ANDHRA UNIVERSITY

DEPARTMENT OF CIVIL ENGINEERING

PROGRAM : M.TECH(ENVIRONMENTAL ENGINEERING AND MANAGEMENT)

REGULATION AND SYLLABUS

EFFECTIVE FROM 2019-2020 BATCH

Department of Civil Engineering
M.Tech. (ENVIRONMENTAL ENGINEERING AND MANAGEMENT)
Scheme of Instruction and Examination
(with effect from 2019-20 Admitted Batch)

I – SEMESTER

Code No.	Course Title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam (hrs)	Ext.	Sess.		
EEM1.1	Numerical Methods and Statistical Analysis	4	--	4	3	70	30	100	3
EEM1.2	Environmental Chemistry	4	--	4	3	70	30	100	3
EEM1.3	Environmental Microbiology and Sanitation	4	--	4	3	70	30	100	3
Program Elective –I EEM1.4	(a) Occupational Health, Safety and Hygiene (b) Watershed Management (c) Remote Sensing and GIS Applications	4	--	4	3	70	30	100	3
Program Elective –II EEM1.5	(a) Environmental Impact Assessment (b) Ecological and Ecosystem Engineering	4	--	4	3	70	30	100	3
EEM1.6	Environmental Engineering Lab.	-	3	3	Viva	50	50	100	1.5
EEM1.7	Case Studies	-	3	3	Viva	50	50	100	1.5
Total		**20**	**6**	**26**		**450**	**250**	**700**	**18**

II – SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam. (hrs)	Ext.	Sess.		
EEM2.1	Advanced Water and Wastewater Treatment	4	--	4	3	70	30	100	3
EEM2.2	Air Pollution and Control	4	--	4	3	70	30	100	3
EEM2.3	Industrial Wastewater Treatment	4	--	4	3	70	30	100	3
Program Elective –III EEM2.4	(a) Disaster Management (b) Agricultural Pollution and Control (c) Environmental Legislation	4	--	4	3	70	30	100	3
Program Elective –IV EEM2.5	(a) Energy, Environment and Sustainability (b) Environmental Biotechnology	4	--	4	3	70	30	100	3
EEM2.6	Environmental Process Design and Drawing	--	3	3	Viva	50	50	100	1.5
EEM2.7	Air and Noise Monitoring Lab.	--	3	3	Viva	50	50	100	1.5
EEM2.8	Seminar	--	3	3	Viva	50	50	100	2
Total		**20**	**9**	**29**		**500**	**300**	**800**	**20**

III SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam (hrs)	Ext	Sess.		
Program Elective –V EEM3.1	(a) Environmental Hydraulics (b) Surface and Groundwater Hydraulics	4	--	4	3	70	30	100	3
Program Elective –VI EEM3.2	(a) Solid and Hazardous Waste Management (b) Climate Change and CDM	4	--	4	3	70	30	100	3
EEM3.3	Dissertation (Preliminary)	--	--	--	Viva	--	100	100	8
Total		**8**	--	**8**		**140**	**160**	**300**	**14**

IV SEMESTER

Code No.	Course title	Scheme of Examination			Total	Credits
		Exam. (hrs)	Ext.	Sess.		
EEM4.1	Dissertation (Final)	Viva	100	--	100	16
Total						**16**

Department of Civil Engineering
M. Tech. (ENVIRONMENTAL ENGINEERING AND MANAGEMENT)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The program is intended to provide the graduates with engineering and technical proficiency in Environmental Engineering and Management. It will enable them to utilize the knowledge to pursue a career and professional accomplishment in the field of environmental engineering. The objectives of the program are to

PEO1. Provide basic principles of environment and their significance in the socio-economic development

PEO2. Relate the knowledge to the graduates to Identify, formulate and design engineered solutions to environmental problems related to various attributes of environment viz. air, water, land and biosphere.

PEO3. Development better processes and technologies useful for the environmental protect needs of society, which are socially relevant and acceptable protect

PEO4. Apply various aspects of sustainable development elements in the design and development of best management practices for environmental management

PEO5. Engross in life long process of learning to keep themselves abreast of new developments in the field of environmental engineering and management and promote skills to work in collaboration with others.

PROGRAMME OUTCOMES (POs):

After completion of the postgraduate program, the student should be able to

PO1. Know the types of environmental pollution, sources, effects, and the general principle of environmental protection

PO2. Analyze and interpret environmental pollution and its characteristics data to identify, formulate, and solve environmental engineering problems

PO3. Design environmental engineering systems used for various environmental protection or conservation practices

PO4. Forecast and predict fate of pollutants in the water and air environment

PO5. Identify best solid waste management practices available for its effective management

PO6. Assess the possible environmental aspects of an activity and predict the environmental impact of developmental projects and provide mitigation measures or technical solutions

PO7. Acquire basic knowledge about environment protection and operation of pollution control techniques and devices

PO8. Pursue life-long learning as a means of enhancing the knowledge and skills in treatment technologies and management practices

PO9. Modelling environmental systems using modern tools and techniques

Civil Engineering

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Program Elective –I									
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Program Elective –II									
EEM1.5	(a) Environmental Impact Assessment (b) Ecological and Ecosystem Engineering	4	--	4	3	70	30	100	3
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EEM1.7	Case Studies	-	3	3	Viva	50	50	100	1.5
	Total	20	6	26		450	250	700	18

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Program Elective –VI									
EEM3.2	(a) Solid and Hazardous Waste Management (b) Climate Change and CDM	4	--	4	3	70	30	100	3
EEM3.3	Dissertation (Preliminary)	--	--	--	Viva	--	100	100	8
	Total	8	--	8		140	160	300	14

IV SEMESTER IV SEMESTER

Code No.	Course Title	Scheme of Examination			Total	Credits
		Exam (hrs)	Ext.	Sess.		
EEM 4.1	Dissertation (Final)	Viva	100	--	100	16
	Total					16

Civil Engineering

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I – SEMESTER

EEM1.1 NUMERICAL METHODS AND STATISTICAL ANALYSIS

Linear system – Gaussian elimination and Gauss – Jordan methods – Matrix inversion – Gauss Seidel method – Non-linear equations – Regula-Falsi and Newton- Raphson methods –interpolation – Newton's and Lagrange's interpolation

Linear Programming – Graphical and Simplex methods – Measures of central tendency, dispersion, Skewness and Kurtosis – Probability – conditional probability – Bayes' theorem

Numerical solutions of ordinary differential equations – Introduction to initial and boundary value problems – Numerical solutions of ordinary differential equations : Taylor's series, Euler's method, Modified Euler's method, Runge- Kutta methods (second and fourth orders) – Predictor.

Random variable – two dimensional random variables – standard probability distributions – Binomial Poisson and normal distributions - moment generating function

Sampling distributions – confidence interval estimation of population parameters – testing of hypotheses – Large sample tests for mean and proportion – t-test, F-test and Chi-square test – curve fitting-method of least squares

Regression and correlation – rank correlation – multiple and partial correlation – analysis of variance-one way and two way classifications – experimental design – Latin square design – Time series analysis.

Reference Books

1. Probability and Statistics for Engineers by Richard A. Johnson, Prentice Hall of India Publications.

2. Numerical methods by S. Armugan, A. ThangapandiIssac, A. Someswaranadham, Scitech Publications (India) Pvt Lt.

Course objectives:

The main Objectives are to learn

1) How to solve linear and non-linear equations
2) Interpolation with equal and unequal interval lengths
3) Linear Programming
4) To obtain numerical solutions of initial value problems
5) Random Variable theory and probability distributions

Course outcomes:

The students are able to

1) Solve linear and non-linear equations by suitable methods

2) Apply Newton's and Lagrange's methods for interpolation
3) Know Graphical and simplex methods
4) Apply Taylor's, Euler's and R-K methods for numerical solution of ODE
5) Generating Binomial, Poisson and normal distributions

Learning outcomes:

The students after attending the course will be able to
1) Apply Direct and indirect methods for the solutions of system of equations
2)Solve non-linear equations by Regula-falsi and Newton's methods
3) Interpolate y for a given x
4) Maximize or minimize the linear programming problems
5) Apply Bayes' theorem for conditional probability
6) Solve initial value problems choosing a suitable technique
7) know the standard probability distributions
8) Solve the Sampling distributions
9) Apply Large sample tests for mean and proportion
10) know the analysis of variance-one way and two way classifications

EEM1.2 ENVIRONMENTAL CHEMISTRY

(Basic concepts of the following branches of the chemistry as applicable to the Environmental Engineering) Quantitative, Qualitative and physical chemistry : Basic concepts of physical chemistry, Gas laws, Laws of Mass action, Common Ion Effect, Solutions, Vapour pressures of liquids, Binary Mixtures, Solutions of solids in Liquids, Oxidation – Reduction potentials, Ionization, Solubility products, Basics of colloidal chemistry- adsorption and absorption – principles

Equilibrium Chemistry : Equilibrium constants and Calculations, Le-Chatelier Principle, Transport and transformation of chemicals – Photo catalysis - Soil chemistry - acid-base and ion-exchange reactions in soil - salt affected soil and its remediation

Organic Chemistry: Properties of Organic Compounds, Sources of Organic Compounds, Isomerism, Types of Organic Compounds, Aliphatic, Aromatic and Heterocyclic. – Principles of green chemistry.

Biochemistry : Enzymes, factors affecting the action of Enzymes, (co-enzymes or cofactors, Temperature, pH, Micro and Macro mutants), Proteins, carbohydrates and fats.

UV visible spectroscopy: Basic principles – application – Flame Photometry - Atomic absorption spectroscopy – Principles – applications, Gas chromatograph and HPLC – Principles and applications.

Nuclear Chemistry : Atomic Structure, Electron orbits, Neutron, Proton, Nuclear structure, Nomenclature of Isotopes, stable and radioactive nucleoids, Nature of Radiation, Energy of Radiation, Units of Radioactivity, half life, α γ and neutron induced reaction, nuclear fission and fusion.

Text Books

1. Chemistry for Environmental Engineering and Science, C.N. Sawyer, P.L. McCarty and G.F. Parkin, Tata McGraw-Hill publication.

2. Environmental Chemistry by AK De, Wiley Publications

Course objectives

to introduce various basic concepts of Inorganic, organic and physical chemistry useful for environmental engineers

to provide knowledge on the key concepts of chemistry, bio chemistry and nuclear chemistry and instrumental methods of analytical techniques used in environmental engineering

to make the student to learn and apply the suitable concept of chemistry and instrumentation techniques in the analysis various environmental sampling and analysis

Course Outcomes:

Upon completion of the course the students will be able to,

Explain the important fundamental concepts of chemistry and principles of various instrumental techniques used in analysis.

Evaluate applicability of a suitable concept or technique for the analysis.

Make use of the instrumental methods of analysis in chemical industries for various applications. Apply the principles of chemistry in environmental sampling and analysiss.

Acquire knowledge in fundamentals oforganic , biochemistry and nuclear chemistry.

Analyze and apply various concepts and techniques as per the suitability and requirement in the analysis and assessment of the environmental sample.

Identify the applications of industrially important analytical techniques of environmental engineering

Learning outcomes

Summarize the fundamental concepts of chemistry.

Make use of the basic concepts of chemistry in various applications of environmental engineering

illustrate the principle of law of mass action and its applications

Explain the application of common ion effect and solubility product in qualitative analysis.

Explain lechatliers principle and equilibrium constants.

apply the lechatliers principle as in industrial chemical processes and synthesis.

Summarize the importance of the acid-base and ion-exchange reactions in soil.

understand - salt affected soil and its remediation

Explain the concept of isomerism of organic compounds with an example.

Distinguish the characteristics of aliphatic, aromatic and heterocyclic compounds.

understand and Apply the principles of green chemistry.

Outline the structure of atom and nucleus.

identify isotopes of nuclides and their involvement in nuclear reactions.

understand the basic concepts of nuclear chemistry and nuclear stability

Illustrate various nuclear reactions .

to know the application of radioactive isotopes in various fields.

Explain the structure and functions of biomolecules.

Outline the characteristics of protiens, carbohydrates ,fats and lipids.

EEM1.3 ENVIRONMENTAL MICROBIOLOGY AND SANITATION

Introduction : Microorganisms - classification, prokaryotic and eukaryotic cells, structure, characteristics, nucleic acids, DNA and RNA, replication. Recombinant DNA - Genetic Engineering. Metabolism Of Microorganisms :Environmental factors, nutrition and metabolism, growth phases, enzymes, carbohydrate, protein, lipids metabolism, respiration, fermentation, Glycolysis, Kreb's cycle, Hexose monophosphate pathway, significance of energetic Microbiology Of Drinking Water : Distribution of microorganisms, indicator organisms, coliforms - fecal coliforms - E.coli, Streptococcus fecalis and Clostridium welchii, differentiation of coliforms - significance - MPN index, M.F. technique, standards. Virusconcentration techniques. Algae in water supplies - problems and control. Microbiology Of Wastewater Treatment : Biodegradation of toxic pollutants - alpha oxidation ,beta oxidation, electron transport system and oxidative phosphorylation mechanism, Microbiology of biological treatment process

Aquatic Microbiology : Ecotoxicology - toxicants and toxicity - factors influencing toxicity, effects, acute, chronic, concentration response relationships, test organisms, toxicity testing bioconcentration - bioaccumulation - bio-magnification - bioassay - biomonitoring.

Sanitation : Industrial sanitation : Schools, Public Buildings, Hospitals, Eating establishments, Swimming pools – Study of factors like Light, Heat, Ventilation, Plumbing fixtures, Cleanliness and maintenance and comfort.. Rural Sanitation : Population habits and environmental conditions, problems of water supply and sanitation aspects, low cost excreta disposal systems. Rural sanitation improvement schemes.

Reference Books

1. Microbiology for sanitary engineers by Mckinney, McGrawHill Publications.
2. Microbiology for Environmental Scientists and Engineers by A. Gaudy & E. Gaudy, McGrawHill Publications.
3. Microbiology by Pelzer, Ecschan& N R Kreig. Tata McGraw Hill Publishing Company Limited.
4. Municipal and Rural sanitation by Victor Ehalers& Earnest W Steel, McGrawHill Book Company.

