Draft of Proposed Course Structure
for Post Graduate Degree Programme

M. Tech. in Civil Engineering
with Specialization in
Environmental Engineering

Presented to Academic Council

on 15 April 2017

Dr. Babasaheb Ambedkar Technological University

Lonere 402 103, Dist- Raigad, Maharashtra, INDIA

Program Objectives

Goal of the Civil engineering with a specialization in Structural Engineering (SE) at Dr. Babasaheb Ambedkar technological University, Lonere (BATU) is to provide students with preparation to become worthy of professional careers in the field and to be motivated for lifelong learning. All prescribed courses have definite objectives and outcomes. Program objectives are expected qualities of engineers as under:

a) Preparation: To prepare students to excel in various educational programmes or to succeed in industry / technical profession through further education/training;

b) Core Competence: To provide students with a solid foundation in mathematical, scientific fundamentals required to solve Environment related problems;

c) Breadth: To train students with a breadth of scientific knowledge to comprehend, analyze, design & create novel products and solutions for real life problems;

d) Professionalism: To inculcate in students professional/ethical attitude, effective team work skills, multidisciplinary approach and to relate engineering issues to a broader context;

e) Learning Environment: To provide students with academic environment of excellence, leadership, ethical guidelines and life-long learning needed for a long / productive career.

In addition to above DBATU graduate is expected to be

1. Taking pride in their profession and have commitment to highest standards of ethical practices and related technical disciplines;
2. Capable of using modern tools efficiently in all aspects of professional practices;
3. Shall be engage in continuous research, development and exchange of knowledge for professional development;
4. Be honest in their control and performing their duties and promote effective use of resources through open, honest and impartial services to the public;
5. Act in such a manner which will uphold the honour, integrity, or dignity of the engineering profession, and avoid knowingly engaging in business or professional practices of a fraudulent, dishonest or unethical nature;
6. Recognize that the lives, safety, health and welfare of the general public are dependent upon engineering, decision and practices;
7. Continue their professional development throughout their careers and provide opportunities for the professional development;

First Semester

Sr. No.	Subject Code	Name of Subject	Hours /Week			Credit	Examination Scheme				
							Theory		CA	PR/ OR	Total
			L	P	T		TH	MTE			
01	CVEE101	Environmental Chemistry and Microbiology	03	--	1	04	60	20	20	--	**100**
02	CVEE102	Physico- chemical process for water and waste water	03	--	1	04	60	20		--	**100**
03	CVEE103	Environmental Legislation and Management	03	--	1	04	60	20	20	--	**100**
04	CVEE104	Communication Skills	02	--	--	02	--	--	25	25	**50**
05	CVEE-L01	PG Lab-I	--	03	--	02	--	--	25	25	**50**
06	CVEE-E1	Elective-I	03	--	--	03	60	20	20	--	**100**
07	CVEE-E2	Elective-II	03	--	--	03	60	20	20	--	**100**
		Total for Semester I	**17**	**03**	**03**	**22**	**300**	**100**	**150**	**50**	**600**

Elective-I

CVEE-E1-01: Environmental Engineering Structures

CVEE-E1-02: Air Quality Modeling

CVEE-E1-03: Ground Water Contamination and Pollution Transport

Elective-II

CVEE-E2-01: Environmental Biotechnology

CVEE-E2-02: Climate Change

CVEE-E2-03: Marin Pollution

Second Semester

Sr. No.	Subject Code	Name of Subject	Hours /Week			Credit	Examination Scheme				
							Theory		CA	PR/ OR	Total
			L	P	T		TH	MTE			
01	CVEE201	Industrial wastewater and Treatment Management	03	--	1	04	60	20	20	--	**100**
02	CVEE202	Solid and Hazardous waste Management	03	--	1	04	60	20	20	--	**100**
03	CVEE-S01	Seminar-I	--	04	--	02	--	--	50	50	**100**
04	CVEE-L02	PG Lab-II or Mini -Project	--	04	--	02	--	--	50	50	**100**
05	CVEE-E3	Elective-III (Departmental)	03	--	--	03	60	20	20	--	**100**
06	CVEE-E4	Elective-IV (Departmental)	03	--	--	03	60	20	20	--	**100**
07	CVEE-E5	Elective-V (Open)	03	--	--	03	60	20	20	--	**100**
		Total for Semester II	**15**	**08**	**02**	**21**	**300**	**100**	**200**	**100**	**700**

Elective-III

CVEE-E3-01: Agricultural Pollution Control

CVEE-E3-02: Environmental Auditing

CVEE-E3-03: Disaster Management and Risk Analysis

Elective- IV

CVEE-E4-01: Environmental Sanitation

CVEE-E4-02: Air Pollution Control

CVEE-E4-03: Geo-environmental Engineering

Elective-V (Open)

CVEE-E5-01: Research Methodology

CVEE-E5-02: Nano Technology for Water and Wastewater Treatment

CVEE-E5-03: Remote Sensing and GIS Application in Environmental Engineering

Third Semester

Sr. No.	Subject Code	Name of the subject	Hours/ Week			Credit	Examination scheme				
							Theory		CA	PR / OR	Total
			L	P	T		TH	Test			
1	CVSE301	Project Management and Intellectual Property Rights (Self Study)*	--	--	--	02	--	--	50	50	**100**
2	CVSEPS1	Project Stage -I	--	--	--	10	--	--	50	50	**100**
		Total for Semester III	**--**	**--**	**--**	**12**	**--**	**--**	**100**	**100**	**200**

Fourth Semester

Sr. No.	Subject Code	Name of the subject	Hours/Week			Credit	Examination scheme				
							Theory		CA	PR/ OR	Total
			L	P	T		TH	Test			
1	CVSEPS2	Project Stage-II	--	--	--	20	--	--	100	100	**200**
		Total for Semester IV	**--**	**--**	**--**	**20**	**--**	**--**	**100**	**100**	**200**
GRAND TOTAL											**1700**

* Student may select this course either from NPTEL/MOOC pool or any other approved reputed source. The submission of course completion certificate is mandatory.

Semester I

CVEE101 Environmental Chemistry & Micro-Biology

Teaching Schemes: 3 Lect. + 1 Tut hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To educate the students in the area of water, air and soil chemistry
- To impart knowledge on the transformation of chemicals in the environment.
- The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.
- The microbiology of wastewater, sewage sludge and solid waste treatment processes is also provided aspects on nutrient removal and the transmission of disease causing organisms are also covered.

Course Contents

Module 1:

Fundamentals of Chemistry for Environmental Engineering: Introduction, Basic Concepts from General Chemistry, Physical Chemistry, Equilibrium Chemistry, Organic, Biochemistry, Colloid Chemistry and Nuclear Chemistry. **(08 Lectures)**

Module 2:

Chemistry of pollutants: Chemistry of pollutants in the Atmosphere, Solid, liquid, gaseous and radioactive pollutants in the atmosphere, formation of physical processes of pollutants in the atmosphere, Effects of temperature, solar radiation and wind current on the various pollutants, Effect of gravitational force and rain scrubbing on air pollutants, Chemical properties of air pollutants chemisorptions, effect of solar radiation on acidic basic characteristics. **(08 Lectures)**

Module 3:

Chemistry of Various Organic and Inorganic Compounds: Carcinogenic compounds and their effects. Hydrocarbons: Chemistry of hydrocarbon decay, environmental effects, effects on macro and micro organisms.

Surfactants: Cationic, anionic and nonionic detergents, modified detergents.

Pesticides: Classification, degradation, analysis, pollution due to pesticides and DDT problems. **(08 Lectures)**

Module 4: Optical Methods

Principles of Optical Methods such as Absorption, Spectrophotometer, Flame photometry, Fluorometry. Principles of Chromatographic Methods such as Gas chromatography, High Performance Liquid Chromatography and Ion Chromatograph **(08 Lectures)**

Module 5: Environmental Microbiology

Scope and Areas of Environmental Microbiology, Cell and its Structure, Introduction to Enzyme and Metabolic Reactions, Aerobic and anaerobic respiration **(08 Lectures)**

Module 6:

Microscopy and Micrometry**:** Observations, Measurements and Isolation of Microorganism, Different Cultures, Media and Techniques of Staining and Enumeration of microorganism.

Applied Microbiology**:** Applied microbiology of Soil, Air, Water and Biological Processes of Wastewater Treatments, Industrial Microbiology. **(08 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of minimum Three Modules.

References:

- C.N. Sawyer, P.L. McCarty and G. F. Parkin, Chemistry for Environmental Engineering and Science, Tata McGraw-Hill, Fifth edition, New Delhi, 2003.
- G.W. Vanloon and S.J. Duffy 'Environmental chemistry – a global perspective, Oxford University press, New York., 2000.
- Tortora. G.J, B.R. Furke, and C.L. Case, "Microbiology-An Introduction" (4th Ed.), Benjamin/Cummings Publ. Co., Inc., California, 1992.
- Pelczar, M. J.Chan E.C.S. and Krieg, N. R. Microbiology, Tata McGraw Hill, New Delhi,1993
- Benefield L. D., Judkins J. F. and Weaned R.L., Process Chemistry for Water and Wastewater Treatment, Prentice Hall, Inc. London, 1987.
- R.E. McKinney, "Microbiology for Sanitary Engineers", McGraw Hill Book Company, 1962.
- W.G. Walter and R.H. McBee, "General Microbiology", East West Edition, 1969.
- Botkin, "Environmental Science" 8th ed.—Wiley, India.
- Microbiology for sanitary engineers - Ross E Mckinney N.York, McGraw Hill Publication.
- Microbiology for environmental scientists and engineers -A.F. Gaudy & E. T. Gaudy McGraw Hill Int. Book Co.

