GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore - 641 013

Regulations, Curriculum And Syllabi For

M.E. (ENVIRONMENTAL ENGINEERING)

(Full Time / Part Time)

2012

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS,
GOVERNMENT COLLEGE OF TECHNOLOGY
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Curriculum

CURRICULUM FOR CANDIDATES ADMITTED
DURING 2012-2013 AND ONWARDS
BRANCH: M.E. (ENVIRONMENTAL ENGINEERING CURRICULAM) - (FULL TIME)

FIRST SEMESTER

S. No.	Subject Code	Course title	Session marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
		THEORY							
1	12EE01	NUMERICAL METHODS AND APPLIED STATISTICS	25	75	100	3	0	0	3
2	12EE02	ENVIRONMENTAL CHEMISTRY	25	75	100	3	0	0	3
3	12EE03	ENVIRONMENTAL MICROBIOLOGY	25	75	100	3	0	0	3
4	12EE04	ENVIRONMENTAL AUDITING AND NEW PRODUCT MANAGEMENT	25	75	100	3	0	0	3
5		ELECTIVE - I	25	75	100	3	0	0	3
6		ELECTIVE - II	25	75	100	3	0	0	3
		TOTAL			600				18

SECOND SEMESTER

S. No.	Subject Code	Course title	Session marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
		THEORY							
7	12EE05	PHYSICO-CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT	25	75	100	3	0	0	3
8	12EE06	BIOLOGICAL PROCESSES FOR WASTEWATER TREATMENT	25	75	100	3	0	0	3
9	12EE07	AIR QUALITY MANAGEMENT	25	75	100	3	0	0	3
10	12EE08	WATER AND SOIL POLLUTION	25	75	100	3	0	0	3
11		ELECTIVE - III	25	75	100	3	0	0	3
12		ELECTIVE - IV	25	75	100	3	0	0	3
		TOTAL			600				18

THIRD SEMESTER

S. No.	Subject Code	Course title	Session marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
		THEORY							
13	12EE09	INDUSTRIAL WASTE WATER TREATMENT	25	75	100	3	0	0	3
14		ELECTIVE - V	25	75	100	3	0	0	3
15		ELECTIVE - VI	25	75	100	3	0	0	3
16	12EE10	PROJECT I	50	150	200	0	0	12	6
		TOTAL			500				15

FOURTH SEMESTER

S. No.	Subject Code	Course title	Session marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
17	12EE11	PROJECT II	100	300	400	0	0	24	12
		TOTAL			400				12

CURRICULUM FOR CANDIDATES ADMITTED
DURING 2012-2013 AND ONWARDS
BRANCH: M.E. (ENVIRONMENTAL ENGINEERING) – PART TIME

FIRST SEMESTER

S. No.	Subject Code	Course title	Session marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
1	12EE01	NUMERICAL METHODS AND APPLIED STATISTICS	25	75	100	3	0	0	3
2	12EE02	ENVIRONMENTAL CHEMISTRY	25	75	100	3	0	0	3
3	12EE03	ENVIRONMENTAL MICROBIOLOGY	25	75	100	3	0	0	3
		TOTAL			300				9

SECOND SEMESTER

S. No.	Subject Code	Course title	Session marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
4	12EE05	PHYSICO-CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT	25	75	100	3	0	0	3
5	12EE06	BIOLOGICAL PROCESSES FOR WASTEWATER TREATMENT	25	75	100	3	0	0	3
6	12EE07	AIR QUALITY MANAGEMENT	25	75	100	3	0	0	3
		TOTAL			300				9

THIRD SEMESTER

S. No.	Subject Code	Course title	Session marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
7	12EE04	ENVIRONMENTAL AUDITING AND NEW PRODUCT MANAGEMENT	25	75	100	3	0	0	3
8		ELECTIVE - I	25	75	100	3	0	0	3
9		ELECTIVE - II	25	75	100	3	0	0	3
		TOTAL			300				9

FOURTH SEMESTER

S. No.	Subject Code	Course title	Session marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
		THEORY							
10	12EE08	WATER AND SOIL POLLUTION	25	75	100	3	0	0	3
11		ELECTIVE - III	25	75	100	3	0	0	3
12		ELECTIVE - IV	25	75	100	3	0	0	3
		TOTAL			300				9

FIFTH SEMESTER

S. No.	Subject Code	Course title	Session marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
		THEORY							
13	12EE09	INDUSTRIAL WASTE WATER TREATMENT	25	75	100	3	0	0	3
14		ELECTIVE - V	25	75	100	3	0	0	3
15		ELECTIVE - VI	25	75	100	3	0	0	3
16	12EE10	PROJECT I	50	150	200	0	0	12	6
		TOTAL			500				15

SIXTH SEMESTER

S. No.	Subject Code	Course title	Session marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
17	12EE11	PROJECT II	100	300	400	0	0	24	12
		TOTAL			400				12

LIST OF ELECTIVE SUBJECTS

S. No.	Subject Code	Course title	Session marks	Final Exam marks	Total marks	Credits			
						L	T	P	C
		THEORY							
1	12EE12	ENVIRONMENTAL QUALITY MEASUREMENT LABORATORY	25	75	100	3	0	0	3
2	12EE13	WATER RESOURCES AND TREATMENT	25	75	100	3	0	0	3
3	12EE14	SOLID AND HAZARDOUS WASTE MANAGEMENT.	25	75	100	3	0	0	3
4	12EE15	URBAN AND RURAL SANITATION	25	75	100	3	0	0	3
5	12EE16	CLIMATE CHANGE AND ADAPTATION	25	75	100	3	0	0	3
6	12EE17	REMOTE SENSING AND GIS APPLICATION IN ENVIRONMENTAL ENGINEERING	25	75	100	3	0	0	3
7	12EE18	SURFACE AND GROUND WATER MODELLING	25	75	100	3	0	0	3
8	12EE19	ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES	25	75	100	3	0	0	3
9	12EE20	ENVIRONMENTAL BIOTECHNOLOGY.	25	75	100	3	0	0	3
10	12EE21	ENVIRONMENTAL GEO TECHNOLOGY.	25	75	100	3	0	0	3
11	12EE22	ENVIRONMENTAL ENGINEERING STRUCTURES.	25	75	100	3	0	0	3
12	12EE23	ADVANCED WASTEWATER TREATMENT AND REUSE.	25	75	100	3	0	0	3
13	12EE24	INSTRUMENTATION, SELECTION AND MANAGEMENT OF ENVIRONMENTAL ENGINEERING EQUIPMENTS	25	75	100	3	0	0	3
14	12EE25	CONTAMINANT TRANSPORT MODELLING	25	75	100	3	0	0	3

12EE01 NUMERICAL METHODS, PROBABILITY & APPLIED STATISTICS

(Common to 12MF01 Manufacturing Engineering)

L	T	P	C
3	0	0	3

NUMERICAL METHODS (09)

Linear system-Gaussian elimination and Gauss-Jordan methods-matrix inversion-Gauss seidel method-nonlinear equations-Regula falsi and Newton-Raphson methods-Interpolation- Newton's and Lagrange's interpolation.

PROBABILITY THEORY (09)

Random Experiments – Sample Space – Definition of probability – Conditional Probability – Addition, Multiplication Theorems – Theorem of Total Probability – Baye's Theorem – Problems.

RANDOM VARIABLES AND DISTRIBUTIONS (09)

Discrete Random Variable – Probability Function – Continuous Random Variable – Probability Density Function – Two Dimensional Random variable's – Distributions (Binomial, Poisson, Normal, Gamma) – Chebyshev's Inequality.

