E.G.S. PILLAY ENGINEERING COLLEGE (AUTONOMOUS)

Department of Civil Engineering

17EV101		STATISTICS FOR ENVIRONMENTAL ENGINEERS	L	T	P	C
			3	2	0	4
		(Common to Full time and Part Time)				

Course Objectives:

1. To introduce the basic concept of Stochastic Processes
2. To enable the students in handling Estimation and Testing of Hypothesis
3. To learn the Application of Statistics in Engineering Decision Making

Unit I	Probability and Random Variable	9 + 3 Hours

Probability concepts – Random Variables – Moment generating function – Standard distributions - Binomial - Poisson - rectangular or Uniform – Normal - Exponential distributions - Functions of random variables –Two dimensional random variables.

Unit II	Stochastic Processes	9 + 3 Hours

Classification – Stationary and Random process – Markov process – Markov chains – Transition probability – Classification of Markov chain – Limiting distribution – First passage time – Poisson process – Birth and death process.

Unit III	Estimation Theory	9 + 3 Hours

Estimation: Point and Interval estimates for population parameters of large sample and small samples, determining the sample size- unbiased Estimators- Maximum Likelihood Estimation-Curve Fitting by Principle of Least square

Unit IV	Testing of Hypothesis- Parametric Tests	9 + 3 Hours

Hypothesis testing: one sample and two sample tests for means and proportions of large samples z-test, one sample and two sample tests for means of small sample t-test, F-test for two sample standard deviations. ANOVA one and two way classification.

Unit V	Non Parametric Tests	9 + 3 Hours

Chi-square test for single sample standard deviation. Chi-square tests for independence of attributes and goodness of fit. Sign test for paired data. Rank sum test. Comparing two populations. Mann – Whitney U test and Kruskal Wallis test.

Total:	45 + 15 Hours

Further Reading

Sampling, distribution, correlation, regression curve fitting by least square methods.

Course Outcomes:

After completion of the course, Student will be able to

1. To acquire knowledge in basic concepts of Probability
2. To characterize phenomenon which evolve with respect to time in a probabilistic manner
3. To estimate the sample size and prediction of unknown values
4. To solve Parametric and non - parametric statistical problem
5. To apply statistical techniques for solving Engineering problems

References:

1. Jay L. Devore, “Probability and Statistics For Engineering and the Sciences”,Thomson and Duxbury, 2002.
2. Richard Johnson. ”Miller & Freund’s Probability and Statistics for Engineer”, Prentice – Hall,Seventh Edition, 2007.
3. Gupta S.C. and Kapoor V.K.”Fundamentals of Mathematical Statistics”, Sultan an Sons, 2001.
4. Dallas E Johnson , “Applied Multivariate Methods for Data Analysis”, Thomson an Duxbury press,1998.
5. Jay L. Devore, “Probability and Statistics For Engineering and the Sciences”,Thomson and Duxbury, 2002.

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Department of Civil Engineering

17EV102		ENVIRONMENTAL CHEMISTRY	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. To educate the students about water chemistry
2. To impart knowledge in the area of air and soil chemistry
3. To impart knowledge on the transformation of chemicals in the environment

Unit I **Introduction** **9 Hours**

Stoichiometry and mass balance-Chemical equilibria, acid base, solubility product(Ksp) ,heavy metal precipitation, amphoteric hydroxides,CO_2 solubility in water and species distribution – Chemical kinetics , First order- 12 Principles of green chemistry.

Unit II **Aquatic Chemistry** **11 Hours**

Water quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation – Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction , pE – pH diagrams, redox zones – sorption- Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation.

Unit III **Atmospheric Chemistry** **7 Hours**

Atmospheric structure –-chemical and photochemical reactions – photochemical smog. Ozone layer depletion – greenhouse gases and global warming, CO_2 capture and sequestration – Acid rain- origin and composition of particulates. Air quality parameters-effects and determination.

Unit IV **Soil Chemistry** **9 Hours**

Nature and composition of soil-Clays- cation exchange capacity-acid base and ion-exchange reactions in soil – Agricultural chemicals in soil-Reclamation of contaminated land; salt by leaching-Heavy metals by electrokinetic remediation.

Unit V **Environmental Chemicals** **9 Hours**

Heavy metals-Chemical speciation –Speciation of Hg &As- Organic chemicals- Pesticides, Dioxins,PCBs,PAHs and endocrine disruptors and their Toxicity- Nano materials, CNT, titania, composites, environmental applications.

Total: 45 Hours

Further Reading

To analyze and create a solution for environmental issues.

Course Outcomes:

After completion of the course, Student will be able to

1. Distinguish the chemistry involved
2. Understand the chemistry involved in water
3. Identify and solve the air pollution related issues
4. Understand the soil related chemistry and issues
5. Identify contaminating chemicals and can work out chemicals need calculations for treatment purpose

References:

1. Sawyer,C.N., MacCarty, P.L. and Parkin, G.F., Chemistry for Environmental Engineering and
2. Science, Tata McGraw – Hill, Fifth edition, New Delhi 2003.
3. Colin Baird „Environmental Chemistry", Freeman and company, New York, 1997.
4. Manahan, S.E., Environmental Chemistry, Eighth Edition, CRC press, 2005.
5. Ronbald A. Hites ,Elements of Environmental Chemistry, Wiley, 2007.

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17EV103		ENVIRONMENTAL MICROBIOLOGY	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.
2. The morphology, behavior and biochemistry of bacteria, fungi, protozoa, viruses, and algae are outlined.
3. The microbiology of wastewater, sewage sludge and solid waste treatment processes is also provided. Aspects on nutrient removal and the transmission of disease causing organisms are also covered.
4. An exposure to toxicology due to industrial products and byproducts are also covered.
5. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.

Unit I **Classification And Characteristics** **5 Hours**

Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology.

Unit II **Microbes And Nutrient Cycles** **10 Hours**

Distribution of microorganisms – Distribution / diversity of Microorganisms – fresh and marine, terrestrial – microbes in surface soil, Air – outdoor and Indoor, aerosols, biosafety in Laboratory – Extreme Environment – archaebacteria – Significance in water supplies – problems and control. Transmissible diseases. Biogeochemical cycles-----Hydrological - Nitrogen, Carbon, Phosphorus, Sulphur, Cycle – Role of Micro Organism in nutrient cycle.

Unit III **Metabolism of Microorganisms** **10 Hours**

Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb‟s cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics.

Unit IV **Pathogens in Wastewater** **10 Hours**

Introduction to Water Borne pathogens and Parasites and their effects on Human, Animal and Plant health, Transmission of pathogens – Bacterial, Viral, Protozoan, and Helminths, Indicator organisms of water – Coliforms - total coliforms, E-coli, Streptococcus, Clostridium, Concentration and detection of virus. Control of microorganisms; Microbiology of biological treatment processes – aerobic and anaerobic, □-oxidation, β-oxidation, nitrification and de-nitrification, eutrophication. Nutrients Removal – BOD, Nitrogen, Phosphate. Microbiology of Sewage Sludge.

Unit V **Toxicology** **10 Hours**

Ecotoxicology – toxicants and toxicity, Factors influencing toxicity. Effects – acute, chronic, Test organisms – toxicity testing, Bioconcentration – Bioaccumulation, biomagnification, bioassay, biomonitoring, bioleaching.

Total: 45 Hours

Further Reading

Identification and culturing of microorganisms from different sources

Course Outcomes:

After completion of the course, Student will be able to

1. The candidate at the end of the course will have a basic understanding on the basics of microbiology and their diversity and on the genetic material in the living cell.
2. The candidate would be able to understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.

	3. The candidate would have understood the role microbial metabolism in a wastewater treatment plant.
	4. The candidate would know the role of microorganisms in contaminated water and the diseases caused.
	5. The candidate has the ability to conduct and test the toxicity due to various natural and synthetic products in the environment.