Course objectives:

CO 1: The purpose of the course/paper is to provide detailed taxonomic classification of microbes; to introduce the basic molecular biological concepts and techniques used in the fields of genetic engineering.

CO 2: To give the information on fundamental energetics of biochemical process, biosynthesis of various amino acids, carbohydrate and lipid metabolism, and metabolic pathway regulation

CO 3: Knowledge on microbiology of drinking water and wastewater treatment will be provided.

CO 4: The problems concerned with ecotoxicology and toxicity testing will be explained in detail.

CO 5: Aspects of industrial sanitation and rural sanitation will be illustrated.

Course outcomes:

1: Provides the understanding and gaining knowledge in concepts and techniques for identification of microbes and also the significance and characteristics of microorganisms.

2: Provides knowledge about enzymes mechanism and regulation; bioenergetics and phosphorylation; again knowledge about various biosynthesis process of biomolecules; clear idea about respiration, fermentation and about energy yield.

3: Provides details of aquatic microbiology, sewage treatment, bioremediation, and applied microbiology.

4: Provides the information about the factors influencing toxicity, effects, acute, chronic, concentration response relationships, test organisms and toxicity testing.

5: Provides knowledge on industrial sanitation of schools, public buildings, hospitals, eating establishments, swimming pools and rural sanitation improvement schemes.

Learning outcomes:

After completion of the course, students will learn about

LO 1: The main goal of the course is focused on the fundamental concepts concerning the interactions between microorganisms and their environment. The main microbiological and molecular techniques used in applied and environmental microbiology will be learned in detail.

LO 2: The students will have knowledge of tools and strategies used in genetic engineering. Understanding of applications of recombinant DNA technology and genetic engineering from academic and industrial perspective. Can use and apply the knowledge of genetic engineering in problem solving and in practice.

LO 3: Students will learn and understand the regulation of biochemical pathways and possible process modifications for improved control over microorganisms for microbial product synthesis.

LO 4: Will gain knowledge of water quality concepts and their effect on treatment process selection; appreciate the importance and methods of operation and maintenance of water supply systems.

LO 5: Students will be able to make technology choice to deal with water quality issues, operate and maintain working treatment systems and do troubleshooting of the problems in these systems.

LO 6: Will know the concept and use of indicator bacteria in water quality monitoring and design considerations of various unit operations and processes of water treatment facilities.

LO 7: Will understand the significance of microorganisms in biogeochemical cycling of nutrients, sustainable development and bioremediation of pollutants for developing strategies of environmental conservation and remediation.

LO 8: Students will become able to analyze chemistry of disinfection and know the kinetics of disinfection. They learn aeration, sedimentation, coagulation and flocculation processes.

LO 9: They can explain need for industrial water quality requirements. During the establishment of a food establishment, they can identify issues to be considered in terms of hygiene.

LO 10: They can describe the norms and different rural water supply schemes; the concepts and importance of hygiene and sanitation; can establish the relationship between microorganisms and sanitation; will define negative effect of microorganisms on hygiene.

EEM1.4(a) OCCUPATIONAL HEALTH, SAFETY AND HYGIENE

Introduction:Need for developing Environment, Health and Safety systems in work places. Regulations and Codes of Practice. Role of trade union safety representatives. International initiatives. Ergonomics and work place.

Occupational Health and Hygiene: Definitions. Categories of health hazards. Exposure pathways and human responses to hazardous and toxic substances. Advantages and limitations of environmental monitoring and occupational exposure limits. Hierarchy of control measures for occupational health risks. Role of personal protective equipment and the selection criteria. Effects on humans, control methods and reduction strategies for noise, radiation and excessive stress.

Workplace Safety and Safety Systems:Features of the satisfactory design of work premises HVAC, ventilation. Safe installation and use of electrical supplies. Fire safety and first aid provision. Significance of human factors in the establishment and effectiveness of safe systems. Safe systems of work for manual handling operations. Control methods to eliminate or reduce the risks arising from the use of work equipment.

Requirements for the safe use of display screen equipment. Procedures and precautionary measures necessary when handling hazardous substances. Contingency arrangements for events of serious and imminent danger.

Techniques of Environmental Safety: Methods of effective implementation and review of health & safety policies. Functions and techniques of risk assessment, inspections and audits. Investigation of accidents- Principles of quality management systems in health and safety management. Industry specific EHS issues

Education and Training:Relationship between quality manuals, safety policies and written risk assessments. Records and other documentation required by an organisation for health and safety. Requirements for and benefits of the provision of information, instruction, training and supervision. Factors to be considered in the development of effective training programmes. Principles and methods of effective training. Feedback and evaluation mechanism.

Reference Books

1. Environmental and Health and Safety Management by Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995

2. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.

3. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005

Course objectives

familiarise with the need for developing environment health and safety systems in workplaces

to impart knowledge on occupational health hazards

to impart knowledge on the use of various personal protective equipment

to input knowledgeon techniques of risk assessment inspections and audits

Have to familiarise with theprinciples and methods of effective training

Course outcomes

the students will be able to

understand the regulations and codes of practice

discuss the occupational hazards

analyze workplace safety

evaluate industry specific YHS issues

understand principles of effective training

Learning outcomes

understand the need for developing environment health and safety systems in workplaces

understandregulations and codes of practice

discuss the categories of occupational health hazards

Analyse the hierarchy of control measures

discuss the role of personal protective equipment

understand the first aid practices

understand the precautionary measures and procedures necessary when handling hazardous substances

discuss the techniques of environmental safety

evaluate industry specific YHS issues

understand education and training methods

EEM1.4(b) WATERSHED MANAGEMENT

Common Syllabus for HCH1.4(b) and EEM1.4(b)

Watershed Management Concept - Introduction- Concept of Watershed Management- History of Watershed Management and its Relevance to India- Watershed Characteristics; Climatic Characteristics- Physiographic Characteristics- Causes of Watershed Deterioration- Effect of Watershed on the Community- Water Resources Region of India .

Principles of Watershed Management- Integrated Watershed Management Approach (IWMA)- Objectives of IWMA- Envisaged Results- Success Criteria- Selection of Watershed Village- Equity Issues for Watershed Policies-

Factors Causing The Inequality- Benchmark Survey- Remote Sensing Survey in Watershed Management- Land Capability Classification.

Soil Erosion: Introduction- Soil Erosion- Factors Affecting Soil Erosion- Different Types and Causes of Erosion- Geologic Erosion- Accelerated Erosion- Estimation of Loss of Soil from Erosion- Soil Loss Models- Sediment Models- Bed Load Models- Control of Soil Erosion.

Management of Natural Drainages- Introduction- Check Dam- Structures for Gully Stabilization and Storage of Water- Rivers or Stream Bank Management Measures in Watershed- River Training Works- Methods of River Training Works.

Wasteland and Land Drainage Management- Introduction- Causes of Wasteland – Water Logging- Salinity- Soil Erosion- Overgrazing- Mining Operation- Industrial Effluent- Brickfields- Inadequate Surface and Subsurface Drainages- Remedial Measures in Wasteland Management- Land Drainage Management- Surface or Overland Drains- Subsurface or Underground Drains- Discharge and Spacing of Tile Drains.

Flood Damage Mitigation Management- Introduction- Mitigation Measures- Structural Mitigation Measures- Non-Structural Mitigation Measures- Flood Plain Zoning- Flood Forecasting.

Water Harvesting- Introduction- Techniques of Water Harvesting- Indigenous Water Harvesting Methods In India- Engineering Methods of Water Harvesting.

Watershed Modeling- Introduction- Data of Watershed for Modeling- Application of Watershed Models- Model Calibration and Validation

Text Book

1. Watershed management by Madan mohan das- Mimi das Saikia- PHI learning pvt. Ltd.

Reference Books

1) Watershed Management by Murty- J.V.S., New Age Intl.- New Delhi 1998.

2) Decision Support System for Integrated Watershed Management by Allam- G.I.Y.- Colorado State University- 1994.

3) Watershed Planning and Management by Vir Singh- R.-- Yash Publishing House- Bikaner-

4) Watershed Management- American Soc. of Civil Engineers- New York- 1975.

Course objectives

to familiarise with the concepts and principles of watershed management.
to impart knowledge on Integrated Watershed Management Approach (IWMA).
impart knowledge on Soil Erosion, Factors Affecting Soil Erosion, Different Types of Erosion.
to input knowledge on Remedial Measures in Wasteland and Land Drainage Management.
To familiarise with the Flood Damage Mitigation Management.

course outcomes

the students will be able to
understand the basic concepts and history of Watershed Management.
evaluate the principles and objectives of IWMA.
design Soil Loss Models, Sediment Models, Bed Load Models for Control of Soil Erosion.
evaluate causes of wasteland and their remedial measures.
understand Techniques of Water Harvesting.

learning outcomes

understand principles of watershed management
understand Watershed Characteristics and causes of Watershed Deterioration
analyze the factors considered in selection of Watershed Village
assess Remote Sensing Survey in Watershed Management
understand Factors Affecting Soil Erosion, Different Types and Causes of Erosion
understand Management Of Natural Drainages by various methods of River Training Works
evaluate the factors causing wasteland

discuss the types Land Drainage Management measures
identify the Structural and Non-Structural Mitigation Measures
understand Indigenous and Engineering Method of Water Harvesting in India.

EEM1.4(c) REMOTE SENSING AND GIS APPLICATIONS

Common Syllabus for HCH1.4(c), SMFE1.4(c) and EEM1.4(c)

Introduction - Definition- Principle of Remote Sensing- History of Development of Remote Sensing- Stages in Remote Sensing- Electromagnetic Radiation and the Electromagnetic Spectrum- Interactions With the Atmosphere- Atmospheric Scattering- Atmospheric Absorption- Atmospheric Windows- Refraction- Interaction of EMR with the Earth's Surface- Reflection- Transmission- Spectral Signature.

Platforms & Sensors- Remote Sensing Systems- Remote Sensing From Space- Remote Sensing Sensors- Resolution- Imaging Sensors- Optical Infrared (OIR) Imagers- Optical Sensors- Thermal Sensors- Microwave Sensors- Active Microwave Sensors- Data Preprocessing- Remote Sensing in India.

Introduction to Image Interpretation- Basic Principles of Image Interpretation- Elements of Image Interpretation- Techniques of Image Interpretation- Interpretation Keys- Introduction to Digital Image Processing- Digital Image- Image Rectification and Registration- Geometric Correction- Image Enhancement Techniques (Only Concepts)- Image Classification - Unsupervised Classification and Supervised Classification- Digital Photogrammetry - Stereo Images from Satellites - Data Merging .

Geographic Information Systems (GIS)- Definitions and Related Technology- GIS Operations- GIS Elements- GIS Concepts and Practice- Map Projection and Coordinate System.

Vector Data Model- Introduction- Vector Data Representation- Geometric Objects- Topology. Vector Data Analysis- Introduction- Buffering- Applications of Buffering- Map Overlay- Feature Type and Map Overlay- Map Overlay Methods- Slivers- Error Propagation in Map - Overlay- Distance Measurement- Map Manipulation.

Raster Data Analysis- Introduction- Analysis Environment- Local Operations- Local Operations With a Single Grid- Local Operations With Multiple Grids- Neighborhood Operations- Zonal Operations.

Terrain Mapping and Analysis- Introduction- Data for Terrain Mapping and Analysis- Surface Models-DEM- TIN. GIS Models and Modeling- Introduction- GIS Modeling- Binary Models- Index Models Remote Sensing & GIS Application in Civil Engineering – Some Case Studies from Literature.

Text Books

1. Fundamentals of Remote Sensing 2nd Ed by George Joseph- University Press- New Delhi.

2. Introduction to Geographic Information Systems by Kang Tsung Chang- Tata Mc.G.H. Publications- New Delhi.

3. Remote Sensing and Image Interpretation by Lillesand- T.M. and Kieffer- Joh Wiley and Sons- New York- 1987.

Reference Books

1. Remote Sensing of the Environment – An Earth Resource Prespective by John R. Jensen- Pearson Education- New Delhi.

2. Geographic Information Systems: A Management Perspective by Aronoff- S. Ottawa: Wdl Publications- 1989.

3. Geographic Information Systems For Geoscientists: Modeling with GIS by Bonham Carter- G-F.- New York: Pergamon Press- 1994.

4. Principles Of Geographical Information Systems by Burrough- P.A And R.A. Mcdonnell.. Oxford: Oxford University Press- 1998.

5. Concepts and Technologies of Geographic Information Systems by Lo- C.P.- and Albert K.W. Young- Prentice Hall of India (Pvt) Ltd- New Delhi.

6. Introductory Digital Image Processing by John R Jensen- Prentice Hall- New Jersey.

7. Application of Remote Sensing to Hydrology Including Groundwater by Farsworth- R.K.- Bawetl- E.C. & Dhanju- M.S.-- IHP- UNESCO- 1984.

VAZEER SIR

EEM1.5(a) ENVIRONMENTAL IMPACT ASSESSMENT

Introduction to EIA: Definition, Concepts, Types, Limitations, components of EIA process, settings – public participation, public hearing. Methodologies: background information, interaction matrix methodologies, network

methodologies etc, environmental setting- various factors, documentation and selection process, environmental indices and indicators for describing affected environment.

EIA notification by Ministry of Environment and Forest (Govt. of India):Provisions in the EIA notification, Categorization of Industries for seeking environmental clearance from concerned authorities, procedure for environmental clearance, procedure for conducting environmental impact assessment report, Rapid and Comprehensive EIA, general structure of EIA document, Environmental management plan, post environmental monitoring. Case studies in EIA.

Prediction and assessment of impact for air and noise environment:Basic information of air quality, identification of type and quantity of air pollutant, existing air quality and air quality standards, impact prediction and assessment, mitigation. Basic information of noise, existing noise levels and standards, prediction of noise levels and assessment of impact, mitigations.