TEST OF HYPOTHESIS (09)

Large sample: Tests for means, variances and proportions - Small samples: Tests for means, variances – Goodness of fit and independence of attributes using Chi-Square distributions.

STATISTICAL QUALITY CONTROL (09)

Control charts for variables: X, R Charts – Control charts for defective: p, np Charts – control Charts for defects: C Charts – Correlation - Regression - Multiple and Partial Correlation – Partial Regression.

Total : 45 Hours

Text Books

1. *Dr. P. Kandasamy, Dr. K. Thilagavathy, Dr. K. Gunavathy,* ***'Numerical Methods',*** *S.Chand and sons, Ram Nagar, New Delhi, 2010.*
2. *T. Veerarajan,* ***Probability, Statistics and Random Process****, Tata McGraw Hill, New Delhi, 2010.*

Reference Books

1. *S. C. Gupta and V. K. Kapoor,* ***Fundamental Statistics****, Sulthan Chand & Sons, New Delhi - 2002.*
2. *S. P. Gupta,* ***Statistical Methods****, Sulthan Chand & Sons, New Delhi - 2002.*
3. *K.S Trivedi* ***'Probability and statistics Reliability, Queuing and computer science Applications'*** *Prentice Hall of India Ltd., New Delhi, 2006.*
4. *Dr. J.S. Chirode* ***'Statistical Methods'*** *Technical Publications, Pune 2010.*
5. *Dr. Manish Goyal,* ***"Statistics and Numerical Methods",*** *University Press, New Delhi, 2010.*
6. *Balagurusamy. E ,* ***'Numerical Methods'****, Tata McGraw Hill Publishers, New Delhi, 2009*

12EE02 ENVIRONMENTAL CHEMISTRY

L	T	P	C
3	0	0	3

BASIC PRINCIPLES OF ANALYTICAL CHEMISTRY (09)

Concentration of solutions-Calculations- Ionic equilibrium of weak electrolytes, – common ion effect - Buffer solutions-Change of pH with salt concentrations, Buffer index-Solubility product, Hydrolysis of salts, Problems- EMF and Electrode potential–Applications of potentiometry in pH measurements, glass electrodes, ion selective electrodes-Fluoride and Nitrate

INSTRUMENTAL METHODS OF ANALYSIS (09)

Spectroscopy-Atomic and Molecular-Difference – Flame emission spectroscopy, and Atomic Absorption Spectroscopy– principle, Instrumentation, Application in determination of metals – Pre concentration techniques in AAS – solvent extraction – Co precipitation – Chelating resins. Molecular spectroscopy – UV– visible spectrophotometer - principle, Instrumentation, Application in determination of mercury, lead and cadmium in water samples. Chromatography – Gas chromatography – simple instrumentation and applications

CHEMICAL KINETICS (09)

Rate constants of first and second order reactions – problems – effect of temperature on reaction rates – Derivation of Arrhenius equation – problems – consecutive reactions – basic concepts of enzymes, cofactors – enzyme catalyzed reactions – Temperature dependence of enzyme activity– Enzyme kinetics- Michalei's Menton equation – significance

Biochemical activity of carbohydrates, proteins, vitamins, oils and fats – Bacterial decomposition under aerobic and anaerobic conditions.

COLLOIDS AND SURFACE CHEMISTRY (09)

Colloids – types, properties (electrical origin of changes and optical) – Electro kinetic properties – Applications. Schulz Hardy rule - Destabilization and destruction of colloids. Hydrophilic colloids-Liquid-liquid systems, Gas in liquid systems-Colloidal electrolytes – surfactants, soaps and detergents – types of detergents, ingredients – Biodegradation of detergents and environmental significance.

BIOCHEMICAL ACTIVITY OF ORGANIC POLLUTANTS (09)

Dyes – Azodyes – Biodegradation environmental effects – Insecticides – Chlorinated pesticides – Organic phosphorus, Pb, Cd, Hg, As pesticides – biodegradation – environmental effects-Trace metals in water-Chemical speciation, Lead, Mercury, Arsenic and chromium-removal by chemical precipitation and adsorption.

Total : 45 Hours

Reference Books

1. *Douglas A. Skoog and Donald M. West,* ***Analytical chemistry:*** *An introduction, CBS publishing Japan Ltd. New york, 1986.*
2. *Sawyer .C.N. and Mc Carty P. L.* ***Chemistry for environmental engineering,*** *McGraw Hill Publications, 4th edition, 1994.*
3. *A. K. De,* ***Environmental Chemistry,*** *New Age international (Pvt.) Ltd. New Delhi, 1996.*
4. *Arthur I. Vogel,* ***A text book of Qualitative inorganic analysis,*** *The English Language Book Society, 1977.*

12EE03 ENVIRONMENTAL MICROBIOLOGY

L	T	P	C
3	0	0	3

CLASSIFICATION & CHARACTERISTICS, METHODS OF STUDY, GROWTH AND METABOLISM OF MICRO ORGANISMS & RESPIRATIONS (09)

Classification of living organisms with special emphasis on micro-organisms, their characteristics and application in Environmental Engineering, DNA & RNA.

Culture of microorganisms: media preparation, sterilization, pure culture, maintenance of cultures – stains and staining, estimation of bacterial numbers.

Growth curves, factors affecting growth, nutritional requirements of micro - organisms, metabolism of micro - organisms: carbohydrates, proteins, fat metabolisms and the role of enzymes.

Aerobic and anaerobic, role of enzymes, bacterial respiration, fermentation and saprogenic action, basic concepts of molecular biology.

MICROBIOLOGY OF WATER AND SEWAGE (09)

Bacteriology of water indigenous and non – indigenous group, bacterial content of various type of water surface and vertical distribution, variation in number and factors governing the same - Water borne diseases and their causative organisms.

Differentiation of faecal and non-faecal coliforms - tests for the presence of coliform organisms - presumptive, confirmed and completed test, MPN index, use of Millipore filter technique, tests for faecal streptococci and clostridium welchi - their sanitary significance, standards for bacteriological quality.

ALGAE AND OTHER ORGANISMS, BIOTRANSFORMATIONS AND BIODEGRADATION (09)

Important Algae groups - algal nutrients, Eutrophication, the problems caused by the algae in water supply and sewage treatment, control of algae, other important organisms in water and sewage - plankton, fungi, plantae & animalia - Control.

Bioconcentration, Biotransfer - important factors, Biodegradation - Enzymatic processes in Biodegradation, Bio magnification, Bio monitoring, Ecotoxicology.

AQUATIC MICROBIOLOGY (09)

Aquatic life - life in ocean, Life at the interface of Sea water with Fresh water and with Land. Fresh water life - Microorganisms in water, Elemental transitions, Organic Pollutants in water, Microbial degradation of organic matter, Radionuclides, Bioassay.

ORGANISMS IN WATER, SEWAGE AND IN SOIL (09)

Indicator organisms - protozoa, amoeba, rotifers, crustaceans, fish, etc.

Soil - Agriculture - nature of soil, soil bacteria, Macronutrients (N, P & K) in soil, Micronutrients in soil. Agriculture Microbial degradation of organic matter, Agriculture and Health, Vermi - composting.

Total : 45 Hours

Reference Books

1. *Pelczar .Jr .M.J., Chan, E.C.S., Krieg.R.Noel., and Pelczar MernaFoss,* ***Microbiology,*** *5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2004.*
2. *Stainer .R.Y., Ingrahorn .J.L., Wheelis .M.C and Painter .P.R.,* ***General Microbiology,*** *MacMillan Edition., Limited., London, 1989.*
3. *Mckinney R. E., & Gall M.,* ***Microbiology for Sanitary Engineers,*** *McGraw Hill Book Co. Inc., New York, 1962.*
4. ***Standard Methods for the Examination of Water and Waste water,*** *20th Edition, WPCF, APHA and AWWA, USA, 1993.*

12EE04 - ENVIRONMENTAL AUDITING AND NEW PRODUCT MANAGEMENT

L	T	P	C
3	0	0	3

ENVIRONMENTAL AUDITING (06)

Environmental Policies and Legislations - Industrial activities and Environment – Prevention versus Control of Industrial Pollution – – Regulation to Encourage Pollution Prevention and Cleaner Production – Environmental Auditing – Types-Environmental Reporting. Environmental statement- Role of Industry, Government and Institutions – Environmental Management Hierarchy - Regulatory versus Market Based Approaches.