References:

1. S.C.Bhatia, Hand Book of Environmental Microbiology, Part 1 and 2, Atlantic Publisher
2. Gabriel Bitton, Wastewater Microbiology, 2nd Edition ,
3. Raina M. Maier, Ian L. Pepper, Charles P. Gerba, Environmental Microbiology, Academic Press.
4. SVS. Rana, Essentials of Ecology and Environmental Science, 3rd Edition, Prentice Hall of India Private Limited
5. Stanley E. Manahan, Environmental Science and Technology, Lewis Publishers.
6. Hurst, C.J. (2002) Manual of Environmental Microbiology. 2nd Ed. ASM PRESS, Washington, D.C. ISBN 1-55581 - 199 - X.
7. Frank C. Lu and Sam Kacew, LU‟s Basic Toxicology, Taylor & Francis, London (4th Ed), 2002

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Department of Civil Engineering

17EV104		TRANSPORT OF WATER AND WASTEWATER	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain
2. To educate the students in computer application on design.

Unit I	General Hydraulics and Flow Measurement	8 Hours

Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement.

Unit II	Water Transmission and Distribution	10 Hours

Need for Transport of water and wastewater-Planning of Water System –Selection of pipe materials, Water transmission main design- gravity and pumping main; Selection of Pumps- characteristics-economics; Specials, Jointing, laying and maintenance, water hammer analysis; water distribution pipe networks Design, analysis and optimization – appurtenances – corrosion prevention – minimization of water losses – leak detection Storage reservoirs.

Unit III	Wastewater Collection and Conveyance	10 Hours

Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

Unit IV	Storm Water Drainage	7 Hours

Necessity- - combined and separate system; Estimation of storm water run-off Formulation of rainfall intensity duration and frequency relationships- Rational methods.

Unit V	Case Studies and Software Applications	10 Hours

Use of computer software in water transmission, water distribution and sewer design – EPANET 2.0, LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based softwares.

	Total:	45 Hours

Further Reading

Designing of pipelines and sewers for various project areas

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the fluid flow properties
2. Design water supply main, distribution network and sewer for various field conditions
3. Design the drainage network for wastewater
4. Design the storm water drainage systems
5. Troubleshooting in water and sewage transmission be able to use various computer software for the design of water and sewage network

References:

1. Bajwa, G.S. Practical Handbook on Public Health Engineering, Deep Publishers, Shimla, 2003
2. "Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
3. "Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban

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Department of Civil Engineering

17EV105		PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. To educate the students on the principles and process designs of various treatment systems for water and wastewater
2. To educate the students on design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Unit I	Introduction	5 Hours

Pollutants in water and wastewater – characteristics, Standards for performance - Significance of physico-chemical treatment – Selection criteria-types of reactor- reactor selection-batch- continuous type-kinetics

Unit II	Treatment Principles	10 Hours

Physical treatment - Screening – Mixing, Equalization – Sedimentation – Filtration – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption – Isotherms – Membrane separation, Reverse Osmosis, nano filtration, ultra filtration and hyper filtration electro dialysis, distillation – stripping and crystallization – Recent Advances. Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends

Unit III	Design of Municipal Water Treatment Plants	10 Hours

Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation – clarifier – tube settling – filters – Rapid sand filters, slow sand filter, pressure filter, dual media Disinfection - Displacement and gaseous type - Flow charts – Layouts – Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Unit IV	Design of Industrial Water Treatment Plants	10Hours

Design of Industrial Water Treatment Units- Selection of process – Design of softeners – Demineralisers – Reverse osmosis plants –Flow charts – Layouts –Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Unit V	Design of Wastewater Treatment Plants	10 Hours

Design of municipal wastewater treatment units-screens-detritors-grit chamber-settling tanks- sludge thickening-sludge dewatering systems-sludge drying beds - Design of Industrial Wastewater Treatment Units-Equalization- Neutralization-Chemical Feeding Devices-mixers- floatation units-oil skimmer Flow charts – Layouts –Hydraulic Profile, PID, construction and O&M aspects – case studies, Retrofitting - Residue management – Upgradation of existing plants – Recent Trends.

	Total:	45 Hours

Further Reading

Implementation of advanced treatment technologies for various wastewater treatment

Course Outcomes:

After completion of the course, Student will be able to

1. Identify the pollutants type in the wastewater
2. Understand the various treatment principles
3. Design the sewage treatment plants
4. Design suitable treatment units for various industries
5. Develop conceptual schematics required for the treatment of wastewater

References:

1. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw Hill, New Delhi, 2003.
2. Qasim, S.R., Motley, E.M. and Zhu.G. Water works Engineering – Planning, Design and Operation, Prentice Hall, New Delhi, 2002.
3. Lee, C.C. and Shundar Lin, Handbook of Envrn Engg Calculations, Mc Graw Hill, NewYork, 1999.

17EV106		**ENVIRONMENTAL CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
			0	**0**	**2**	**1**
		(Common to Full time and Part Time)				

Course Objectives:	
	1. To train in the analysis of physical parameters of water and waste water
	2. To train in the analysis of chemical parameters of water and waste water

List of Experiments:	
1. Good Laboratory Practices, Quality control, calibration of Glassware	03
2. Sampling and Analysis of water (pH, alkalinity, hardness chloride, Sulphate, turbidity EC, TDS, nitrate, fluoride)	12
3. Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals).	12
4. Sampling and analysis of air pollutants Ambient & Stack (RSPM, SO2 and NOx)	09
5. Sampling and characterization of soil (CEC & SAR, pH and K).	09
Total:	**45 Hours**

Course Outcomes:	
	After completion of the course, Student will be able to
	1. assess quality of environment
	2. conduct analysis on characteristics of water and waste water

References:
1. APHA, Standard Methods for the Examination of Water and Wastewater, 21st Ed.
2. Washington, 2005.
3. Laboratory Manual for the Examination of water, wastewater soil Rump, H.H. and Krist, H.
4. Second Edition, VCH, Germany, 1992.
5. Methods of air sampling & analysis ,James P.Lodge Jr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.

17EV107		**ENVIRONMENTAL MICROBIOLOGY LABORATORY**	**L**	**T**	**P**	**C**
			0	**0**	**2**	**1**
		(Common to Full time and Part Time)				

Course Objectives:	
	1. To train in the analysis of physical parameters of water and waste water
	2. To train in the analysis of chemical parameters of water and waste water

List of Experiments:
1. Preparation of culture media
2. Isolation, culturing and Identification of Microorganisms
3. Microorganisms from polluted habitats (soil, water and air)
4. Measurement of growth of microorganisms, Assay of enzymes involved in biotransformation
5. Biodegradation of organic matter in waste water Analysis of air borne microorganisms
6. Staining of bacteria
7. Effect of pH, temperature on microbial growth
8. Pollutant removal using microbes from industrial effluent.
9. Effect of pesticides on soil microorganisms
10. Bacteriological analysis of wastewater (Coliforms, E.coli, Streptococcus) – MPN
11. Bacteriological analysis of wastewater (Coliforms, Streptococcus) - MF techniques
12. Effect of Heavy metals on microbial growth
13. Detection of Anaerobic bacteria (Clostridium sp.)
14. Bioreactors
Total: **45 Hours**

Course Outcomes:	
	After completion of the course, Student will be able to
	1. Field oriented testing of water, wastewater and solid waste for microbial contamination.
	2. Perform toxicity test.

References:	
1.	Standard methods for the examination of water and wastewater, American Public Health Association (21st edition) 2005.
2.	Charles Gerba, Environmental Microbiology: A laboratory manual, Elsevier Publications, 2012.
3.	Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, and Linda D. Stetzenbach, Manual of Environmental Microbiology, 3rd Edition, ASM Press, 2007.

