

CIVIL ENGINEERING DEPARTMENT

M.TECH. ENVIRONMENT ENGINEERING

**Course of Study & Scheme of Examination
2016-17**



**Maulana Azad National Institute of Technology,
Bhopal**

SCHEME
M.TECH IN ENVIRONMENTAL ENGINEERING

FIRST SEMESTER

Course No.	Subject	Scheme of periods per week			Total Credits
		L	T	P	
ENV511	Physico-Chemical Treatment Processes	3	-	-	3
ENV512	Air Pollution Control	3	-	-	3
ENV513	Biological Treatment Processes	3			3
	Elective 1	3	-	-	3
	Elective 2	3	-	-	3
	Open Elective 1	3	-	-	3
ENV514	Lab Practice 1	-	-	3	2
ENV515	Seminar1	-	2	-	2
Total credits 22					

SECOND SEMESTER

Course No.	Subject	Scheme of periods per week			Total Credits
		L	T	P	
ENV521	Industrial Waste Management	3	-	-	3
ENV522	Solids Waste Management	3	-	-	3
ENV523	Environmental Impact Assessment.	3	-		3
	Elective 3	3	-	-	3
	Elective 4	3	-	-	3
	Open Elective 2	3	-	-	3
ENV524	Lab Practice 2	-	-	3	2
ENV525	Seminar2	-	2		2
Total credits 22					

LIST OF DEPARTMENT ELECTIVES

- ENV531 Environmental Microbiology & Ecology
- ENV532 Environmental Chemistry
- ENV533 Environmental Monitoring
- ENV534 Environmental Auditing and Management Systems
- ENV535 Industrial Waste Treatment
- ENV536 Resource Generation from Waste
- ENV537 Hazardous and Biomedical Waste Management

Scheme and Syllabus M.Tech. Environmental Engineering (BOS dt.21.10.2016)

ENV538 Environmental Economics & Socio-Economic Planning

ENV539 Noise Pollution and Control

LIST OF OPEN ELECTIVES

ENV551 Advanced Mathematics

ENV552 Environmental Modelling

ENV553 Global Environmental Issues And Sustainable Development

ENV554 Environmental Legislation

THIRD SEMESTER

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
ENV611	Major Project Dissertation Phase- I	-	-	-	23
Total credits 23					

FOURTH SEMESTER

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
ENV648	Major Project Dissertation Phase- II	-	-	-	23
Total credits 23					

SYLLABUS

M.TECH IN ENVIRONMENTAL ENGINEERING

FIRST SEMESTER

ENV511 PHYSICO-CHEMICAL TREATMENT PROCESSES

Definitions of unit operations and processes. their applications in environmental engineering. Unit operations : mixing :types of impellers, baffling, fluid regions, power curves, scale up, mixing and gas transfer, flocculation. Sedimentation : types, long tube tests, scale up, sedimentation equipment, batch flow and continuous flow operations. Flotation and aerosol separation : methods of flotation, chemical agents promoting flotation, gas particle contact. Aerosol, separation- particle characteristics, gravity settlers, centrifugal separators, impingement separators, electrostatic precipitators, scrubbers. flow through beds of solids : slows and filters, rapid sand filters, disinfection : various methods and kinetics, ion exchange units, adsorption towers, contacting towers, flow through expanded beds, flow through porous plates and membranes. Vacuum filtration -rotary drum filters yields, specific resistance, experimental determination of specific resistance. gas transfer - mechanism of transfer, film coefficients and equilibrium relationship, gas disperses, packed columns, tray columns, spray units adsorption, fixed bed and moving bed adsorption, leaching, dispersed contact operation, leaching calculations.

Unit processes - chemical unit processes -chemical precipitation, adsorption and desorption disinfection with various agents.

Treatment plants related case studies.