EA TOOLS (10)

Environmental Impact Assessment - Life Cycle Assessment - Elements of LCA – Life Cycle Costing – Eco Labelling – Environmental Management Systems- Standards – ISO 14001,19000 – Environmental audit –Environmental Risk Assessment – Technology Assessment - Tools with case studies

CLEANER PRODUCTION (10)

Definition – methodology – Historical evolution – Benefits – Promotion – Barriers Overview of CP - Assessment Steps and Skills - Preparing for the Site, Visit, Information gathering, and Process Flow Diagram - Material Balance - CP Option Generation – Technical and Environmental Feasibility analysis – Economic valuation of alternatives – Total Cost Analysis – CP Financing – Establishing a Program – Organizing a Program – Preparing a Program Plan – Measuring Progress – Pollution Prevention and Cleaner Production Awareness Plan.

ENVIRONMENTAL ASPECTS OF NEW PRODUCT,DEVELOPMENT (10)

New Product Development Process(NPDP) –Objectives- oppurtunities in Product Design –Product Life cycle Management – PRO launch –Basics,benefits,Phase gate,Design for Environment,Design for Six Sigma(DFSS), Best Available Technology concept (BAT) -Project Management - goals and Life cycle

SUSTAINABLE DEVELOPMENT (9)

Sustainable development – Indicators of Sustainability – Sustainability Strategies - Barriers to Sustainability – Industrialization and sustainable development – Industrial Ecology – SHE – Six-Age Model- Cleaner Production (CP) in Achieving Sustainability – Business opportunities and Success for sustainable future

Total : 45 Hours

Reference books

1. *World Bank Group* ***'Pollution Prevention and Abatement Handbook – Towards Cleaner Production',*** *World Bank and UNEP, Washington D. C., 1998.*
2. *Prasad modak C. Visvanathan and Mandar parasnis ,* ***'Cleaner Production Audit',*** *Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok, 1995.*
1. *Robert.G.Cooper,'****Winning at New Products'*** *Third Edition, Basic Books, A member of the Perseus Books Group,2001*
2. *Richard Welford and Richard Starkey , Business and the Environment, University Press 2010*
3. *www.prod-dev.com*
4. *www.environmentalexpert.com*
5. *www.cleanerproduction.com*

12EE05 PHYSICO-CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT

L	T	P	C
3	0	0	3

CHARACTERISTICS OF WATER AND WASTE WATER (09)

Water Quality-Physical, chemical and biological parameters of water- Water Quality requirement - Potable water standards -Wastewater Effluent standards -Water quality indices. Water purification systems in natural systems-Physical processes-chemical processes and biological processes - Requirements of successful operation - Operational problems – Trouble shooting .

SCREENING AND FLOATAION (09)

Preliminary treatment: Screening – different types of screens – description, analysis and design – Flow equalization - skimming tank – grit removal and disposal – velocity control in the grit chamber - Floatation – types – Theory of analysis and design.

SEDIMENTATION AND FLOCCULATION (09)

Mixing, Clarification - Sedimentation; Types; Aeration and gas transfer – Coagulation and flocculation, coagulation processes - stability of colloids - destabilization of colloids Clariflocculation.

FILTRATION (09)

Filtration - theory of granular media filtration; Classification of filters; slow sand filter and rapid sand filter; mechanism of filtration; modes of operation and operational problems; negative head and air binding; dual and multimedia filtration.

ADSORPTION AND ADVANCED TREATMENTS (09)

Adsorption, adsorption equilibria- adsorption isotherms, Disinfection - chlorine dioxide; chloramines; ozonation; UV radiation - Ion Exchange-processes, Application Membrane Processes, Reverse osmosis, Ultrafiltration, Electrodialysis.

Total:45 Hours

Reference books

1. *METCALF & EDDY,* ***"Wastewater Engineering Treatment Disposal Reuse",*** *Tata McGraw-Hill, New York, 2003.*
2. *HOWARD S. PEAVY, DONALD R. ROWE & GEORGE TCHOBANOGLOUS,* ***"Environmental Engineering",*** *McGraw-Hill, 1988.*
3. *QASIM. S.R.,* ***"Wastewater Treatment Plant – Planning, Design and operation,*** *Holt Rinchart and Winston, New York, 2002.*
4. *WEBER, W.J.* ***Physicochemical processes for water quality control,*** *John Wiley and sons, Newyork, 1983.*

12EE06 BIOLOGICAL PROCESSES FOR WASTEWATER TREATMENT

L	T	P	C
3	0	0	3

INTRODUCTION,PROCESSANALYSISANDSELECTION (09)

Biological treatment processes – objectives - Choice of treatment method – Environmental impact and other considerations in planning the treatment – Cost of Wastewater treatment – Reactors used for the treatment – mass balance analysis – Reactions, Reaction rates – Enzyme reaction. Modelling of ideal flow and non ideal flow reactors – Reactors in parallel – Reactors in series – Tracer tests – Estimation of dispersion coefficient.

FUNDAMENTALS OF PROCESS KINETICS (09)

Role of microorganisms – Microbial growth kinetics - Biological oxidation process - loading – MCRT - F/ M ratio - Determination of biokinetic coefficients – Modelling of suspended growth treatment process – Description, Design and operating parameters – Modelling of plug flow reactors.

SUSPENDED GROWTH TREATMENT PROCESS - ACTIVATED SLUDGE PROCESS AND PONDS (09)

Treatment Process Loading – Biological & solids retention time – F/M ratio – Determination of Bio-kinetic constants – application of kinetics to Biological Treatment - Suspended Growth Treatment Process – Modelling of Suspended Growth Treatment Process – CFSTR – PFR - Design of Activated Sludge Process – Modifications (only theory) – Oxidation pond – Aerated lagoons – Oxygen requirements – arrangement for transfer of oxygen – Secondary clarifier - design features. Stabilization ponds – Classification – Application – Process design, flow pattern and analysis of Aerobic ponds – Facultative ponds – Anaerobic ponds – maturation ponds – Construction and performance.

SUSPENDED GROWTH TREATMENT PROCESS - DIGESTION PROCESS (09)

Sludge Digestion – Sources of sludge – Characteristics – Quantities – Anaerobic digestion – Process – Kinetic relationship – gas production – design considerations. Anaerobic treatment of liquid wastes – Anaerobic sludge blanket process – design considerations. Aerobic Digestion – Kinetics – Oxygen requirements – Design considerations.

ATTACHED GROWTH TREATMENT PROCESS (09)

Attached Growth Treatment Process – Substrate Removal in Attached Growth Treatment Process - Trickling Filter – Process – Classification - design based on popular design equations – NRC, Rankine's and Eckenfelder equation - Rotating Biological contactors – Anaerobic attached growth treatment processes – upflow packed bed – upflow expanded bed – Fluidized bed – Down flow bed. (only theory)

Total : 45 Hours

Reference books

1. *Metcalf and Eddy,* ***"Waste Water Engineering – Treatment and reuse"****, Tata McGraw-Hill, New Delhi, 2003.*
2. *Arceivala S. J.,* ***"Waste Water Treatment and disposal,*** *Marceldekker publishers,1981.*
3. *Larry D. Benefield and Clifford W. Randall,* ***"Biological process design for Wastewater Treatment"****, 1980.*
4. *Howard S. Peavy, Donald R. Rowe and George Techobanoglous,* ***"Environmental Engineering",*** *McGraw – Hill co., 1987.*
5. *Arceivala S. J.,* ***"Wastewater Treatment and Pollution control"****, Tata McGraw-Hill Co., New Delhi, 1998.*
6. Linvil G. Rich., **"Low-Maintenance, Mechanically simple wastewater treatment Systems"** , McGraw-Hill Co., 1980.