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Department of Civil Engineering

17EV201		PRINCIPLES AND DESIGN OF BIOLOGICAL TREATMENT SYSTEMS	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

To educate the students on the principles and process designs of various treatment systems for water and wastewater and students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Unit I	Introduction	10 Hours

Objectives of biological treatment – significance – Principles of aerobic and anaerobic treatment - kinetics of biological growth – Factors affecting growth – attached and suspended growth - Determination of Kinetic coefficients for organics removal – Biodegradability assessment -selection of process- reactors-batch-continuous type.

Unit II	Aerobic Treatment of Wastewater	10 Hours

Design of sewage treatment plant units –Activated Sludge process and variations, Sequencing Batch reactors, Membrane Biological Reactors-Trickling Filters-Bio Tower-RBC-Moving Bed Reactors-fluidized bed reactors, aerated lagoons, waste stabilization ponds – nutrient removal systems – natural treatment systems, constructed wet land – Disinfection – disposal options – reclamation and reuse – Flow charts, layout, PID, hydraulic profile, recent trends.

Unit III	Anaerobic Treatment of Wastewater	10 Hours

Attached and suspended growth, Design of units – UASB, up flow filters, Fluidized beds MBR, septic tank and disposal – Nutrient removal systems – Flow chart, Layout and Hydraulic profile – Recent trends.

Unit IV	Sludge Treatment and Disposal	5 Hours

Design of sludge management facilities, sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity) Layout, PID, hydraulics profile – upgrading existing plants – ultimate residue disposal – recent advances.

Unit V	Construction Operations and Maintenance Aspects	10 Hours

Construction and Operational Maintenance problems – Trouble shooting – Planning, Organizing and controlling of plant operations – capacity building - Retrofitting Case studies – sewage treatment plants – sludge management facilities.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Develop conceptual schematics required for biological treatment of wastewater
2. Translate pertinent criteria into system requirements.

References:

1. Arceivala, S.J., Wastewater Treatment for Pollution Control, TMH, New Delhi, Second Edition, 2000.
2. Manual on “Sewerage and Sewage Treatment” CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
3. Metcalf & Eddy, INC, „Wastewater Engineering – Treatment and Reuse, Fourth Edition, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2003.
4. F.R. Spellman, Hand Book of Water and Wastewater Treatment Plant operations, CRC Press, New York (2009).

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Department of Civil Engineering

17EV202		AIR POLLUTION MONITORING AND CONTROL	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends

Unit I	Introduction	7 Hours

Structure and composition of Atmosphere – Sources and classification of air pollutants - Effects of air pollutants on human health, vegetation & animals, Materials & Structures – Effects of air Pollutants on the atmosphere, Soil & Water bodies – Long- term effects on the planet – Global Climate Change, Ozone Holes – Ambient Air Quality and Emission Standards – Air Pollution Indices – Emission Inventories – Ambient and Stack Sampling and Analysis of Particulate and Gaseous Pollutants.

Unit II	Air Pollution Modelling	5 Hours

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Transport & Dispersion of Air Pollutants – Modeling Techniques - Air Pollution Climatology.

Unit III	Control Of Particulate Contaminants	11 Hours

Factors affecting Selection of Control Equipment – Gas Particle Interaction, – Working principle, Design and performance equations of Gravity Separators (cyclone) , Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations - Process Control and Monitoring – Costing of APC equipment – Case studies for stationary and mobile sources.

Unit IV	Control of Gaseous Contaminants	11 Hours

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations - Costing of APC Equipment – Case studies for stationary and mobile sources.

Unit V	Indoor Air Quality Management	11 Hours

Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollution and its control – Membrane process - UV photolysis – Internal Combustion Engines - Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Apply sampling techniques
2. Apply modelling techniques
3. Suggest suitable air pollution prevention equipment's and techniques for various gaseous and particulate pollutants to Industries. Discuss the emission standards

References:

1. Lawrence K. Wang, Norman C. Parelra, Yung Tse Hung, Air Pollution Control Engineering, Tokyo, 2004.
2. Noel de Nevers, Air Pollution Control Engg., Mc Graw Hill, New York, 1995.
3. David H.F. Liu, Bela G. Liptak „Air Pollution", Lweis Publishers, 2000.
4. Anjaneyulu. Y, „Air Pollution & Control Technologies" Allied Publishers (P) Ltd., India, 2002.
5. Arthur C.Stern, „Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2006.
6. Wayne T.Davis, „Air Pollution Engineering Manual", John Wiley & Sons,Inc.,2000.
7. Daniel Vallero " Fundamentals of Air Pollution", Fourth Edition,2008.

17EV203		INDUSTRIAL WASTE MANAGEMENT	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.

Unit I **Introduction** **8 Hours**

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling -generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management.

Unit II **Industrial Pollution Prevention & Waste Minimisation** **8 Hours**

Prevention vis a vis Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing & Promoting Pollution Prevention Programs in Industries.

Unit III **Industrial Wastewater Treatment** **10 Hours**

Flow and Load Equalisation – Solids Separation – Removal of Fats, Oil & Grease- Neutralisation – Removal of Inorganic Constituents – Precipitation, Heavy metal removal , Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Eletrodialysis & Evaporation – Removal of Organic Constituents – Biological treatment Processes, Chemical Oxidation Processes, Advanced Oxidation processes – Treatability Studies.

Unit IV **Wastewater Reuse and Residual Management** **9 Hours**

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects.

Unit V **Case Studies** **10 Hours**

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries

Total: **45 Hours**

Course Outcomes:

After completion of the course, Student will be able to

1. Define the Principles of pollution prevention and mechanism of oxidation processes.
2. Suggest the suitable technologies for the treatment of wastewater.
3. Discuss about the wastewater characteristics
4. Design the treatment systems

References:

1.	Industrial wastewater management, treatment & disposal, Water Environment
2.	Lawrance K.Wang, Yung . Tse Hung, Howard H.Lo and Constantine Yapijakis, " handlook of Industrial and Hazardous waste Treatment", Second Edition, 2004.
3.	Metcalf & Eddy/ AECOM, water reuse Issues, Technologies and Applications, The Mc Graw- Hill companies, 2007.
4.	Nelson Leonard Nemerow, "industrial waste Treatment", Elsevier, 2007.
5.	W.Wesley Eckenfelder, "Industrial Water Pollution Control", Second Edition, Mc Graw Hill, 1989.
6.	Paul L. Bishop, „Pollution Prevention: - Fundamentals and Practice", Mc-Graw Hill International, Boston, 2000.

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17EV204		SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipment.

Unit I	Sources, Classification and Regulatory Framework	9 Hours

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management –- Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes , plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management.

Unit II	Waste Characterization and Source Reduction	8 Hours

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse.

Unit III	Storage, Collection and Transport Of Wastes	9 Hours

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport.

Unit IV	Waste Processing Technologies	10 Hours

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes - Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment.

Unit V	Waste Disposal	9 Hours

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation
2. Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste
3. Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges

References:

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.

2. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001.
3. CPHEEO, "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2000.
4. Vesilind P.A., Worrell W and Reinhart, Solid waste Engineering, Thomson Learning Inc., Singapore, 2002.
5. Paul T Williams, Waste Treatment and Disposal, Wiley, 2005

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7EV205		ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.
2. To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

Unit I	Introduction	8 Hours

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

Unit II	Impact Identification and Prediction	10 Hours

Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment.

Unit III	Social Impact Assessment and EIA Documentation	8 Hours

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation.

Unit IV	Environmental Management Plan	7 Hours

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

Unit V	Environmental Risk Assessment and Management	12 Hours

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipathway exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
2. Know about the legal requirements of Environmental and Risk Assessment for projects.