Prediction and assessment of impact for water and soil environment:Basic information of water quality (Surface water and groundwater), water quality standards, identification of impact, prediction of impact and assessment, mitigations. Background information of soil environment, soil and groundwater standards, prediction and assessment of impact for groundwater and soil, mitigations.

Prediction and assessment of impact on cultural and socioeconomic environment:Basic information on cultural resources, rules and regulations for cultural resources like archaeological, historical structures, Cultural system, prediction and assessment of impact, mitigations. Basic information of socio-economic environment, description of existing socio-economic environment, prediction and assessment of impact, mitigation, resettlement and rehabilitation.

Text Books

1. Environmental Impact Assessment by Larry W. Canter. Mc-Grawhill Co.
2. Environmental Impact Assessment Methodologies by Y Anjaneyulu, and Valli Manikkam, BSP Books PVT Ltd

Reference Books

1. Environmental Impact Analysis Handbook, John G. Rau and David C. Wooten (Ed), McGraw Hill Book
2. Environmental Impact Assessment– Urban and Jain.

Course objectives

to familiarise with EIA methodologies

To impart knowledge on EIA case studies

To input skills on prediction and assessment of air and noise environment

to input skills for prediction and assessment of water and soil environment

to familiarise with cultural and socio economic environment

course outcomes

the students will be able to

understand the concept and methodologies of EIA

Understand the procedure for environmental clearance

discuss the basic information on environmental attributes like air water noise,

discuss thestandards ,impacts and mitigation

discuss the socio economic attribute, resettlement and rehabilitation issues

Learning outcomes

understand the concept and definition of EIA

understand EIA methodologies

Analyse case studies

Discuss the procedure for environmental clearance

identify air quality impacts prediction and mitigation

identify noise levels ,impacts and mitigation

Prediction of water quality, impacts and mitigation

understand soil environment

discuss cultural resources, assessment of impacts and mitigation

discuss the social economic attribute, impact assessment and mitigation

EEM1.5(b) ECOLOGICAL AND ECOSYSTEM ENGINEERING

Development and evolution of ecosystems – Principles and concepts – Energy flow and material cycling – productivity – Classification of ecotechnology – ecological engineering.

Classification of systems – Structural and functional interactions of environmental systems –Mechanisms of steady-state maintenance in open and closed systems

Classification of ecotechnology - Principles and components of Systems and ModelingModeling and ecotechnology – Classification of ecological models – Applications- Ecological economics- Self-organizing design and processes – Multi seeded microcosms.

Self organizing processes - Multiple seeded microcosms- Interface coupling in ecological systems - Concept of energy - Adapting ecological engineering systems to potentially catastrophic events - Agro ecosystems - Determination of sustainable loading of ecosystems.

Ecosanitation – soil infiltration systems–Wetlands and ponds–Source separation systems– Aqua cultural systems – Agro ecosystems – Detritus based treatment for solid wastes – marine systems- Case studies. Reference Books 1. Kangas, P.C. and Kangas, P., Ecological Engineering: Principles and Practice, Lewis Publishers, 2. Etnier, C. and Guterstam, B., Ecological Engineering for Wastewater Treatment, Lewis Publishers, 3. Concepts of Ecology by Kormondy, PHI Publications

Course objectives

To understand evolution of ecosystems and flow of energy.

To estimate the productivity and recycling of material and classification and modeling of eco technology.

To understand the agro, aqua, wetland and marine ecosystems.

To evaluate the sustainable loading for self organizing processes.

Course outcomes

Knowledge of inter dependencies and flow of energy, material, pollutant and biomass in a closed and open systems.

Design of sustainable loading for self sustainable processes and catastrophic events.

Details of agro, aqua, marine, wetland ecosystems for treatment and ecosanitation.

Case studies as examples.

Learning outcomes

Understanding of evolution and development of various ecosystems. Classifiction of ecotechnology. Mechanism of steady state in ecosystems.

Flow and dissipation of energy, pollutant, material etc. in closed and open eco systems. Concepts of ecoengineerig to develop sustainable loading in treating the systems.

Study of ecological economics. Study, classify, design and development of ecological models.

Usage of microcoisms for development of large scale ecosanitation.

Exposure to case studies.

Agro ecosystems, aqua, marine ecosystems etc. exposes in the direction of ecosanitation.

EEM1.6 ENVIRONMENTAL ENGINEERING LABORATORY

1. Sampling and characterization of water and wastewater by gravimetric, volumetric and colorimetric methods
2. Settling Column Analysis for type II settling,
3. Break point chlorination,
4. Determination of Dosage of lime-soda for removal of hardness 5. Media preparation and inoculation
6. Test for plate count
7. Coliforms – fecal coliforms – E.coli
8. M.P.N. and M.F. techniques.
9. Bioassay study
10. Sampling and analysis of ambient air for SPM, SO2, Oxides of nitrogen
11. Instrumental methods of analyses for particulates, HC, CO, NOx, SO2.

Reference Books

1. Chemistry for Environmental Engineers, by Sawyer, C.N. and McCarty, P.L. and Parkin, G.F. McGraw Hill,
2. Environmental Chemistry, by De.A.K. New Age International Ltd.
3. Standard Methods for the Examination of Water and Wastewater, 21th Edition, American Public Health Association, Washington. D.C. 2005.

EEM1.7 CASE STUDIES

Each student shall submit two case studies related to Environmental Studies and face viva-voce examination.

II – SEMESTER

EEM2.1 ADVANCED WATER AND WASTEWATER TREATMENT

Physical and Chemical Treatment: Screening, Grit removal, Aeration and gas transfer, Application of Membrane Processes, Reverse Osmosis, Micro-filtration, Nano-filtration, Ultrafiltration and Electrodyalisis Chemical precipitation, other solids removal operations, Control of odour, Control of volatile organic compounds. Theory of Sedimentation – flocculent particle settling – theory of coagulation and flocculation- zeta potential - Filtration - theory of granular media filtration – head loss cleaning of filter media - backwash hydraulics – Theory of chlorination – equilibrium constants.

Principles:Objectives of biological treatment significance - aerobic and anaerobic treatment kinetics of biological growth - factors affecting growth – attached, suspended and Hybrid growth systems. Determination of kinetic coefficients for organics removal – Biodegradability assessment – selection of process – reactors – batch & continuous type

Aerobic Treatment of Wastewater:Design and construction aspects and the relevant parameters of significance of the units: Activated Sludge Process, Trickling Filters, Aerated Lagoons, Rotating Biological Contactors, Sequential Batch Reactors (SBR), Stabilization ponds, Hybrid reactors for the treatment of wastewater :– IFAS, MBBR, MBR, Expanded / fluidized bed bio reactors

Anaerobic Treatment of Waste Water:Sludgehandling and treatment -Sludge digestion: theory and principles - Disposal of digested sludge, Anaerobic ponds, UASB reactors and various modifications in UASB process and anaerobic filters. Two stage /phase reactors – biogas generation.

Reference Books

1. Wastewater Engineering, Treatment and Reuse. Metcalf & Eddy, Inc. Tata McGraw-Hill Publications
2. Biological Processes Design for wastewaters, Benefield, L.D. and Randall C.W. Prentice-Hall, Inc.
3. Wastewater treatment for Pollution Control by Arceivala, Tata McGraw Hill Publication
4. Water and wastewater technology by Hammer and Hammer, PHI Publications

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EEM2.2 AIR POLLUTION AND CONTROL

Introduction:Definition - Sources and classification of Air Pollutants - Photochemical smog - Effects of air pollution on health of Human & Animals, vegetation & materials, air quality, Global effects of air pollution.

Meteorology and Dispersion of air pollutants:Temperature lapse rates and Stability, Wind velocity and turbulence, Wind Rose, plume behaviour, Measurement of meteorological variables. Dispersion of Air pollutants: Theories on modeling of Air pollutants. Gaussian model, Equations for the estimation of pollutant concentrations of emissions. Plume Rise – Equations for estimation. Effective stack height and mixing depths

Sampling and Particulate Pollution Control Methods:Atmospheric sampling and stack sampling methods. Air quality standards.

Types of particulate pollution control methods – Settling chambers, Cyclone separators, Scrubbers, Filters and Electrostatic precipitators, design aspects and principle of these air pollution control units.

Gaseous pollution control methods and automobile pollution:Types of gaseous pollution control methods – absorption, adsorption and combustion processes. Automobile pollution, sources of pollution, composition of auto exhausts, Control methods. Planning for conducting Air pollution survey Noise Pollution- Definitions – Significance in general - sources, measurement - effects and control measures, noise legislations

Reference Books

1. Environmental Engineering, Peavy and Rowe, Mc-Graw Hill Publication.
2. Air Pollution Control Engineering,. N.D. Nevers, Mc-Graw Hill Publication.
3. Air Pollution, M. N. Rao and HVN Rao Tata Mc-Graw Hill Publication.
4. Air pollution and control, KVSG Murali Krishna. Kaushal and Company, Kakinada
5. An Introduction to Air Pollution by RK Trivedy and PK Goel, BSP Books PVT Ltd
6. Environmental Pollution Control Engineering by CS Rao, New Age Publications
7. Air pollution Control Technologies by Anjaneyulu, Allied Publishers

Course objectives

to familiarise with the sources and effects of air pollution
to impart knowledge on atmospheric stability and plume behaviour
impart knowledge on ambient air quality monitoring and stack monitoring
to input knowledge on air pollution control
To familiarise with noise pollution sources effects and controls

course outcomes

the students will be able to
understand the sources and effects of air pollution
analyse the gaussian flow model to obtain ground level concentrations
design air quality survey
evaluate suitability of various air pollution control equipment
understand noise pollution causes effects and controls

learning outcomes

understand air pollution sources and effects

understand global impacts of air pollution

analyze plume behaviour based on atmospheric stability

estimate pollutant concentrations through modelling

understand atmospheric sampling procedures

understand stack sampling method

evaluate the suitability of various particulate control equipment

discuss the types of gaseous pollution control methods

design noise monitoring survey

understand sources effects controls of noise pollution

EEM2.3 INDUSTRIAL WASTEWATER TREATMENT

Introduction: 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.

Pollution Prevention & unit operations:Prevention and Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy – Source & reduction techniques – Strength & volume Reduction - Material balance - Evaluation of Pollution prevention options - Waste minimization Circles. Equalisation - Neutralisation – Oil separation – Flotation – Precipitation – Heavy metal Removal– Aerobic and anaerobic biological treatment – High Rate reactors - Chemical oxidation – Ozonization – carbon adsorption Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal.

Wastewater Reuse And Residual Management: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 – Management of RO rejects.

Manufacturing process and sources of effluent from the process of industries like fertilizer, pulp and paper, sugar, distillery, tannery, food processing, dairy and Pharmaceuticals, Industrial manufacturing process description, wastewater characteristics, and source reduction options

Manufacturing process and sources of effluent from the process of industries like: Steel, Petroleum Refineries, Textiles, Atomic Energy Plants, Metal finishing and other Mineral Processing Industries. Industrial manufacturing process description, wastewater characteristics, and source reduction options

Reference Books

1. Industrial Waste Water Pollution Control, W. Wesley Eckenfelder Jr.,McGraw Hill Publishing Company.

2. Wastewater Treatment for Pollution Control, Arceivala, S.J., McGraw-Hill, 1998.

3. Industrial waste treatment Handbook, Frank Woodard, Butterworth Heinemann, New Delhi, 2001.

4. Waste water treatment, M.N.Rao & A.K. Datta, Oxford & IBH Publishing Co Pvt.Ltd.

5. Industrial waste treatment – contemporary practice and vision for the future, Nelson Leonard Nemerow, Elsevier, Singapore, 2007

COURSE OBJECTIVES

To understand the variety of pollutants other than sewage and biodegradable and quantities.

To analyze the nature of industrial pollutants and their sources and quntities.

To evaluate various treatment facilities available to treat non biodegradable wastes from said industries.

To apply various disposal methods of pollutants and to design the best suited methods.

To study and understand the manufacturing processes of the given industries.

COURSE OUTCOMES

The knowledge of various liquid industrial pollutants both in quantity and quality and strengths of pollution can be understood.

The prevention and control of industrial pollutants by other methods can be understood.

The listed industries can be studied in detail.

The reuse point of view can be evaluated.

LEARNIG OUTCOMES

Nature, origin, characterization, toxicity, sampling etc. of industrial pollutants other than sewage is evaluated under the control regulatory agencies and bodies will help to deal similar pollutants effectively.

Pollution prevention and unit operations and processes can be studied and analyzes.

Disposal and reuse of treated wastes are studied economically.

Sludge disposal mechanism can be applied.

Processes of the given industries and manufacturing units are under stood with detailed flow diagrams and pollution reduction at the source itself can be studied.

EEM2.4(a) DISASTER MANAGEMENT

Common Syllabus for CTPM2.4(a) and EEM2.4(a)

Types of Disasters: Disaster - concept and definitions of disaster, causes of disasters, types – natural disasters – floods, droughts, cyclones, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold wave, global warming, sea level rise, ozone depletion. Man-made disasters: Sociological – political – industrial and human disasters. Risk Assessment and Analysis Concept and elements of Hazards, Risks and Vulnerability – Policies of Disaster Management, Identification of Crisis Situation, strategic developments, roles and responsibilities of recovery team, importance of team building in disaster management. Disaster Preparedness: Prevention and Preparedness – Plan, Action and Accountability, Concept and Nature of Disaster Preparedness, Plan of Disaster Preparedness for People with Special Needs/Vulnerable Groups, with Relevance to Housing, Infrastructure and Livestock, Community Based Disaster Preparedness Plan, Role of Information technology, Education, Communication and training. Medical and health preparedness plan. Disaster Damage Assessment and Response: Needs and Damage Assessment– Control process and measurement – modern and traditional methods of response, Disaster Response Plan – roles of response teams and forces. Epidemiological Study of Disasters - Medical and Health Response to Different Disasters - Role of Information and Communication Technology in Health Response Disaster Mitigation and Recovery: Disaster Mitigation – meaning and concept – structural mitigation and non-structural mitigation – mitigation strategies and emerging trends. Reconstruction and rehabilitation for development, Medium and long-term recovery aspects, Participative Rehabilitation Process: Community involvement and development of infrastructure.

