, Solid Waste Engineering, Thomson Learning Inc., Singapore, 2002.

EE1141: Remote Sensing and GIS (3-0-0: 3 credits)

UNIT I

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. (7 lectures)

UNIT II

Sensors: Passive and Active Sensors; Major Remote Sensing Sensors; Satellite band designations and principal applications; Colour/False Colour, Aerial Photography/Aerial Photo Interpretation. (7 lectures)

UNIT III

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. (8 lectures)

UNIT IV

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. (8 lectures)

UNIT V

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. (7 lectures)

Books and 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.

EE1142: Geoinformatics (3-0-0: 3 credits)

UNIT I

Introduction to Remote Sensing: Introduction to remote sensing – Electromagnetic spectrum – Physics of remote sensing – Effects of atmosphere – Atmospheric windows – Interaction of earth surface features with EMR – Spectral characteristics of vegetation, water, soil, etc. Various types of platforms– Airborne and space based platforms -Characteristics of different types of platforms – Characteristics of Remote Sensors –Multi spectral sensors – Multi Spectral Scanners –Microwave remote sensing- Factors affecting Microwave measurement-Radar wave bands- SLAR and SAR. (7 lectures)

UNIT II

Introduction to Sensors: Sensors- Satellite system parameters- sensor parameters-spatial, spectral and radiometric resolution – False colour composite (FCC) –Multi spectral photographs – Thermal and microwave imaging system- Earth Resources satellite and Meteorological satellites Different types of data products and their characteristics –Basic principles of digital image processing. (7 lectures)

UNIT III

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. (8 lectures)

UNIT IV

Introduction to GIS: Geographic Information system -History and development of GIS-GIS definitions and Terminology-Architecture-System concepts: Coordinate systems-Standard GIS packages. Type of data -Spatial and non- spatial data -Data structure - Points -Lines - Polygon -Vector and raster -Files and data formats-Spatial data modelling- Raster GIS model and Vector GIS models -GIS data file management and Database models. (8 lectures)

UNIT V

Geospatial Data Analysis: Data input and data editing-Input methods –GPS as data capture-data editing. Spatial analysis – Data retrieval – Query – Simple analysis –Record – Buffering and Overlay – Vector data analysis – Raster data analysis – Modeling in GIS – Digital elevation model – DTM. (7 lectures)

Books and References

1. Lilles and T.M. and Kiefer R.W., Remote sensing and Image Interpretation, Second Edition, John Wiley and Sons, 1987.
2. Anji Reddy, M. Remote Sensing and Geographical Information System, BSP Publications., 2001.
3. Chang, K (2005). Introduction to Geographic Information Systems, Tata McGraw Hills Edition, NewDelhi.
4. Paul Curran P.J., Principles of Remote Sensing, ELBS, 1983.

EE1103: Research Methodology and IPR (2-0-0: 2 Credits)

Unit I: 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. (4 lectures)

Unit II: Effective literature studies approaches, analysis Plagiarism and Research ethics. (4 lectures)

Unit III: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee. (4 lectures)

Unit IV: 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. (6 lectures)

Unit V: Patent Rights: Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications. (4 lectures)

Unit VI: 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. (4 lectures)

Books and 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.

EE1151: Instrumental Techniques in Science and Technology

(3-0-0: 3 credits)

Unit-I

Treatment of data in quantitative analysis: Accuracy, precision, standard deviation, and types of errors, minimization of error, significant figures, criteria for rejection of data. (7 lectures)

Unit- II

Principles of instrumentation: Advantages, calibration of instruments, applications, and limitations of the following analytical techniques. (7 lectures)

Unit- III

Spectrochemical Methods: Spectrophotometry, FTIR, NMR, Atomic Absorption and Emission Spectrophotometry, Flame Photometry, Fluorimetry, Nepheleometry, Inductively Coupled Plasma Spectrometry and MS, XRD, SEM, TEM, AFM, XPS etc. (10 lectures)

Unit- IV

Electrochemical Methods: Polarography, Pulse Polarography, Ion Selective Electrodes Oscilloscopic Polarography, Cyclic Voltametry, Anodic Stripping Voltametry. (7 lectures)