References

1. Physicochemical processes for water quality control- Walter J. Weber, John Wiley & Sons
2. Process chemistry for water and wastewater treatment- Larry D. Benefield, Joseph F. Judkins, Barron L. Weand, Prentice-Hall
3. Environmental Engineering- Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, McGraw-Hill
4. Manual on water supply and treatment- CPHEEO *Ministry of Urban Development*, Govt. of India (MoUD)
5. Water Treatment- American Water Works Association, New Delhi, 2003

ENV512 AIR POLLUTION CONTROL

Sources of air pollution- effects of air pollution in regional and global scale, effect of air pollution on human health, plant life and materials, air pollution episodes; emission factors inventory and predictive equations, atmospheric meteorology, dispersion of air pollutants and modelling – Gaussian Plume Model, Box Model, Briggs Equation, air sampling and monitoring, Principle and working of dust fall jar, high volume sampler and other sampling devices. air pollution control devices such as – settling chambers, scrubbers, filters and electrostatic precipitators. Vehicular pollution and control.

Case studies of Air Pollution and Control

References

1. Air Pollution- C.R. Philips, Dhanpat Rai *Publishing Company*
2. AIR Pollution- MN Rao & MN Rao, Tata McGraw- Hill *Publishing ..*
3. Environmental Pollution and Control Engg- C.S. Rao, New Age International.
4. Air Pollution- Perkins, H.C, Mcgraw- Hill *Book Company Pub ...*
5. Fundamentals of *Air Pollution*- AC Stern, Academic Press Inc

ENV513 BIOLOGICAL TREATMENT PROCESSES

Sewage characteristics, quantity & quality, flow rate, treatment flow -sheets. sewage treatment process, reactor type, hydraulic characteristics, C-diagram, principle of biological treatment-derivation of bacterial growth kinetics used in designing of wastewater treatment plant. Process design and operation of activated sludge process and its modification. Bulking and rising sludge. design of secondary settling tank. Oxidation ditch, extended aeration system, SBR; process design and operation of mechanically aerated lagoon and waste stabilization pond system, septic tank, cesspools and their effluent disposal methods. Design and operation of biological nitrification - denitrification system; luxurious phosphorus uptake, aerobic attached growth process -process design and operation of trickling filter, RBC, bio filter, anaerobic treatment: process microbiology and biochemistry; application for treatment of sewage, advantage and disadvantages, floating aquatic plant system and its design and operation, sludge characteristics and disposal methods -design and operation of sludge drying bed.

Case studies related to biological treatment processes.

References

1. Wastewater Engineering- Treatment, disposal, Reuse: Metcalf & Eddy , Tata McGraw-Hill;

2. Environmental Engineering- Peavy, HS, Donald RR & G. Tchobanoglous, McGraw-Hill Science/*Engineering/Math*
3. Wastewater Treatment for Pollution Control- Soli J Arceivala, Tata McGraw-Hill Education
4. Wastewater Treatment Plants Planning, Design and Operation- S.R..Qasim, Holt, Rinehart & Winston, CRC Press,
5. Manual on sewage and sewerage treatment - CPHEEO, *Ministry of Urban Development*, Govt. of India (MoUD)

ENV514 LAB PRACTICE 1

Sampling and analysis of inorganic and organic substances , experiments on UV-VIS spectrophotometer, Flame photometer, AAS, GC, TOC etc. Determination of SPM; PM₁₀; SO₂; NO_x and CO in ambient air; Respirable dust monitoring experiments on noise pollution monitoring equipment; experiments on stack monitoring kits; Wind rose diagram. Determination of MLSS and MLVSS. Sludge Volume Index (SVI) and development of sludge settling characteristics curve and design of PST based on settling curve. Determination of BOD₅:TKN ratio, determination of the COD:BOD₅ ratio

References

1. Standard Methods for the Examination of Water and Wastewater- Andrew D. (ed.). Eaton, Mary Ann H.(ed.), Franson, American Public Health Association

ENV515 SEMINAR 1

SECOND SEMESTER

ENV521 INDUSTRIAL WASTE MANAGEMENT

Adsorption, kinetics & equilibrium studies, Ion exchange and Membrane Process, Separation processes, reverse osmosis, Ultra filtration, Electro dialysis. Chemical oxidation: Oxidation processes, principle & theory of chemical oxidation, Adsorption, kinetics and equilibrium studies. Effect of chemical constituents in waste water, Unit operations and process and treatment flow sheets. Nitrogen Conversion and Removal : Nitrification, denitrification, nitrification-denitrification Nitrogen removal by physical-chemical process phosphorous removal, removal of

repactory organics, removal of dissolved inorganic substances, removal of dissolved, inorganic substances,. Ultimate disposal of contaminants. Land treatment method : Development of land treatment systems. Land application of sludge, effluent disposal & reuse.