Reference Books:

1. Disaster Management by Dr. Mrinalini Pandey, Wiley India Pvt. Ltd.

2. Natural Hazards & Disaster Management by R.B.Singh, Rawat Publishers & Distributors.

3. Disaster Management: Future Challenges and opportunities by Jagbir Singh4, I.K. International Publishing House Pvt. Ltd

4. Natural Disaster Management , Jon Ingleton, Tudor Rose Holdings Ltd (1999).

5. Disaster Management, Rajib Shaw and RR Krishnamurthy, Universities Press, Hyderabad.

RAJASEKHAR SIR

EEM2.4(b) AGRICULTURAL POLLUTION AND CONTROL

Environmental issues in agriculture:Types of farming systems, agro meteorology, waterand nutrients requirement.

Fertilizers, pesticides, herbicides:types of fertilizers, pesticides and other agrochemicals, soil and water conservation practices. Natural fertilizers, pesticides and herbicides- green practices in agriculture yield improvement

Water logging and salinity: causes and effects. Wastewater reuse in agriculture,management and control of agricultural waste, recycling and reuse. Biotechnology in reduction of CO_2 emission, Bio-scrubbers, Bio-beds, Bio-trickling filters and their applications.

Novel methods of pollution control: Methane production, Root zone treatment, Membrane technology.

Reference Books

1. Microbial Biotechnology: A. N. Glazer and H. Nikaids, Cambridge University Press, 2007.

2. Molecular Biotechnology: Gleek and Pasternack.

3. Biotechnology: A Text Book of Industrial Microbilogy, T. D. Brock, Sinauer Associates Incorporated; 2nd ed edition (May 1990)

4. Industrial Microbiology: Presscott and Dunn, CBS Publishers

5. Biotechnology: B. D. Singh, Kalyani Publishers.

6. Soil & Ground Water Pollution from Agricultural activities, T.V.Ramachandra, TERI Press.

Course objectives

to familiarise with farming systems

impart knowledge on agrochemicals

to input knowledge on green practices in agriculture

impart knowledge on water logging and salinity

impart knowledge on novel methods in pollution control

Course outcomes

the students will be able to

understand types of farming systems

analyze practices of water and soil conservation

Understand water logging salinity causes and effects

discuss biotechnological measures in pollution control

learning outcomes

understand farming systems

understands the concepts of aggro meteorology

discuss the use of various agrochemicals

evaluate green practices in agriculture

understand the causes and effects of water logging

understand the causes and effects of salinity

discuss waste water reuse in agricultural management

biotechnology applications in agricultural waste management

discuss membrane technology

discuss root zone treatment

EEM2.4(c) ENVIRONMENTAL LEGISLATION

Introduction: Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – National and International multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration etc – Institutional framework (SPCB/CPCB/MOEF) - Supreme Court Judgments in Landmark cases

Water (P & CP) Act, 1974: 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.

Air (P & CP) Act, 1981: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.

Environment (Protection) Act 1986: 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, authorization – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

Other Acts & Management Systems: Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Fundamentals of Environmental Management and ISO 14000 series - principles and elements. The ISO 14001- Environmental management systems standards.

Reference Books

1. CPCB, Pollution Control acts, Rules and Notifications issued there under Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.

2. Environmental law and policy in India by Shyam Divan and Armin Roseneranz, Oxford University Press, New Delhi, 2001.

3. Environmental law and enforcement by Greger I. Megregor, Lewis Publishers, London1994.

4. Constitution of India [Referred articles from part-III, part-IV and part-IV A]

5. Handbook of environmental management and technology: Gwendolyn Holmes, Ben Ramnarine Singh, Louis Theodore.

6. The ISO 14000 Handbook: Joseph Cascio.

7. ISO 14004: Environmental management systems: General guidelines on principles, systems and supporting techniques (ISO 14004:1996 (E)).

8. ISO 14001: Environmental management systems.

Course objectives

to understand the legislative framework of environmental regulation, its implementation and adjudication.

to identify core environmental issues and legal and institutional responses to them.

to analyze the role of judiciary in environmental protection.

to introduce the basic concepts and principles of environmental law and to analyze these principles as tools of environmental protection, where the laws and policies fall short.

to understand development of environmental law in an international perspective, specifically developed and developing countries perspective

Course outcomes

the students will be able to

understand the National Environmental policies.

discuss the National and International multilateral environmental agreements and Protocols.

analyze the principles as tools of environmental protection.

evaluate various laws related to water, air and environment.

understand principles of ISO 14000 and ISO 14001- Environmental management systems standards

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Learning outcomes:

The course gives students the opportunity to grapple with contemporary legal debates in environment law.

to sensitize the students towards human activities that adversely affect the environment and the need for regulation of such activities.

develop a thorough understanding of practice and procedure followed by various environmental law enforcing agencies/bodies.

to pursue environmental litigation before the National Green Tribunal and assist the Tribunal as a researcher or in any other capacity.

assist industries and projects in obtaining environmental clearance and compliances with other environmental laws..

be familiar with the laws, policies and institutions in the field of environment.

acquire the skills needed for interpreting laws, policies and judicial decisions in a holistic perspective.

acquire the ability to evaluate the role of law and policy in conservation and management of natural resources and prevention of pollution.

understand principles of ISO 14000 and ISO 14001- Environmental management systems standards.

EEM2.5(a) ENERGY, ENVIRONMENT AND SUSTAINABILITY

Introduction:Sustainable Development – Indicators of Sustainability – Sustainability Strategies- Barriers to Sustainability – Industrial activity and Environment – Industrialization and sustainable development. Cleaner Production (CP) in Achieving Sustainability –Principles Cleaner Production, Definition, Importance Historical evolution, Benefits, Promotion, Barriers, Role of Industry, Government and Institutions, Industrial Ecology, clean development mechanism, reuse, recovery, recycle, raw material substitution.

Cleaner Production Project Development and Implementation:Overview of Cleaner Production (CP) Assessment Steps and Skills, Process Flow Diagram, Material Balance, CP Option Generation – Technical and Environmental Feasibility analysis – Economic valuation of alternatives - Total Cost Analysis – CP Financing – Preparing a Program Plan – Measuring Progress – Pollution Prevention and Cleaner Production Awareness Plan – Waste audit – Environmental Statement, carbon credit, carbon sequestration, carbon trading, Life Cycle Assessment - Elements of LCA – Life Cycle Costing – Eco Labelling

Green Technology - Definition of green building, benefits and challenges, public policies and market-driven initiatives, effective green specifications. Overview of the Building Energy System Design Process. Assessing human functional and physiological smart growth- needs, local climate and free energy resources. Design scenarios- Day lighting , Electric Lighting.

Availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Non-conventional energy sources: Solar Energy- process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and application.

Biomass energy: Concept of biomass energy utilization, types of biomass energy, conversion processes, Wind Energy, energy conversion technologies, their principles, equipment and suitability in context of India.

Reference Books

1. Pollution Prevention: Fundamentals and Practice, Paul L Bishop (2000) McGraw Hill International.

2. Pollution Prevention and Abatement Handbook – Towards Cleaner Production, World Bank Group (1998) World Bank and UNEP, Washington D.C.

3. Cleaner Production Audit, Environmental System Reviews, No.38, Prasad Modak, C.Visvanathan and Mandar Parasnis (1995) Asian Institute of Technology, Bangkok

4. Handbook of Organic Waste Conversion, .Bewik M.W.M.

5. Industrial Ecology and Sustainable Engineering by Graedel Allenby, PHI Publications

Course Objectives

To study the definition, principles, strategies, indicaters and barriers of sustainability and to understand clear production.

To understand cleaner production, assessment steps and skills, technical and environmental feasibility analysis.

To understand green technology. Achive knowledge towards green buildings.

Utilizing nonconventional energy sources.

To understand environmental problems related to energy resources, equipment and suitability in context of India.

Course Outcomes

Exposure towards sustainable development, clar production, green building, climate chanes, energy recourses, life cycle analysis, waste audit, carbon credits, etc. for the sustainable development in general and particularly in Indian context can be achieved.

Learning Outcomes

Knowledge on sustainable development, industrialization and sustainable development, minimum damage to environment, consideration of climate, reduce, reuse, recovery, recycle of raw material can be achieved.

Concepts of clear production, roles of industry, government, institutions, coordinations in achieving can be studied.

Development of green technology, utilization of available resources in favaourble climate can be analyzed.

Estimation and evaluation of energy needs, waste audit, ecolabelling, carbon credits etc. can be studied.

Energy resources required for future uses, estimation, identification, selection,

conversion technologies, principles, equipment and suitability in context of India can be achieved.

EEM2.5(b) ENVIRONMENTAL BIOTECHNOLOGY

Environmental Biotechnology: Principles and concepts - usefulness to mankind. Degradation of high concentrated toxic pollutants- halogenated, non halogenated, petroleum hydrocarbons, metals - Mechanisms of detoxification – oxidation - dehalogenation - biotransformation of metals - biodegradation of solid wastes.

Biofilm Kinetics: Microbial aggregation-idealized biofilm-Steady state biofilm – soluble microbial products and inert biomass- non steady state biofilms.

Microbial cell/enzyme technology – adapted microorganisms – biological removal of nutrients – algal biotechnology– extra cellular polymers - Biogas technology. Concept of rDNA technology – expression vectors – mutation – construction of microbial strains - radioactive probes - protoplast fusion technology – applications.

Biotechnological remedies for environmental pollution - decontamination of groundwater –Bioremediation: Scope and characteristics of contaminants- contaminant availability for biodegradation- Engineering strategies for bioremediation – evaluation of bioremediation.

Environmental effects and ethics of microbial technology – genetically engineered organisms – Microbial containment-Risk assessment.

Text Books

1. Environmental Biotechnology: Principles and Applications by Rittmann., B.E. and McCarty, P.L ,Tata McGraw-Hill,
2. Biological degradation of wastes by Martin. A.M, Elsevier Applied Science.
3. Environmental Biotechnology by Scraqq, Oxford Publications
4. Environmental Biotechnology by Bhattacharya and Banerjee, Oxford Publications

Course Objectives:

To make the student learn about origin and evolution of microbes.

To make the student understand structure and functioning of different microbial groups

To make them to acquaint the cultivation of microbes in artificial medium.

To make the student learn about Concept of rDNA technology.

To make the student understand Environmental effects and ethics of microbial technology

Course Outcomes:

At the end of the course, the student will be able to

Understand environment and biotechnology

Differentiate the biological waste water treatment methods

Describe the applications of biodegradation and bioremediation

Discuss genetically engineered organisms

Explain Microbial containment and it's Risk assessment

Learning outcomes:

understand the types Principles and concepts of biotechnology.

evaluate the mechanisms of detoxification

discuss the Steady state biofilms and non steady state biofilms.

understand Biogas technology

discuss the Concept of rDNA technology

understand Biotechnological remedies for environmental pollution

Understand Engineering strategies for bioremediation

understand effects and ethics of microbial technology

realize Microbial containment and Risk assessment

EEM2.6 ENVIRONMENTAL PROCESS DESIGN AND DRAWING

Review of the Principles of design and drawing of water supply and treatment units from source to distribution system.

Review of Principles of design and drawing of wastewater treatment units.

Detailed design and drawings of various types of intake structures, conduits, pipes, ground level reservoirs and elevated service reservoirs.

Preparation of drawings for various house plumbing fixtures. Design and drawings of various types of distribution systems and various methods of analysis of distribution networks

Text Books

1. Elements of Public Health Engineering by Duggal, S.Chand Publishers.

2. Water Supply and Sanitary Engineering by Birdie, Dhanpat Rai Publishing Company (p) Ltd (2010)

3. Water Supply and Sanitary Engineering by Hussain, Oxford and IBH Publishers.

EEM2.7 AIR AND NOISE MONITORING LABORATORY

1. Particulate Sampling – Dust Fall, Pollution Suspended Particulates and Total Particulate Matters using High Volume Sampler / Respirable Dust Sampler.

2. Experiment on Respirable Dust – Estimating RPM.

3. Estimating Sulphur Dioxide, NOx in Ambient Air Using High Volume Air Sampler.

4. Stack Sampling Techniques and Demonstration of Stack Monitoring.

5. Exercises on Ambient Gas Monitoring including CO & VOC.

6. Demonstration / Exercises on Air Pollution Control Devices – Bag Filter, Scrubber, Cyclone and ESP.

7. Exercises on Auto Exhaust Analyser for Petrol Vehicle and Diesel Vehicle Smoke test for Diesel Vehicle.

8. Exercises on Noise Measuring Instruments.

9. Exercises on Luxmeter (Light Intensity measuring Instrument)

10. Demonstration on Wind Monitoring and Analysis of Data for Wind rose Diagrams.

11. Demonstration of Rain Gauges.

Reference Books

1. Air pollution and Control by Henry C Perkins, Mc Graw Hill Pvt Ltd, New Delhi, 1974.

2. Air Pollution (vol. I), Air Pollution and its effects (vol. II), Analysis, Monitoring and Surveying (vol. III), Sources of Air Pollution and their control by Stern A. C., Academic press, New York, 1968. 53

EEM2.8 SEMINAR

Each student has to select a topic and collect about 10 papers with at least 5 journal papers and prepare a report and give a seminar at the end of the semester

III SEMESTER

EEM3.1(a) ENVIRONMENTAL HYDRAULICS

Common Syllabus for EEM3.1(a) and HCH3.1(a)

Hydrology: Statistical analysis of Hydrological Data -, Intensity–Duration frequency Curves. Hydraulics of groundwater flow: Non–equilibrium flow, Yield estimations, Interferences Infiltration galleries, ground water recharge

Transportation and distribution of water: Storage capacity, Pumping of Water, Design and selection of economical diameter of pumping main. Distribution of Water - Pressure and capacity requirements of distribution system, Analysis of networks, Appurtenances in a distribution layout, detection and prevention of leakage mains.