Course Outcomes: On completion of the course, student will be able to:

- Determine chemicals need calculations for treatment purpose Ability to identify contaminating chemicals.
- Understanding on the basics of microbiology and their diversity and on the genetic material in the living cell.
- Understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.
- Understood the role microbial metabolism in a wastewater treatment plant
- Conduct and test the toxicity due to various natural and synthetic products in the environment.

CVEE102 Physico-Chemical Process for Water and Waste Water Treatment

Teaching Schemes: 3 Lect. + 1 Tut hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To educate the students on the principles and process designs of various treatment systems for water and wastewater.
- To impart knowledge about the advanced treatment for water and wastewater.

Course Contents

Module 1: Introduction

Process Dynamics, Reactions and Reactors: Reactors Used for the Treatment of Wastewater, Mass transport processes, The Mass-Balance Principle, Reactions kinetics and reaction rates, Configurations of ideal and non-ideal reactors, Principle of ideal reactor design, Completely mixed batch reactors, Completely mixed flow reactors, Determination of rate parameters in CMF reactors, Plug Flow Reactors. **(08 Lectures)**

Module 2:

Coagulation and Flocculation**:** Coagulation Process, Stability of colloids, Repulsive and Attractive Potentials, destabilization of Colloids, Transport of colloidal particles, Destabilization in Water and Wastewater Treatment by Al(III) and Fe(III). Synthetic Organic polymers, Activated Silica, Selection of a coagulant.

Sedimentation Processes: Zone Settling, Compression, Sedimentation tank design for water and wastewater, Design of tube settlers, Concept and design aeration and gas transfer. **(06 Lectures)**

Module 3: Water and wastewater purification systems

Biological and chemical processes for water and wastewater purification, Secondary and Tertiary treatment systems with their design, Aeration and gas transfer.

Filtration**:** Filtration process; Principle Mechanisms of filtration, Filter Hydraulics backwash hydraulics, Rate control Patterns and Methods, Head loss patterns at Constant Rate, Slow sand and Rapid sand Filtration and their performances, Design of Gravity filters, Design and Operating variables for deep Granular Filters: Filter media, Fluidization and bed expansion in backwashing, Under drainage systems with design, operational problems. **(12 Lectures)**

Module 4: Disinfection

History and modes of disinfection, rates of disinfection, disinfection concentration Factors affecting disinfection such as temperature, pH and organic matter, Chemical Disinfectants – chlorine and Chlorine derivatives; Non Chemical Methods for Disinfection : Ozonation, UV radiation. **(06 Lectures)**

Module 5:

Reverse Osmosis**:** Osmosis and Osmotic Pressure, Water and Solute Diffusion, Properties of Cellulose Acetate Membranes, Feed temperature and pH, Solute rejection, System Design, Pretreatment and Flux Maintenance, Application.

Chemical Oxidation**:** Limitation of Oxidative Processes and Oxidizing agents in Water and Wastewater Treatment, Principle and Theories of Chemical Oxidation, Concept and definition, Thermodynamic and kinetic consideration, Role of pH in Chemical Oxidation, Balancing Redox reaction **(12 Lectures)**

Module 6: Advanced Treatment

Adsorption processes: types of adsorption, factors influencing, adsorption equilibrium and development of adsorption isotherms, activated carbon adsorption kinetics, analysis and design of Granular Activated carbon and PAC contactors.

Miscellaneous methods**:** Ion Exchange: Exchange processes, Exchange Materials, Synthetic Exchange resins, Exchange reaction, Equilibria, Exchange Isotherm. **(06 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Weber, W.J., Physicochemical processes for water quality control, John Wiley and sons, Newyork, 1983.
- Peavy, H.S., Rowe, D.R. and Tchobanoglous, G. Environmental Engineering, McGraw Hills, New York 1985.
- Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw- Hill Publication, New Delhi, 2003.
- Water & Waste Water Engineering by Fair and Gayer. C.A. Sastry, Water Treatment Plants, Narosa Publishing House, Bombay, 1996.

Course Outcomes: On completion of the course, student will be able to:

- Developed conceptual schematics required for the treatment of water and wastewater and
- Translate pertinent forcing criteria into physical and chemical treatment system.

CVEE103 Environmental Legislation and Management

Teaching Schemes: 3 Lect. + 1 Tut hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To educate the students on the principles and process designs of various treatment systems for water and wastewater.
- To impart knowledge about the advanced treatment for water and wastewater.

Course Contents

Module 1: Introduction

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols Montreal Protocol, Kyoto agreement, Rio declaration, Functions and Constitutions of SPCB and CPCB. **(04 Lectures)**

Module 2: Water (P & Cp) Act, 1974 and 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 Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation. **(08 Lectures)**

Module 3: Environment (Protection) Act 1986

Genesis of the Act – delegation of powers – Role of Central Government - Latest EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management. **(06 Lectures)**

Module 4: Fundamentals of Environmental Management and ISO 14000 series

Background and development of ISO 14000 series, its need Environmental management Plans, principles and elements. The ISO 14001- procedure to be followed to obtain ISO: 14001 certification, implications of ISO

Environmental law in India**:** Environmental policy and laws **(08 Lectures)**

Module 5: Role of Judicary and NGO

International concern for environment, Role of judiciary in environmental protection, Environmental audit, ISO certification, Environmental management system, International and national efforts at environmental protection; Environmental policy. Relevant Provisions of Indian Forest Act, Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases, Role of NGO in Nature Conservation. **(08 Lectures)**

Module 6:

Important powers and functions of the MPC board under both the water and air acts, Role of SPCB in implementation of various notifications issued by Central Govt. under Environment (Protection) Act, 1986, Hazardous waste(Management and Handling) Rules, 1989, Bio-7 Medical Waste (M & H) Rules, 1998, Notifications issued by Govt. of Maharashtra for the protection and improvement of environment. **(08 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- CPCB, "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992,

Central Pollution Control Board, Delhi, 1997.

- Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi, 2001.
- Greger I. Megregor, "Environmental law and enforcement", Lewis Publishers, London1994.
- Constitution of India [Referred articles from part-III, part-IV and part-IV A]
- Pares Distn. Environmental Laws in India (Deep, Lated edn.)
- Handbook of environmental management and technology: Gwendolyn Holmes, Ben Ramnarine Singh, Louis Theodore.
- The ISO 14000 Handbook: Joseph Cascio.
- ISO 14004: Environmental management systems: General guidelines on principles, systems and supporting techniques (ISO 14004:1996 (E)).
- ISO 14001: Environmental management systems: Specification with guidance for use (ISO 14001:1996b(E))(International organization for standardization-Switzerland).

Course Outcomes: On completion of the course, student will be able to:

- Understand the necessity to study the environmental laws and act.
- Know about the legal requirements of Environmental and Risk Assessment for projects.

CVSE 104 Communication Skills

Teaching Schemes: **2** Lect. hrs/week; **Evaluation Scheme:** Oral 25; Class Assessment 25

Objectives:

- To impart knowledge about the project research proposals and reports
- The course provides a basic knowledge of language for technical purpose and helps to improve presentation skills.

Course Contents

Module 1: Language for Technical Purpose and Presentation Tools

Technical vocabulary, Sentence structures, Microsoft office, Graphical presentations **(03 Lectures)**

Module 2: Formal Written Communication

Drafting Letters, e-Mails, Memos, Notices, Circulars, Schedules. **(03 Lectures)**

Module 3: Project Research Proposals and Reports

Research Proposal: What's a research proposal? Essentials, Abstract, Aims, Background & significance, Design & methods, Writing a sample proposal.

Project Report: Types of reports, Planning a report, Collection & organization of information, Structure & style, Proofreading etc. Writing a sample report. **(06 Lectures)**

Module 4: Leadership Skill and Team Building, Working.

Leadership Skills**:** Leadership quality and styles, Emotional intelligence, Diplomacy and Tact and effective communication, Case studies.

Need of team, Effective teams, Group development, Roles in group, Case studies. **(06 Lectures)**

Module 5: Business Meetings

Understanding role of meetings, planning meetings, developing meeting agendas, scheduling meetings, conducting meetings effectively, Taking notes and publishing minutes and concluding meetings, action plans, Demo meetings. **(06 Lectures)**

Module 6: Presentation Skills

Preparation, Understanding audience, Use of presentation tools, Presentation, nonverbal techniques, handling questions, Demo presentations. **(04 Lectures)**

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- S. Hariharan, et.al. Soft Skills; MJP Publishers, 2010.
- John Seely, Oxford Guide to Effective Writing and Speaking; Oxford University Press, 2009.
- Thomas N. Huckin and Leslie A. Olsen, Technical Writing and Professional Communication
- for Nonnative Speakers of English; Tata McGraw Hills, International Edition, 1991.
- Jeff Butterfield,Soft Skills for Everyone,cengage Learning India Private Limited,2010.
- L. Ann Masters & Harold R. Wallace, Personal Development for Life & Work,10e,Cengage
- Learning India Private Limited,2011.

Course Outcomes: On completion of the course, students will be able to:

- Know about leadership skills and presentation skills.
- Should have gained knowledge on presentation tools and basics of project research proposals and reports.