Appropriate case studies.

Reference

1. Wastewater Engineering: Treatment, Disposal, Reuse- Metcalf &Eddy, Tata McGraw-Hill.
2. Wastewater Treatment for Pollution Control- Soli J. Arceivala, Tata McGraw-Hill Education.
3. Wastewater Treatment Plants: Planning, Design & Operation- S.R. Qasim, Holt, Rinehart, Winston, S. Chand.
4. Wastewater Treatment - D W Sunderstorm and H.E. Klei, Prentice Hall.

ENV522 SOLID WASTE MANAGEMENT

Solid Waste, Sources, types, composition, physical, chemical and biological properties of solid wastes, sources and types of hazardous and infections wastes in municipal solid wastes, Solid waste generation and collection, Handling, storage, processing, transportation, Disposal of solid wastes : Materials separation and processing, thermal conversion, biological and chemical conversion, recycling of material in municipal solid wastes, Land filling, Composing, gas generation, closure of landfills, Industrial solid wastes: Composition, biodegradable, non biodegradable hazardous, toxic solid wastes, methods of detoxification, disposal on land disposal into water bodies.

Management of Biomedical, Nuclear, electronic, agro-waste and flyash.

Legal aspects of municipal solid waste collection, conveyance, treatment and disposal, Hazardous wastes: Origin, quantity and quality parameters, Treatment and disposal methods: Physico-chemical and biological, stabilization and solidification, thermal methods, land disposal, site remediation.

Case studies related to solid waste management.

References

1. Solid Waste Management- Frank Kreith, McGraw-Hill
2. Management of Solid Wastes in Developing Countries - Frank Flintoff, World Health Organization
3. Solid Waste Conversion to Energy- Harvey Alter, J.J. Dunn, M. Dekker
4. Solid Waste Management Manual- CPHEEO *Ministry of Urban Development*, Govt. of India (MOUD)

ENV523 ENVIRONMENTAL IMPACT ASSESSMENT

Role of EIA as a tool for Sustainable Development. Concept of Carrying Capacity and Limits to growth in terms of population, Food, Resources, Capital, Energy, Land Services etc.

Impact Assessment: Environmental, Social and Economic issues, Issues in collection of baseline data, preliminary concept of Natural Resource Accounting, Concept of Screening, Initial environmental examination (IEE), Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS), and Strategic Environmental Assessment., Rapid and Comprehensive EIA. Methodologies: Including Checklists, Matrices and Networks, EIA: Case studies and Issues. Procedures for Environmental Clearance by the Government of India, Mitigation Strategies, Environmental Management, Appropriate Setting of Industries and Projects for minimizing impacts. Concept of Zoning Atlas.

References

1. Environmental Impact Assessment - Larry, W. Canter McGraw-Hill.
2. Introduction to Environmental Impact Assessment - John Glasson, R. Therivel and A. Chandwic, Routledge, Taylor & Francis.
3. Methods of Environmental Impact Assessment - Peter Morris, Riki Therivel, Routledge, Taylor & Francis.
4. A Practical Guide to Environmental Impact Assessment - Paul, A Erickson, CBS Publishers & Distributors Pvt Ltd.

ENV524 LAB PRACTICE 2

Advance Environmental Engineering

ENV525 SEMINAR 2

DEPARTMENT ELECTIVES

ENV531 ENVIRONMENTAL MICROBIOLOGY AND ECOLOGY

Microorganism ,nutrition and growth conditions , metabolic classification of microorganisms , ATP formation ,metabolism , kinetics of biological growth bacterial growth in terms of numbers and mass, growth curve, interpretation of curve, substrate limited growth, Monod's expression, substrate utilization and cell growth, effect of endogenous metabolism, effect of temperature application of growth and substrate removal kinetics to biological treatment, central pathways; aerobic anaerobic metabolism of carbohydrates, proteins, lipids, nucleic acids and hydrocarbons, control of metabolic reactions.