Hydraulics of Sewers: Design of sewers in full and partial flow conditions, Flow at Sewer transitions, Sewage pumping. Open channel flow–design of open channel flow sections.

Transport phenomenon – diffusion – dispersion – advection – adsorption - conservative and non-conservative pollutants. Governing Equations for flow and transport in surface and subsurface waters-chemical and biological process models-simplified models for lakes, streams, and estuaries.

Modelling of the transport phenomenon: complexity - coupled and uncoupled models – linear and nonlinear models - Solution techniques – calibration. Numerical models: FDM, FEM and Finite volume techniques - explicit vs. implicit methods - numerical errors. Different types of Stream quality modeling and Groundwater transport modeling.

Reference Books

1. Water and waste water Engineering by Fair Gayer and Okun, I. K. International Pvt. Ltd.
2. Engineering Hydrology by K. Subramanya, Tata McGraw-Hill Education
3. Hydrodynamics of transport for water quality modeling by Martin, L.J. and McCucheon, S.C, Lewis Publishers.
4. Groundwater by Freeze, R.A. and Cherry. J.A. Prentice Hall,
5. Groundwater Hydrology by Todd, Wiley Publications

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EEM3.1(b) SURFACE AND GROUND WATER HYDRAULICS

Land Processes – Subsurface and Channel Processes- Precipitation – Rain gauge network, Abstractions, Infiltration, Evaporation, Transpiration, Process and models

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

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.

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

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

Reference Books:

1. Applied Hydrology by Ven Te Chow, Mc GrawHill Science Publishers
2. Elementary Hydrology by Singh, Vijay, Prentice Hall 3. Ground Water by Raghunath, Mc Graw Hill.
4. Hydraulics of Groundwater by Bear, J., Mc Graw Hill.
5. Surface water quality modeling by Chapra,, McGraw Hill Publication

Course objective:

1. To develop an understanding of land process and the importance of rainfall, runoff and infiltration etc., and to study in details about the types of Hydrographs
2. To understand the concept of watershed and conceptual Models.
3. To study in details about the properties of aquifer and ground water flow
4. To impart knowledge about Well hydraulics and Infiltration galleries
5. To study about the natural and artificial recharge of ground water

Course outcome:

1. Acquainted with the principles of surface and groundwater hydraulics
2. Familiar with the concepts andmodelling techniques for application to various problems.
3. Ability to design and calculate the occurrence and movement of ground water.
4. Acquire knowledge for natural and artificial recharge of ground water

Learning outcomes:

The students will be able to

1. Understand the land processes forsubsurface and channel Processes
2. Gain knowledge about the methodsand models for rainfall estimation, Infiltration, Evaporation, Transpiration
3. Analyze the concepts, applications and problem associated with Unit Hydrograph & S-curve hydrograph.
4. Understand the applications of watershed model and conceptual Models.
5. Gain knowledge about the concept ofoccurrence and movement of ground water, properties of aquifer, groundwater flow equations and assumptions of Dupuit Forchheimer.
6. Analyze the concept and problems associated with Well hydraulics and Infiltration galleries.
7. Analyze the concept and problem for water table aquifer, unconfined and confined for non-leaky and leaky aquifers
8. Understand the concepts forwell design criteria and groundwater pumping tests.
9. Understand the concept and problem arise fornatural and artificial recharge of ground water and salt water intrusion.
10. Analyse the application of finite difference in ground water.

EEM3.2(a) SOLID AND HAZARDOUS WASTE MANAGEMENT

Introduction: Definition of solid waste – waste generation, sources and types of solid waste – sampling and characterization – Determination of composition of Municipal Solid Waste – Onsite storage and handling of solid waste.

Collection and Transport of Solid Waste:Type and methods of waste collection systems, analysis of collection system Optimization of collection routes– alternative techniques for collection system. Transfer and Transport: Need for transfer operation, transport means and methods, transfer station types and design requirements. Separation and Processing and Transformation of Solid Waste- Waste as a Resource Economics, Disposable Materials, Recycling Collection, Processing, Potential for Reuse

Processing and disposal: Unit operations used for separation and processing, Materials Recovery facilities, Source reduction and waste minimization, Metal Separation & Recovery Waste transformation through combustion and composting, anaerobic methods for materials recovery and treatment – Energy recovery – biogas generation and cleaning– Incinerators. Landfills: Site selection, design and operation, drainage and leachate collection systems – designated waste landfill remediation.

Hazardous Waste Management:Definition and identification of hazardous wastes-sources and characteristics – hazardous wastes in Municipal Waste – Hazardous waste regulations – minimization of Hazardous Waste-compatibility, handling and storage of hazardous waste-collection and transport, e-waste - sources, collection, treatment and reuse.

Hazardous waste treatment technologies - Design and operation of facilities for physical, chemical and thermal treatment of hazardous waste – Solidification, chemical fixation and encapsulation, incineration. Hazardous waste landfills: Site selection, design and operation – remediation of hazardous waste disposal sites.

Text Books

1. Integrated Solid Waste Management: Engineering Principles and Management Issues by George Tchobanoglous , Hilary Theisen, Samuel A Vigil. McGraw-Hill Series in Water Resources and Environmental Engineering

2. Environmental Engineering by Howard S.Peavy, Donald R.Rowe and George Tchobanognous, McGraw Hill Publishing Company.

Reference Books

1. Hazardous Waste Management, Charles A. Wentz; McGraw Hill Publication, 2. Solid and Hazardous Waste Management by MN Rao, Razia Sultana, BSP Books 3. Municipal Solid Waste Management by P Jayaramireddy, BSP Books PVT Ltd.

Course objectives

to familiarise with sources and types of solid waste and sampling of municipal solid waste

to impart knowledge on functional elements of solid waste management

to import skills on waste processing techniques like composting bio gas generation and incineration

Input skill for design of sanitary landfill

to impart knowledge on hazardous waste management

course outcomes

the students will be able to

understand the sources and types of solid wastes

determine the composition and characteristics of municipal solid waste

discuss Functional elements of solid waste management

Design the sanitary landfill

understand hazardous waste management

learning outcomes

understand the types and sources of solid wastes

Functional elements of solid waste management

evaluate a municipal solid waste sample for its characteristics

discuss the segregation techniques

design waste processing techniques like composting, bio gas generation

design sanitary landfill

understand hazardous waste characteristics

Understand eBay stand its management

understand hazardous waste management technologies

design and operation of hazardous waste landfills

EEM3.2(b) CLIMATE CHANGE AND CDM

Introduction: Atmosphere – weather and Climate - Causes of global and regional climate change- climate parameters – Temperature, Rainfall, Humidity, Wind – Global ocean circulation – El Nino and its effect - Carbon cycle.

Global Warming: Emission sources of green house gases, Green House effect as a natural phenomenon, and due to anthropogenic activities, Recent role of green house effect. Global warming potential, Past present and future scenario of global warming.

Impacts of Climate Change: Effects of Climate Changes on living systems – health effects, agriculture and food security, forestry, human migration, socioeconomic impacts- coastal areas, tourism, industry and business, vulnerability assessment- infrastructure. Sea level rise, Coastal erosion and landslides, strategies to combat global warming.

Mitigating Climate Change IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation - Identifying adaption options – designing and implementing adaption measures – surface albedo environment-reflective roofing and reflective paving – enhancement of evapotranspiration - tree planting programme – green roofing strategies – energy conservation in buildings – energy efficiencies –Concept of carbon sequestration, Carbon sequestration modalities and procedures, Carbon capture and storage, Carbon trading, Montreal protocol, Kyoto protocol, Role and functions of IPCC, National and International action plan on climate change.

Alternate Fuels and Renewable Energy source – coal, natural gas – wind energy, hydropower, solar energy, nuclear energy, geothermal energy – biofuels – Energy policies for a cool future - Clean Development Mechanism - Energy Audit.

Text Books

1. Air Pollution, KL Dorean, CBS Publishers & Distributers Pvt. Ltd. New Delhi.

2. Principles and Practices of Air Pollution Control and Analysis, J.R. Mudakavi, I.K. International Publishing House Pvt. Ltd., New Delhi.

3. Carbon Capture: Sequestration and Storage (Issues in Environmental Science and

4. Technology), RE Hester and RM Harrison, Royal Society of Chemistry; 1 edition (January 20, 2010)

5. Climate Change: causes, Effects and Solutions, John T. Hardy. Willy Publication, USA.

6. Earth ? s Climate Past and Future by Ruddiman W.F, freeman W.H. and Company,

7. Global Warming and Climate Change. Vol I & II.by Velma. I. Grover, Science Publishers, 2005.

8. Climate Change – An Indian Perspective by Dash Sushil Kumar, Cambridge University Press India Pvt. Ltd, 2007

Reference Books

1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK, 2007

2. Climate Change and Biodiversity by Thomas E, Lovejoy and Lee Hannah, TERI Publishers, 2005

3. Impacts of Climate Change and Climate Variability on Hydrological Regimes by Jan C. van Dam, Cambridge University Press, 2003.

Course objectives

to familiarise with Causes of global and regional climate change

to impart knowledge on Past present and future scenario of global warming

to import skills on Impacts of Climate Change

Input skill for IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation

to impart knowledge on Clean Development Mechanism

course outcomes

the students will be able to

understand the Carbon cycle occurred due to climate change.

determine the role of green house effect and Global warming potential

discuss Effects of Climate Changes on all living systems

Design the green roofing strategies for energy conservation

understand Clean Development Mechanism

learning outcomes

understand the climate parameters such as Temperature, Rainfall, Humidity, Wind

assess Carbon cycle and global ocean cycle

evaluate Emission sources of green house gases

discuss the Recent role of green house effect

design strategies to combat global warming

design and implement adaption measures of IPCC Technical Guidelines

understand Concept of carbon sequestration

Understand Montreal protocol and Kyoto protocol

understand Alternate Fuels and Renewable Energy sources

discuss Clean Development Mechanism

EEM3.4 DISSERTATION (Preliminary)

The student shall submit a brief report on the selected topic of his/her dissertation work and attend for a formal viva-voce examination before a Committee comprising the Chairman, BOS, Head of the Department and the Guide.

IV – SEMESTER

EEM 4.1 DISSERTATION (Final)

The student shall submit his/her dissertation work and attend for a formal viva-voce examination before a Committee comprising the Chairman, BOS, Head of the Department, the Guide and the External Examiner.

Department of Civil Engineering

SCHEME OF INSTRUCTION & SYLLABUS
FOR

M.Tech. (ENVIRONMENTAL ENGINEERING AND MANAGEMENT)

(with effect from 2019-20 Admitted Batch)

Department of Civil Engineering
A.U. College of Engineering (A)
Visakhapatnam

Department of Civil Engineering
M.Tech. (ENVIRONMENTAL ENGINEERING AND MANAGEMENT)
Scheme of Instruction and Examination
(with effect from 2019-20 Admitted Batch)

I – SEMESTER

Code No.	Course Title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam (hrs)	Ext.	Sess.		
EEM1.1	Numerical Methods and Statistical Analysis	4	--	4	3	70	30	100	3
EEM1.2	Environmental Chemistry	4	--	4	3	70	30	100	3
EEM1.3	Environmental Microbiology and Sanitation	4	--	4	3	70	30	100	3
Program Elective –I EEM1.4	(a) Occupational Health, Safety and Hygiene (b) Watershed Management (c) Remote Sensing and GIS Applications	4	--	4	3	70	30	100	3
Program Elective –II EEM1.5	(a) Environmental Impact Assessment (b) Ecological and Ecosystem Engineering	4	--	4	3	70	30	100	3
EEM1.6	Environmental Engineering Lab.	-	3	3	Viva	50	50	100	1.5
EEM1.7	Case Studies	-	3	3	Viva	50	50	100	1.5
Total		**20**	**6**	**26**		**450**	**250**	**700**	**18**

II – SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam. (hrs)	Ext.	Sess.		
EEM2.1	Advanced Water and Wastewater Treatment	4	--	4	3	70	30	100	3
EEM2.2	Air Pollution and Control	4	--	4	3	70	30	100	3
EEM2.3	Industrial Wastewater Treatment	4	--	4	3	70	30	100	3
Program Elective –III EEM2.4	(a) Disaster Management (b) Agricultural Pollution and Control (c) Environmental Legislation	4	--	4	3	70	30	100	3
Program Elective –IV EEM2.5	(a) Energy, Environment and Sustainability (b) Environmental Biotechnology	4	--	4	3	70	30	100	3
EEM2.6	Environmental Process Design and Drawing	--	3	3	Viva	50	50	100	1.5
EEM2.7	Air and Noise Monitoring Lab.	--	3	3	Viva	50	50	100	1.5
EEM2.8	Seminar	--	3	3	Viva	50	50	100	2
Total		**20**	**9**	**29**		**500**	**300**	**800**	**20**

III SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam (hrs)	Ext	Sess.		
Program Elective –V EEM3.1	(a) Environmental Hydraulics (b) Surface and Groundwater Hydraulics	4	--	4	3	70	30	100	3
Program Elective –VI EEM3.2	(a) Solid and Hazardous Waste Management (b) Climate Change and CDM	4	--	4	3	70	30	100	3
EEM3.3	Dissertation (Preliminary)	--	--	--	Viva	--	100	100	8
Total		**8**	--	**8**		**140**	**160**	**300**	**14**

IV SEMESTER

Code No.	Course title	Scheme of Examination			Total	Credits
		Exam. (hrs)	Ext.	Sess.		
EEM4.1	Dissertation (Final)	Viva	100	--	100	16
Total						**16**

M.Tech. (ENVIRONMENTAL ENGINEERING AND MANAGEMENT)
Syllabus
(with effect from 2019-20 Admitted Batch)

I – SEMESTER

EEM1.1 NUMERICAL METHODS AND STATISTICAL ANALYSIS

Linear system – Gaussian elimination and Gauss – Jordan methods – Matrix inversion – Gauss Seidel method – Non-linear equations – Regula-Falsi and Newton- Raphson methods –interpolation – Newton's and Lagrange's interpolation

Linear Programming – Graphical and Simplex methods – Measures of central tendency, dispersion, Skewness and Kurtosis – Probability – conditional probability – Bayes' theorem

Numerical solutions of ordinary differential equations – Introduction to initial and boundary value problems – Numerical solutions of ordinary differential equations : Taylor's series, Euler's method, Modified Euler's method, Runge- Kutta methods (secomd and fourth orders) – Predictor.