12EE07 AIR QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

GENERAL (09)

Atmosphere as a place of disposal of pollutants – Air Pollution – Definition - Air Pollution and Global Climate - Units of measurements of pollutants - Air quality criteria - emission standards - Ambient air quality standards - Air pollution indices - Air quality management in India.

SOURCES, CLASSIFICATION AND EFFECTS (09)

Sources and classification of air pollutants - Man made - Natural sources - Type of air pollutants - Pollution due to automobiles - Analysis of air pollutants - Chemical, Instrumental and biological methods.Air pollution and its effects on human beings, plants and animals - Economic effects of air pollution - Effect of air pollution on meteorological conditions - Changes on the Meso scale, Micro scale and Macro scale.

SAMPLING, METEOROLOGY AND AIR QUALITY MODELLING (09)

Sampling and measurement of particulate and gaseous pollutants - Ambient air sampling - Stack sampling. Environmental factors - Meteorology - temperature lapse rate and stability – Adiabatic lapse rate - Wind Rose - Inversion – Wind velocity and turbulence - Plume behaviour - Dispersion of air pollutants - Maximum mixing depth - Dispersion model - Fixed Box models – Multiple cell models - Estimation of plume rise - Stack design.

AIR POLLUTION CONTROL MEASURES (09)

ontrol - Source correction methods - Control equipments - Particulate control methods - Settling chamber - cyclone separators - inertial devices - Electrostatic precipitator - scrubbers - Control of gaseous emissions - Absorption - Absorption equipments - adsorption and combustion devices.

AIR POLLUTION SURVEY, LEGISLATIONS AND CASE STUDIES (09)

Air pollution survey - Air pollution legislation and regulations – Environmental criteria for siting industries and green belts - Air pollution in Indian cities. Case studies - some specific industries - cement industry - refineries - fertilizer - paper industry - Sources of pollutants and its controls - Cost benefit analysis.

Total : 45 Hours

Reference books

1. *C. S. Rao,* ***"Environmental Pollution Control Engineering",*** *Wiley Eastern Limited, 2000.*
2. *Stern A. C.,* ***"Air Pollution" (vol. I), "Air Pollution and its effects"*** *(vol. II),* ***"Analysis, Monitoring and Surveying"*** *(vol. III),* ***"Sources of Air Pollution and their control",*** *Academic press, New York, 1968.*
3. *Air Pollution act, 1981 (India).*
4. *Howard S. Peavy, Donald R. Rowe and Geroge Tchobanoglous,* ***"Environmental Engineering",*** *McGraw - Hill Co., 1986.*
5. *Kenneth wark, Cecil F.warner,* ***"Air Pollution its Origin and Control",*** *Harper and Row Publishers, Newyork, 1981.*
6. *Dr. Y. Anjaneyulu,* ***"Air Pollution and Control Technologies",*** *Allied publishers (P) Ltd., 2002.*

12EE08 WATER AND SOIL POLLUTION CONTROL

L	T	P	C
3	0	0	3

INTRODUCTION TO STREAM POLLUTION (09)

Biological aspects of stream pollution - Bacterial growth phases in stream - Zones of stream – aeration to pollution - Benthal decomposition in streams - Hydrological consideration - sampling for effective evaluation - factors affecting self purification - Flow measurements - Limitation of disposal by dilution.

PURIFICATION CAPACITY OF STREAMS (09)

Deoxygenation, reaeration constants - Temperature effects - oxygen sag analysis - Sag curve by Streeter-Phelps formulation - Channel Scour - photosynthesis on streams - oxygen sag computations – Hull's modification of sag curve analysis - Assessment of pollution capacity of streams – Water quality standards.

DISPOSAL INTO ESTUARY AND LAKE (09)

Estuarine analysis - Modified Streeter Phelps techniques. Limnological aspects - Lakes - Oxygen balance - Lake water quality and objectives.

DISPOSAL INTO SEA (09)

Characteristics of sea water - Environmental considerations in sea disposal - Estimation of dissolved oxygen balance. Discharge from a line diffuser in a homogeneous liquid – estimation of initial dilution - design of out fall system.

DISPOSAL ON LAND (09)

Land treatment - Irrigation and cropping - SAR, RSC, percent Boron - Nutrients - organics - pathogens and toxic substances - Traditional criteria for irrigation water. Land requirement - Precautions in operating waste water irrigation systems - other methods – Rapid infiltration - overland flow – Ground water pollution – Case studies of soil pollution.

Total : 45 Hours

Reference books

1. *Nelson Leonard Nemerow* - ***Scientific Stream Pollution Analysis***, *McGraw Hill, 1974.*
2. *Metcalf and Eddy* - ***Waste Water Engineering Treatment and Disposa****l* - *McGraw Hill,2003.*
3. *Areceivala S. J.,* ***Wastewater Treatment and Disposal*** *– Marcel Dekar - 1981.*
4. *U. N. Maihda* - ***Water Pollution and Disposal of Waste Water on land****, McGraw Hill, 1983.*

12EE09 INDUSTRIAL WASTEWATER MANAGEMENT

L	T	P	C
3	0	0	3

STANDARDS OF WASTE WATER AND REGULATIONS (09)

Sources and types of industrial wastewater – Environmental impacts – Regulatory requirements – generation rates – characterization – Toxicity and Bioassay tests. Prevention vs Control of Industrial Pollution– Source reduction techniques – Waste Audit- Evaluation of pollution prevention options.

TREATMENT TECHNIQUES (09)

Waste minimization - Equalization - Neutralization – Oil separation – Flotation – Precipitation – Heavy metal Removal – adsorption – Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors - Chemical oxidation – Ozonation – Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal

REUSE AND RESIDUE MANAGEMENT (09)

Individual and Common Effluent Treatment Plants – Zero effluent discharge systems -Wastewater reuse – Disposal of effluent on land – Quantification, characteristics and disposal of Sludge.

CASE STUDIES I (09)

Industrial manufacturing process description, wastewater characteristics and effluent treatment flow sheet for Textiles, Sugar mill, distilleries, Thermal power plant, Nuclear power plant, Petroleum refineries, Fertilizers and Dairy.

CASE STUDIES I (09)

Industrial manufacturing process description, wastewater characteristics and effluent treatment flow sheet for Tanneries, Pulp and Paper mill, Chemical industries, Metal finishing industries, Iron and Steel industries, Meat packing industries and Poultry plant - Automobile Industry- Industrial estates and Industrial Clusters.