PG Lab-I

CVEE-L01 Waste Water Treatment Lab

Teaching Schemes: 3 Pract. hrs/week; **Evaluation Scheme:** Oral 25; Class Assessment 25

Objectives:

- To train in the analysis of physico-chemical parameters with hands on experience

Laboratory Work:

Practical work consist of a journal giving details of the following with analysis from Industrial wastewater

- Study on Sampling and preservation of samples
- Preparation of Standard Solutions.
- Demand analysis for the following from Industrial wastewater
  (a) Dissolved oxygen. (b) Chemical oxygen Demand (c) Biochemical oxygen demand
- Nutrient Analysis from sewage and Industrial Wastewater using UV-Visible Spectrophotometer
  (a) Total Nitrogen (b) Nitrogen ammonia
  (c) Nitrogen (Nitrate) (d) Nitrogen (Nitrites)
  (e) Phosphates Total & other form
- Following analysis from water and Wastewater
  (a) Sulphates, (b) Nitrates,
  (c) Oil & Grease (d) Phenols
  (e) Volatile acids
- Study of Stack monitoring process.
- GIS Applications in Environmental Engineering

Introduction to GIS, concepts and data base structure, introduction to GIS software, Introduction to Remote Sensing. Applications in Environmental Engineering

Course Outcomes: On completion of the course, students will be able to:

- Able to assess quality of environment

Elective I

CVEE-E1/01 Environmental Engineering Structures

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To impart knowledge about the analysis and design of water tanks.
- The course provides a basic understanding on designs, repair and rehabilitation of Environmental Structures.

Course Contents

Module 1: Design of Pipes

Structural design of a) Concrete b) Prestressed Concrete c) Steel and d) Cast-iron piping mains, sewerage tanks design - anchorage for pipes - massive outfalls - structural design and laying hydrodynamic considerations, Advances in the manufacture of pipes. **(06 Lectures)**

Module 2:

Design of concrete roofing systems a) Cylindrical b) Spherical and c) Conical shapes using membrane theory and design of various types of folded plates for roofing with concrete. IS Codes for the design of water retaining structures. **(06 Lectures)**

Module 3: Analysis and Design of Water Tanks

Design of circular, rectangular and spherical type of tanks using concrete. Design of prestressed concrete cylindrical tanks - Economic analysis - introduction to computer aided design and packages. **(06 Lectures)**

Module 4:

Underground reservoirs and swimming pools, Intake towers, Structural design including foundation of water retaining structures such as settling tanks, clarifloculators, aeration tanks etc. - effect of earth pressure and uplift considerations - selection of materials of construction **(08 Lectures)**

Module 5: Repair and Rehabilitation of Structures

Diagnosing the cause and damage, identification of different types of structural and non-structural cracks – repair and rehabilitation methods for Masonry, Concrete and Steel Structures **(08 Lectures)**

Module 6:

Exposure on Steel, Lattice Structures Used In Water and Sewerage Works. **(06 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References

- Reinforced Concrete by P. Dayaratnam.

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

Course Outcomes: On completion of the course, student will be able to:

- Be able to select various pipe materials for water supply main, distribution network and sewer.
- Be able to design water supply main, distribution network and sewer for various field conditions.

Elective I

CVEE-E1/02 Air Quality Modeling

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To introduce the fundamentals of air pollution with a background on historical perspective on air pollution.
- To introduce the theory of dispersion of air pollution in the atmosphere.
- To discuss the major approaches for air pollution modeling.
- To demonstrate the features and the use of most widely used commercial and freely available air quality models.

Course Contents

Module 1: Modeling Concept

Overview of different types of models-deterministic and stochastic approach- Steps in model development- numerical and simulations models- calibration and validation of models- Limitations-Transport phenomena- Mass balance analysis-Model development and decision making. **(06 Lectures)**

Module 2: Air Pollution Modeling

Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution –Transport of air Pollutants – Meteorological settling for dispersal of air pollutants vertical structure of temperature and stability, atmosphere, transport and diffusion of stack emission –atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics. **(06 Lectures)**

Module 3: Air Quality Models

Types modeling technique, modeling for non reactive pollutants, single source, short term impact, multiple sources and area sources, fixed box models- diffusion models **(06 Lectures)**

Module 4:

Gaussian plume derivative- modification of Gaussian plume equation- long term average- multiple cell model – receptor oriented and source oriented air pollution models- model performance, accuracy and utilization. Singularity. **(08 Lectures)**

Module 5:

Air quality index: categories of air quality index, determination of air quality index (AQI): National AQI, Extreme value indices, Regional indices. **(08 Lectures)**

Module 6:

Indoor Air Pollutants - Volatile Organic Compounds , Inorganic Gaseous Pollutants Respirable Particulates, Bioaerosols, Radon and its decay products-Infectious disease transmission- A/C units in indoor- Odours and sick building syndrome-Indoor Air quality Models. **(08 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- J. L. Schnoor, Environmental Modeling Fate and Transport of Pollutants in Water, Air and Soil, John Wiley & Sons Inc., New York, 1996.
- Arthur C. Stern, Air Pollution, Air Pollutants, their transformation and Transport, (Ed.), (Third Ed.) Volume I, Academic Press, 2006.
- Zanneti, P. "Air Pollution Modeling Theories", Computational Methods and Available Software. Van Nostrand Reinhold, New York. 1990
- Boubel R.W., Fox D.L., Turner D.B & Stern A.C., "Fundamentals of Air Pollution" Academic Press, New York, 1994
- Schnoor J.L., "Environmental Modeling Fate and Transport of Pollutants in Water, Air and Soil", John Wiley & Sons Inc., New York, 1996.
- Arthur C. Stern Air Pollution (3rd Ed.) Volume I – Air Pollutants, their transformation and Transport, (Ed.), Academic Press, 2006.
- Deaton and Wine Brake, “Dynamic Modeling of Environmental Systems”, Wiley & Sons, 2002.

Course Outcomes: On completion of the course, students will be able to:

- Develop conceptual schematics required for air quality modeling.
- Translate pertinent criteria into air pollution control.

Elective I

CVEE-E1/03 Groundwater Contamination and Pollution Transport

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To understand the important characteristics and design principles of the ground water containment and
- To understand the remediation techniques as well as know the relevant regulations for contaminated site remediation.

Course Contents

Module 1: Introduction

Ground water and the hydrologic cycles-Ground water as a resource-Ground water contamination-Ground water as a Geotechnical problem-Ground water and geologic processes. Physical properties and principles-Darcy's Law-Hydraulic Head and Fluid Potential piezometers and Nests. Hydraulic conductivity and permeability-Homogeneity and Anisotropy porosity and voids Ratio-Unsaturated flow and the water table-Steady state flow and Transient Flow-compressibility and effective stress-Transmissivity and storativity-Equations of Ground water flow-Limitations of Darcian Approach-hydro dynamic dispersion. **(06 Lectures)**

Module 2: Hydrologic Cycle and Flownet

Flow nets-Graphical construction-Flow nets by numerical simulation, steady state Regional Ground water Flow-Steady state hydrologic-budgets- Fluctuations in ground water levels. **(06 Lectures)**

Module 3:

Resource Evalution**:** Development of Ground water Resources-Exploration for Acquifers-the response of Ideal acquifers to pumping-Measurement of parameters -Laboratory tests- Piezometer test-pumping tests-Estimation of saturated hydraulic conductivity-Numerical simulation for aquifer yield prediction-Artificial recharge and induced infiltration-Land subsidence-sea water intrusion **(06 Lectures)**

Module 4: Chemical Properties And Principles

Constituents-chemical equilibrium- Association and Dissociation of dissolved species-effects of concentration gradients-Mineral dissolution and solubility- Oxidation and Reduction Process-Ion exchange and Adsorption- Environmental isotopes-Field Measurement of Index parameters. **(08 Lectures)**

Module 5:

Chemical Evolution: Hydro Chemical Facies- Ground water in carbonate terrain-Ground water in crystalline rocks-Ground Water in complex sedimentary systems- Geochemical interpretation of 14C Dates-process rates and molecular diffusion **(08 Lectures)**

Module 6: Solute Transport

Water Quality Standards-Transport Process-Nonreactive Constituents In Homogeneous Media And Heterogenous Media-Transport In Fracture Media-Hydeochemical Behaviour of Contaminants-Trace Metals-Nitrogen-Trace Nonmetals Organic Substances- Measurement of Parameters-Velocity-Dispersivity-Chemical Partitioning-Sources of Contamination- Land Disposal Of Solid Wastes-Sewage Disposal On Land. **(08 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References

- Randall J. Charbeneau, “Ground Water Hydraulics and Pollutant Transport ", 2000.
- Allen Freeze, R. and John A. Cherry, "Ground Water ". Prentice Hall.Inc.1979.

Course Outcomes: On completion of the course, students will be able to

- Understand the geology and hydraulics of groundwater.
- Formulate problems, generating and prioritizing a set of alternative solutions in ground water pollution control.
- Explain economical and technically feasible solution for groundwater remediation.

Elective II

CVEE-E2/01 Environmental Biotechnology

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To understand the genetic engineering structures for remediation of contaminated site.
- The microbiology of wastewater, sewage sludge and solid waste treatment processes is also provided. Aspects on nutrient removal and the transmission of disease causing organisms are also covered.

- The morphology, behavior and biochemistry of bacteria, fungi, protozoa, viruses, and algae are outlined.