Random variable – two dimensional random variables – standard probability distributions – Binomial Poisson and normal distributions - moment generating function

Sampling distributions – confidence interval estimation of population parameters – testing of hypotheses – Large sample tests for mean and proportion – t-test, F-test and Chi-square test – curve fitting-method of least squares

Regression and correlation – rank correlation – multiple and partial correlation – analysis of variance-one way and two way classifications – experimental design – Latin square design – Time series analysis.

Reference Books

1. *Probability and Statistics for Engineers by Richard A. Johnson, Prentice Hall of India Publications.*
2. *Numerical methods by S. Armugan, A. ThangapandiIssac, A. Someswaranadham, Scitech Publications (India) Pvt Lt.*

EEM1.2 ENVIRONMENTAL CHEMISTRY

(Basic concepts of the following branches of the chemistry as applicable to the Environmental Engineering)

Quantitative, Qualitative and physical chemistry : Basic concepts of physical chemistry, Gas laws, Laws of Mass action, Common Ion Effect, Solutions, Vapour pressures of liquids, Binary Mixtures, Solutions of solids in Liquids, Oxidation – Reduction potentials, Ionization, Solubility products, Basics of colloidal chemistry- adsorption and absorption – principles

Equilibrium Chemistry : Equilibrium constants and Calculations, Le-Chatelier Principle, Transport and transformation of chemicals – Photo catalysis - Soil chemistry - acid-base and ion-exchange reactions in soil - salt affected soil and its remediation

Organic Chemistry: Properties of Organic Compounds, Sources of Organic Compounds, Isomerism, Types of Organic Compounds, Aliphatic, Aromatic and Heterocyclic. – Principles of green chemistry.

Biochemistry : Enzymes, factors affecting the action of Enzymes, (co-enzymes or cofactors, Temperature, pH, Micro and Macro mutants), Proteins, carbohydrates and fats.

UV visible spectroscopy: Basic principles – application – Flame Photometry - Atomic absorption spectroscopy – Principles – applications, Gas chromatograph and HPLC – Principles and applications.

Nuclear Chemistry : Atomic Structure, Electron orbits, Neutron, Proton, Nuclear structure, Nomenclature of Isotopes, stable and radioactive nucleoids, Nature of

Radiation, Energy of Radiation, Units of Radioactivity, half life, α, γ and neutron induced reaction, nuclear fission and fusion.

Text Books

1. *Chemistry for Environmental Engineering and Science, C.N. Sawyer, P.L. McCarty and G.F. Parkin, Tata McGraw-Hill publication.*
2. *Environmental Chemistry by AK De, Wiley Publications*

EEM1.3 ENVIRONMENTAL MICROBIOLOGY AND SANITATION

Introduction : Microorganisms - classification, prokaryotic and eukaryotic cells, structure, characteristics, nucleic acids, DNA and RNA, replication. Recombinant DNA - Genetic Engineering.

Metabolism Of Microorganisms :Environmental factors, nutrition and metabolism, growth phases, enzymes, carbohydrate, protein, lipids metabolism, respiration, fermentation, Glycolysis, Kreb's cycle, Hexose monophosphate pathway, significance of energetic

Microbiology Of Drinking Water : Distribution of microorganisms, indicator organisms, coliforms - fecal coliforms - E.coli, Streptococcus fecalis and Clostridium welchii, differentiation of coliforms - significance - MPN index, M.F. technique, standards. Virus-concentration techniques. Algae in water supplies - problems and control.

Microbiology Of Wastewater Treatment : Biodegradation of toxic pollutants - alpha oxidation ,beta oxidation, electron transport system and oxidative phosphorylation mechanism, Microbiology of biological treatment process

Aquatic Microbiology : Ecotoxicology - toxicants and toxicity - factors influencing toxicity, effects, acute, chronic, concentration response relationships, test organismns, toxicity testing bioconcentration - bioaccumulation - bio-magnification - bioassay - biomonitoring.

Sanitation : Industrial sanitation : Schools, Public Buildings, Hospitals, Eating establishments, Swimming pools – Study of factors like Light, Heat, Ventilation, Plumbing fixtures, Cleanliness and maintenance and comfort..

Rural Sanitation : Population habits and environmental conditions, problems of water supply and sanitation aspects, low cost excreta disposal systems. Rural sanitation improvement schemes.

Reference Books

1. *Microbiology for sanitary engineers by Mckinney, McGrawHill Publications.*
2. *Microbiology for Environmental Scientists and Engineers by A. Gaudy & E. Gaudy, McGrawHill Publications.*
3. *Microbiology by Pelzer, Ecschan& N R Kreig. Tata McGraw Hill Publishing Company Limited.*
4. *Municipal and Rural sanitation by Victor Ehalers& Earnest W Steel, McGraw-Hill Book Company.*

EEM1.4(a) OCCUPATIONAL HEALTH, SAFETY AND HYGIENE

Introduction:Need for developing Environment, Health and Safety systems in work places. Regulations and Codes of Practice. Role of trade union safety representatives. International initiatives. Ergonomics and work place.

Occupational Health and Hygiene**:** Definitions. Categories of health hazards. Exposure pathways and human responses to hazardous and toxic substances. Advantages and limitations of environmental monitoring and occupational exposure limits. Hierarchy of control measures for occupational health risks. Role of personal protective equipment and the selection criteria. Effects on humans, control methods and reduction strategies for noise, radiation and excessive stress.

Workplace Safety and Safety Systems:Features of the satisfactory design of work premises HVAC, ventilation. Safe installation and use of electrical supplies. Fire safety and first aid provision. Significance of human factors in the establishment and effectiveness of safe systems. Safe systems of work for manual handling operations. Control methods to eliminate or reduce the risks arising from the use of work equipment.

Requirements for the safe use of display screen equipment. Procedures and precautionary measures necessary when handling hazardous substances. Contingency arrangements for events of serious and imminent danger.

Techniques of Environmental Safety: Methods of effective implementation and review of health & safety policies. Functions and techniques of risk assessment, inspections and audits. Investigation of accidents- Principles of quality management systems in health and safety management. Industry specific EHS issues

Education and Training:Relationship between quality manuals, safety policies and written risk assessments. Records and other documentation required by an organisation for health and safety. Requirements for and benefits of the provision of information, instruction, training and supervision. Factors to be considered in the development of effective training programmes. Principles and methods of effective training. Feedback and evaluation mechanism.

Reference Books

1. *Environmental and Health and Safety Management by Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995*
2. *The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.*
3. *Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005*

EEM1.4(b) WATERSHED MANAGEMENT

Common Syllabus for HCH1.4(b) and EEM1.4(b)

Watershed Management Concept - Introduction- Concept of Watershed Management- History of Watershed Management and its Relevance to India- Watershed Characteristics; Climatic Characteristics- Physiographic Characteristics- Causes of Watershed Deterioration- Effect of Watershed on the Community- Water Resources Region of India .

Principles of Watershed Management- Integrated Watershed Management Approach (IWMA)- Objectives of IWMA- Envisaged Results- Success Criteria- Selection of Watershed Village- Equity Issues for Watershed Policies- Factors Causing The Inequality- Benchmark Survey- Remote Sensing Survey in Watershed Management- Land Capability Classification.

Soil Erosion: Introduction- Soil Erosion- Factors Affecting Soil Erosion- Different Types and Causes of Erosion- Geologic Erosion- Accelerated Erosion- Estimation of Loss of Soil from Erosion- Soil Loss Models- Sediment Models- Bed Load Models- Control of Soil Erosion.

Management of Natural Drainages- Introduction- Check Dam- Structures for Gully Stabilization and Storage of Water- Rivers or Stream Bank Management Measures in Watershed- River Training Works- Methods of River Training Works.

Wasteland and Land Drainage Management- Introduction- Causes of Wasteland – Water Logging- Salinity- Soil Erosion- Overgrazing- Mining Operation- Industrial Effluent- Brickfields- Inadequate Surface and Subsurface Drainages- Remedial Measures in Wasteland Management- Land Drainage Management- Surface or Overland Drains- Subsurface or Underground Drains- Discharge and Spacing of Tile Drains.

Flood Damage Mitigation Management- Introduction- Mitigation Measures- Structural Mitigation Measures- Non-Structural Mitigation Measures- Flood Plain Zoning- Flood Forecasting.

Water Harvesting- Introduction- Techniques of Water Harvesting- Indigenous Water Harvesting Methods In India- Engineering Methods of Water Harvesting.

Watershed Modeling- Introduction- Data of Watershed for Modeling- Application of Watershed Models- Model Calibration and Validation

Text Book

1. *Watershed management by Madan mohan das- Mimi das Saikia- PHI learning pvt. Ltd.*

Reference Books

1) *Watershed Management by Murty- J.V.S., New Age Intl.- New Delhi 1998.*
2) *Decision Support System for Integrated Watershed Management by Allam- G.I.Y.-- Colorado State University- 1994.*
3) *Watershed Planning and Management by Vir Singh- R.-- Yash Publishing House- Bikaner-*
4) *Watershed Management- American Soc. of Civil Engineers- New York- 1975.*

EEM1.4(c) REMOTE SENSING AND GIS APPLICATIONS

Common Syllabus for HCH1.4(c), SMFE1.4(c) and EEM1.4(c)

Introduction - Definition- Principle of Remote Sensing- History of Development of Remote Sensing- Stages in Remote Sensing- Electromagnetic Radiation and the Electromagnetic Spectrum- Interactions With the Atmosphere- Atmospheric Scattering- Atmospheric Absorption- Atmospheric Windows- Refraction- Interaction of EMR with the Earth's Surface- Reflection- Transmission- Spectral Signature.

Platforms & Sensors- Remote Sensing Systems- Remote Sensing From Space- Remote Sensing Sensors- Resolution- Imaging Sensors- Optical Infrared (OIR) Imagers- Optical Sensors- Thermal Sensors- Microwave Sensors- Active Microwave Sensors- Data Preprocessing- Remote Sensing in India.

Introduction to Image Interpretation- Basic Principles of Image Interpretation- Elements of Image Interpretation- Techniques of Image Interpretation- Interpretation Keys- Introduction to Digital Image Processing- Digital Image- Image Rectification and Registration- Geometric Correction- Image Enhancement Techniques (Only Concepts)- Image Classification - Unsupervised Classification and Supervised Classification- Digital Photogrammetry - Stereo Images from Satellites - Data Merging .

Geographic Information Systems (GIS)- Definitions and Related Technology- GIS Operations- GIS Elements- GIS Concepts and Practice- Map Projection and Coordinate System.

Vector Data Model- Introduction- Vector Data Representation- Geometric Objects- Topology.
Vector Data Analysis- Introduction- Buffering- Applications of Buffering- Map Overlay- Feature Type and Map Overlay- Map Overlay Methods- Slivers- Error Propagation in Map - Overlay- Distance Measurement- Map Manipulation.

Raster Data Analysis- Introduction- Analysis Environment- Local Operations- Local Operations With a Single Grid- Local Operations With Multiple Grids- Neighborhood Operations- Zonal Operations.

Terrain Mapping and Analysis- Introduction- Data for Terrain Mapping and Analysis- Surface Models-DEM- TIN.
GIS Models and Modeling- Introduction- GIS Modeling- Binary Models- Index Models
Remote Sensing & GIS Application in Civil Engineering – Some Case Studies from Literature.

Text Books

1. *Fundamentals of Remote Sensing 2nd Ed by George Joseph- University Press- New Delhi.*
2. *Introduction to Geographic Information Systems by Kang Tsung Chang- Tata Mc.G.H. Publications- New Delhi.*
3. *Remote Sensing and Image Interpretation by Lillesand- T.M. and Kieffer- Joh Wiley and Sons- New York- 1987.*

Reference Books

1. *Remote Sensing of the Environment – An Earth Resource Prespective by John R. Jensen- Pearson Education- New Delhi.*
2. *Geographic Information Systems: A Management Perspective by Aronoff- S. Ottawa: Wdl Publications- 1989.*

3. *Geographic Information Systems For Geoscientists: Modeling with GIS by Bonham Carter- G-F.- New York: Pergamon Press- 1994.*
4. *Principles Of Geographical Information Systems by Burrough- P.A And R.A. Mcdonnell.. Oxford: Oxford University Press- 1998.*
5. *Concepts and Technologies of Geographic Information Systems by Lo- C.P.- and Albert K.W. Young- Prentice Hall of India (Pvt) Ltd- New Delhi.*
6. *Introductory Digital Image Processing by John R Jensen- Prentice Hall- New Jersey.*
7. *Application of Remote Sensing to Hydrology Including Groundwater by Farsworth- R.K.- Bawetl- E.C. & Dhanju- M.S.-- IHP- UNESCO- 1984.*

EEM1.5(a) ENVIRONMENTAL IMPACT ASSESSMENT

Introduction to EIA**:** Definition, Concepts, Types, Limitations, components of EIA process, settings – public participation, public hearing. Methodologies**:** background information, interaction matrix methodologies, network methodologies etc, environmental setting- various factors, documentation and selection process, environmental indices and indicators for describing affected environment.

EIA notification by Ministry of Environment and Forest (Govt. of India):Provisions in the EIA notification, Categorization of Industries for seeking environmental clearance from concerned authorities, procedure for environmental clearance, procedure for conducting environmental impact assessment report, Rapid and Comprehensive EIA, general structure of EIA document, Environmental management plan, post environmental monitoring. Case studies in EIA.