Microbiology and ecology of activated sludge process, trickling filters, oxidation ponds, aerobic and anaerobic digesters, anaerobic filters, UASB reactors, composting, vermiculture and other methods. Reduction of pathogen in treatment processes. Nuisance microorganisms, Indicator microorganisms, Bacteriological tests :plate count, presumptive confirmed and completed tests for coli forms, fecal coli forms test fecal streptococci test, bifido bacterium test, clostridium welchii test, MTD MF techniques, algae counting. Ecology: basic principles, food chain, trophic structure, grass production to total community respiration ratio (P/R), biogeochemical cycles, limiting factors - liebig's law extended, ecological regulation, important ecosystems.

References

1. Fundamentals of Ecology- MC Dash, Tata McGraw-Hill Education.
2. Microbiology- E.C.S. Chan, Michael J. Pelczar, Jr.,Noel R. Krieg, Tata McGraw-Hill Education Pvt. Ltd
3. Fundamentals of Ecology (3rded)- Eugene P. Odum,Gary W. Barrett, Thomson Brooks/Cole
4. Microbiology for Environmental Scientists and Engineers - Gaudy, AF and Gaudy, McGraw-Hill

ENV532 ENVIRONMENTAL CHEMISTRY

Acid base equilibria, solubility equilibria ,oxidation reduction equilibria , solubility equilibrium for slightly soluble salts, effect of other solutes on salt solubilities, competing acid-base equilibria, effect of complexions, hydrolysis, computing total soluble species concentration, competing solid phase equilibria, equilibrium diagrams. oxidation reduction processes, Nernst equation, stability, diagrams, measuring redox potential.

Colloidal chemistry , nuclear chemistry , adsorption , basic concepts, factors affecting adsorption, isotherm studies. ion exchange, reverse osmosis, fluoride removal iron and manganese removal analysis of various ions , trace organics and trace inorganics, instrumental methods of analysis, gas analysis.

References

1. Chemistry for Environmental Engineering and Sciences- CN Sawyer, PL McCarty and GF Parkin, McGraw-Hill Education
2. Environmental Chemistry :Stanley E. Manahan, CBS *Publishers* & Distributors Pvt Ltd
3. Aquatic Chemistry - W. Stumm& JJ Morgan, Wiley
4. Principles and Application of Aquatic Chemistry- FMM Morel & JG Hering, Wiley

ENV533 ENVIRONMENTAL MONITORING

Principals of instrumentation: advantages. Applications and limitations of the analytical techniques- spectrophotometry, atomic absorption and emission spectrophotometry, flame photometry, nephelometry, inductively coupled plasma spectrometry , mass spectrometry, FTIR, NMR, electrochemical methods: polarography, ion selective electrodes, chromatography: classification, general ideas about absorption, partition and column chromatography, paper and thin layer chromatography, gas chromatography, high performance liquid chromatography, ion chromatography, remote sensing application: basics of remote sensing, application of remote sensing in environmental monitoring – landforms, soil, vegetation, land use and wetland mapping, monitoring of air quality parameters: methods, equipments, standards monitoring of water and soil quality parameters: methods, equipments, units and standards , environmental quality modeling, environmental quality indices. Case studies.

References

1. Instrumental Methods of Analysis- HH Willard & LL Dean, John Wiley
2. Instrumental Methods of Chemical Analysis - GW Ewing,Mcgraw-Hill College
3. Modern Methods of Chemical Analysis - RL .Recsok& LD Shields, John Wiley & Sons Inc
4. Fundamentals of Molecular Spectroscopy - CN. Banwell, McGraw-Hill Education (India) Pvt Limited

ENV 534 ENVIRONMENTAL AUDITING AND MANAGEMENT SYSTEMS

Concepts of environmental audit, objectives of audit. Types of audits; features of effective auditing; programme planning; organisation of auditing programme, pre-visit data collection. audit protocol; onsite audit; data sampling - inspections - evaluation and presentation; exit interview; audit report - action plan - management of audits; waste management contractor audits. Life cycle approach.

introduction; principles & elements of successful environmental management; ISO principles; EMS; Creating an environmental management system in line with ISO: 14000; benefits of an environmental management system; principles & elements of successful environmental management: leadership, environmental management planning, implementing an environmental management system, measurement & evaluations required for an environmental management system, environmental management reviews & improvements; legal and regulatory concerns; Integrating ISO 9000 & ISO 14000.