Course Contents

Module 1: Introduction

Environmental Biotechnology -Principles and concepts - scope and importance, usefullness to mankind. Biotechnological remedies for environmental pollution- decontamination of groundwater – Bioremediation - Production of proteins – biofertilizers Physical, chemical and microbiological factors of composting – health risk – pathogens – odor management **(08 Lectures)**

Module 2:

Genetic engineering structure of DNA, RNA, Replication of DNA, genetic code, Transcription, Protein synthesis, Biotechnological remedies for environmental pollution, decontamination of groundwater – bioremediation. **(08 Lectures)**

Module 3:

Microbial cell/enzyme technology – adapted microorganisms – biological removal of nutrients – algal biotechnology– extra cellular polymers - Biogas technology. **(08 Lectures)**

Module 4:

Concept of DNA technology – expression vectors – cloning of DNA – mutation – construction of microbial strains - radioactive probes - protoplast fusion technology – applications. **(08 Lectures)**

Module 5:

Environmental effects and ethics of microbial technology – genetically engineered organisms- Microbial containment-Risk assessment. **(08 Lectures)**

Module 6:

Microbiology of waste water treatment- a) Aerobic processes: Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. b) Anaerobic processes: Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactor. biofertilizers, Physical, chemical and microbiological factors of composting **(08 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Microbial Biotechnology : A. N. Glazer and H. Nikaids.
- Molecular Biotechnology : Gleek and Pasternack.
- Biotechnology : A Text Book of Industrial Microbilogy, T. D. Brock,
- Industrial Microbiology : Presscott and Dunn.
- Biotechnology : B. D. Singh , Kalyani Publishers.
- T.V.Ramachandra, Soil & Ground Water Pollution from Agricultural activities, TERI
- Biological degradation and Bioremediation of toxic chemicals: Chaudhury, G.R., Dioscorides Press, Oregon, 1994
- Biological degradation of wastes: Martin. A.M, Elsevier Applied Science, London, 1991.
- Soil Microbiology Ecology: Blaine Metting. F (Jr.,) Marcel Dekker Inc., 1993.

Course Outcomes: On completion of the course, students will be able to:

- Understand the basics of microbiology and their diversity and on the genetic material in the living cell.

- Understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.
- Understood the role microbial metabolism in a wastewater treatment plant.
- Know the role of microorganisms in contaminated water and the diseases caused.

Elective II

CVEE-E2/02 Climate Change

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To understand the impacts of human activities on climate changes and change in rainfall intensities
- To study about Global and Indian Climatology and development of monsoons.

Course Contents

Module 1: Introduction

Atmosphere and its constituents, Synoptic observations- surface and upper air, Tropical meteorology: Easterly Waves, ET-ITCZ, Inversion. Monsoon – Onset, Activity, Withdrawal, Breaks, Depressions, Easterly Jet Stream. Post Monsoon - Cyclones in the Indian Seas, N. E. Monsoon **(04 Lectures)**

Module 2:

Global Climatology - Global distribution of pressure and temperature at mean sea level in winter and summer, distribution of annual rainfall and its variability, distribution of moisture and clouds, Vertical distribution of temperature. General circulation of atmosphere, Development of monsoons, Major categories of world climates **(06 Lectures)**

Module 3:

Indian Climatology - Different seasons, Distribution of Means Sea level pressure/temperature in different seasons, Wind circulation and temperature distribution over India in lower, middle and upper troposphere in different seasons. **(08 Lectures)**

Module 4:

Indian rainfall in different seasons, Indian summer monsoon, onset, withdrawal, rainfall distribution, inter annual variability of monsoon. Main synoptic pressure systems causing weather over India in different seasons. **(12 Lectures)**

Module 5:

Climate Change & Variability - Overview of the climatic history of the earth. Long term changes (Climate of Past century, past millennium, past glacial period), Methods of determining past climate. Possible causes of climate change- External (Milankovitch variation and Solar activity) and Internal (natural and anthropogenic). General idea of internal dynamical processes of the atmosphere, oceanic processes, Cryospheric processes, land processes **(06 Lectures)**

Module 6:

Man's impact on climate, Greenhouse gases and global warming, basic radiation processes, Climate feedback mechanism, Climate predictability, future climate, potential consequences, International efforts to minimize climate change and their effects. Indian scenario **(06 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Atmosphere, Weather and Climate R.J. Barry and R.G. Chorley (Methuen Publication)
- South West Monsoon" by Y.P. Rao (IMD Publication) .
- An Introduction to Meteorology by S. Pettersen
- Elements of meteorology by Miller, Thompson and Paterson.
- General Meteorology by H.R. Byer
- Monsoon by P.K. Das.

Course Outcomes: On completion of the course, students will be able to:

- Understand the basics of global and Indian Climatology.
- Understood impact of human activities on climate change.

Elective II

CVEE-E2/03 Marine Pollution

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To educate the Coastal and Marine Environment.
- To find sources of marine pollution and methods for monitoring, modeling and control.

Course Contents

Module 1: Marine Pollution

Definition, categories of additions, Pollutant and its classification. Organic wastes: BOD, COD, dilution factor, Fluctuations in DO, Consequences of organic discharges to estuaries with examples; Thames and Mersey estuary; Consequences of sludge dumping at sea with reference to Thames and Firth of Clyde. Sewage treatment: Primary, Secondary and Tertiary treatment processes. Solid waste pollution: Classification and disposal of solid wastes. **(04 Lectures)**

Module 2: Marine corrosion

Definition, corrosion reactions, classification of corrosion, factors affecting corrosion of metals in sea water and prevention of marine corrosion. The state of some seas in the world (pollution aspect); The North Sea, the Mediterranean Sea and the Baltic Sea. **(06 Lectures)**

Module 3: Oil spills and cleanup

Sources, major accidental spills, fate of spilled oil on the sea, consequences of oil spills and treatment of oil spills. Pesticide pollution: inputs, fate in the sea, factors affecting the bioaccumulation of pesticides, DDT the most wide spread molecule, Impact of pesticides on the Environment, Mode of poisoning of pesticides, Methods to minimize pesticide pollution. **(08 Lectures)**

Module 4:

Conservative pollutants: Measures of contamination, toxicity, measurement of toxicity, acute and chronic exposure, Detoxification. Metal pollution in coastal waters (Hg, Pb, Cd, Cu, Zn and Fe), The present status of coastal pollution in India and future strategies.

Radioactive Pollution: Sources, Classification and effects of radiation; Protection and control from radiation: Maximum permissible dose concept, dose limits, Disposal of radioactive wastes; Beneficial aspects of radiation and food safety

(12 Lectures)

Module 5: Indicator organisms

Criteria for selection of indicator organism: Quantitation of pollution load, basic pre-requisites, response to different pollution load and time integration capacity, Macro algae, crustaceans and mollusks as indicator organisms for monitoring of trace metal Pollution. **(06 Lectures)**

Module 6:

Red tides: distribution, types of poisoning, effects and methods to minimize red tides in the sea. Monitoring strategies of marine pollution: Critical pathway approach and Mass balance approach.

Standards in water quality: Assessment of pollution damage: The need, seriousness of damage, assessment of damage and problems of measuring impact. **(06 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Chemical Oceanography (Vol: 3) 1975- Riley J.P and Skirrow, G.
- The health of the oceans. 1976 Goldberg, E.D
- Marine Pollution. 1986 Clark, R.B.
- Quantitative aquatic biological indicators. 1980 Phillips J.D.H.
- Thermal and radioactive pollution. 1994. Sharma, B.K and Kaur, H.
- Water Pollution. 1994. Sharma, B. K and Kaur, H.
- Marine and offshore corrosion. 1985. Chandler, K. A.

Course Outcomes: On completion of the course, students will be able to:

- Know about marine environment and learn the physical concepts lying behind the oceanic currents and natural processes of various activities happening over the marine environment.
- Acquired knowledge on the marine pollution and the effect of the same on the ecology.
- Should have gained knowledge on remote sensing and various other techniques for measuring and monitoring oceanic environment parameters.
- Should have acquired knowledge on control of marine pollution and sustainable development.

Semester II

CVEE201 Industrial Waste Water Treatment Management

Teaching Schemes: 3 Lect. + 1 Tut hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.
- Understand principles of various processes applicable to industrial wastewater treatment.
- Identify the best applicable technologies for wastewater treatment from the perspective of yield production.

Course Contents

Module 1: Introduction

Sources of Pollution:– Sources and Characteristics of industrial wastewater Environmental impacts – Regulatory requirements – generation rates –-Prevention vs Control of Industrial Pollution– Toxicity and Bioassay tests ,Source reduction techniques – Waste Audit -Evaluation of pollution prevention options. **(08 Lectures)**

Module 2:

Wastewater Treatment: Waste minimization - Equalization - Neutralization – Oil separation – Flotation –Precipitation – Heavy metal Removal – adsorption – Aerobic and anaerobic biological .Treatment – Sequencing batch reactors – High Rate reactors .

Advanced Treatment Methods: Nitrification and De-nitrification – Phosphorous removal – Heavy metal removal – Membrane Separation Process – Air Stripping and Absorption Processes. **(06 Lectures)**

Module 3:

Special Treatment Methods Chemical oxidation –Ozonation – Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal Disposal of Treated Waste. **(08 Lectures)**

Module 4:

Industrial Waste Study: Manufacturing process and sources of effluent from the process of industries like chemical, fertilizer, petroleum, petro -chemical, paper, sugar, distillery, tannery, food processing, dairy and steel manufacturing.

