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

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<tr>
<th>Sr. No.</th>
<th>Subject Code</th>
<th>Name of Subject</th>
<th>Hours /Week</th>
<th>Credit</th>
<th>Examination Scheme</th>
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### 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:** Marine Pollution
## Second Semester

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<th>Sr. No.</th>
<th>Subject Code</th>
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**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

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### Fourth Semester

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**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:

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:

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

Module 2:
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:
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.

(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:

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.
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

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,
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
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.

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

**References:**

**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

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**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.
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:

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:

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

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.  

Module 3:  

(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  

(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

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, usefulness 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:
- Molecular Biotechnology : Gleek and Pasternack.
- Biotechnology : A Text Book of Industrial Microbiology, T. D. Brock,
- Industrial Microbiology : Presscott and Dunn.
- 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

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**

(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
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. 

Module 6:
Standards in water quality: Assessment of pollution damage: The need, seriousness of damage, assessment of damage and problems of measuring impact.

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.
- Water Pollution. 1994. Sharma, B. K and Kaur, H.

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.

Module 2:

Module 3:

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.

Module 5:

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.

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.

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.

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.

Module 3:

(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:
- Solid waste management –A. D. Bhide.
- Solid waste management handbook – Pavoni.

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-S01 Seminar 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) Sewaraages 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**

(08 Lectures)

**Module 2: 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

Module 6:
Agricultural air pollution control: Odorous emissions related to storage and handling of animal wastes, Biotechnology in reduction of CO₂ emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications.
Novel methods of pollution control: Vermitechnology, Methane production, Root zone treatment, Membrane technology, Biodegradable plastics.

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:
- Molecular Biotechnology : Gleek and Pasternack.
- Biotechnology : A Text Book of Industrial Microbiology, T. D. Brock,
- Industrial Microbiology : Presscott and Dunn.
- 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:

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:

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:
- Savinder Singh Environmental Geography, Prayag Pustak Bhawan, 1997.
- R. B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 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/](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 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

Module 6:

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

- Savinder Singh Environmental Geography, Prayag Pustak Bhawan, 1997.
- R. B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 1994.
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-environmental 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

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.

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.

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.

Module 5: Contaminant Site Remediation

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.
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

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.

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
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:
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
Module 6: Vibration Isolation
Bioremediation: from environmental processes to production of functional bionanominerals, Microbial manufacture of silver nanoparticles 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 Nanotechnology: Charles P. Poole Jr., Chapman and Hall/CR

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

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)

Module 5: Introduction to Intellectual Property Rights


International Scenario

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

Module 6: Patent Rights


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


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.