Unit- V

Chromatography: Classification, General ideas about Adsorption, Partition, and Column Chromatography, Paper and Thin Layer Chromatography. Gas Chromatography (GC), High Performance Liquid chromatography (HPLC), Ion chromatography, Physical and Biological methods of Monitoring. (7 lectures)

Books and References:

1. Instrumental Methods of Analysis - HH Willard & LL Dean, John Wiley, 1976.
2. Modern Methods of Chemical Analysis – RL. Recsok & LD Shields, John Wiley & sons, Inc, 1990.
3. Instrumental Methods of Chemical Analysis -GW Ewing, McGraw Hill Book Company, Inc. 1975.
4. Modern Methods of Chemical Analysis - RL Pecsok & LD Shields, John Wiley & Sons, Inc. 1986.
5. Fundamentals of Molecular Spectroscopy - CN. Banwell, McGraw Hill, NY, 1990.

SEMESTER II

EE1201: Air & Noise Pollution Control (3-0-0: 3 credits)

Unit – I

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. (7 lectures)

Unit –II

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. (8 lectures)

Unit –III

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. (8 lectures)

Unit –IV

Engineered system for gaseous contaminants: Adsorption, Absorption, Condensation, Combustion and Automobile emissions control, Catalytic Converter in IC engine. (6 lectures)

Unit –V

Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; outdoor and indoor noise propagation; psycho-acoustics and noise criteria, effects of noise on health, noise standards and limit values;

noise instrumentation and monitoring procedure, Noise indices. (8 lectures)

Books and references

1. Peavy, H.S., Rowe, D.R., Tchobanoglous, G. Environmental Engineering, McGraw Hills, New York 1985.
2. Rao C.S., Environmental pollution control Engineering, New age international Ltd, New Delhi, 2007.
3. Environmental Engineering – Arcadio P. Sincero and Gregoria A. Sincero, Prentice Hall of India, 1999.
4. Flagan, R.C., and Seinfeld, J.H., Fundamentals of Air Pollution Engineering, Prentice Hall, New Jersey, 1988.

EE1202: Wastewater Engineering (3-0-0: 3 credits)

Unit I

Wastewater characteristics: Quantity and quality, flow rate, reaction kinetics, reactor type, hydraulic characteristics, C-diagram, treatment processes. (7 lectures)

Unit II

Primary treatment: Design and operation of screening and grit chamber, Sedimentation, design and operation PST, chemical precipitation. (8 lectures)

Unit III

Secondary treatment: Principle of biological treatment-derivation of bacterial growth kinetics used in designing of wastewater treatment plant, suspended culture system, activated sludge, ponds and lagoons, membrane bioreactors, MBBR, algal bioreactor, sequential batch reactors, oxidation pond, oxidation ditch, bulking and rising sludge, attached culture systems, trickling filters, rotating biological contractor, reed bed technology, natural and constructed wetlands, Anerobic digester, UASB, Fenton's process, Secondary clarification, disinfection of effluents. (12 lectures)

Unit IV

Sludge treatment and disposal: Sludge characteristics, thickening, digestion, and disposal. (6 lectures)

Unit V

Advanced treatment processes: Nutrient removal, solids removal, microbial fuel cell, electrochemical process, Membrane processes, adsorption, ion-exchange, centralized and decentralized treatment Processes. (6 lectures)

Books and References

1. Wastewater Engineering: Treatment, disposal, Reuse - Metcalf & Eddy Inc.4th ed.TMGHl, New Delhi, 2003.

2. Environmental Engineering- Peavy, HS, Donald RR & G. Tchobanoglous, MGH Int. Ed. New York, 1985.

3. Wastewater Treatment for Pollution Control - Soli J Arceivala, Tata McGraw Hill, 2nd ed.1998.

EE1251: Environmental Policies, Laws, and Impact Assessment (3-0-0: 3 credits)

UNIT-I

Environmental Policies: EP of GoI and the working of the Ministry of Environment, Forests and Climate Change, Central Pollution Control Board, State Pollution Control Boards,