Industrial Waste Management: Characteristics and composition of effluent and different methods of treatment & disposal of effluent for the following industries: Steel, Petroleum Refineries, Tanneries, Atomic Energy Plants and other Mineral Processing Industries. **(08 Lectures)**

Module 5:

Common Effluent Treatment Plants (CETPs): Location, Need, General Design considerations and principles, Operation & Maintenance Problems, Zero effluent discharge systems, Wastewater reuse, Waste Audit. **(04 Lectures)**

Module 6:

Complete design of wastewater treatment plant of any industry listed above with all components, details, drawings and cost estimation. Dyestuff and dye manufacturing industries with method of treatment - adsorption, Treatment with polymer coagulation. **(08 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting of theoretical as well as numerical aspects of the course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References

- W. Wesley Eckenfelder Jr., Industrial Waste Water Pollution Control.
- Arceivala, S.J., Wastewater Treatment for PollutionControl, McGraw-Hill, 1998.
- Frank Woodard, Industrial waste treatment Handbook, Butterworth Heinemann, New Delhi, 2001.
- M. N. Rao & Datta, Waste water treatment.
- N.L. Nemerow, Liquid waste of Industry, Addison Wesely. 1996.
- Callegly, Forster and Stafferd, Treatment of Industrial Effluent, Hodder and Stonghton. 1988.
- Hardam S. Azad, (ED), Industrial Wastewater Management Hand Book 1988.
- Indian standards: IS: 2490 (1963), IS: 3306 (1065).

Course Outcomes: On completion of the course, students will be able to:

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

CVEE202 Solid and Hazardous Waste Management

Teaching Schemes: 3 Lect. + 1 Tut hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

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

Course Contents

Module 1: Introduction

Solid waste management: Objective, Functional elements, Environmental impact of mismanagement.

Solid waste: Sources, types, Composition, Quantities, Physical, chemical and Biological properties. **(06 Lectures)**

Module 2:

Solid Waste Generation Rate: Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems.

Transfer station: Meaning, Necessity, Location and Economic analysis, Transportation of solid waste: Means and Methods, Routing of vehicles.

Sorting and Material Recovery: Objectives, Stages of sorting, sorting operations, Guidelines for sorting for materials recovery, typical material recovery facility for a commingled solid waste. **(10 Lectures)**

Module 3:

Composting of solid waste: Principles, Methods, Factors affecting, Properties of compost, Vermicomposting.

Energy recovery from solid waste: Parameters affecting, Biomethanation, Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options. Landfills: Definition, Essential components, Site selection, Land filling methods, Leachate and landfill gas management. **(06 Lectures)**

Module 4:

Indian Scenario: Present scenario and measures to improve system for different functional elements of solid waste management system. Elements of financial management plan for solid waste system. **(10 Lectures)**

Module 5:

Economy and financial aspects of solid waste management. Disposal options for Biomedical waste, Other Waste Types: Nuclear and Radio Active Wastes. **(06 Lectures)**

Module 6:

Hazardous waste management: Problems and issues of hazardous waste management, Need for hazardous waste management—Legislations on management and handling of HW, Toxicology and risk assessment, Hazardous Characteristics – TCLP tests – waste sampling- reduction of wastes at source – Recycling and reuse, labeling and handling of hazardous wastes, incineration – solidification and stabilization of hazardous wastes **(08 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the course shall be performed by the candidate.

Guidelines for Class Test: Class test shall cover syllabus of any three Modules.

References:

- Michael D. LaGrega, Philip L Buckingham, Jeffrey C.E vans and Environmental
- Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001.
- Vesilind P.A., Worrell W and Reinhart, Solid waste Engineering, Thomson Learning Inc., Singapore, 2002.
- Charles A. Wentz, Hazardous Waste Management, Second Edition, Pub: McGraw Hill International Edition, New York, 1995.
- Solid waste management –A. D. Bhide.
- Solid waste management handbook – Pavoni.
- Hilary Theisen and Samuel A, Vigil, George Tchobanoglous, Integrated Solid Waste Management, McGraw- Hill, New York, 1993
- CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.

Course Outcomes: On completion of the course, students will be able to:

- Design and optimize the techniques in Solid and Hazardous waste treatment.
- Acquire knowledge on the specialized Solid and Hazardous waste treatment.
- Formulate problems, gathering data related to the problem, generating and prioritizing a set of alternative solutions, and selecting as well as implementing the best alternative for Solid and Hazardous waste treatment.

CVEE-S01Seminar I

Teaching Schemes: 4 Pract. hrs/week; **Evaluation Scheme:** Class Assessment 25; Oral Examination 25

Laboratory Scheme:

Seminar I shall be presented on one of the advanced topics chosen in consultation with the supervisor. Students must study latest literature. The concepts must be clearly understood and presented by the student. All modern methods of presentation should be

used by the student. Minimum 03 presentations are expected within period of semester by the student. A hard copy of the report should be submitted before delivering the seminar. A copy of the report in soft form must be submitted to the Supervisor along with other details, if any.

PG Lab-2

CVEE-L02 Advance Waste Water Treatment Lab

Teaching Schemes: 4 Pract. hrs/week; **Evaluation Scheme:** Class Assessment 25; Oral Examination 25

Objectives:

- To train the students in the analysis of various biological and microbiological techniques, enzymes assay, pollutant removal and bioreactors

Laboratory Work:

Practical work consist of a journal giving details of the following with analysis from wastewater.

The term work will consist of –

- **Microbiological techniques.**
    a) Microscopy, staining techniques.
    b) Isolation and growth of bacteria.
    c) Microbiological quality of water - MPN and membrane filtration technique and E coli test.
- **Metal Analysis from Industrial wastewater using Atomic Adsorption Spectrophotometer**
    a) Arsenic
    b) Nickel
    c) Chromium
- Visits, Detailed Study, and report submission of any two of the following Industries with respect to Total water consumption, Sources of Wastewater generation its characteristics and Treatment methods-----

Dairy, Fertilizer, Distillery, Sugar, Pulp & Paper, Iron & Steel, Metal Plating, Oil Refinery

- Visit to Air Polluting Industries like Thermal Power plant /Cement Manufacturing Industry etc.
- Detailed Study with report submission on Air Pollution Control Devices with their design principles, Study of Stack monitoring process.
- Introduction to Soft Computing Techniques Study and application of software in
    a) Design of Water Treatment plants
    b) Sewage Treatment plant
    c) Effluent treatment plant and
    d) Sewarages Systems.

It is mandatory to have such softwares in the laboratory.

- GIS Applications in Environmental Engineering

Introduction to GIS, concepts and data base structure, introduction to GIS software, Introduction to Remote Sensing. Applications in Environmental Engineering

Course Outcomes: On completion of the course, the students will be able to:

- At the end of experimental exercise, the candidate would be able to perform field oriented testing of water, wastewater and solid waste for microbial contamination.
- The candidate would be able to observe and identify the microbes in the contaminated environment.

CVEE-L02 Mini Project

Teaching Schemes: 4 Pract. hrs/week; **Evaluation Scheme:** Class Assessment 25; Oral Examination 25

Laboratory Scheme:

Mini project shall be based on one of the topic chosen in consultation with the supervisor. Mini project may be interdisciplinary nature. Areas of recent techno-management development shall be explored. Research innovations may be considered as prospective areas. Mini project may be related with main project to explore possibilities of continuation further and to study the pre-requisites.

Elective III

CVEE-E3/01 Agricultural Pollution Control

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To impart knowledge about the agricultural activities and their environmental impacts.
- Understand principles of agricultural air pollution control.
- To impart knowledge about the water logging, soil salinity, their environmental impacts and remedial measures.

Course Contents

Module 1: Introduction

Environmental issues in agriculture: Types of farming systems, agro meteorology, water and nutrients requirement. Agricultural Activities and Environmental Impacts: Major Agricultural Practices, Irrigation Drainage Systems, Impact of Agricultural Activities on Environment, Crops, Diseases, Nutrients and its Control. Irrigation practices its negative impacts on Soil (land degradation) **(08 Lectures)**

Module 2: Fertilizers

Types of fertilizers, pesticides and other agrochemicals, soil and water conservation practices. Environmental Impacts of Fertilizers: Different types of Fertilizers Inorganic, Organic and Synthetic fertilizers. Effects on Environment due to use of fertilizers. **(07 Lectures)**

Module 3: Environmental Impacts of Pesticides and Properties of Pesticides

Adsorption solubility in Water and Volatilization Soil Conservation; Vegetative practices And Mechanical Practices. Ground water Characterization and suitable remedial measures for avoiding its Contamination Pollution control monitoring strategies and plans. **(06 Lectures)**

Module 4:

Water logging and salinity: Water logging: Its effects, Water logging control, Environmental effects due to water logging Remedial Measures, Preventive and Curative Water logging measures.

Soil Salinity: Classes of Saline and Alkali Soil, Improvement of Saline and Alkaline Soil Leaching and Reclaiming Saline soil. **(06 Lectures)**

Module 5:

Wastewater reuse in agriculture: management and control of agricultural waste; recycling and reuse.