Total : 45 Hours

Reference books

1. *Eckenfelder, W.W.,* ***Industrial Water Pollution Control,*** *McGraw-Hill, 1999.*
2. *Arceivala, S.J.,* ***Wastewater Treatment for Pollution Control,*** *McGraw-Hill, 1998.*
3. *Frank Woodard,* ***Industrial waste treatment Handbook****, Butterworth Heinemann, New Delhi, 2001.*
4. *Nemerow N. L., "****Industrial Water Pollution"****, Addison - Wesley Publishing Company Inc., USA, 1978.*
5. *Mahajan S. P.* ***"Pollution Control in process industries"****, Tata McGraw Hill Publishing Co Ltd., New Delhi, 1989.*

12EE12 ENVIRONMENTAL QUALITY MEASUREMENT LABORATORY

L	T	P	C
3	0	0	3

1. Physical and chemical characteristics of water – pH, Electrical conductivity, Turbidity, Alkalinity, Acidity, Hardness, Sulphates, Fluorides, Nitrates. Analysis of solids content of water: Total solids, suspended solids, volatile solids, non volatile solids, Residual Chlorine analysis, Optimum coagulant dosage, Break point Chlorination.
2. Test on dissolved oxygen, BOD and COD
3. Ambient air quality Analysis: Determination of SPM, CO, NOx and SOx.
4. Soil Analysis**:** pH, Conductivity, Cation exchange capacity, Sodium Adsorption ratio
5. Microscopic Examination of Microorganisms: Preparation of bacterial smear - staining - Hanging drop technique - plate count test, MPN tests and MFT Tests.
6. Color removal from wastewater by adsorption
7. Settling tests on activated sludge
8. Determination of kinetic coefficients of ASP
9. Evaluation of aerator performance.

Reference books

1. *Metcalf & Eddy, Inc.,* ***'Waste water Engineering, Treatment, Disposal and Reuse'****, Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003.*
2. *Rich L. G.,* ***"Unit Processes in Sanitary Engineering",*** *John Wiley & Sons, Inc., New York, 1963.*

12EE13 WATER RESOURCES AND TREATMENT

L	T	P	C
3	0	0	3

STORM WATER DRAINAGE & GROUND WATER (09)

Storm water drainage - Statistical analysis for design, storage studies, mass diagram - draft – storage – frequency curves, risk in storage design – types of reservoirs - Various intakes. Movement of ground water - ground water hydraulics - non-equilibrium formulae - methods of images - application of storage equation.

DISTRIBUTION SYSTEM, COAGULATION AND FLOCCULATION (09)

Distribution system - Principles of design - Hardy cross method - Newton Raphson method - equivalent pipe method - method of section - electrical analogy methods, computer applications in distribution network analysis - laying and maintenance of distribution system – appurtenances. Coagulation - optimum dose - Coagulant aids - mixing and flocculation - mixing and stirring devices – flocculator - mean velocity gradient and power input - polyelectrolytes.

SEDIMENTATION, FLOATATION & DISINFECTION (09)

Sedimentation - General equations for sedimentation - Types of settling - effects of temperature and viscosity - basin efficiency - short circuiting - upward flow tanks - sludge blanket - inlet and outlet arrangements - sludge removal.Disinfection - Factors affecting disinfection, contact period, concentration time-temperature relationship, chlorination, free and combined available chlorine, types of chlorination, effect on various micro organisms, chlorinators, other methods.

FILTRATION (09)

Principles of Filtration – carman kozeny equation – Filter sand specification – hydraulics of filtration through homogenous and stratified beds, clogging of filters, hydraulics of filter washing, wash water trough, and design of filter under drains, filter appurtenances, variable rate of filtration, performance of slow, rapid, gravity, high rate, pressure filters – filters with composite filter medium, diatomaceous earth filter.

SOFTENING OF WATER, REMOVAL OF IRON, MANGANESE, FLUORIDE &CORROSION (09)

Lime soda treatment, split treatment, recarbonation, use of polyphosphates, disposal of sludge, ion exchange, demineralization, industrial water treatment. Removal of iron and manganese in water, fluoridation and defluoridation. Theory of corrosion, galvanic,electrolytic and biochemical corrosion, factors affecting corrosion, methods of prevention and control in water supply systems, methods of protection, stabilization, Langlier index.

Total : 45 Hours

Reference books

1. *Fair, Geyer and Okun, Vol.I &II,* ***Water supply and Waste Water Removal,*** *John Wilsey & Sons, Inc., 1968.*
2. *Linsley R. K. and Franzini J. B.,* ***Water Resources Engineering****, Mc Graw-Hill, inc., Tokyo,1985.*
3. *Linsley R. K. Jr., Kohler M. A., and panlhns J.L.H.,* ***Hydrology for Engineers****, Tata McGraw-Hill Book-Co., Singapore, 1988.*
4. *Manual for* ***Water supply and Treatment – CPHEEO, Ministry of Works and Housing,*** *New Delhi, 1999.*
5. *Raghunath H. M. –* ***Ground Water****, Wiley Eastern Limited, New Delhi 1988.*

12EE14 SOLID AND HAZARDOUS WASTE MANAGEMENT

L	T	P	C
3	0	0	3

SOLID WASTE GENERATION, STORAGE AND MANAGEMENT SYSTEM (09)

Definition of solid wastes – types of solid wastes –solid Waste Management - Goals and objectives – Functional elements in a solid waste management system – Interrelationships - public awareness.Generation of solid waste - Sources and types of solid wastes – sampling - Composition – Generation rates – Factors affecting generation rates. Onsite handling, Storage and Processing of solid wastes - necessary equipments.

COLLECTION AND TRANSFER OF SOILD WASTES (09)

Collection of solid waste - Collection services - collection system, equipments – Time and frequency of collection - labour requirements – Factors affecting collection – Analysis of collection systems – collection routes – Preparation of Master schedules. Transfer and Transport – Need for transfer operations - Transfer stations – types Transport means and methods - location of transfer stations.

PROCESSING TECHNIQUES AND RECOVERY OF ENERGY (09)

Processing Techniques – purposes – Mechanical volume reduction – necessary equipments – Chemical volume reduction – incinerators – Mechanical size reduction – Selection of equipments - Component separation – Methods – Drying and Dewatering. Incineration of solid wastes – Disposal in landfills: site selection, design, and operation of sanitary landfills – Leachate and landfill gas management; landfill closure and post-closure environmental monitoring landfill remediation – Regulatory aspects of municipal solid waste management. Composting – anaerobic and aerobic composting – Vermicomposting – unit operations associated with composting anaerobic digestion of municipal solid waste – Pyrolysis – reduction methods- Mechanical and Biological Treatment and landfilling

HAZARDOUS WASTES (09)

Hazardous waste definition – Physical and biological routes of transport of hazardous substances – sources and characterization categories and control. Sampling and analysis of hazardous wastes – analytical approach for hazardous waste characterization – proximate analysis – survey analysis – directed analysis – analytical methods.

HAZARDOUS WASTE MANAGEMENT (09)

Biomedical waste: Definition, sources, classification, collection, segregation Treatment and Disposal – Radioactive waste: Definition, Sources, Low level and high level radioactive wastes and their management, Radiation standard by ICRP and AERB – E-waste characteristics, generation, collection, transport and disposal.

Total : 45 Hours

Reference books

1. *Techbanoglous Thiesen Ellasen :* ***Solid waste Engineering Principles and Management,*** *McGraw Hill, 1977.*
2. *Hagerty D.J., Pevani J. L., and Heer J. E.,* ***Solid Waste Management*** *, Van Nostrand Reinhld, 1979.*
3. *Vesilind P.A. and Rimer A.E.* ***Unit operations in resources recovery engineering****, Prentice Hall, 1981.*
4. *S. K. Shukla, P. R. Srivastava,* ***Waste Management and control Commonwealth*** *Publishers, New Delhi, 1991.*
5. *B. B. Sundaresan, A. D. Bhide –* ***Solid Waste Management, Collection, Processing and Disposal****, Mudrashilpa Offset Printers, 2001.*
6. ***Manual on Solid Waste Management,*** *CPHEEO, Ministry of Urban Development, GOI, New Delhi, 2000.*
7. ***Management of Solid waste in developing countries*** *by FrankFlintoff , WHO regional publications 1976*

12EE15 URBAN AND RURAL SANITATION

L	T	P	C
3	0	0	3

GENERAL AND BASIC PRINCIPLES OF HEALTHFUL HOUSING (09)

Control of environment – Engineering methods - Modes of transmission of diseases – Mosquitoes and Flies - Life cycle, important characteristics and control measures of carriers. Basic principles of healthful housing - heating - ventilation - lighting - air conditioning – noise control in residential buildings.