Environmental Policies- National and International; International treaties, Carbon management- Kyoto Protocol and Clean Development Mechanism (CDM), Carbon Neutrality, Environmental Acts, Rules and Notifications, Environmental standards, Criteria for standard setting. (7 lectures)

UNIT-II

Framework for EIA: Screening, Scoping, and baseline studies; Techniques for assessment of impacts on physical resources, human use values and quality of life value. Impact assessment methodologies – various methods, their applicability. Strategic Environmental Assessment. Cumulative impact assessment. Risk and uncertainty in EIA; Environmental Management Planning; Disaster management planning. (10 lectures)

UNIT-III

Environmental audit: Introduction, objectives, types, features, planning of audits; Organisation of Audition Programme, pre-visit data collection. Audit Protocol; Onsite Audit; Data Sampling- Inspections- Evaluation and presentation; Exit interview; Audit Report- Action Plant- Management of Audits; Waste Management Contractor Audits. Life Cycle Approach. (7 lectures)

UNIT-IV

Introduction and Formulation of ISO Guidelines in Environmental Management Systems: ISO 14001 Series, Principles; Accreditation Process, Environmental Auditor Criteria, Benefits of EMS; Aspect-Impact Analysis, Continual Improvement, Environmental Performance, Environmental policy, Vision and Mission Objective and Target Environmental Management Planning, Implementing EMS, Plan-Do-Check-Act (PDCA), Preventive and Corrective Action, Internal and External Audits, Documentation, Roles and Responsibilities, Management Reviews & Improvements. (8 lectures)

UNIT-V

Legal and Regulatory Concerns: Integrating ISO 9000 & ISO 14000. Preparation of ISO Manuals for Industry; Integrating ISO 9000, ISO 14001 and OHSAS 18001; Case Studies Quality Assurance (QA) and Quality Control (QC). Life Cycle Approach. OHSAS 18001. (7 lectures)

Book and References

1. Environmental Impact Assessment – Larry, W. Canter (2nded), McGraw Hill Inc. Singapore, 1996.
2. Strategic Environmental Assessment – Riki Therirvel, E. Vilson, S. Thompson, D. Heaney, D. Pritchar. Earthscan, London, 1962.
3. Environmental Impact Assessment- Cutting edge for the 21st century-Alan Gilpin, CUP, London, 1994

EE1252: Environmental Management (3-0-0: 3 credits)

UNIT-I

Human impact on environment: Concept of Sustainable Development, International Summits on environmental pollution control and sustainable development, Conventions, Agreements, Transboundary issues, Environmental policies of India- Environmental Acts, Rules and Notifications, The Environmental pollution Acts- The water; Act, the Air (Prevention & Control of pollution Act.), Environmental Protection Act, Wildlife Act., Environmental standards. (7 lectures)

UNIT- II

International accreditation: ISO 9000, ISO 14000 and OHSAS 18001, Introduction and Formulation of ISO Guidelines in Environmental Management Systems, Plan-Do-Check-Act (PDCA), Preventive and Corrective Action, Internal and External Audits, Documentation, Roles and Responsibilities, Management Reviews & Improvements, Life Cycle Approach (LCA)- Elements of LCA, Life Cycle Costing, Eco Labelling. (8 lectures)

Unit- III

Concepts of EIA: Basic, Rapid and Comprehensive EIA, Legislative and Environmental clearance procedures in India, Elements of EIA, -factors affecting EIA Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters, EIA Methodologies: Introduction, Criteria for the selection of EIA Methodology, E I A methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, overlay methods, cost/Benefit Analysis. (8 lectures)

Unit IV

Impact of Developmental Activities and Land use: Introduction, Methodology for the assessment of soil and ground water, Delineation of study area, Identification of activities. Assessment of Impact of development Activities on Vegetation and wildlife, environmental Impact of Deforestation-Causes and effects of deforestation. Prediction and Assessment of Impact: Quality, Impact prediction, Assessment of Impact significance, Identification and Incorporation of mitigation measures. EIA in surface water, Air and Biological environment: Assessment of Impacts on surface water environment, Air pollution sources, generalized approach for assessment of Air pollution Impact. Case studies and preparation: of Environmental Impact assessment statement for various Industries. (8 lectures)