Waste water Reuse in Agriculture: Types of Reuse, Reuse of urban waste water in Agriculture and horticulture from skewered area, Reuse considering techno economic aspect Preliminary Primary and secondary treatment and tertiary treatment to removed residual pollutants. Mechanized and Physicochemical Processes **(07 Lectures)**

Module 6:

Agricultural air pollution control: Odorous emissions related to storage and handling of animal wastes, Biotechnology in reduction of CO_2 emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications.

Novel methods of pollution control: Vermitechnology, Methane production, Root zone treatment, Membrane technology, Biodegradable plastics. **(08 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Microbial Biotechnology : A. N. Glazer and H. Nikaids .
- Molecular Biotechnology : Gleek and Pasternack.
- Biotechnology : A Text Book of Industrial Microbilogy, T. D. Brock,
- Industrial Microbiology : Presscott and Dunn.
- Biotechnology : B. D. Singh , Kalyani Publishers.
- T.V. Ramachandra, Soil & Ground Water Pollution from Agricultural activities, TERI.

Course Outcomes: On completion of the course, students will be able to:

- Design and optimize the techniques in agricultural waste treatment.
- Acquire knowledge on the agricultural waste water reuse treatment.
- Formulate problems, gathering data related to the problem, generating and prioritizing a set of alternative solutions, and selecting as well as implementing the best alternative for agricultural pollution.

Elective III

CVEE-E3/02 Environmental Auditing

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- Formulate the Environmental report for various issues related to environmental issues.
- Apply various methods of environmental audit.

Course Contents

Module 1: Environmental Audit

Definition of Environment Audit and its importance for industries. Environmental management system audits Types of audits, General audit methodology and basic structure of audit. Elements of an audit process and its importance. Concept of ISO14000 **(06 Lectures)**

Module 2:

Requirements of Rule 14 for Environmental Audit under Environmental protection Act 1986, Definitions of a. Signatory, b. Consumption Audit, c. Pollution audit, d. Hazardous audit, d. Solid waste audit, e. Disposal audit, f. Cost audit, g. Investment audit, h. Voluntary. **(06 Lectures)**

Module 3: Pre-audit Activities for the Manager

Selecting the audit team, planning the audit **(04 Lectures)**

Module 4: Pre-audit Activities for the Auditor

Drawing up the audit specification, obtaining information before the audit, Checklists, Case studies of red category industries **(06 Lectures)**

Module 5:

Conducting the Audit: The opening meeting, Evaluation of the EMS, Interviewing, Site tour and observations

Evaluating the Audit Results: Evaluation of the audit results, the closing meeting, Recommendations, the audit report **(06 Lectures)**

Module 6: Environmental Reporting

Purpose of producing an environmental report, writing the report, Independent validation. **(06 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Larry W. Canter," Environment Impact Assessment ", McGraw-Hill Book Company, New York.
- G.J. Rau and C.D. Weeten, "Environmental Impact Analysis Hand book, McGraw Hill, 1980.
- Vijay Kulkarni and T V Ramchandra. “Environmental management” Capital Publishing Co.
- Mhaskar A.K., “Environmental Audit" Enviro Media Publications.
- S.K. Dhameja, "Environmental Engineering and Management" S.K. Kalaria and Sons Publishers.

Course Outcomes: On completion of the course, students will be able to:

- Design environmental report on various conditions.
- Acquire knowledge on the agricultural waste water reuse treatment.
- Formulate the methodology for prediction and assessment of various impacts on environment.
- Apply various methods of environmental audit.

Elective III

CVEE-E3/03 Disaster Management and Risk Analysis

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- Formulate the maps on special and non special data for prediction and forecasting for disaster preparedness.

Course Contents

Module 1: Disaster

Definition, Classification, Natural and Anthropogenic, Accidents, Disaster Profile of India. Geo-climatic and Social conditions, Past records, Vulnerable areas of the country, national Response approach. **(06 Lectures)**

Module 2:

Risk assessment, Contingency Planning, Major Natural disasters, Earth Quake, Cyclone, Flood, Epidemics, Check list-Agencies, Personnel, Equipment, Materials, Services and Time management **(06 Lectures)**

Module 3:

Prediction and forecasting, disaster preparedness, data base Assessment of disaster relief and Rehabilitation measures, Mobilization of men and material. **(06 Lectures)**

Module 4: Legal frame work, Trigger mechanism

Water, Climate and Geologically related Chemical, Industrial, Nuclear, GIS enabled Disk net **(06 Lectures)**

Module 5:

Maps Special and non special data, Activities, Agencies, Resources and Funds, Implementation and Monitoring Flood Hazard Map **(06 Lectures)**

Module 6:

Quick response flow chart, Emergency operation center, Emergency support functions, Disaster specific modules **(06 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- R. B. Singh (Ed) Environmental Geography, Heritage Publishers New Delhi,1990.
- Savinder Singh Environmental Geography, Prayag Pustak Bhawan, 1997.
- Kates, B.I & White, G.F The Environment as Hazards, oxford, New York, 1978.
- R. B. Singh (Ed) Disaster Management, Rawat Publication, New Delhi, 2000.
- H. K. Gupta (Ed) Disaster Management, Universiters Press, India, 2003.
- R. B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 1994.
- A. S. Arya Action Plan For Earthquake, Disaster, Mitigation in V.K. Sharma (Ed) Disaster Management IIPA Publication New Delhi, 1994.
- R. K. Bhandani an overview on Natural & Man made Disaster & their Reduction, CSIR, New Delhi.
- M. C. Gupta Manuals on Natural Disaster management in India, National Centre for Disaster Management, IIPA, New Delhi, 2001.
- Reference http://www.du.ac.in/

Course Outcomes: On completion of the course, students will be able to:

- After the completion of course, the student will be able to understand the necessity to study the impacts and risks of disasters and the methods to overcome these impacts.
- The student will also know about the legal requirements of Environmental and Risk Assessment for projects.

Elective III

CVEE-E4/01 Environmental Sanitation

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To impart knowledge and create awareness about industrial sanitation and hygiene.
- To impart knowledge about various types of communicable diseases and their control measures.

Course Contents

Module 1:

Epidemiology: Communicable diseases, Micro-organisms, Methods of communication, Diseases communicated by discharges of intestines, nose and throat, other communicable diseases and their control. **(06 Lectures)**

Module 2:

Insects and Rodent Control: Mosquitoes, life cycles, factors of diseases control methods – natural and chemical, Fly control methods and prevention of fly breeding, Rodents and public health, plague control methods, engineering and bio-control methods, disinfectants (Phenols, Lime, Chlorine, Ammonium compounds), Insecticides (DDT, BHC). **(06 Lectures)**

Module 3:

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

Industrial Hygiene: Occupational Hazards, Industrial poisons, Dust, Noise, Heat, Compressed air, Vibrations and shocks-Industrial plant sanitation. **(06 Lectures)**

Module 4: Rural Sanitation

Rural areas, Population habits and environmental conditions, problems of water supply and sanitation aspects, low cost excreta disposal systems. Rural sanitation improvement schemes, Case studies on sanitation. Emergency Sanitation practices during Natural calamity **(06 Lectures)**

Module 5: Water supply in buildings

Plumbing terminology. Definitions, Water supply in building. The water connection, The water storage, Storage tanks-domestic storage tanks, Flushing Storage Tanks. Principles Governing Design of Water supply in buildings, Lay out. Estimating Requirements, Design of Water pipes. **(06 Lectures)**

Module 6:

Building Drainage: Traps, Gully Traps, Intercepting Traps or Interceptors. Sanitary Fittings—Water Closets.

Flushing Cistern: Wash Basin or Lavatory Basin, Sink, Urinals. The Plumbing System of Drainage - Single Stack System, One-Pipe System. Choice of System, Principles governing Design of Building Drainage, Layout, Quantity of Flow. Pipes for drainage, Drainage design of high rise buildings. **(06 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References

- R. B. Singh (Ed) Environmental Geography, Heritage Publishers New Delhi,1990.
- Savinder Singh Environmental Geography, Prayag Pustak Bhawan, 1997.
- Kates, B.I & White, G.F The Environment as Hazards, oxford, New York, 1978.
- R. B. Singh (Ed) Disaster Management, Rawat Publication, New Delhi, 2000.
- H. K. Gupta (Ed) Disaster Management, Universiters Press, India, 2003.
- R. B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 1994.

- Dr. Satender , Disaster Management t in Hills, Concept Publishing Co., New Delhi, 2003.
- A. S. Arya Action Plan For Earthquake, Disaster, Mitigation in V.K. Sharma (Ed) Disaster Management IIPA Publication New Delhi, 1994.
- R. K. Bhandani an overview on Natural & Man made Disaster & their Reduction, CSIR, New Delhi.
- M. C. Gupta Manuals on Natural Disaster management in India, National Centre for Disaster Management, IIPA, New Delhi, 2001.
- Reference http://www.du.ac.in/

Course Outcomes: On completion of the course, the students will be able to:

- Formulate issues of rural water supply and sanitation.
- Acquire skills and understanding about the development of these projects with cost effective implementation and, operation & maintenance.
- Develop an ability of effective resource planning for rural environmental projects

Elective IV

CVEE-E4/02 Geo-environmental Engineering

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To impart knowledge about sources and types of ground contamination and their remedial measures.