PLUMBING AND SWIMMING POOL SANITATION, OPERATION AND MAINTANENCE (09)

Scope of plumbing - definition of plumbing terms - general principles of good plumbing system – water seal - types of traps, siphonage – design of plumbing system for multistory buildings - plumbing codes and standards.Transmission of diseases in swimming pools - quality standards of pool water - design features of pools and their appurtenances.Measures of Urban drainage and flood control benefits-Effective urban water user organizations.General approaches to operations and maintenance-Complexity of operations and need for diagnostic analysis-

REFUSE AND FOOD SANITATION (09)

Refuse characteristics in urban and rural areas - conditions and factors affecting collection, quantity and conveyance of solid waste - disposal methods - incineration - design of incinerators sanitary landfill - composting - waste recycling - biogas and gobar gas plants. Food borne and food caused diseases – food poisoning - food preservation – precautions in the design of kitchen - bactericidal treatment of kitchen utensils - Bacteriological contents of milk borne diseases - essential of milk sanitation - dairy barn sanitation - pasteurization methods - milk tests

URBAN AND RURAL WATER SUPPLY SYSTEM (09)

Water supply arrangements in urban buildings - design of water supply systems for multistoried buildings - consideration in the development of water supply programmes for rural areas - health and economical aspects in the design and installation of rural water supply systems - methods of construction and development of different types of wells - sanitation of rural wells - pumps for rural wells - treatment methods for rural water supply.

RURAL SANITATION (09)

Layout of drainage systems in urban domestic areas - methods of disposal of night soil in rural areas - different privies - Twin pit pour flush toilets, VIP latrines - water carriage method of sewage disposal - cesspools and seepage pits - septic tank systems - oxidation ponds - aerated lagoons.

Total: 45 Hours

Reference books

1. *Salvato,* ***Environmental Sanitation****, John Wiley & Sons, New York, 1982.*
2. *Ehler and Steel,* ***Municipal Rural Sanitation****, Mc - Graw Hill Book Co.,New York, 1964.*
3. *E.G. Wagner and J.N. Lanoix, Excreta* ***Disposal for Rural areas and small communities****, W.H.O. Publication, Geneva, 1958.*
4. *E.G. Wagner and J.N.Lanoix,* ***Water supply for rural areas and small communities****, W.H.O. Publication, Geneva, 1958.*
5. *Babbit H.E and Donald J.J.,* ***Water supply Engineering,*** *Mc - Graw Hill Book Co., New York, 1962.*

12EE16 CLIMATE CHANGE AND ADAPTATION

L	T	P	C
3	0	0	3

EARTH'S CLIMATE SYSTEM (09)

Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes - The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

OBSERVED CHANGES AND ITS CAUSES (09)

Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.

IMPACTS OF CLIMATE CHANGE (09)

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES (09)

Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

CLEAN TECHNOLOGY AND ENERGY (09)

Clean Development Mechanism – Carbon Trading - examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.

Total: 45 Hours

Reference books

1. *Jan C. van Dam, I**mpacts of Climate Change and Climate Variability on Hydrological Regimes**, Cambridge University Press, 2003.*
2. *IPCC fourth assessment report - **The AR4 synthesis report,** 2007*
3. *IPCC fourth assessment report –Working Group I Report, **" The physical Science Basis",** 2007*
4. *IPCC fourth assessment report - Working Group II Report, **" Impacts, Adaptation and Vulnerability"**, 2007*
5. *IPCC fourth assessment report – Working Group III Report**" Mitigation of Climate change",** 2007*
6. *Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., **'Climate Change and Water'.** Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 2008.*
7. *Dash Sushil Kumar, **"Climate Change – An Indian Perspective"**, Cambridge University Press India Pvt. Ltd, 2007.*

12EE17 REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL ENGINEERING

L	T	P	C
3	0	0	3

FUNDAMENTALS OF REMOTE SENSING (09)

Introduction to remote sensing – Principles of Electro – Magnetic Radiation – Energy /Matter interaction with Atmosphere and land surface – spectral reflectance of earth materials and vegetation – Data products.

AERIAL PHOTOGRAPHY AND SATELLITE REMOTE SENSING (09)

Aerial Photography – Photogrammetry And Visual Image Interpretation. Various satellites in orbit and their sensors – Resolutions – Multispectral Remote Sensing system (MSS) and design – VISIBLE - NIR remote sensing - Thermal IR Radiation properties, systems and application – Microwave and LIDAR remote sensing – Principles, applications and Significance.

DATA ANALYSIS AND GIS (09)

Data Analysis – Visual interpretation and digital image processing – Classification. Introduction to GIS, Concepts, Components of GIS, Data Base Structure – Rater and Vector data models, Scale, Projection, Datum and Coordinate system – Data acquisition and conversion techniques – Database management System, Query development, Spatial querying – Various GIS software.

REMOTE SENSING AND GIS APPLICATIONS (09)

Applications of Remote sensing and GIS –Introduction to Global Positioning System (GPS) – Management and Monitoring of Land, air and water pollution studies – Conservation of resources – Coastal zone management – Limitations.

LABORATORY PRACTICES (09)

Data sources – Visual interpretation - digital image processing – Introduction to ENVI image processing software – GIS / Data Analysis in ARC GIS.

Total: 45 Hours

Text Books

1. *Anji Reddy,* ***"Remote Sensing and Geographical Information system",*** *B S publications 2001.*
2. *M.G. Srinivas (Edited by)* ***"Remote sensing applications",*** *Narosa publishing house, 2001*
3. *A M. Chandra and S.K .Ghosh,* ***"Remote Sensing and Geographical Information System"****, Narosa Publishing House, 2006.*

Reference books

1. *Lintz, J. and Simonet,* ***Remote Sensing of Environment****, Addison Wesley Publishing Company, 1994.*
2. *Burroughs P.A,* ***Principles of Geographical Information System,*** *Oxford University Press, 1998.*
3. *Thomas M Lille sand ,Rupiah W. Kiefer & Jonathan W. Chip man* ***"Remote sensing and Image Interpretation"*** *John Wiley Sons, 2004.*

12EE18 SURFACE AND GROUND WATER MODELLING

L	T	P	C
3	0	0	3

SURFACE WATER HYDROLOGY (09)

Land processes – Subsurface and Channel Processes – Precipitation – Rain gauge network, Abstractions, Infiltration, Evaporation, Transpiration, Process and Models.

SURFACE RUNOFF MODEL (09)

Unit Hydrograph & S curve Hydrograph, Dimensionless Unit hydrograph, GUIH, Watershed model and Conceptual Models.

GROUNDWATER HYDROLOGY (09)

Occurrence and Movement of Ground water, Properties of aquifer, Groundwater flow equations, Dupuit Forchheimer assumptions, Well hydraulics, Partial penetration of wells, Interference of wells, Collector wells and Infiltration galleries.

GROUNDWATER FLOW (09)

Pumping tests, Analysis for unconfined and non leaky and leaky confined aquifer and water table aquifer, Locating hydro geologic boundaries, Well design criteria.

GROUNDWATER MODEL (09)

Natural and Artificial Recharge of Ground water – Salt water intrusion, Application of Finite Difference in ground water.