Prediction and assessment of impact for air and noise environment:Basic information of air quality, identification of type and quantity of air pollutant, existing air quality and air quality standards, impact prediction and assessment, mitigation. Basic information of noise, existing noise levels and standards, prediction of noise levels and assessment of impact, mitigations.

Prediction and assessment of impact for water and soil environment:Basic information of water quality (Surface water and groundwater), water quality standards, identification of impact, prediction of impact and assessment, mitigations. Background information of soil environment, soil and groundwater standards, prediction and assessment of impact for groundwater and soil, mitigations.

Prediction and assessment of impact on cultural and socioeconomic environment:Basic information on cultural resources, rules and regulations for cultural resources like archaeological, historical structures, Cultural system, prediction and assessment of impact, mitigations. Basic information of socio-economic environment, description of existing socio-economic environment, prediction and assessment of impact, mitigation, resettlement and rehabilitation.

Text Books

1. *Environmental Impact Assessment by Larry W. Canter. Mc-Grawhill Co.*
2. *Environmental Impact Assessment Methodologies by Y Anjaneyulu, and Valli Manikkam, BSP Books PVT Ltd*

Reference Books

1. *Environmental Impact Analysis Handbook, John G. Rau and David C. Wooten (Ed), McGraw Hill Book*
2. *Environmental Impact Assessment– Urban and Jain.*

EEM1.5(b) ECOLOGICAL AND ECOSYSTEM ENGINEERING

Development and evolution of ecosystems – Principles and concepts – Energy flow and material cycling – productivity – Classification of ecotechnology – ecological engineering.

Classification of systems – Structural and functional interactions of environmental systems –Mechanisms of steady-state maintenance in open and closed systems

Classification of ecotechnology - Principles and components of Systems and Modeling- Modeling and ecotechnology – Classification of ecological models – Applications- Ecological economics- Self-organizing design and processes – Multi seeded microcosms.

Self organizing processes - Multiple seeded microcosms- Interface coupling in ecological systems - Concept of energy - Adapting ecological engineering systems to potentially catastrophic events - Agro ecosystems - Determination of sustainable loading of ecosystems.

Ecosanitation – soil infiltration systems–Wetlands and ponds–Source separation systems– Aqua cultural systems – Agro ecosystems – Detritus based treatment for solid wastes – marine systems- Case studies.

Reference Books

1. *Kangas, P.C. and Kangas, P., Ecological Engineering: Principles and Practice, Lewis Publishers,*
2. *Etnier, C. and Guterstam, B., Ecological Engineering for Wastewater Treatment, Lewis Publishers,*
3. *Concepts of Ecology by Kormondy, PHI Publications*

EEM1.6 ENVIRONMENTAL ENGINEERING LABORATORY

1. Sampling and characterization of water and wastewater by gravimetric, volumetric and colorimetric methods
2. Settling Column Analysis for type II settling,
3. Break point chlorination,
4. Determination of Dosage of lime-soda for removal of hardness
5. Media preparation and inoculation
6. Test for plate count
7. Coliforms – fecal coliforms – E.coli
8. M.P.N. and M.F. techniques.
9. Bioassay study
10. Sampling and analysis of ambient air for SPM, SO_2, Oxides of nitrogen
11. Instrumental methods of analyses for particulates, HC, CO, NOx, SO_2.

Reference Books

1. *Chemistry for Environmental Engineers, by Sawyer, C.N. and McCarty, P.L. and Parkin, G.F. McGraw Hill,*
2. *Environmental Chemistry, by De.A.K. New Age International Ltd.*
3. *Standard Methods for the Examination of Water and Wastewater, 21th Edition, American Public Health Association, Washington. D.C. 2005.*

EEM1.7 CASE STUDIES

Each student shall submit two case studies related to Environmental Studies and face viva-voce examination.

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II – SEMESTER

EEM2.1 ADVANCED WATER AND WASTEWATER TREATMENT

Physical and Chemical Treatment**:** Screening, Grit removal, Aeration and gas transfer, Application of Membrane Processes, Reverse Osmosis, Micro-filtration, Nano-filtration, Ultrafiltration and Electrodyalisis Chemical precipitation, other solids removal operations, Control of odour, Control of volatile organic compounds.

Theory of Sedimentation – flocculent particle settling – theory of coagulation and flocculation- zeta potential - Filtration - theory of granular media filtration – head loss cleaning of filter media - backwash hydraulics – Theory of chlorination – equilibrium constants.

Principles:Objectives of biological treatment significance - aerobic and anaerobic treatment kinetics of biological growth - factors affecting growth – attached, suspended and Hybrid growth systems. Determination of kinetic coefficients for organics removal – Biodegradability assessment – selection of process – reactors – batch & continuous type

Aerobic Treatment of Wastewater:Design and construction aspects and the relevant parameters of significance of the units: Activated Sludge Process, Trickling Filters, Aerated Lagoons, Rotating Biological Contactors, Sequential Batch Reactors (SBR), Stabilization ponds, Hybrid reactors for the treatment of wastewater :– IFAS, MBBR, MBR, Expanded / fluidized bed bio reactors

Anaerobic Treatment of Waste Water:Sludgehandling and treatment -Sludge digestion: theory and principles - Disposal of digested sludge, Anaerobic ponds, UASB reactors and various modifications in UASB process and anaerobic filters. Two stage /phase reactors – biogas generation.

Reference Books

1. *Wastewater Engineering, Treatment and Reuse. Metcalf & Eddy, Inc. Tata McGraw-Hill Publications*
2. *Biological Processes Design for wastewaters, Benefield, L.D. and Randall C.W. Prentice-Hall, Inc.*
3. *Wastewater treatment for Pollution Control by Arceivala, Tata McGraw Hill Publication*
4. *Water and wastewater technology by Hammer and Hammer, PHI Publications*

EEM2.2 AIR POLLUTION AND CONTROL

Introduction:Definition - Sources and classification of Air Pollutants - Photochemical smog - Effects of air pollution on health of Human & Animals, vegetation & materials, air quality, Global effects of air pollution.

Meteorology and Dispersion of air pollutants:Temperature lapse rates and Stability, Wind velocity and turbulence, Wind Rose, plume behaviour, Measurement of meteorological variables. Dispersion of Air pollutants: Theories on modeling of Air pollutants. Gaussian model, Equations for the estimation of pollutant concentrations of emissions. Plume Rise – Equations for estimation. Effective stack height and mixing depths

Sampling and Particulate Pollution Control Methods:Atmospheric sampling and stack sampling methods. Air quality standards.

Types of particulate pollution control methods – Settling chambers, Cyclone separators, Scrubbers, Filters and Electrostatic precipitators, design aspects and principle of these air pollution control units.

Gaseous pollution control methods and automobile pollution:Types of gaseous pollution control methods – absorption, adsorption and combustion processes. Automobile pollution, sources of pollution, composition of auto exhausts, Control methods. Planning for conducting Air pollution survey

Noise Pollution- Definitions – Significance in general - sources, measurement - effects and control measures, noise legislations

Reference Books

1. *Environmental Engineering, Peavy and Rowe, Mc-Graw Hill Publication.*
2. *Air Pollution Control Engineering,. N.D. Nevers, Mc-Graw Hill Publication.*
3. *Air Pollution, M. N. Rao and HVN Rao Tata Mc-Graw Hill Publication.*
4. *Air pollution and control, KVSG Murali Krishna. Kaushal and Company, Kakinada*
5. *An Introduction to Air Pollution by RK Trivedy and PK Goel, BSP Books PVT Ltd*
6. *Environmental Pollution Control Engineering by CS Rao, New Age Publications*
7. *Air pollution Control Technologies by Anjaneyulu, Allied Publishers*

EEM2.3 INDUSTRIAL WASTEWATER TREATMENT

Introduction: 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.

Pollution Prevention & unit operations:Prevention and Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy – Source & reduction techniques – Strength & volume Reduction - Material balance - Evaluation of Pollution prevention options - Waste minimization Circles. Equalisation - Neutralisation – Oil separation – Flotation – Precipitation – Heavy metal Removal– Aerobic and anaerobic biological treatment – High Rate reactors - Chemical oxidation – Ozonization – carbon adsorption - Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal.

Wastewater Reuse And Residual Management: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 – Management of RO rejects.

Manufacturing process and sources of effluent from the process of industries like fertilizer, pulp and paper, sugar, distillery, tannery, food processing, dairy and Pharmaceuticals, Industrial manufacturing process description, wastewater characteristics, and source reduction options

Manufacturing process and sources of effluent from the process of industries like: Steel, Petroleum Refineries, Textiles, Atomic Energy Plants, Metal finishing and other Mineral Processing Industries. Industrial manufacturing process description, wastewater characteristics, and source reduction options

Reference Books

1. *Industrial Waste Water Pollution Control, W. Wesley Eckenfelder Jr.,McGraw Hill Publishing Company.*
2. *Wastewater Treatment for Pollution Control, Arceivala, S.J., McGraw-Hill, 1998.*
3. *Industrial waste treatment Handbook, Frank Woodard, Butterworth Heinemann, New Delhi, 2001.*
4. *Waste water treatment, M.N.Rao & A.K. Datta, Oxford & IBH Publishing Co Pvt.Ltd.*
5. *Industrial waste treatment – contemporary practice and vision for the future, Nelson Leonard Nemerow, Elsevier, Singapore, 2007*

EEM2.4(a) DISASTER MANAGEMENT

Common Syllabus for CTPM2.4(a) and EEM2.4(a)

Types of Disasters:

Disaster - concept and definitions of disaster, causes of disasters, types – natural disasters – floods, droughts, cyclones, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold wave, global warming, sea level rise, ozone depletion. Man-made disasters: Sociological – political – industrial and human disasters.

Risk Assessment and Analysis

Concept and elements of Hazards, Risks and Vulnerability – Policies of Disaster Management, Identification of Crisis Situation, strategic developments, roles and responsibilities of recovery team, importance of team building in disaster management.

Disaster Preparedness:

Prevention and Preparedness – Plan, Action and Accountability, Concept and Nature of Disaster Preparedness, Plan of Disaster Preparedness for People with Special Needs/Vulnerable Groups, with Relevance to Housing, Infrastructure and Livestock, Community Based Disaster Preparedness Plan, Role of Information technology, Education, Communication and training. Medical and health preparedness plan.

Disaster Damage Assessment and Response:

Needs and Damage Assessment– Control process and measurement – modern and traditional methods of response, Disaster Response Plan – roles of response teams and forces. Epidemiological Study of Disasters - Medical and Health Response to Different Disasters - Role of Information and Communication Technology in Health Response

Disaster Mitigation and Recovery:

Disaster Mitigation – meaning and concept – structural mitigation and non-structural mitigation – mitigation strategies and emerging trends. Reconstruction and rehabilitation for development, Medium and long-term recovery aspects, Participative Rehabilitation Process: Community involvement and development of infrastructure.

Reference Books:

1. *Disaster Management by Dr. Mrinalini Pandey, Wiley India Pvt. Ltd.*
2. *Natural Hazards & Disaster Management by R.B.Singh, Rawat Publishers & Distributors.*
3. *Disaster Management: Future Challenges and opportunities by Jagbir Singh4, I.K. International Publishing House Pvt. Ltd*
4. *Natural Disaster Management , Jon Ingleton, Tudor Rose Holdings Ltd (1999).*

5. *Disaster Management, Rajib Shaw and RR Krishnamurthy, Universities Press, Hyderabad.*

EEM2.4(b) AGRICULTURAL POLLUTION AND CONTROL

Environmental issues in agriculture:Types of farming systems, agro meteorology, waterand nutrients requirement.

Fertilizers, pesticides, herbicides:types of fertilizers, pesticides and other agrochemicals, soil and water conservation practices. Natural fertilizers, pesticides and herbicides- green practices in agriculture yield improvement

Water logging and salinity**:** causes and effects. Wastewater reuse in agriculture,management and control of agricultural waste, recycling and reuse.

Biotechnology in reduction of CO_2 emission, Bio-scrubbers, Bio-beds, Bio-trickling filters and their applications.

Novel methods of pollution control: Methane production, Root zone treatment, Membrane technology.

Reference Books

1. *Microbial Biotechnology: A. N. Glazer and H. Nikaids, Cambridge University Press, 2007.*
2. *Molecular Biotechnology: Gleek and Pasternack.*
3. *Biotechnology: A Text Book of Industrial Microbilogy, T. D. Brock, Sinauer Associates Incorporated; 2nd ed edition (May 1990)*
4. *Industrial Microbiology: Presscott and Dunn, CBS Publishers*
5. *Biotechnology: B. D. Singh, Kalyani Publishers.*
6. *Soil & Ground Water Pollution from Agricultural activities, T.V.Ramachandra, TERI Press.*

EEM2.4(c) ENVIRONMENTAL LEGISLATION

Introduction: Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – National and International multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration etc – Institutional framework (SPCB/CPCB/MOEF) - Supreme Court Judgments in Landmark cases

Water (P & CP) Act, 1974: 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.

Air (P & CP) Act, 1981: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.

Environment (Protection) Act 1986: 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, authorization – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

Other Acts & Management Systems: Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Fundamentals of Environmental Management and ISO 14000 series - principles and elements. The ISO 14001- Environmental management systems standards.

Reference Books

1. *CPCB, Pollution Control acts, Rules and Notifications issued there under Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.*
2. *Environmental law and policy in India by Shyam Divan and Armin Roseneranz, Oxford University Press, New Delhi, 2001.*
3. *Environmental law and enforcement by Greger I. Megregor, Lewis Publishers, London1994.*
4. *Constitution of India [Referred articles from part-III, part-IV and part-IV A]*
5. *Handbook of environmental management and technology: Gwendolyn Holmes, Ben Ramnarine Singh, Louis Theodore.*
6. *The ISO 14000 Handbook: Joseph Cascio.*
7. *ISO 14004: Environmental management systems: General guidelines on principles, systems and supporting techniques (ISO 14004:1996 (E)).*
8. *ISO 14001: Environmental management systems.*

EEM2.5(a) ENERGY, ENVIRONMENT AND SUSTAINABILITY

Introduction:Sustainable Development – Indicators of Sustainability – Sustainability Strategies- Barriers to Sustainability – Industrial activity and Environment – Industrialization and sustainable development. Cleaner Production (CP) in Achieving Sustainability –Principles Cleaner Production**,** Definition, Importance Historical evolution, Benefits, Promotion, Barriers, Role of Industry, Government and Institutions, Industrial Ecology, clean development mechanism, reuse, recovery, recycle, raw material substitution.