Course Contents

Module 1: Fundamentals of Geo-enviromental Engineering

Scope of geo-environmental engineering -multiphase behavior of soil – role of soil in geo-environmental applications – importance of soil physics, soil chemistry, hydrogeology, biological process **(06 Lectures)**

Module 2: Earthquake Response of Systems

Sources and type of ground contamination – impact of ground contamination on geo-environment - case histories on geo-environmental problems. **(06 Lectures)**

Module 3: Soil-Water-Contaminant Interaction

Soil mineralogy characterization and its significance in determining soil behavior – soil-water interaction and concepts of double layer – forces of interaction between soil particles. **(06 Lectures)**

Module 4:

Concepts of unsaturated soil – importance of unsaturated soil in geo-environmental problems -measurement of soil suction - water retention curves - water flow in saturated and unsaturated zone, Soil-water-contaminant interactions and its implications – Factors effecting retention and transport of contaminants. **(06 Lectures)**

Module 5: Contaminant Site Remediation

Site characterization – risk assessment of contaminated site- remediation methods for soil and groundwater – selection and planning of remediation methods – some examples of in-situ remediation. **(06 Lectures)**

Module 6: Advanced Soil Characterization

Contaminant analysis - water content and permeability measurements – electrical and thermal property evaluation – use of GPR for site evaluation - introduction to geotechnical centrifuge modeling. **(06 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References

- Reddi L.N. and Inyang, H. I.,"Geoenvironmental Engineering,Principles and Applications" Marcel Dekker Inc. New York, 2000.
- Sharma H.D. and Reddy K. R. ,"Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
- Rowe R. K. ,"Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
- Yong, R. N.,"Geoenvironmental Engineering,Contaminated Soils,Pollutant Fate, and Mitigation" CRC Press, New York, 2001
- Fredlund D.G. and Rahardjo, H.,"Soil Mechanics for Unsaturated Soils" Wiley- Interscience, USA, 1993.
- Hillel D.,"Introduction to Environmental Soil Physics"Academic Press, New York, 2003.
- Alvarez-Benedi J. and Munoz-Carpena, R., "Soil-Water Solute Process Characterization: An Integrated Approach" CRC Press, New York, 2005.
- Sparks, D.L.,"Environmental Soil Chemistry" AcademicPress, New York, 2002.
- Berkowitz, B. Dror, I. and Yaron, B., "Contaminant Geochemistry" Springer, Germany, 2008.

Course Outcomes: On completion of the course, the students will be able to:

- Formulate issues of soil contamination.
- Acquire skills and understanding about the development of these projects with cost effective implementation and, operation & maintenance.
- Develop an ability of effective resource planning for geo-environmental projects

Elective IV

CVEE-E4/03 Air Pollution and Control

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

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

Course Contents

Module 1: Introduction

Definition, Sources and classification of Air Pollutants, Photochemical smog, Effects of air pollution on health, vegetation & materials, air quality, Global effects of air pollution **(06 Lectures)**

Module 2: Meteorology

The atmosphere, zones of atmosphere, scales of meteorology, meteorological parameters, Heat, Wind, Pressure, Moisture and humidity, Rainfall and precipitation, Temperature lapse rate, Maximum mixing depth (MMD), Plume behavior, Effect of topography on pollutant dispersion, effect of air pollutant on meteorology, Air pollution modeling, Minimum stack height.

(06 Lectures)

Module 3: Modeling of Dispersion of Air Pollutants

Dispersion of Air pollutants, Theories on modeling of Air pollutants, Gaussian model etc. Equations of the estimation of pollutant concentrations, Plume Rise – Equations for estimation. Effective stack height and mixing depths. **(06 Lectures)**

Module 4:

Particulate Pollution Control Methods**:** Dilution, Source control, Control by using equipments such as Settling chambers, Cyclones, Fabric Filters, Electrostatic precipitators, Wet Scrubbers/Wet Collectors, design and principle of these air pollution control units.

Gaseous pollution control: Types of gaseous pollution control methods – absorption, adsorption and combustion processes. SOx Control Technology, Desulfurization of flue gas emissions, NOx Control Technology, Automobile pollution, sources of pollution, composition of auto exhausts, Control methods. **(06 Lectures)**

Module 5: Air pollution Monitoring and Management

Guidelines of Statutory Bodies, Legal aspects, Responsibility of calling Structural Audit, Scope of Investigation, Involvement of Original Consultants & Representatives of Statutory Bodies, Frequency of Structural Audits. **(06 Lectures)**

Module 6:

Automobile Pollution: Vehicular emissions, Motor fuel combustion, Automobile emission control.

Odour pollution: Theory of Odour, Sources of Odour, Measurement of Odour, Odour control method.

Indoor Air Pollution: Causes of air pollution, Sources and effects of indoor air pollutants, changes in indoor air quality, Control of indoor air pollutants, air cleaning systems, Cigarette smoke. **(06 Lectures)**

References

- H. C. Perkins, Air Pollution.
- Peavy and Rowe, Environmental Engineering, Mc-Graw Hill Publication.
- N.D. Nevers, Air Pollution Control Engineering, Mc-Graw Hill Publication.
- M. N. Rao et al. Air Pollution, Tata Mc-Graw Hill Publication.
- Noel de Nevers, Air Pollution control Engineering, Mc-Graw Hill Publication, New York.
- Richard W. Boubel et al., Fundamentals of Air Pollution, Academic Press, New York.
- KVSG Murali Krishna. Air pollution and control, Kaushal and Company, Jagannaickpur, Kakinada-2.
- Davis. Environmental Engineering, Mc-Graw Hill Publication.
- C.S. Rao., Environmental Pollution Control Engineering, Wiley Eastern Limited, New Delhi (1991).
- John H. Seinfeld, Air Pollution: Physical and Chemical Fundamental, Mc-Graw Hill book Co. 1988.
- Paul N. Cheremisinoff, Richard A. Young, Air Pollution Control and Design Handbook, Part-I, Marcel Dekker Inc., New York 1977).
- Paul N. Cheremisinoff (ed.), Encyclopedia of Environmental Control Technology, Vol. 2, Air Pollution Control, Guld Publishing Company. (1989).

Course Outcomes: On completion of the course, the students will be able to:

- Analyze air pollution related environmental issues.
- Formulate the economical and technically feasible solutions to air pollution problems.
- Analyze and develop competency in use of various air modeling software.
- Apply the basic and advance air pollution knowledge in research and development.

Elective V

CVEE-E5/01 Research Methodology (Open Elective)

Teaching Schemes: 4 Pract. hrs/week; **Evaluation Scheme:** Class Assessment 25; Oral Examination 25.

Objectives:

- To impart knowledge and formulate research proposals.

Course Contents

Module 1:

Introduction, meaning of research, objectives, types and role of scientific and engineering related research in advancing the knowledge, defining a research problem, formulation of a hypothesis, research design and features of good design, methods of data collection, approaches and techniques for data acquisition, processing, analyses and synthesis, Designing a questionnaire, Interpretation of results, Report Writing, Aspects of literature review, Different ways of communication and dissemination of research results. **(06 Lectures)**

Module 02:

Descriptive Statistics, Probability and Distribution: Basic statistical concepts, Measures of central tendency and dispersion, Elements of Probability, Addition and multiplication theorems of probability, Examples, probability distributions, Binomial, Poisson and normal distributions. **(06 Lectures)**

Module 03:

Sampling Techniques: Random sampling, simple random sampling and stratified random sampling, Non-sampling errors. **(06 Lectures)**

Module 04:

Correlation and Regression: Product moment correlation coefficient and its properties. Simple linear regression and multiple linear regressions, Statistical Inference: Statistical hypotheses, Error Types, level of significance, Chi-square Test and F distributions. Central limit theorem, Tests for the mean, equality of two means, variance, large sample tests for proportions, Confidence interval. **(06 Lectures)**

Module 05:

Design of Experiments: Analysis of variance. Data Classification, Completely randomized, randomized block, Factorial experiments, Yates technique. **(06 Lectures)**

Module 06:

Multivariate Data Analysis: Multivariate normal distributions. Mean vector, variance, covariance matrix and correlation matrix, Step wise regression, Selection of best subject of variables, Classification and discrimination problems, Factor analysis, Principal component analysis. Data analysis using software's. **(06 Lectures)**

Term Work

Student shall critically read recent three to four journal articles within the broader field of their prospective specializations to identify research and knowledge gaps and accordingly formulate specific research questions. On the basis of these research questions student will retrieve additional relevant information and prepare well-articulated and content rich introductory problem description as well as proposed research methodology notes. This shall be assessed jointly by the subject teacher and research guide of the student.

References:

- Gupta S. C. and Kapoor V. K, “Fundamentals of Mathematical Statistics”, Sultan Chand & Company New Delhi.
- Gupta S. C. and Kapoor V. K, “Fundamentals of Applied Statistics”, Sultan Chand & Com. N.Delhi.

- Montogomery D. C., "Probability and Applied Statistics for Engineers", Wiley Int.Student Edition
- Walpole Ronald E, Myers Raymond H and Myers Sharon L, "Probability & Statistics for Engineers and Scientists", 6thEdition, Prentice Hall.
- Ross S. M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edi, Elsevier
- Miller and Freund: Probability and Statistics for Engineers", EEE
- Johnson R. and Wichern, "Applied Multivariate Statistical Analysis", 3rd Edi, Prentice Hall India
- Douben K. J., "Research Methodologies – Principles and Guidelines of Applied Scientific Research", UNESCO-IHE Lecture Notes LN0317/06/01, Delft, the Netherlands.
- Holtom D. and E. Fisher, "Enjoy Writing Your Science Thesis - a Step by Step Guide to Planning and Writing Dissertations and Theses for Undergraduate and Graduate Science Students", ImperialCollege Press. ISBN 1-86094-207-5, London, UK.
- Kumar R., "Research Methodology- a Step-by-step Guide for Beginners", Sage Publications. ISBN 0-7619-6213-1. London, UK.