References:

1. Renewable Energy Environment and Development- Maheswar Dayal, Konark Publishers
2. Planning and Implementation of ISO14001, Environmental Management System- Girdhar Gyani, Raj Publishing House, Jaipur
3. ISO: 14000 Handbook- Joseph Caseio (Ed), McGraw-Hill Professional
4. INSIDE ISO: 14000 – The Competitive Advantage of Environmental Management- Don Sayre, St Lucie Pree,

ENV535 INDUSTRIAL WASTE TREATMENTS

Effluent standards, minimal national standards (minas). sources and effects of various pollutants, disposal of industrial wastes-on land, in creeks and the sea, in inland streams, into impoundments, importance of planning location of industries and industrial estates, common effluent treatment plants, their economics and management, pretreatment of wastes : volume and strength reduction, recovery of bye products , reuse of wastewater, waste segregation. Conventional methods of treatment of wastewater: removal of suspended solids, inorganic and organic dissolved solids, sludge disposal. low cost treatment plants. common effluent treatment plant, design and operation. Detailed considerations of wastes from industries such as textile (cotton, wool, rayon, synthetics), sugar, pulp and paper, distilleries, oil refineries, petrochemicals, pharmaceuticals, dairy, food processing, soaps and detergents, mining, iron

and steel, pickling, plating, galvanizing, tanning slaughterhouse, fertilizers, pesticides, dyes and dye intermediates, radioactive wastes, Recovery of byproducts, reuse of wastewaters with or without treatment. Actual case studies.

References

1. Industrial Water Pollution Control- Eckenfelder, McGraw-Hill Education (ISE Editions)
2. Environmental Industrial Pollution control- P.R.Trivedi and Gurdeep Raj, Jain Book Agency.
3. Pollution Control in process industries- S.P.Mahajan, Tata McGraw-Hill Education.
4. Waste Water Treatment for Pollution Control - SoliJ. Arcieivala, Tata McGraw-Hill Education

ENV536 RESOURCE GENERATION FROM WASTE

Biomass as a source of energy, type of biomass, biomass as conversion technology: wet process & dry process. Anaerobic digestion: the biochemistry of anaerobic digestion, factors affecting anaerobic digestion, types of digesters, process design, gas production, collection. method for maintenance of biogas plant, problems related to bio gas plants. Bio fuels: energy plantation, plants proposed for energy plantation, ethanol production, biodiesel, esterification & economics of bio diesel. Biological production of hydrogen. Thermal processes: combustion of bio-fuel, gasification of biomass, classification of gasifiers, chemistry of gasification process, and problems in gasifiers, pyrolysis, and alcohol fuels.

References

1. Bio-energy - Caroline S. Harwood, Arnold L. Demain, Wiley.
2. Bio fuels Engineering Process Technology- Cype Drypcho, McGraw-Hill.
3. Biomass to bio fuel: Strategies for global industries- Alain Verts, Nasib Qureshi, Hideaki Yukawa and Hans P. Blaschek , Wiley.
4. Non conventional energy resources- G.D. Rai, Khanna Publishers.

ENV537 HAZARDOUS AND BIOMEDICAL WASTE MANAGEMENT

Hazardous wastes: landmark episodes, classification, generation, guidelines of HWM, regulatory frame work, basal convention, monitoring of critical parameters/provide risk analysis. hazan, hazop, consequence analysis. Faculty and eventry analysis. Emergency management: Indian and international legislation in respect of the above. Case studies, leakage, explosion, oil spills and fire of hazardous chemical storage. Leakage in atomic plants, hazardous chemicals: physical properties, chemical composition, lethal dose and concentration. storage, collection and transport, hazardous waste treatment: characterization of waste, compatibility and flammability of chemicals, physico-chemical and biological treatment of hazardous waste including waste reduction, neutralization, incineration, combustion and pyrolysis, stabilization ,

solidification, bio-remediation, precautions in collection, reception, , transport, storage and disposal. import procedure for environmental surveillance, radioactive waste management - sources, measures, health effects; nuclear power plants and fuel production; waste generation from nuclear power plants; disposal options. Biomedical waste characterization, segregation, treatment and management.