Unit V

Environmental Audit & Environmental legislation: objectives of Environmental Audit, Types of environmental Audit, Audit protocol, stages of Environmental Audit, on-site activities, evaluation of Audit data and preparation of Audit report. Post Audit activities, Environmental Management Plan. (7 lectures)

Book and References

1. Environmental Impact Assessment Methodologies, by Y. Anjaneyulu, B.S. Publication, Sultan Bazar, Hyderabad.
2. Environmental Science and Engineering, by J. Glynn and Gary W. Hein Ke – Prentice Hall Publishers
3. Environmental Science and Engineering, by Suresh K. Dhaneja – S.K.,Katania & Sons Publication, New Delhi.
4. Environmental Pollution and Control, by Dr. H.S. Bhatia – Galgotia Publication (P) Ltd, Delhi
5. Environmental Impact Assessment, by R. R. Barthwal – New Age Interational Publishers, New Delhi

EE1261: Thermodynamics and Atmosphere (3-0-0: 3 credits)

UNIT-I

Gas laws and Thermodynamics: Gay-Lussac laws, Boyle's law, Avogadro's hypothesis, Dalton's law, Laws of thermodynamics, adiabatic and isothermal processes, Entropy, consequences of second law. (7 lectures)

UNIT-II

Atmosphere: Structure and composition of atmosphere, variation of pressure and temperature, photochemical pollution, atmosphere aerosol and its thermodynamics, Ozone, greenhouse effect and global warming. (8 lectures)

UNIT-III

Water and its transformation: Thermodynamic properties of water, latent heat, Clausius-Clapeyron equation, moist air; humidity variables, mean molecular weight of moist air, clod formation and classification, Precipitation, atmospheric visibility: dew, frost, fog, smog. (8 lectures)

UNIT-IV

Thermodynamic diagrams: Area-Equivalent transformations, tephigram, emagram, graphical representation of thermodynamic variables. (7 lectures)

UNIT-V

Radioactive transfer in atmosphere: Blackbody radiation, absorption spectra of atmospheric gases, optically thin and thick approximations, aerosol scattering, calculation of radiative heating and cooling, role of atmospheric dust in relation to radiation. (7 lectures)

Books and references

1. Introduction to Environmental Physics: Planet earth, life and climate, Taylor and Francis, 2001.
2. Physics of Atmospheres, H.G. Houghton, Cambridge.
3. An Introduction to Atmospheric thermodynamics, A.A. Tsonis.

EE1262: Environmental Fluid Mechanics (3-0-0: 3 credits)

UNIT-I

Introduction: Concepts, Significance and Definitions, Diffusion: Fickian diffusion, Diffusion coefficients, Diffusion equation, One-dimensional diffusion equation, Solution to the one-dimensional diffusion equation. (6 lectures)

UNIT-II

Advective Diffusion Equation: Derivation of the advective diffusion equation: Point-source solution, Incompressible fluid, Rule of Thumb. Solutions to the advective diffusion equation: Initial spatial concentration distribution, Fixed concentration, Fixed, no-flux boundaries. Application: Diffusion in a Lake, Fishery intake protection. (6 lectures)

UNIT-III

Turbulence and mixing: Mathematical descriptions of turbulence, The turbulent advective diffusion equation, Turbulent diffusion coefficients in rivers, Longitudinal dispersion: Derivation of the advective dispersion equation, Calculating longitudinal dispersion coefficients. Application: Dye studies, Dye study in Cowaselon Creek. (8 lectures)

UNIT-IV

Physical, Chemical, and Biological Transformations: Concepts and definitions, Reaction kinetics. Incorporating transformation with the advective diffusion equation: Homogeneous reactions- The advective-reacting diffusion equation, Heterogeneous reactions-Reaction boundary conditions. Application: Wastewater treatment plant. (6 lectures)