References:

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996
2. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003 World Bank –Source book on EIA
3. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
4. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook",

	McGraw Hill Inc., New York,1996.
5.	K. V. Raghavan and A A. Khan, Methodologies in Hazard Identification and Risk Assessment, Manual by CLRI, 1990.
6.	Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

17EV206		UNIT OPERATIONS AND PROCESSES LABORATORY	L	T	P	C
			0	0	2	1
		(Common to Full time and Part Time)				

Course Objectives:

1. To develop the skill for conducting Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models.
2. To develop the skill for conducting Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models.

List of Experiments:

1. Coagulation and Flocculation	7
2. Batch studies on settling	10
3. Studies on Filtration- Characteristics of Filter media	7
4. Water softening	7
5. Adsorption studies/Kinetics	7
6. Reverse Osmosis- Silt Density Index	7
7. Kinetics of suspended growth process (activated sludge process)- Sludge volume Index	14
8. Anaerobic Reactor systems / kinetics (Demonstration)	10
9. Advanced Oxidation Processes – (Ozonation, Photocatalysis)	14
10. Disinfection for Drinking water	7
Total:	**45 Hours**

Course Outcomes:

After completion of the course, Student will be able to

1. Conduct treatability studies for water and waste water treatment.
2. Design laboratory models for various unit operations and processes.

References:

1. Metcalf and Eddy. Inc. „Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. Lee, C.C. and Shun dar Lin. Handbook of Environmental Engineering Calculations, Mc Graw Hill, New York, 1999.
3. Casey T.J., Unit Treatment Processes in Water and Wastewater Engineering, John Wileys Sons, London, 1993.
4. David W.Hendricks, „Water Treatment Unit Processes: Physical and Chemical", CRC Press, Boca Raton, 2006.

17EV001		AIR POLLUTION METEOROLOGY AND MODELING	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.

Unit I **Atmospheric Pollution** **9 Hours**

Atmospheric Pollution, type of pollutants, gaseous and particulate pollutants, size of atmospheric particles, emission inventory, various sources of emissions, bio-mass burning, pollution formation in combustion, Visibility and Acid Deposition Industrial pollution.

Unit II **Meteorology** **9 Hours**

Air pollution meteorology: sources of air pollution, methods for air pollution measurement and control, meteorological factors that contribute to air quality degradation, basic chemistry of the atmosphere and how it contributes to secondary pollutant formation. Effect of air pollution on Human health, material and vegetation,

Deposition of particulate pollutants in the respiratory system.		
Unit III	**Transport Models**	**9 Hours**
Atmospheric chemical transport models, box models, three-dimensional atmospheric chemical transport models, components of air quality forecasting and modelling, evaluation and validation, air quality standards and index, long range transpoanad rt of pollutants. Back trajectory construction and applications		
Unit IV	**Dispersion Models**	**9 Hours**
Transport and dispersion of air pollutants - wind velocity, wind speed and turbulence; estimating concentrations from point sources - the Gaussian Equation - atmospheric stability - Air pollution modelling and prediction - Plume rise, modelling techniques.		
Unit V	**Software Modelling**	**9 Hours**
Exposure to computer models for air quality.		
	Total:	**45 Hours**

Course Outcomes:	
	After completion of the course, Student will be able to
	1. Know the causes of climate change
	2. Know the effects of climate change on various environments and various models.

References:

1. Rao.M.N. &RaoH.V.N., “Air Pollution”, Tata McGraw Hill,2006.
2. Richard W. Boubel, Donald L. Fox, D. Bruce Turner & Arthur C. Stern, “Fundamentals of Air Pollution, Hardcover”, 2007.
3. Kenneth Wark, Cecil F. Warn,“Air pollution its origin and control”, 2007.
4. StevenC.Chapra, "Surface Water quality modeling", The McGraw-Hill- Companies Inc., New York, 1997.

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17EV002		CLIMATE CHANGE AND MODELING	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.

Unit I	Climate Change and Climate Variability	9 Hours

Introduction – Atmosphere - weather and Climate - climate parameters (Temperature ,Rainfall, Humidity, Wind etc) – Equations governing the atmosphere - Numerical Weather Prediction Models - Introduction to GCMs - Application in Climate Change Projections.

Unit II	IPCC SRES Scenarios	9 Hours

Intergovernmental Panel on Climate Change (IPCC) - An Overview - Key Assumptions - Scenario Family - Storyline (A1, B1, A2, B2).

Unit III	Global Climate MODEL (GCM) and Regional Climate Model (RCM)	9 Hours

Some typical GCMs (HadCM3Q-UK Met Office) - Issues with GCMs - Introduction to RCMs and LAMs - some typical RCMs like PRECIS, Sim CLIM, MAGICC/SCENGENE - Advantages and Disadvantages of GCMs and RCMs.

Unit IV	Downscaling Global Climate Model - An Overview	9 Hours

Need for downscaling - Selection of GCMs for regional climate change studies - Ensemble theory – Selection of - Ensembles, Model Domain (Spatial domain and temporal domain), Resolution and climate variables - Lateral boundary conditions - Methods of downscaling (Statistical and Dynamical) - examples from each and their limitations.

Unit V	Analysis /Post Processing	9 Hours

a. Model validation - post processing – Introduction to Analysis tools - Ferret, R, Grads, IDL, SPSS, ArcGIS
b. Climate change Impact - Vulnerability assessment – adaptation strategies.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

3. Know the causes of climate change
4. Know the effects of climate change on various environments and various models.

References:

1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK.
2. McGuffie, K. and Henderson-Sellers, A. "A Climate Modelling Primer, Third Edition, John Wiley & Sons, Ltd, Chichester, UK. ,2005
3. Neelin David J, "Climate Change and Climate Modelling", Cambridge University Press
4. Thomas Stocker, "Introduction to Climate Modelling", Advances in Geophysical and Environmental Mechanics and Mathematics. Springer Publication.

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17EV003		COMPUTING TECHNIQUES IN ENVIRONMENTAL ENGINEERING	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. To educate the students to know about computing techniques
2. Develop the different numerical technique and logic like ANN, Fuzzy
3. To educate the students on aspects data management
4. Develop the model Applications for monitoring and management of Environment

Unit I	Computing Principles	10 Hours

Introduction to Computing techniques – Algorithms and Flowcharts, Numerical methods - Solution to ordinary and partial differential equation using Finite difference and Finite element method , Numerical integration and differentiation, Design of digital models for Environmental applications.

Unit II	Artificial Intelligence	9 Hours

Knowledge based Expert system concepts - Principle of Artificial Neural Network (ANN) – Neural Network Structure – Neural Network Operations – ANN Algorithm - Application of ANN Model to Environmental field – Genetic Algorithms

Unit III	Fuzzy Logic	9 Hours

Fuzzy sets, fuzzy numbers, fuzzy relations, fuzzy measures, fuzzy logic and the theory of uncertainty and information; applications of the theory to inference and control, clustering, and image processing - Network analysis models.

Unit IV	Data Management	9 Hours

Data base structure - Data acquisition - Data warehouse - Data retrieval-Data format Attribute - RDBMS - Data analysis - Network data sharing - Statistical Analysis (SYSTAT) - Regression - factor analysis - histogram - scatter diagram - Goodness of fit.

Unit V	Environmental Modeling using MATLAB	8 Hours

Introduction to MATLAB Software – Environmental modeling principles and MATLAB Applications – Pollutants transport, decay and degradation modeling using MATLAB. Case studies.

Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the computing techniques.
2. Ability to apply the principle of soft computing for solving Environmental problems
3. Ability to assess the Environmental Impacts using ANN and Fuzzy logic.
4. Ability to employ modern advanced computing tools in environmental studies

References:

1. Aliev R. A, and Aliev Rashad, "Soft Computing and its Applications", World Scientific Publications Co. Pte. Ltd. Singapore, 2014.
2. Chepra S. C. and Canele R. P., "Numerical Methods for Engineers", McGraw-Hill, a business unit of The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020. 6th Edition 2014.
3. Data-Driven Modeling: Using MATLAB in Water Resources and Environmental Engineering, Springer; 2014 edition.