Total: 45 hours

Reference books

1. *Ven Te Chow,* ***"Applied Hydrology",*** *Mc Graw Hill Science Publishers, 1988.*
2. *Singh, Vijay .,* ***"Elementary Hydrology",*** *Prentice Hall, 1994.*
3. *Raghunath.* ***"Ground Water"****, Mc Graw Hill, 2007.*
4. *Bear, J.,* ***Hydraulics of Ground water****, Mc Graw Hill, 2007.*

12EE19 ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES

L	T	P	C
3	0	0	3

INDUSTRIAL HAZARDS (09)

Occupation, Health and Hazards - Safety Health and Management: Occupational Health Hazards - Ergonomics - Importance of Industrial Safety. Radiation and Industrial Hazards : Types and effects - Vibration - Industrial Hygiene - Different air pollutants in industries and their effects. Electrical, fire and Other Hazards - General causes, Machine Guards and its types, Automation.

SAFETY PRACTICES (09)

Safety at Workplace - Safe use of Machines and Tools: Safety in use of different types of unit operations - Ergonomics of Machine guarding - working in different workplaces - Operation, Inspection and maintenance. Plant Design and Housekeeping, Industrial lighting, Vibration and Noise

ACCIDENT TECHNIQUES (09)

Accident Prevention Techniques - Principles of accident prevention - Definitions, Theories, Principles - Hazard identification and analysis, Event tree analysis, Hazop studies, Job safety 7analysis - Theories and Priciples of Accident causation - First Aid : Body structure and functions - Fracture and Dislocation, Injuries to various body parts

SAFETY LAWS (09)

Safety Management System and Law - Legislative measures in Industrial Safety: Various acts involved in Detail-Occupational safety, Health and Environment Management : Bureau of Indian Standards on Health and Safety, 14489, 15001 - OSHA, Process safety management (PSM) and its principles - EPA standards- Safety Management : Organizational & Safety Committee - its structure and functions

SAFETY DOCUMENTATION (09)

Plant Layout for Safety -design and location,distance between hazardous units, lighting, colour coding, pilot plant studies, Housekeeping - Accidents Related with Maintenance of Machines - Work Permit System : Significance of Documentation Directing Safety : Definition, Process, Principles and Techniques Leadership : Role, function and attribution of a leader Case studies - involving implementation of health and safety measures in Industries

Total: 45 hours

Reference books

1. *R.K. Jain and Sunil S. Rao,* ***Industrial safety, Health and Environment Management****, Khanna publishers, New Delhi (2006).*
2. *Frank P. Lees -* ***Loss of Prevention in Process Industries****, Vol 1 and 2, Butterworth - Heinamann Ltd., London (1991)*
3. ***Industrial Safety*** *- National Council of India*
4. ***Factories Act with Amendments 1987,*** *Govt. of India Publications DGFASLI, Mumbai*

12EE20 ENVIRONMENTAL BIOTECHNOLOGY

L	T	P	C
3	0	0	3

INTRODUCTION: BASICS& PRINCIPLES (09)

Basic information on DNA and RNA Microbes- prokaryotes and eukaryotes, metabolism- carbohydrate, protein, lipids. Analysis of metabolism for environmental application and its mechanism, effective microorganism, Mechanism of detoxification, Photorespiration, immobilization, biodegradation, biogeochemical cycle

FUNDAMENTALS OF BIOLOGICAL INTERVENTION (09)

Extremophiles and thermophiles and its potential applications in environmental issues, diverse degradative abilities of microbes, inhibitors of degradation-xenobiotics, endocrine disrupters

INDUSTRIAL APPLICATION (09)

Decontamination of ground water, biofertilizers, physical, chemical and microbiological factors of composting, health risk, odor management, biological removal of nutrients- biotrickling filters, biomembrane technology

GENETIC MANIPULATION (09)

Basic principles of genetic engineering, concept of recombinant technology-expression vectors- cloning of DNA – mutation, protoplast fusion technology, genetically modified organisms, risk assessment

INTEGRATED ENVIRONMENTAL BIOTECHNOLOGY (09)

Bioenergy, biogas production, biodiesel, Bioremediation, factors affecting bioremediation , Biosorption, mechanism of biosorption, waste minimization, ,pollution prevention, Biosensors and its application in environmental issues, integrated agricultural application, plant disease suppression, biomonitoring, phytoremediation, microbes external to the plants, plant/ microbe interaction, Biotransformation

Total: 45 hours

Reference books

1. *Wainwright M.,* ***An Introduction to Environmental Biotechnology****, 1999.*
2. *Martin, A. M.,* ***Biological Degradation of Wastes****, Elsevier Appl. Science, New York, 1991.*
3. *Sayler, Gray S. Robert Fox and James W. Blackburn* ***Environmental Biotechnology for Waste Treatment****, Plenum Press, New York, 1991.*
4. *Bruce E. Rittman, Eric Seagram, Brian Alwen and Albert J. Valocchi, Chittaranjan Ray, Lutgarde Raskin,* ***Insitu Bioremediation*** *(2nd Ed.) nays' Publ. U.S.A. 1994.*
5. *Old, R. W., and Primrose, S.B.,* ***Principles of Gene Manipulation*** *(3 rd Ed.) Blackwell Sci. Publ., Cambridge, 1985.*

12EE21 ENVIRONMENTAL GEOTECHNOLOGY

L	T	P	C
3	0	0	3

INTRODUCTION (09)

Introduction to Environmental Geotechniques – Environmental cycles and their interaction – Soil water environment interaction relating to geotechnical problems – Effect of pollution on soil-water behavior – Sources, production and classification of wastes – Environmental regulations in India – Case studies of foundation failures by ground contamination.

SITE SELECTION AND METHODS OF DISPOSAL (09)

Criteria for selection of sites for waste disposal – parameters controlling the selection of waste disposal sites – current practices for waste disposal - subsurface disposal techniques – Passive contaminant Systems – Leachate contamination – application of geosynthesis and other techniques in solid waste management – liquid waste disposal - rigid or flexible membrane liners.

HYDROLOGY OF CONTAMINANTS (09)

Transport phenomena in saturated and partially saturated porous media – contaminant migration and contaminant hydrology – Hydrological design for ground water pollution control – Ground water pollution downstream of landfills – pollution of aquifers by mining and liquid wastes – protection of aquifers.

HAZARDOUS WASTE DISPOSAL (09)

Hazardous waste control and storage system – stabilization / solidification of wastes – Processes and Functions – Monitoring and performance of contaminant facilities – Environmentally safe disposal of solid and liquid waste.

REMEDIAL MEASURES (09)

Evaluation of contaminated sites – Exsitu and insitu remediation – Bio-remediation – Soil washing, soil heating - electro kinetics – Bio venting – Ground water remediation – Air sparring – reactive well.

Total : 45 Hours

Reference books

1. *Wentz C. A.,* ***Hazardous Waste Management****, McGraw Hill, Singapore, 1989.*
2. *Daniel D. E.,* ***Geotechnical Practice for waste disposal****, Chapman and Hall, London, 1993.*
3. *Lagrega M. D., Buckingham P. L., and Evans J. C.,* ***Hazardous waste management****, McGraw Hill, 1994.*

12EE22 ENVIRONMENTAL ENGINEERING STRUCTURES

(Common to 12SE29 M.E. Structural Engineering)

L	T	P	C
3	0	0	3

DESIGN OF PIPES (09)

Structural design of Concrete, Prestressed Concrete, Steel and Cast iron pipes - piping mains – joints – Leak detection - sewerage tank design – anchorage for pipes – massive outfalls – structural design - laying – Testing - hydrodynamic considerations - Advances in the manufacture of pipes.

DESIGN OF CONCRETE ROOFING SYSTEMS (09)

Design of concrete roofing systems – Cylindrical, Spherical and Conical shapes using membrane theory and design of various types of folded plates for roofing with concrete – Design of pumping stations – Drainage plan of a building.