Course Outcomes: On completion of the course, the students will be able to:

- Critically evaluate current research.
- Develop hypothesis and a research proposal
- Design methods of data collection and to select appropriate tools for analysis
- Illustrate method of communication of scientific results for peer review

Elective V

CVEE-E5/02 Nano-technology for water and wastewater treatment

(Open Elective)

Teaching Schemes: 4 Pract. hrs/week; **Evaluation Scheme:** Class Assessment 25; Oral Examination 25

Objectives:

- To impart knowledge and research about nanotechnology for treatment of wastewater.

Course Contents

Module 1: Introduction

Background, what is nanotechnology, types of nanotechnology and nano-machines, top down and bottom up techniques, Molecular nanotechnology, atomic manipulation-nano dots, self assembly. **(06 Lectures)**

Module 2:

Dip pen nanolithography, Simple details of characterization tools- SEM, TEM, STM, AFM **(06 Lectures)**

Module 3: Characterisation of Nano materials

Nan particles and water, Responsible use of nano materials: an industry point of view, Policy aspects of innovation, Analytical techniques for characterisation of nano materials. **(06 Lectures)**

Module 4: Effective, High-Performance Water and Wastewater Purification Systems

Nano and micro engineered membrane technology, Applications of nanotechnology for drinking water, Biocatalysts for reductive treatment of water contaminated with priority pollutants, Video conferencing with Asian Institute of Technology nanotechnology laboratory **(06 Lectures)**

Module 5: Bio-nanotechnology and Nonmanufacturing

Virus-based single-enzyme nanoreactors, Measurement of bacterial-particle interactions with atomic force microscopy

(06 Lectures)

Module 6: Vibration Isolation

Bioremediation: from environmental processes to production of functional bionanominerals, Microbial manufacture of silver nano particles for water disinfection, Microbial manufacture of chalcogen nanoparticles and quantum dots. **(06 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References

- Nanotechnology-Basic Science and Emerging Technologies Mick Wilson, Kamali Kannangra Geoff Smith, Michelle Simons and Burkhard Raguse, Overseas Press.
- Nanotechnology-A Gentle Introduction to the Next Big Idea Mark Ratner and Daniel Ratner, Prentice Hall
- Nanotechnology: Rebecca L Johnson, Lerner Publications.
- Introduction to Nanotechnogy: Charles P. Poole Jr., Chapman and Hall/CR
- Mick Wilson, Kamali Kannangara, Geoff smith, "Nanotechnology: Basic Science and Emerging Technologies", Overseas press, 2005.
- Charles P. Poole Jr and. Frank J.Owens, "Introduction to Nanotechnology", Wiley Interscience, 2003.
- Mark A.Ratner, Daniel Ratner,"Nanotechnology: A gentle introduction to the next Big idea", Pearson Education, 2003.
- Hari Singh Nalwa, "Nanostructured materials and Nanotechnology", Academic press, 2001.
- Alexei Nabok, "Organic and Inorganic Nanostructures", Artech House Publishers, 2005.

Course Outcomes: On completion of the course, the students will be able to:

- Formulate issues of water contamination.
- Apply the knowledge of nano-technology for various types of wastewater treatments.

Elective V (Open Elective)

CVEE-E5/03 Remote Sensing and GIS applications in Environmental Engineering

Teaching Schemes: 4 Pract. hrs/week; **Evaluation Scheme:** Class Assessment 25; Oral Examination 25

Objectives:

- To impart knowledge on the concept and application of GIS and Remote Sensing for management and monitoring of land, air, water and pollution studies.

Course Contents

Module 1: Fundamentals of Remote Sensing

Definition, Physics of Remote Sensing, Electromagnetic Radiation and its interactions with atmosphere, Spectral reflectance of earth materials and vegetation. **(06 Lectures)**

Module 2: Platforms and Sensors

Aerial Photographs, Active and passive sensors, Data products, Various satellites in orbit and their sensors **(06 Lectures)**

Module 3: Data Processing

Data analysis - Visual Interpretation and Digital Image Processing – classification **(06 Lectures)**

Module 4: GIS

Introduction to GIS, concepts and Data base structure, various GIS softwares **(06 Lectures)**

Module 5: Remote Sensing and GIS Applications

Management and monitoring of land, air, water and pollution studies, conservation of resources, coastal zone management - Limitations. **(06 Lectures)**

Module 6: Laboratory Practices

Reflectance measurement, Visual Interpretation, Digital Image Processing, data analysis in ARC/INFO. **(06 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References

- Lillies and T.M. and Kiefer, R.W., "Remote Sensing and Image Interpretation ", John Wiley and Sons, 1994.
- Burrough, P.A. and McDonnell, R.A., "Principles of Geographical Information Systems ", Oxford University Press, 1998.
- Lintz, J. and Simonet, " Remote Sensing of Environment ", Addison Wesley Publishing Company, 1994.

Course Outcomes: On completion of the course, the students will be able to:

- Describe Spatial and non-spatial database of geographic information system.
- Acquire and create spatial data from satellite imagery, printed maps, online sources, &GPS.
- Develop spatial and thematic models for presentation, analysis and decision-making.
- Use the GPS, GIS software packages.
- Integrate GPS- GIS techniques for problem solving of construction projects.

Semester III

Project Management and Intellectual Property Rights

Teaching Schemes: Self Study; **Evaluation Scheme:** Class Assessment 25; Oral Examination 25

Course Content

Project Management

Module 1: Introduction to Project Management

Project, Project vs. operation, Brief history of project management, Role of a Project Manager, benefits of project management, Project lifecycle: Initiating, Planning, Executing, Controlling, and Closing processes. Project Integration Management - Project plan development, Project plan execution, and Overall change control. **(06 Lectures)**

Module 2: Beginning a Project

Project Selection, Defining criteria, Project selection methods, Sacred Cow, Comparative Benefit Model (CBM), Quality functional deployment (QFD), Scope Definition, Project Charter development **(06 Lectures)**

Module 3: Risk Management

Project Risk Management Processes, Types of Risk, Risk Defined, Risk Factors, Risk Factors Risk identification, Qualitative risk analysis, Quantitative risk analysis, Risk planning, Risk control. **(06 Lectures)**

Module 4: Professional Responsibility (Ethics)

Ensuring Integrity and Professionalism, Project Management Knowledge Base, Enhancing Individual Competence, Balancing Stakeholder Interests, Interactions with Team Members and Stakeholders, Templates, Tools and Techniques. **(06 Lectures)**

Intellectual Property Rights

Module 5: Introduction to Intellectual Property Rights

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

International Scenario

International cooperation on Intellectual Property, Procedure for grants of patents, Patenting under PCT. **(06 Lectures)**

Module 6: Patent Rights

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Recent Developments in IPR

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies. **(06 Lectures)**

References

- PMBOK® Guide 5th Edition, ISBN 978-1935589679
- Managing Across Cultures: The 7 Keys to Doing Business with a Global Mindset 1st Edition, ISBN 978-0071605854
- The PMP Exam: How to Pass on Your First Try 5th Edition, ISBN 978-0982760857
- The PMP Exam: Quick Reference Guide 5th Edition, ISBN 978-0982760895
- T. Hegazy, Computer-based construction project management, Prentice Hall, New Jersey, 2002.
- S. M. Levy, Project management in construction, 5 th ed., McGraw Hill, New York, 2007.
- PMI, A guide to the project management body of knowledge, 3 rd ed., Project Management Institute, Pennsylvania, 1996.
- Prabuddha Ganguly, " Intellectual Property Rights",Tata Mc-Graw Hill.
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley "Intellectual Property in New Technological Age".

CVEEPS1 Project Stage I

Evaluation Scheme: Class Assessment 25; Oral Examination 25

Dissertation Stage I and Synopsis Approval Presentation:

It is a course requirement under the guidance of faculty Supervisor. PG student from second year is required to do innovative and research oriented applied work related to various theory and laboratory courses. Dissertation work may cover analytical formulation, experimentation or survey based project or combination of these. Student are encouraged to undertake an interdisciplinary type project.

- **Synopsis:**

It is expected from the student to carry out exhaustive literature survey with consultation of his/her Supervisor for not less than 15 reputed national, international journal and conference papers. Student should present the Synopsis Submission Presentation (SSP)

with literature survey report to justify about the research gap, innovativeness, applicability, relevance and significance of the work. Student shall undertake project work after approval of synopsis.

- **Dissertation Stage I presentation:**

It is expected that student shall present preliminary results from his/her work during the semester with report as per prescribed format. If student is not showing satisfactory performance, then he/she will be given grace period of 2 weeks. After 2 weeks student will be again evaluated with grade penalty. Minimum 02 ISE presentations should be delivered by the student during semester.

Semester- IV

CVEEPS2 Project Stage II

Evaluation Scheme: Class Assessment 25; Oral Examination 25

Based on the guidelines and progress of stage II works, all the desired work should be completed and final dissertation report will be prepared and presented during examination. It is desirable that student presents/publishes the research paper in peer reviewed conference/research journals. If student is not showing satisfactory performance, then he/she will be given grace period of 4 weeks. After 4 weeks student will be again evaluated with grade penalty.