4. Mathews J. H. and Fink K.D. , "Numerical methods using MATLAB", Pearson Education2010.

17EV004		**ENVIRONMENTAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
		(Common to Full time and Part Time)				

Course Objectives:

1. To impart students an understanding of pollution of environment by air, water and soil responsible and
2. To impart knowledge on degradation of natural resources
3. To impart knowledge on degradation of biodiversity.

Unit I	**Introduction**	**5 Hours**

Principles and concepts of environmental biotechnology -usefulness to mankind.

Unit II	**Degradation**	**11 Hours**

Degradation of high concentrated toxic pollutants – non-halogenated, halogenated -petroleum hydrocarbons - metals. Mechanisms of detoxification, oxidation reactions, dehalogenation -biotransformation of metals. Microbial cell/enzyme technology -adapted microorganisms -biological removal of nutrients –micro algal biotechnology and applications in agriculture - role of extra cellular polymers.

Unit III	**Biotechnological remedies**	**11 Hours**

Biotechnological remedies for environmental damages - decontamination of ground water systems – subsurface environment - reclamation concepts - bioremediation. Production of proteins – bio fertilizers. Biodegradation of solid wastes - physical, chemical and microbiological factors of composting - health risk - pathogens – odor management - technologies of commercial importance advances in biogas technology - case study.

Unit IV	**DNA Technology**	**9 Hours**

Concept of DNA technology - plasmid - cloning of DNA - mutation - construction of microbial strains

Unit V	**Environmental Ethics**	**9 Hours**

Environmental effects and ethics of microbial technology - safety of genetically engineered organisms.

	Total:	**45 Hours**

Course Outcomes:

After completion of the course, Student will be able to

1. Differentiate between different environmental pollutants
2. Distinguish between different pollutants
3. identify the appropriate waste treatment to the relevant problem

References:

1. Fulker M.H. Environmental Biotechnology, CRC Press, 2010.
2. Wainwright, M, an Introduction to Environmental Biotechnology, 1999.
3. Martin, A.M., Biological Degradation of Wastes, Elsevier Appl. Science, New York, 1991
4. Gray, S.S., Fox, R and James W. Blackburn Environmental Biotechnology for Waste Treatment, Plenum Press, New York 1991.
5. Rittmann, B.E, Seagren, E., Wrenn, B. A and Valocchi A.J, Ray, C and Raskin, L Insitu Bioremediation (2nd Ed.) Nayes Publ. U.S.A. 1994.

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17EV005		ENVIRONMENTAL POLICIES AND LEGISLATION	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

To impart knowledge on the policies, legislations, institutional frame work and enforcement mechanisms for environmental management in India.

Unit I	Introduction	9 Hours

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration– Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework(SPCB/CPCB/MoEF)

Unit II	Water (P&CP) Act, 1974	8 Hours

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Unit III	Air (P&CP) Act, 1981	8 Hours

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation

Unit IV	Environment (Protection) Act 1986	13 Hours

Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorisation – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

Unit V	Other Topics	7 Hours

Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Know the National environmental legislations and the policies
2. plan programmes to comply with the legal requirements related to organizations

References:

1. CPCB "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.
2. Greger I.Megregor "Environmental law and enforcement", Lewis Publishers, London. 1994.
3. Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi, 2001.

17EV006		ENVIRONMENTAL SYSTEM ANALYSIS	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. To introduce about ecological modeling, single and multi-species modeling on a brief.
2. To educate about the modeling of CSTR and the kinetics of reaction taking place in it.
3. Introduce the concepts of river and stream water modeling, water quality parameters modeling.
4. To educate about the microbial energetic in various reactors systems.
5. To elaborate the computational techniques for modeling

Unit I **Ecological System** **9 Hours**

Basic concepts in ecology and ecological modeling, Population Dynamics: Birth and death processes. Single species growth, Prey-predator models: Lotka-Volterra, Rosenzweig-MacArther, Kolmogorov models. Multi-species modeling - Structural analysis and stability of complex ecosystems.

Unit II **Continuous-Flow Reactor Modeling** **9 Hours**

CSTR, Plug-Flow, Dispersion. A case study of a tubular reactor with axial dispersion, Parameter Calibration: Search algorithms for nonlinear dynamical models, Variance of estimated parameters. Application to Monod and Haldane kinetics.

Unit III **Water Quality Modeling** **9 Hours**

Rivers and streams water quality modeling -dispersion and mixing- water quality modeling process-model sensitivity-assessing model performance; Models for dissolved oxygen and pathogens- Pollutant and nutrient dynamics -Dissolved Oxygen dynamics -Groundwater quality modeling.

Unit IV **Microbial Dynamics and Energetics** **9 Hours**

Requirements for carbon and nutrient removal. Activated sludge: Process schemes: completely mixed, plug-flow, SBR, nutrient removal. Anaerobic digestion: process dynamics, Operational control of wastewater treatment processes.

Unit V **Computer Based Solutions** **9 Hours**

Formulation of linear optimization models. Linear programming. Sensitivity testing and duality. Solution techniques and computer programming; Formulation of linear optimization models. Application of models-simulation, parameter estimation and experimental design.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Develop conceptual schematics required for system analysis
2. Translate pertinent criteria into system requirements.

References:

1. Deaton, M.L and Winebrake, J.J., "Dynamic Modeling of Environmental Systems", Springer-Verlag, 2000
2. Orhon, D and Artan, N., "Modeling of Activated Sludge Systems, Technomic" Publ. Co., 1994.
3. Chapra, S.C. "Surface Water-Quality Modeling", McGraw-Hill, 1997.

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17EV007		LAND FILL ENGINEERING AND REMEDIATION TECHNOLOGY	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				
Course Objectives:						
	1. To understand the important characteristics and design principles of the waste containment and remediation industry					
	2. To impart the knowledge on relevant regulations and engineering design requirements of landfills and contaminated site remediation					

Unit I	**Landfill Basics**	**8 Hours**

Waste management Hierarchy- Need for landfills –Environmental Protection by Landfills- Landfill Classification – Sanitary and Secure Landfills - Components and Configuration - Legal framework for landfilling – Landfill Site investigation- Regional Landfills- Environmental control using site design –- Landfill Design Tasks

Unit II	**Landfill Liners and Cover Systems**	**10 Hours**

Landfill barrier system components – Design of Compacted clay liners: Factors affecting hydraulic conductivity , Water content-density criteria, Thickness, Desiccation - Geo synthetic Clay Liners and Geomembranes; types, manufacturing, handling, seaming and testing - Asphalt Barriers and Capillary barrier - Composite Liner system design- liner construction and quality control- Leakage through Liners- vapor transmission and chemical compatibility - Installation of Geo membranes - Liner Leakage Mechanism – Diffusion - Controls on advection through liners - Single phase flow- advection-diffusion- Landfill cover systems- Design of Cover Systems – Daily Cover – Intermediate Cover – Final Cover - Flow through Landfill Covers- Design and Analysis of Slope Stability- Anchor Trenches- Access ramps - Erosion control

Unit III	**Leachate and Landfill Gas Management**	**9 Hours**

Waste decomposition in landfills - Factors affecting leachate and landfill gas generation – Factors affecting Leachate Quantity in active and post closure conditions- Hydrologic Evaluation of Landfill Performance (HELP) model – Leachate Drainage Layer – Geotextile and Geonet design – Leachate Collection and Removal systems-Temporal trends in leachate composition – Design of Landfill gas collection and removal systems- Gas condensate issues & knockouts - Leachate treatment methods (biological and physico-chemical)- Leachate re-circulation & bioreactor landfills- monitoring and control of leachate and Landfill gas- Landfill Settlement

Unit IV	**Landfill Operation and Closure**	**8 Hours**

Landfill Construction and Operational Controls – Fill Sequencing Plans – Cell Construction- Dozer and Compactor operations-Selection of Landfill Equipment- Landfill Administration-Record Keeping-Topographic mapping-Environmental Controls – Odour, Vector and Litter Control – Landfill Safety - Fire Control – Ground and Surface water Monitoring – Methane Gas monitoring - Audits of landfill environmental performance and management – Post Closure care and use of landfills – Landfill Economics- landfill construction and operational cost estimation – establishing tipping fees.