ANALYSIS AND DESIGN OF WATER TANKS (09)

IS Codes for the design of water retaining structures. Design of circular, rectangular, spherical and Intze type of tanks using concrete. Design of prestressed concrete cylindrical tanks – Economic analysis – introduction to computer aided design and packages.

DESIGN OF SPECIAL PURPOSE STRUCTURES (09)

Underground reservoirs and swimming pools, Intake towers, Structural design including foundation of water retaining structures such as settling tanks, clariflocculators, aeration tanks, etc.,- effect of earth pressure and uplift considerations – selection of materials of construction.

REPAIR AND REHABILITATION OF STRUCTURES (09)

Diagonising the cause and damage, identification of different types of structural and non-structural cracks – repair and rehabilitation methods for Masonry, Concrete and Steel Structures. Exposure on Steel, Lattice Structures used in water and sewerage works.

Total : 45 Hours

Reference books

1. ***Prestressed Concrete*** *by Krishna Raju, Tata McGraw Hill Publishing Co. 2nd edition, 1988.*
2. ***Reinforced Concr****ete by N. C. Sinha & S .K. Roy -S. Chand and Co.,1985.*
3. *Hulse R. and Mosley W. H.,* ***Reinforced Concrete Desi****gn by Computer, Macmillan Education Ltd., 1986.*
4. *Ramaswamy G. S.,* ***Design and Construction of Concrete shell roofs,*** *CBS Publishers, India, 1986*
5. *Green J. K. and Perkins P. H.,* ***Concrete liquid retaining structures****, Applied Science Publishers, 1981.*

12EE23 ADVANCED WASTEWATER TREATMENT AND REUSE

L	T	P	C
3	0	0	3

GENERAL AND STRIPPING (09)

Need for advanced wastewater treatment – technologies used for advanced treatment –conventional reactor modifications in advanced treatment-oxidation processes – regulations in removal of NBOD and other nutrients- Selection of unit operation in advanced treatment. Gas stripping – Analysis of gas stripping – Design of stripping towers – applications. – Air stripping of ammonia – Breakpoint chlorination – Ion exchange.

NITROGEN REMOVAL AND OXIDATION PROCESSES (09)

Nutrient removal – Nitrogen removal – forms and sources of nitrogen – Biological nitrogen removal – Nitrification kinetics – Denitrification kinetics – Design parameters – Nitrogen removal by – physical and chemical processes. Oxidation processes-advanced oxidation process in removal of nitrogen and phosphorus derivatives-use of peroxy,Cl- and oxy radicals in reducing COD.

MEMBRANE SEPARTION PROCESSES AND ELECTRO DIALYSIS (09)

Membrane separation processes – process classification – membrane materials-Symmetric and asymmetric membranes – membrane configuration – membrane fouling- Molecular weight cutoff – Reverse osmosis – theory – membrane structure and rejection mechanism – osmotic pressure – Transport models and flux equations – ultrafiltration – Electrodialysis – theory – power requirement.

PHOSPHOROUS REMOVAL (09)

Phosphorous removal – By biological methods – Phosphorous removal by chemical addition – chemistry of precipitation with Aluminium, calcium and Iron – Comparison of processes – Estimation of sludge produced from chemical precipitation of phosphorous with lime in PST.

WASTEWATER RECLAMATION AND REUSE (09)

Merits and demerits of advanced treatment-applications of treated wastewater- Wastewater reclamation and reuse – The role of water recycling in the hydrologic cycle – wastewater reuse applications – public health and environmental issues in water reuse – Level of treatment – Risk Assessment – Ground water recharge with reclaimed water.

Total : 45 Hours

Reference books

1. *METCALF & EDDY,* ***"Wastewater Engineering Treatment Disposal Reuse"****, Tata McGraw-Hill, New York, 2003.*
2. *Arceivala S. J.'* ***"Wastewater treatment and Disposal"*** *Marcelderdekker Publishers,1981.*
3. *HOWARD S. PEAVY, DONALD R. ROWE & GEORGE TCHOBANOGLOUS, "****Environmental Engineering",*** *McGraw-Hill, 1988.*
4. *QASIM S. R.,* ***"Wastewater Treatment Plant – Planning, Design and operation****, Holt Rinchart and Winston, New York, 2002.*
5. *Larry D. Benefield and Clifford W. Randall,* ***"Biological Process Design for Wastewater Treatment"*** *, Prentice - Hall Series in Environmental sciences, 1980.*

12EE24 INSTRUMENTATION, SELECTION AND MANAGEMENT OF ENVIRONMENTAL ENGINEERING EQUIPMENTS

L	T	P	C
3	0	0	3

GENERAL (09)

Study of machinery, electric motors types and characteristics, other prime covers, pumps, capacity, operation and maintenance of pumping machinery, air compressors preventive maintenance, break-down maintenance, schedules – Factors to be considered in the selection of the equipments.

INSTRUMENTATION (09)

pH meter - Flame Emission Spectrometry. Absorption spectrometry - Nephelometry - Atomic Absorption Spectrometry - Gas chromatography – working principle and components. Total carbon analyser – Mercury Analyser polar graph for metal estimation and organic compounds - Ion selective Electrode -SO2 and CO analyser – Instrument components and its working principle.

WATER SUPPLY MACHINERY AND WASTEWATER MACHINERY (09)

Drilling equipment, pumping equipment for wells. Machinery required for primary and secondary treatment, sewage pumps , sludge pumps, vaccum filtration equipment.

EQUIPMENTS FOR TREATMENT UNITS (09)

Equipment for treatment unit - electrically and mechanically operated agitators, mixers, aerators, chlorinators, Surface aerators. Meters for measurement of flow, head, electricity.

AIR POLLUTION CONTROL EQUIPMENTS (09)

Working principles of electrostatic precipitator – cyclone separators – settling chamber – operation and Maintenance. Machinery for solid waste collection and disposal incineration – compactors – magnetic separators- incinerators.

Total : 45 Hours

Reference books

1. ***Operation and Control of Water Treatment Processes*** *COX CR WHO 1964.*
2. *Course Manual on* ***Preventive Maintenance of Water Distribution System****, NEERI, 1973.*
3. *Trivedy R. K. & Goel P.K.,* ***Chemical and Biological methods for water pollution studies****, Environmental publication, Karat, 1986.*
4. *Standards Methods for the* ***Examination of Water and Waste Water,*** *17th Edition, WPCF, APHA and AWWA, USA, 1989.*

12EE25 CONTAMINANT TRANSPORT MODELLING

L	T	P	C
3	0	0	3

TRANSPORT (09)

Transport phenomenon – diffusion – dispersion – advection – adsorption - conservative and non-conservative pollutants.

PROCESS MODELS (09)

Governing Equations for flow and transport in surface and subsurface waters - chemical and biological process models - simplified models for lakes, streams, and estuaries.

APPLICATIONS (09)

Model complexity - model resolution - coupled and uncoupled models - linear and nonlinear models - Solution techniques – calibration - application and evaluation of environmental control – bioremediation –

NUMERIC MODELS (09)

Numerical models: FDM, FEM and Finite volume techniques - explicit vs. implicit methods - numerical errors - High resolution techniques –

SOFTWARES (09)

Stream quality modeling using QUAL2K - Groundwater transport modeling using VISULA MODFLOW.

Total : 45 hours

Reference books

1. *Martin, L.J. and McCucheon, S.C,* ***Hydrodynamics of transport for water quality modeling,*** *Lewis Publishers, Boca Raton, 1999.*
2. *Freeze, R.A. and Cherry. J.A.* ***Groundwater****, Prentice Hall, 1979.*