Reference books:

1. Solid Waste Engineering Principles & Management Issues- G. Tchobanoglous, GH. Theisen, McGraw-Hill.
2. Environmental Engineering- H S Peavy, DR Rowe & G Tchobanoglous, McGraw-Hill Science/Engineering/Math.
3. Quarry Reclamation - NJ Coppin and A.D. Bradshaw, London : Mining Journal Books.
4. Hazardous Waste Management (2nd ed)- MD, PL Buchingham& JC Evans, McGraw Hill.

ENV538 ENVIRONMENTAL ECONOMICS AND SOCIO-ECONOMIC PLANNING

Economy and environment -the historical development of environmental economics; the circular economy, the sustainable economy. economics of pollution;-the optimal level of pollution, the market achievement of optimal pollution, taxation and optimal pollution, environmental standards, taxes and subsidies, marketable pollution permits, measuring environmental damage -total economic volume and valuation methodology, pollution control policy in mixed economics. environmental values ethics; discounting the future, alternative to adjusting discounting rates, economics of natural resources;-renewable resources, extinction of species, optimal use of exhaustible resources measuring and mitigating natural resource scarcity. Development and environment;- development, preservation and conservation, irreversibility and sustainability, environment and the developing countries. Carrying capacity based development planning. cost benefit analysis of environmental change; appraisal of sustainable development projects; principles of cost allocation, preventive, punitive and social costs, socio-economic planning: importance of socio-economic development planning. Social indicators and their importance; social impacts of industrial and developmental activities. Quality of life concept- and its use in development planning. Social surveys and socio-economic data generation. Social cost of environmental pollution. Rehabilitation and resettlement of project affected people. Laws related to social development.

References:

1. Economic Analysis of Environmental Impacts - Dixon, John, A, Scura LF, Routledge

2. Values for the Environment A Guide to Economic Approach - Winpeny JT, Overseas Development Institute
3. Environmental Assessment Source Book (Vol – 1)- World Bank, Environment, Work bank e-Library.
4. The World bank, Valuing the Environment- Barde J and Pearce DW

ENV539 NOISE POLLUTION AND CONTROL

Noise pollution: basics, sources, indices, noise instrumentation and monitoring procedure. Outdoor and indoor noise propagation; psycho-acoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: noise standards and limit values, control. Noise regulation, occupational safety and health act (OSHA).

Acoustical Concepts, Noise Characteristics and Sources of Noise, Measuring Instruments and Techniques, Health Effect of Noise, Environmental Noise Measurement, Noise standards and limits, Noise Impact Assessment studies, Noise Control Techniques, Case studies of noise pollution control

References

1. Noise Pollution and Control Strategy- S.P. Singal Narosa Pub House
2. Noise and Audiology- D.M. Lipscomb, University Park Press
3. Environmental Noise Pollution- PE Cunniff, McGraw Hill

OPEN ELECTIVE

ENV551 ADVANCED MATHEMATICS

System mathematics: concept of a system and system analysis, introduction to mathematical programming techniques. linear programming, feasible solutions, solutions, simplex and revised simplex methods, duality, integer programming, Brach and Bount, Cut, transportation and assignment algorithms

Non-linear programming, single variable and multi variable optimization problems with and without constraints, quadratic programming, geometric programming, goal programming, network analysis, game theory and queuing systems

Mathematical modeling: introduction, development of models, model evaluation, modeling and information content of data. Characteristics of distribution, A.M.G.M., H.M., median and mode, mean and standard deviation. Statistical frequency distributions, common probability functions, confidence intervals, tolerance limits, hypothesis testing, fundamentals of simulation. Binomial normal and Poisson distribution, theory of MPN, calibration and evaluation of linear models,

stepwise regression analysis, regression analysis of non-linear models, random sampling, choice of samples and selection, large and small samples, students 't' distribution, vital statistics, mortality tables, birth rate, death rate.

References

1. Numerical Methods for Scientific & Engg. Computation- Jain, Iyenge and Jain, New Age International, 2003.
2. Numerical Methods for Mathematics, Science and Engineering- John H Mathews, Prentice Hall
3. Applied Numerical Analysis- CF Gerald and PO Wheatley, Addison Wesley
4. Fundamentals of Applied Statistics- S.C. Gupta and V. K. Kapoor, Sultan Chand & Sons

ENV552 ENVIRONMENTAL MODELLING

Systems approach - concept and analysis. Problems formulation, model construction and deriving solution from models. Modelling of wastewater management systems- model formation and solution. Modelling of pesticide management problems; optimization model for planning municipal wastewater treatment.