Unit V	**Contaminated Site Remediation**	**10 Hours**

Contaminated sites - Fate and behaviour of toxics and persistent substances in the environment – Engineering Issues in Site Remediation - Site Characterization - Framework for risk assessment at landfill sites - Remediation Principles: Source Control and Management of Migration Covers, Cut-off Walls, Solidification / Stabilization - Pump-and-Treat Systems - Solvent Vapor Extraction, Air Sparging, Soil Flushing –

Bioremediation - Natural Attenuation - Remedy Selection and Risk Assessment – Geotechnical Aspects of In Situ Remediation Technology - Specific case studies in contaminated site remediation – Rehabilitation of Open dumps- Landfill Mining.		
	Total:	**45 Hours**

Course Outcomes:	
	After completion of the course, Student will be able to
	1. Have an overview of the Indian and international landfill regulations and guidelines for the design, construction, operation and management of landfills
	2. Design and construction of landfills, processes in landfills, methods for management and treatment of landfill gas and leachate
	3. Have an in-depth understanding of the key pollutants in leachate and gas, their potential environmental impacts and the engineering design and performance of control systems used to manage and treat pollutant and waste emissions from sites
	4. Apply a risk based assessment of contaminated sites and implement site remediation technologies

References:

1. David E Daniel and Robert M. Koerner "Waste Containment Facilities –Guidance for construction Quality Assurance and Construction Quality Control of Liner and Cover Systems, American Socirty of Civil Engineers, ASCE Press.2007,
2. Donald L Wise and Debra J Trantolo, "Remediation of Hazardous Waste Contaminated Soils, Marcel Dekker Inc., New York,1994
3. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.
4. Hari D Sharma and Krishna R. Reddy, Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Techonolgies, John Wiely, New Jersy, 2004
5. Neal Bolton P.E "The Handbook of Landfill Operations", Blue Ridge Services Inc., Atascadro, CA – ISBN 0-9646956-0-x, 1995

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17EV008		MEMBRANE TECHNOLOGIES FOR WATER AND WASTE WATER TREATMENT	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

To introduce the concept and principles of membrane separation and its applications in water and wastewater treatment.

Unit I	Membrane Filtration Processes	10 Hours

Solid Liquid separation systems- Theory of Membrane separation – mass Transport Characteristics- Cross Flow filtration - Membrane Filtration- Flux and Pressure drop -Types and choice of membranes, porous, non-porous, symmetric and asymmetric – Plate and Frame, spiral wound and hollow fibre membranes – Liquid Membranes

Unit II	Membrane Systems	10 Hours

Microfiltration principles and applications – Ultra filtration principles and applications - Nano Filtration principles and applications – Reverse Osmosis: Theory and design of modules, assembly, plant process control and applications – Electro dialysis : Ion exchange membranes, process design- Pervaporation – Liquid membrane – Liquid Pertraction – Supported Liquid Membrane and Emulsion Liquid membrane - Membrane manufactures – Membrane Module/Element designs – Membrane System components – Design of Membrane systems - pump types and Pump selection– Plant operations – Economics of Membrane systems

Unit III	Membrane Bioreactors	9 Hours

Introduction and Historical Perspective of MBRs, Biotreatment Fundamentals, Biomass Separation MBR Principles, Fouling and Fouling Control, MBR Design Principles, Design Assignment, Alternative MBR Configurations, Commercial Technologies, Case Studies.

Unit IV	Pretreatment Systems	8 Hours

Membrane Fouling – Control of Fouling and Concentration Polarisation-Pretreatment methods and strategies – monitoring of Pretreatment – Langlier Index, Silt Density Index, Chemical cleaning , Biofoulant control.

Unit V	Case Studies	8 Hours

Case studies on the design of membrane based water and wastewater treatment systems – zero Liquid effluent discharge Plants – Desalination of brackish water.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be

1. familiar with main membrane processes, principles, separation mechanisms, and applications
2. understand the selection criteria for different membrane processes
3. know the principle of the most common membrane applications
4. Carry out design of project for a particular membrane technology application.

References:

1. Anthony Wachinski, Membrane Processes for water reuse, McGraw-Hill, USA, 2013
2. Baker, R.W., "Membrane technology and applications", 2nd., John Wiley 2004
3. Jorgen Wagner, "Membrane Filtration handbook, Practical Tips and Hints, 2nd Edition, Revision2, Osmonics Inc., 2001.
4. Noble, R.D. and Stern, S.A., "Membrane Applications", Elservier,Netherlands,1995.
5. Symon Jud, MBR Book – "Principles and application of MBR in water and wastewater treatment", Elservier, 2006.

17EV009		REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL MANAGEMENT	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. To educate the students on aspects of Remote Sensing
2. Develop the different remote sensing technique
3. To educate the students on aspects of GIS and data management
4. Develop the GIS Applications for monitoring and management of environment

Unit I	**Remote Sensing Elements**	**8 Hours**

Historical Perspective, Principles of remote sensing, components of Remote Sensing, Energy source and electromagnetic radiation, Electromagnetic spectrum, Energy interaction, Spectral response pattern of earth surface features, Energy recording technology.

Unit II	**Remote Sensing Technology**	**9 Hours**

Classification of Remote Sensing Systems, , Aerial photographs, Photographic systems – Across track and along track scanning, Multispectral remote sensing, Thermal remote sensing, Microwave remote sensing – Active and passive sensors, RADAR, LIDAR

Unit III	**Social Impact Assessment and EIA Documentation**	**9 Hours**

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation.

Unit IV	**Environmental Management Plan**	**10 Hours**

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

Unit V	**Environmental Risk Assessment and Management**	**9 Hours**

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipathway exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

Total:	**45 Hours**

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
2. Know about the legal requirements of Environmental and Risk Assessment for projects.

References:

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996
2. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003 World Bank –Source book on EIA

3.	Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
4.	Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York,1996.
5.	K. V. Raghavan and A A. Khan, Methodologies in Hazard Identification and Risk Assessment, Manual by CLRI, 1990.
6.	Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

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17EV010		RESOURCE AND ENERGY RECOVERY FROM WASTE	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. To understand the principles and design of recovering materials and energy from wastes through mechanical, biological and thermal methods and manage the undesirable by-products

Unit I	Mechanical Processing for Material Recycling	10 Hours

Resource recovery for a sustainable development- Material and energy flow management and analysis - Systems and processes for reduction, reuse and recycling -Objectives of Waste Processing-Source Segregation and Hand Sorting-Waste Storage and Conveyance – Shredding – Pulping - Size Separation by Screens- Density Separation by Air Classification –magnetic and electromechanical separation processes- Design Criteria and Equipment selection

Unit II	Biological Processing for Resource Recovery	10 Hours

Mechanisms of Biological Processing – Aerobic Processing of Organic fraction - Composting methods and processes- factors affecting- Design of Windrow Composting Systems- In Vessel Composting- Compost Quality Control- Vermiculture: definition, scope and importance - common species for culture - Environmental requirements - culture methods- Applications of vermiculture- Potentials and constraints for composting in India-Largescale and decentralized plants.