UNIT-V

Boundary exchange: Exchange into a stagnant water body, Exchange into a turbulent water body, Lewis-Whitman model, Film-renewal model. Air-Water interface: General gas transfer, Aeration: The Streeter-Phelps equation. Sediment-Water interface: Adsorption/desorption in disperse aqueous systems. (6 lectures)

UNIT-VI

Atmospheric Mixing: Atmospheric turbulence, Atmospheric planetary boundary layer (APBL), Turbulent properties of a neutral APBL, Effects of buoyancy. Turbulent mixing in three dimensions. Atmospheric mixing models: Near and Far Field solutions. (6 lectures)

Books and references

1. Chin, D. A. (2013) *Water-Quality Engineering in Natural Systems*. 2nd Edition. New Jersey: John Wiley & Sons, Inc.
2. Fernando, H. J. S. (2013) *Handbook of Environmental Fluid Dynamics*. Volumes 1 and 2. Boca Raton, FL: CRC Press, Taylor & Francis.
3. Fischer, H. B., List, E. J., Koh, R. C. Y., Imberger, J., and Brooks, N. H. (1979). Mixing in Inland and Coastal Waters. Academic Press: San Diego, California.

4. Hemond, H. F. and Fechner-Levy, E. J. (2000). Chemical Fate and Transport in the Environment. Second Edition. Academic Press: San Diego, California.

EE1271: Renewable Energy System and Generation (3-0-0: 3 credits)

UNIT 1

Conventional and non-conventional energy: World energy sources and their classification, Fossil fuels - past, present & future, small hydropower, Alternative energy: Fuel cell: design, operation, classification, conversion efficiency, applications. Hydrogen energy: production methods, storage, transportation and utilization; Thermo nuclear energy; Energy audit: Energy Conservation. (8 lectures)

UNIT II

Solar energy: Introduction, storage of solar thermal energy, solar window, flat plate collectors and concentrating collectors, Installation of flat plate collectors, performance analysis, effect of various parameters on collector performance, applications of solar energy. (7 lectures)

UNIT III

Wind energy: Introduction, wind characteristics, air density, power in wind, wind turbines, Lift and drag, Types of rotor, wind energy extraction, extraction of wind turbine power, power density duration curve, Weibull probability density function. Wind rose data, Energy pattern factor in wind power. (8 lectures)

UNIT IV

Geothermal and ocean energy: Structure of earth's interior, plate tectonic theory, Geothermal gradients and resources, geothermal power generation, Indian scenario of geothermal energy; Principle of ocean thermal energy conversion system, Principles of Wave and Tidal energy conversion. (7 lectures)

UNIT V

Energy from Biomass: Introduction, Biomass resources, biofuels, biogas technology, producer gas, liquid fuel, biochemical conversion, biomass gasification, energy recovery

from urban waste, power generation from landfill, biodiesel, biomass energy scenario of India. (7 lectures)

Books and references

1. Renewable energy sources and emerging technologies by D.P. Kothari, K.C. Singal and Rakesh Ranjan, PHI learning private ltd.
2. Non-conventional energy sources by G.D. Rai, Khanna publishers
3. Energy conservation and management by S. s. Thipse, Narosa publication
4. Alternate Energy Sources, Applications and Technologies by N.K. Giri , Khanna Publishers; First edition (2012)
5. Renewable Energy Resources for Sustainable Development, by A.M. Omer, Discovery publishing house (2017)

EE1272: Green Technology and Alternative Energy (3-0-0:3 credits)

UNIT I

Introduction: Study the nexus between energy, environment and sustainable development; Energy sources, sun as the source of energy; photosynthesis; classification of energy sources, fossil fuel reserves and resources - overview of global/ India's energy scenario. Reneawable and non renewable energy, World energy sources and their classification, Fossil fuels - past, present & future, small hydropower, Alternative energy: Fuel cell: design, operation, classification, conversion efficiency, applications. Hydrogen energy: production methods, storage, transportation and utilization; Thermo nuclear energy; Energy audit – Energy Conservation. (8 lectures)