Cleaner Production Project Development and Implementation:Overview of Cleaner Production (CP) Assessment Steps and Skills, Process Flow Diagram, Material Balance, CP Option Generation – Technical and Environmental Feasibility analysis – Economic valuation of alternatives - Total Cost Analysis – CP Financing – Preparing a Program Plan – Measuring Progress – Pollution Prevention and Cleaner Production Awareness Plan – Waste audit – Environmental Statement, carbon credit, carbon sequestration, carbon trading, Life Cycle Assessment - Elements of LCA – Life Cycle Costing – Eco Labelling

Green Technology - Definition of green building, benefits and challenges, public policies and market-driven initiatives, effective green specifications. Overview of the Building Energy System Design Process. Assessing human functional and physiological smart growth- needs, local climate and free energy resources. Design scenarios- Day lighting , Electric Lighting.

Availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Non-conventional energy sources: Solar Energy- process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and application.

Biomass energy: Concept of biomass energy utilization, types of biomass energy, conversion processes, Wind Energy, energy conversion technologies, their principles, equipment and suitability in context of India.

Reference Books

1. *Pollution Prevention: Fundamentals and Practice, Paul L Bishop (2000) McGraw Hill International.*
2. *Pollution Prevention and Abatement Handbook – Towards Cleaner Production, World Bank Group (1998) World Bank and UNEP, Washington D.C.*
3. *Cleaner Production Audit, Environmental System Reviews, No.38, Prasad Modak, C.Visvanathan and Mandar Parasnis (1995) Asian Institute of Technology, Bangkok*
4. *Handbook of Organic Waste Conversion, .Bewik M.W.M.*
5. *Industrial Ecology and Sustainable Engineering by Graedel Allenby, PHI Publications*

EEM2.5(b) ENVIRONMENTAL BIOTECHNOLOGY

Environmental Biotechnology: Principles and concepts - usefulness to mankind. Degradation of high concentrated toxic pollutants- halogenated, non halogenated, petroleum hydrocarbons, metals - Mechanisms of detoxification – oxidation - dehalogenation - biotransformation of metals - biodegradation of solid wastes.

Biofilm Kinetics: Microbial aggregation-idealized biofilm-Steady state biofilm – soluble microbial products and inert biomass- non steady state biofilms.

Microbial cell/enzyme technology – adapted microorganisms – biological removal of nutrients – algal biotechnology– extra cellular polymers - Biogas technology. Concept of rDNA technology – expression vectors – mutation – construction of microbial strains - radioactive probes - protoplast fusion technology – applications.

Biotechnological remedies for environmental pollution - decontamination of groundwater –Bioremediation: Scope and characteristics of contaminants- contaminant availability for biodegradation- Engineering strategies for bioremediation – evaluation of bioremediation.

Environmental effects and ethics of microbial technology – genetically engineered organisms – Microbial containment-Risk assessment.

Text Books

1. *Environmental Biotechnology: Principles and Applications by Rittmann., B.E. and McCarty, P.L ,Tata McGraw-Hill,*
2. *Biological degradation of wastes by Martin. A.M, Elsevier Applied Science.*
3. *Environmental Biotechnology by Scraqq, Oxford Publications*
4. *Environmental Biotechnology by Bhattacharya and Banerjee, Oxford Publications*

EEM2.6 ENVIRONMENTAL PROCESS DESIGN AND DRAWING

Review of the Principles of design and drawing of water supply and treatment units from source to distribution system.

Review of Principles of design and drawing of wastewater treatment units.

Detailed design and drawings of various types of intake structures, conduits, pipes, ground level reservoirs and elevated service reservoirs.

Preparation of drawings for various house plumbing fixtures.

Design and drawings of various types of distribution systems and various methods of analysis of distribution networks

Text Books

1. *Elements of Public Health Engineering by Duggal, S.Chand Publishers.*
2. *Water Supply and Sanitary Engineering by Birdie, Dhanpat Rai Publishing Company (p) Ltd (2010)*
3. *Water Supply and Sanitary Engineering by Hussain, Oxford and IBH Publishers.*

EEM2.7 AIR AND NOISE MONITORING LABORATORY

1. Particulate Sampling – Dust Fall, Pollution Suspended Particulates and Total Particulate Matters using High Volume Sampler / Respirable Dust Sampler.
2. Experiment on Respirable Dust – Estimating RPM.
3. Estimating Sulphur Dioxide, NOx in Ambient Air Using High Volume Air Sampler.
4. Stack Sampling Techniques and Demonstration of Stack Monitoring.
5. Exercises on Ambient Gas Monitoring including CO & VOC.
6. Demonstration / Exercises on Air Pollution Control Devices – Bag Filter, Scrubber, Cyclone and ESP.
7. Exercises on Auto Exhaust Analyser for Petrol Vehicle and Diesel Vehicle Smoke test for Diesel Vehicle.
8. Exercises on Noise Measuring Instruments.
9. Exercises on Luxmeter (Light Intensity measuring Instrument)
10. Demonstration on Wind Monitoring and Analysis of Data for Wind rose Diagrams.

11. Demonstration of Rain Gauges.

Reference Books

1. *Air pollution and Control by Henry C Perkins, Mc Graw Hill Pvt Ltd, New Delhi, 1974.*
2. *Air Pollution (vol. I), Air Pollution and its effects (vol. II), Analysis, Monitoring and Surveying (vol. III), Sources of Air Pollution and their control by Stern A. C., Academic press, New York, 1968. 53*

EEM2.8 SEMINAR

Each student has to select a topic and collect about 10 papers with at least 5 journal papers and prepare a report and give a seminar at the end of the semester

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III SEMESTER

EEM3.1(a) ENVIRONMENTAL HYDRAULICS

Common Syllabus for EEM3.1(a) and HCH3.1(a)

Hydrology: Statistical analysis of Hydrological Data -, Intensity–Duration frequency Curves. Hydraulics of groundwater flow: Non–equilibrium flow, Yield estimations, Interferences Infiltration galleries, ground water recharge

Transportation and distribution of water: Storage capacity, Pumping of Water, Design and selection of economical diameter of pumping main. Distribution of Water - Pressure and capacity requirements of distribution system, Analysis of networks, Appurtenances in a distribution layout, detection and prevention of leakage mains.

Hydraulics of Sewers: Design of sewers in full and partial flow conditions, Flow at Sewer transitions, Sewage pumping. Open channel flow–design of open channel flow sections.

Transport phenomenon – diffusion – dispersion – advection – adsorption - conservative and non-conservative pollutants. Governing Equations for flow and transport in surface and subsurface waters-chemical and biological process models-simplified models for lakes, streams, and estuaries.

Modelling of the transport phenomenon: complexity - coupled and uncoupled models – linear and nonlinear models - Solution techniques – calibration. Numerical models: FDM, FEM and Finite volume techniques - explicit vs. implicit methods - numerical errors. Different types of Stream quality modeling and Groundwater transport modeling.

Reference Books

1. *Water and waste water Engineering by Fair Gayer and Okun, I. K. International Pvt. Ltd.*
2. *Engineering Hydrology by K. Subramanya, Tata McGraw-Hill Education*
3. *Hydrodynamics of transport for water quality modeling by Martin, L.J. and McCucheon, S.C, Lewis Publishers.*
4. *Groundwater by Freeze, R.A. and Cherry. J.A. Prentice Hall,*
5. *Groundwater Hydrology by Todd, Wiley Publications*

EEM3.1(b) SURFACE AND GROUND WATER HYDRAULICS

Land Processes – Subsurface and Channel Processes- Precipitation – Rain gauge network, Abstractions, Infiltration, Evaporation, Transpiration, Process and models

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

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.

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

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

Reference Books:

1. *Applied Hydrology by Ven Te Chow, Mc GrawHill Science Publishers*
2. *Elementary Hydrology by Singh, Vijay, Prentice Hall*
3. *Ground Water by Raghunath, Mc Graw Hill.*
4. *Hydraulics of Groundwater by Bear, J., Mc Graw Hill.*
5. *Surface water quality modeling by Chapra,, McGraw Hill Publication*

EEM3.2(a) SOLID AND HAZARDOUS WASTE MANAGEMENT

Introduction: Definition of solid waste – waste generation, sources and types of solid waste – sampling and characterization – Determination of composition of Municipal Solid Waste – Onsite storage and handling of solid waste.

Collection and Transport of Solid Waste:Type and methods of waste collection systems, analysis of collection system Optimization of collection routes– alternative techniques for collection system. Transfer and Transport**:** Need for transfer operation, transport means and methods, transfer station types and design requirements. Separation and Processing and Transformation of Solid Waste- Waste as a Resource Economics, Disposable Materials, Recycling Collection, Processing, Potential for Reuse

Processing and disposal: Unit operations used for separation and processing, Materials Recovery facilities, Source reduction and waste minimization, Metal Separation & Recovery Waste transformation through combustion and composting, anaerobic methods for materials recovery and treatment – Energy recovery – biogas generation and cleaning– Incinerators. Landfills**:** Site selection, design and operation, drainage and leachate collection systems –designated waste landfill remediation.

Hazardous Waste Management:Definition and identification of hazardous wastes-sources and characteristics – hazardous wastes in Municipal Waste – Hazardous waste regulations – minimization of Hazardous Waste-compatibility, handling and storage of hazardous waste-collection and transport, e-waste - sources, collection, treatment and reuse.

Hazardous waste treatment technologies - Design and operation of facilities for physical, chemical and thermal treatment of hazardous waste – Solidification, chemical fixation and encapsulation, incineration. Hazardous waste landfills: Site selection, design and operation – remediation of hazardous waste disposal sites.

Text Books

1. *Integrated Solid Waste Management: Engineering Principles and Management Issues by George Tchobanoglous , Hilary Theisen, Samuel A Vigil. McGraw-Hill Series in Water Resources and Environmental Engineering*
2. *Environmental Engineering by Howard S.Peavy, Donald R.Rowe and George Tchobanognous, McGraw Hill Publishing Company.*

Reference Books

1. *Hazardous Waste Management, Charles A. Wentz; McGraw Hill Publication,*
2. *Solid and Hazardous Waste Management by MN Rao, Razia Sultana, BSP Books*
3. *Municipal Solid Waste Management by P Jayaramireddy, BSP Books PVT Ltd.*

EEM3.2(b) CLIMATE CHANGE AND CDM

Introduction: Atmosphere – weather and Climate - Causes of global and regional climate change- climate parameters – Temperature, Rainfall, Humidity, Wind – Global ocean circulation – El Nino and its effect - Carbon cycle.

Global Warming: Emission sources of green house gases, Green House effect as a natural phenomenon, and due to anthropogenic activities, Recent role of green house effect. Global warming potential, Past present and future scenario of global warming.

Impacts of Climate Change: Effects of Climate Changes on living systems – health effects, agriculture and food security, forestry, human migration, socioeconomic impacts- coastal areas, tourism, industry and business, vulnerability assessment- infrastructure. Sea level rise, Coastal erosion and landslides, strategies to combat global warming.

Mitigating Climate Change IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation -Identifying adaption options – designing and implementing adaption measures – surface albedo environment- reflective roofing and reflective paving – enhancement of evapotranspiration - tree planting programme – green roofing strategies – energy conservation in buildings – energy efficiencies –Concept of carbon sequestration, Carbon sequestration modalities and procedures, Carbon capture and storage, Carbon trading, Montreal protocol, Kyoto protocol, Role and functions of IPCC, National and International action plan on climate change.

Alternate Fuels and Renewable Energy source – coal, natural gas – wind energy, hydropower, solar energy, nuclear energy, geothermal energy – biofuels – Energy policies for a cool future - Clean Development Mechanism - Energy Audit.

Text Books

1. *Air Pollution, KL Dorean, CBS Publishers & Distributers Pvt. Ltd. New Delhi.*
2. *Principles and Practices of Air Pollution Control and Analysis, J.R. Mudakavi, I.K. International Publishing House Pvt. Ltd., New Delhi.*
3. *Carbon Capture: Sequestration and Storage (Issues in Environmental Science and*
4. *Technology), RE Hester and RM Harrison, Royal Society of Chemistry; 1 edition (January 20, 2010)*
5. *Climate Change: causes, Effects and Solutions, John T. Hardy. Willy Publication, USA.*
6. *Earth "s Climate Past and Future by Ruddiman W.F, freeman W.H. and Company,*
7. *Global Warming and Climate Change. Vol I & II.by Velma. I. Grover, Science Publishers, 2005.*
8. *Climate Change – An Indian Perspective by Dash Sushil Kumar, Cambridge University Press India Pvt. Ltd, 2007*

Reference Books

1. *IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK, 2007*

2. *Climate Change and Biodiversity by Thomas E, Lovejoy and Lee Hannah, TERI Publishers, 2005*
3. *Impacts of Climate Change and Climate Variability on Hydrological Regimes by Jan C. van Dam, Cambridge University Press, 2003.*

EEM3.4 DISSERTATION (Preliminary)

The student shall submit a brief report on the selected topic of his/her thesis work and attend for a formal viva-voce examination before a Committee comprising the Chairman, BOS, Head of the Department and the Guide.

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IV – SEMESTER

EEM 4.1 DISSERTATION (Final)

The student shall submit his/her thesis work and attend for a formal viva-voce examination before a Committee comprising the Chairman, BOS, Head of the Department, the Guide and the External Examiner.