Unit III	Bio-Chemical Conversion of Waste to Energy	9 Hours

Principles and Design of Anaerobic Digesters – Process characterization and control- The biochemistry and microbiology of anaerobic treatment - Toxic substances in anaerobic treatment - Methane generation by Anaerobic Digestion- Anaerobic reactor technologies - Commercial anaerobic Technologies- Single stage and multistage digesters- Digester design and performance- Gas collection systems-Methane Generation and Recovery in Landfills – Biofuels from Biomass

Unit IV	Thermo-Chemical Conversion of Waste To Energy	8 Hours

Principles and Design of Energy Recovery Facilities -Types and principles of energy conversion processes - Incinerator design - Mass Burn and RDF Systems- Composition and calorific value of fuels and waste, Determination of the stoichiometric air consumption, Calculation of the flue gas composition - grate firing designs, boiler design, removal of bottom ash, heat recovery- Emission Controls – flue gas cleaning, de-dusting, flue gas scrubbers, DeNOx processes, dioxins and furans - Alternative thermal processes: co-incineration, pyrolysis, gasification, plasma arc - Process characterization and control- waste heat recovery- Bottom ash: Quantity, quality, treatment, utilization, disposal- Facility design- decentralized mobile plants- Planning and construction of incineration plants

Unit V	Case Studies on Waste Recycling	8 Hours

Recycling technologies for paper, glass, metal, plastic – Used Lead Acid Battery Recycling –End of Life Vehicle Recycling – Electronic Waste Recycling – Waste Oil Recycling – Solvent Recovery - Drivers and barriers for material recycling: social, legal and economic factors - Environmental impacts of waste recycling - Design for the environment: the life cycle approach

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the fundamental principles of existing and emerging technologies for the treatment of waste and recovery of materials and energy from waste;

	2. Appreciate the increasing importance of waste and resource management in achieving environmental sustainability.
	3. Analyze and describe the potential of solid waste as a secondary raw material,

References:

1. Aarne Veslind and Alan E Rimer (1981), " Unit operations in Resource Recovery Engineering", Prentice Hall Inc., London
2. Manser A G R, Keeling A A (1996). Practical handbook of processing and recycling on municipal waste. Pub CRC Lewis London, ISBN 1-56670-164
3. Chiumenti, Chiumenti, Diaz, Savage, Eggerth, and Goldstein , Modern Composting Technologies , JG Press October 2005
4. Charles R Rhyner (1995),Waste Management and Resource Recovery, Lewis Publishers
5. Gary C. Young (2010)Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons , John Wiley & Sons

17EV011		WATER QUALITY MODELING	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. To introduce the fundamentals of mathematical models for water quality and the importance of model building.
2. To educate about the water parameters modeling and various ground water quality Modeling.
3. To demonstrate the features and the use of most widely used computerized models for water quality.

Unit I	Modeling Perceptions	9 Hours

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

Unit II	Pollutant Transport and Reactor Modeling	10 Hours

Transport phenomena – Advection, diffusion, dispersion- simple transport models – Plug flow models- Application of PFR and MFR model - Steady state and time variable solutions-completely mixed systems, concept and models in Completely Stirred Tank Reactors, mass balance equations, loading types, feed forward vs. feedback reactor systems.

Unit III	Surface Water Quality Modeling	10 Hours

Water quality modeling of Streams, Lakes and impoundments and Estuaries – Water quality– model sensitivity – assessing model performance; Models for dissolved oxygen, pathogens and BOD-Streeter Phelps model for point and distributed sources - Modified Streeter Phelps equations -Toxicant modeling in flowing water.

Unit IV	Groundwater Quality Modeling	8 Hours

Groundwater flow and mass transport of solutes, Degradation of organic compounds, application of concepts to predict groundwater contaminant movement, seawater intrusion – basic concepts and modeling.

Unit V	Water Quality Modeling Software	8 Hours

Exposure to surface water and groundwater quality modeling software‟s – MIKE 21, QUAL2E and MODFLOW Models and their application, Case studies.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Develop conceptual schematics required for modeling.
2. Translate pertinent criteria into system requirements.

References:

1. Steven C. Chapra, “Surface Water Quality Modeling”, Tata McGraw-Hill Companies,Inc., New Delhi, 2008.
2. “Water Quality Modelling for Rivers and Streams” Authors: Benedini, Marcello, Tsakiris, George, Springer Netherlands 2013.
3. “Hydrodynamics and Water Quality: Modeling Rivers, Lakes, and Estuaries”, Zhen-Gang Ji, John Wiley

	& Sons, 2008.
4.	"Modeling Groundwater Flow and Contaminant Transport By Jacob Bear, A. H.-D. Cheng, Springer Science & Business Media, 2010.
5.	"Mathematical Modeling of Groundwater Pollution" Ne-Zheng Sun, Alexander Sun, Springer New York, 2012

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Department of Civil Engineering

17EV012		NOISE POLLUTION AND CONTROL ENGINEERING	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. To know the basics, importance of noise pollution measurement.
2. To study the various effects of noise pollution.
3. To learn the importance of methods of control of noise.
4. To study the various noise pollution regulations.
5. To know the basics, importance of noise pollution measurement.

Unit I	**Sources of Noise Pollution**	**9 Hours**

Sources of noise – Units and Measurements of Noise – Noise Power level, Intensity level, Pressure level – Relationship, Noise level meter – Weighted networks – Decibeladdition – Octave Band – Noise spectrum – Equivalent Noise – Day and night time –Standards, Equations and Application.

Unit II	**Characterization of Noise Pollution**	**9 Hours**

Characterization of Noise from Construction, Mining, Transportation and Industrial Activities, Airport Noise – General Control Measures – Effects of noise pollution – auditory effects, non-auditory effects.

Unit III	**Prevention& Control of Noise Pollution**	**9 Hours**

Noise Menace – Noise and the Fetus – Prevention and Control of Noise Pollution – Control of noise at source, control of transmission, protection of exposed person - Control of other types of Noise Sound Absorbent – Noise Pollution Analyzer – Auditorium Designing – Anti Noise Device.

Unit IV	**Acoustics of Noise**	**9 Hours**

Designing out Noise – Industrial Noise Control – effects of noise on workers efficiency -Acoustic quieting - mechanical isolation technique, acoustical absorption, constrained layer damping – OSHA Noise standards – public education – other non- legislative measures.

Unit V	**Regulatory Aspects of Noise Pollution**	**9 Hours**

Legislation Noise and the Administrative Function – Planning against Noise – Noise and the Law – The Rajasthan noise control Act 1963, Railway Act 1890 (Related to noise only), The Aircraft Act 1934 (Related to noise only), Factories Act 1948 (Related to noise only), The Environmental Protection Act 1986 – Noise pollution remedies.

	Total:	**45 Hours**

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the necessity to study the impacts and risks that will be caused by Noise pollution and the methods to overcome these impacts.
2. Know about the legal requirements for preventing and controlling noise pollution.

References:

1. Peterson and Gross .E Jr., “Hand Book of Noise Measurement”, 7th Edn, 2003.
2. Antony Milne, “Noise Pollution: Impact and Counter Measures”, David & Charles PLC, 2009.

17EV013		OPERATION AND MAINTENANCE OF ETP PLANTS	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. To educate the student on the various Operation & Maintenance aspects of Water treatment systems, sewer systems, sewage treatment plants and Effluent Treatment Plants.

Unit I	Elements of Operation and Maintenance	9 Hours

Strategy for Good Operation and Maintenance- Knowledge of process and equipment- Preventive and Corrective maintenance scheduling- - Operation and Maintenance Plan - Proper and adequate tools, Spare units and parts - Training Requirements- Laboratory control- Records and Reports- Housekeeping - Corrosion prevention and control –Sampling procedure-Analytical techniques- Code of practice for analytical laboratories- Measurement of Flows, Pressures and Levels -Safety in O&M Operations - Management Information System - Measures for Conservation of Energy- management of residues from plant maintenance.