UNIT II

Solar Energy: Solar radiation: measurements and prediction. Indian's solar energy potential and challenges, Solar thermal energy conversions systems: flat plate collectors, solar concentrators and other applications. Solar Photovoltaic: Principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. (7 lectures)

UNIT III

Introduction of Geothermal Energy: Geothermal resources; definition and classification, Hydrothermal system, Hot dry rock systems, Geo pressured reservoirs, Magma energy, Dry rock and hot aquifer analysis Utilization of geothermal resources, Direct utilization; Swimming bathing & balneology, space conditioning, district heating, Geothermal heat pump; basic concept of heat pump, air conditioner, heating and cooling mode in heat pump, Heat pump with geothermal resources; typical GHP loop configuration Ocean Thermal: Introduction, OTEC history and technology progress, working principle, resources & site Requirement, Principles of Wave and Tide energy conversion. (8 lectures)

UNIT IV

Wind Energy: Wind Resource: Meteorology of wind, Indian's wind energy potential and challenges, distribution across the world, Eolian features, Biological indicators. Wind measurement systems: anemometers, wind velocity distributions, wind shear, turbulence, Betz limit and energy potentials. Wind Energy Conversion Systems: Classifications and applications. (7 lectures)

UNIT V

Bioenergy: Biomass as energy resources; bio energy potential and challenges- Classification and estimation of biomass; Source and characteristics of biofuels: Biodiesel, Bioethanol, Biogas, Types of biomass energy conversion systems waste to energy conversions.

(7 lectures)

Books and references

1. Renewable energy sources and emerging technologies by D.P. Kothari, K.C. Singal and Rakesh Ranjan, PHI learning private ltd.
2. Non-conventional energy sources by G.D. Rai, Khanna publishers
3. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis
4. C. S. Solanki,- Solar Photovoltaics: Fundamental Applications and Technologies, Prentice Hall

EE1111 (0-0-2: 2 credits)

1. Determination of concentration of Fe^{2+} by potentiometric titration
2. Determination of adsorption isotherms acetic acid on activated charcoal
3. Determination of the enthalpy of neutralization of reaction between acid and base
4. Studying the effect of temperature and concentration on the rate of a reaction
5. Preparation of Indigo & its use in vat dyeing and studying their effects on environment
6. Determination of total residual chlorine present in water sample by iodometric titration
7. Determination of ionization constant of weak monobasic acid by conductometric method
8. Determination of solubility of sparingly soluble salt
9. Determination of equilibrium constant of a reaction with the help of a colorimeter
10. Detection of adulterants present in the milk sample
11. Estimation of the amount of ferrous and ferric ion in a solution containing both ions
12. Green Chemistry–A solvent-free synthesis of organic compound

EE1112 (0-0-2: 2 credits)

1. To determine pH, conductivity, colour, turbidity, odour
2. To estimate the total solids, total dissolved solids and volatile solids
3. To determine acidity and alkalinity
4. To determine hardness (Ca and Mg)
5. To determine Chloride
6. To determine Sulphate
7. To determine residual chlorine
8. To determine Fluoride, nitrate, nitrite
9. To determine particulate matter (PM10), SO_2, NOx in ambient environment
10. To determine Noise level

EE1211 (0-0-2: 2 credits)

1. To determine DO
2. To determine BOD
3. To determine COD
4. To determine ammonia
5. To determine phosphate
6. To determine Sludge Volume Index
7. To determine MPN count - total and fecal coliform
8. To determine oil and grease
9. Determination of protein, carbohydrate, Chl-a
10. Field visit

EE1212 (0-0-2: 2 credits)

1. Sources of image acquisition
2. Image Interpretation
3. Various tools in GIS
4. Database management tools
5. Vectorization exercise (Raster to Vector)
6. Analysis of vectors
7. Photo interpretation and Photogrammetry
8. Image Registration and Geo-referencing
9. Enhancement using Band ratio and NDVI
10. Reading and displaying satellite data from BIL, BSQ and BIP Formats
11. Generating False Colour Composite (FCC)
12. Map reading of Survey of India topo sheets.