Lagrange multipliers- unconstrained and constrained optimisation, limitations. sequential search algorithms- box algorithm, limitations linear programming models, solution and sensitivity analysis; general linear programming models for air quality management of agricultural non-point source pollution. separable and integer programming- application to multi-objective planning. application of integer programming to municipal solid waste management. transportation models. dynamic programming models- application to land use planning and air pollutant emission control. present value concepts- optimization over time.

References

1. Handbook of Environmental and Ecological Modelling - Jorgensen S.E., H. Sorensen B., and Nielsen S.N., Lewis Publishers, New York.
2. Fundamentals of Atmospheric Modelling- Jacobson Mark Z., Elsevier Science.
3. An Introduction to Water Quality Modelling- James A. (Ed), Wiley.
4. Techniques for Environmental System Analysis- R.H. Pantell, J. Wiley, cop. 1976.

ENV553 GLOBAL ENVIRONMENTAL ISSUES AND SUSTAINABLE DEVELOPMENT

Earth capital – natural resources, renewable and non-renewable ecosystem services, biogeochemical cycles, redundancy & biodiversity, environmental degradation and its impacts on various cycles.

Society and use of fossil fuels, carbon dioxide & global warming, the likely impacts, the importance of mitigation on methane, connections with meat eating and livestock, sectoral contributions, international interventions and the role of united world action.

Biodiversity & introduced species, ecosystem components, species interactions, loss of habitats and adaptation, bio-concentration and bioaccumulation, loss of food webs.

Genetically modified foods and their fallouts, green revolution, and the consequences of food grown on chemical fertilizers and pesticides, urbanization and its consequences, fallouts of expanding transportation, housing, and lifestyle sectors. spread of modern diseases, case studies of significant environmental problems and disasters and the lessons learnt, historical role of technology, and the consequences of modern technology.

Role of environmental ethics, Anthro-Centric versus eco-centric world views, ecological traditions, Religio-philosophical approaches, Semitic versus non-Semitic perceptions of environment and their fallouts, role of science and technology in environmental degradation and conservation, the concept of deep ecology and Gaia hypothesis.

References:

1. Global Environmental Issues- Frances Harris, J. Wiley, cop.
2. An introduction to global environmental issues- instructor's manual- Kevin T. Pickering, Routledge.
3. Global environmental issues: A climatological approach - David D. Kemp, Routledge.

ENV554 ENVIRONMENTAL LEGISLATION

Environmental acts - their need, historical background, national and international acts and agreements, genesis of environmental acts - general procedure followed in changing a bill into an act; implementation of an act, role of executive, legislature, and judiciary. legislative powers and their limitations.

Major National Acts – The Water (prevention and control of pollution) Act, The Air Act, The Environment (protection) Act, Hazardous waste Rules, Biomedical Waste (Management and Handling) Rules,, Municipal Solid Waste Rules, Batteries (Management and Handling) Rules,

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e-waste (management and handling) Rules, Prevention of Cruelty to Animals (Slaughter House) Rules, Slaughter Act.

Role and Functions of the Central and State Pollution Boards and the powers vested in them., Municipal Acts, Acts related to Land Ownership and use, Factory Act, Acts related to Environmental and Occupational health, Industrial hygiene, Significant International and Interstate Conventions and Treaties on issues such as Climate Change, Ozone depletion, Riparian Rights and sharing of Waters etc, ISO: 14000 - its need, procedure and significance, ISO: 14000 Certification, National Certifications, Role of BIS, Role of Public Hearing, Non - Governmental Organizations and their role, Role of Civil Society, and Judiciary, Water Policy, Rehabilitation Policy, and other related major policies of the government of India. Amendments to various Acts from time to time.

References

1. Environmental Legislation in India- K.R. Gupta, Jain *Book Depot* (JBD)
2. Environmental Law- DS Sengar, Prentice Hall of Indi
3. ISO 14001 and beyond- environmental management systems in the real world -Christopher Sheldon, Green Publishing