Unit II	Operation and Maintenance of Supply Systems	9 Hours

Operational problems, O&M practices and Records of Operation of Reservoir and Intakes - Causes of Failure of Wells- Rehabilitation of Tube wells & Bore Wells- Prevention of Incrustation and Corrosion- Maintenance of Lined and Unlined Canals- Problems in Transmission Mains- Maintenance of Pipelines and Leakage Control- Repair Method for Different types of Pipes- Preventive and corrective maintenance of water pumps – Algal Control - O&M of Service Reservoirs - Problems in the water Distribution System and remedies- Water Quality Monitoring and Surveillance- Water Meters, Instrumentation, Telemetry & Scada- Computerised Water Billing System

Unit III	Operation and Maintenance of Sewer Systems	9 Hours

Components and functions of sewer system – Conduits or pipes – Manholes – Ventilating shaft – Maintenance of collection system – Operational Problems– Clogging of pipes – Hazards – Precautions against gas hazards – Precautions against infections – Devices for cleaning the conduits – Preventive and corrective maintenance of sewage pumps –operation and maintenance of sewage pumping stations- Maintenance Hazards and Operator Protection -Case Studies.

Unit IV	Operation and Maintenance of Physico-Chemical Treatment Units	9 Hours

Operation and maintenance in screen chamber, Grit Chamber and clarifiers- - Operation issues, troubleshooting guidelines and record keeping requirements for clarifier, Equalization basins, Neutralization unit - Chemical storage and mixing equipment - Chemical metering equipment - Flash mixer –Filters, thickeners and centrifuges- Filter Press - Start-up and maintenance inspection - Motors and Pumps - Hazards in Chemical Handling – Jar Test - Chlorination Equipment - Membrane process systems- SDI and LSI determination- Process Chemistry and Chemical dosage calculations- Case Studies

Unit V	Operation and Maintenance of Biological Treatment	9 Hours

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation.

		Total:	**45 Hours**
Course Outcomes:			
	After completion of the course, Student will be able to		
	1. To identify the problems in treatment plants		
	2. To operate and maintain effluent treatment plants		
	3. To trouble shooting for smooth functioning of the plants.		
References:			

1. CPHEEO , Manual on operation and maintenance of water supply systems, Central Public Health and Environmental Engineering Organisation, Ministry of Urban Development, Government of India 2005
2. Ministry of Drinking Water and Sanitation, operation and maintenance manual for rural water supplies, Government of India, 2013
3. Metcalf & Eddy, Inc., G. Tchobanoglous, H. D. Stensel, R. Tsuchihashi, and F. L.Burton. "Wastewater Engineering: Treatment and Resource Recovery"5th edition). McGraw Hill Company.,2014
4. Ananth S Kodavasal, The STP Guide-Design, Operation and maintenance, Karnataka State Pollution Control Board, Bangalore,2011
5. Frik Schutte, handbook for the operation of water Treatment Works,The Water Research Commission, The Water Institute of Southern Africa, TT265/06, 2006.

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17EV014		MARINE POLLUTION AND CONTROL	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. To educate the Coastal and Marine Environment.
2. To educate the ocean dynamics
3. To find sources of marine pollution and methods for monitoring, modeling and control.

Unit I	Marine and Coastal Environment	9 Hours

Seas and oceans, Continental area, Coastal zone, Properties of sea water, Principles of Marine Geology, coastal features – Beaches, Estuaries, Lagoons–The oceans and climate

Unit II	Ocean Hydrodynamics	9 Hours

Wave Theory, Waves in shallow waters – Refraction, Diffraction and Shoaling, Approximations for deep and shallow water conditions – Tidal Classification - General circulation of ocean waters - Ocean currents - Coastal sediment transport - Onshore offshore sediment transport - Beach formation and coastal processes - Tsunamis, storm surge, El Niño effect.

Unit III	Marine Pollution Sources and Effects	9 Hours

Sources of Marine Pollution – Point and non-point sources, Pollution caused by Oil Exploration, Dredging, Offshore Structures, Agriculture Impacts of pollution on water quality and coastal ecosystems – Marine discharges and effluent standards.

Unit IV	Marine Pollution Monitoring	9 Hours

Basic measurements - Sounding boat, lead lines, echo sounders – current meters - tide gauge - use of GPS – Measurement of coastal water characteristics – sea bed sampling – Modeling of Pollutant transport and dispersion - Oil Spill Models - Ocean Monitoring satellites – Applications of Remote Sensing and GIS in monitoring marine pollution

Unit V	Environmental Risk Assessment and Management	9 Hours

Pollution Control strategies – Selection of optimal Outfall locations - National and International Treaties, Coastal Zone Regulation – Total Maximum Daily Load applications – Protocols in Marine Pollution – ICZM and Sustainable Development

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Know about marine environment. And learnt the physical concepts lying behind the oceanic currents and natural processes of various activities happening over the marine environment.
2. Get knowledge on the marine pollution and the effect of the same on the ecology.
3. Gain knowledge on remote sensing and various other techniques for measuring and monitoring oceanic environment parameters.
4. Acquire knowledge on control of marine pollution and sustainable development.

References:

1. "Marine Pollution R.B. Clark, C. Frid and M Atttrill, Oxford Science Publications, 5th Edition, 2005.
2. Marine Pollution: New Research - Tobias N. Hofer, Nova Publishers, 2008
3. Marine pollution Dr.P. C.Sinha , Anmol Publications Pvt. Ltd, 1998.
4. Laws, E.A., "Aquatic pollution", an introductory text. John Wiley and Sons, Inc., New York, 2000.
5. Practical Handbook of Estuarine and Marine Pollution, Michael J. Kennish, Volume 10 of CRC Marine

Science, CRC Press, 1996.

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17EV015		ENVIRONMENT, HEALTH AND SAFETY FOR INDUSTRIES	L	T	P	C
			3	0	0	3
		(Common to Full time and Part Time)				

Course Objectives:

1. To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948.
2. To familiarize students with powers of inspectorate of factories.
3. To help students to learn about Environment act 1986 and rules framed under the act.
4. To provide wide exposure to the students about various legislations applicable to an industrial unit.

Unit I	Factories Act – 1948	9 Hours

Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures- Tamilnadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948.

Unit II	Environment Act – 1986	9 Hours

General powers of the central government, prevention, control and abatement of environmental pollution- Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board.

Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution- powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures.

Unit III	Manufacture, Storage and Import Of Hazardous Chemical Rules 1989	9 Hours

Definitions – duties of authorities – responsibilities of occupier – notification of major accidents – information to be furnished – preparation of offsite and onsite plans – list of hazardous and toxic chemicals – safety reports – safety data sheets.

Unit IV	Other Acts And Rules	9 Hours

Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules – hazardous wastes (management and handling) rules, 1989, with amendments in 2000- the building and other construction workers act 1996., Petroleum rules, Gas cyclinder rules-Explosives Act 1983-Pesticides Act.

Unit V	International Acts and Standards	9 Hours

Occupational Safety and Health act of USA (The Williames - Steiger Act of 1970) – Health and safety work act (HASAWA 1974, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI).

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able

1. To list out important legislations related to health, Safety and Environment.
2. To list out requirements mentioned in factories act for the prevention of accidents.
3. To understand the health and welfare provisions given in factories act.

	4. To understand the statutory requirements for an Industry on registration, license and its renewal.
	5. To prepare onsite and offsite emergency plan.

References:

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
3. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt.Ltd., New Delhi.
4. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
5. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
6. The Mines Act 1952, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
7. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.
8. National seminar on hazardous waste management organized by National Safety council, Ministry of environment and forests, Government of India, United States – Asia environmental partnership, Tamilnadu pollution control board and Indian chemical manufacturers association, April 2001.