PONDICHERY ENGINEERING COLLEGE, PUDUCHERRY – 605 014

CURRICULUM AND SYLLABI FOR AUTONOMOUS STREAM

M.TECH. (ENVIRONMENTAL ENGINEERING) COURSES
( FOR STUDENTS ADMITTED FROM ACADEMIC YEAR 2015-16 ONWARDS)

CURRICULUM

I SEMESTER

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subjects</th>
<th>Category</th>
<th>Periods</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA151</td>
<td>Mathematics for Environmental Engineering</td>
<td>TY</td>
<td>3 1 0</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>CY151</td>
<td>Environmental Chemistry and Microbiology</td>
<td>TY</td>
<td>4 0 0</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>CE151</td>
<td>Principles of Physico-Chemical and Biological Treatment Systems</td>
<td>TY</td>
<td>3 1 0</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>CE152</td>
<td>Air Pollution Control Engineering</td>
<td>TY</td>
<td>3 1 0</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>- Elective – I</td>
<td>TY</td>
<td>- - -</td>
<td>40 60 100</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>- Elective – II</td>
<td>TY</td>
<td>- - -</td>
<td>40 60 100</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CE153</td>
<td>Environmental Chemistry and Microbiology Laboratory.</td>
<td>LB</td>
<td>0 0 3</td>
<td>60 40 100</td>
<td>2</td>
</tr>
</tbody>
</table>

Total Credits 26

II SEMESTER

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subjects</th>
<th>Category</th>
<th>Periods</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE154</td>
<td>Transport of Water and Wastewater</td>
<td>TY</td>
<td>3 1 0</td>
<td>40 60 100</td>
<td>4</td>
</tr>
<tr>
<td>CE155</td>
<td>Design and Operation of Water and Wastewater Treatment Systems</td>
<td>TCM</td>
<td>3 0 2</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>- Elective – III</td>
<td>TY</td>
<td>- - -</td>
<td>40 60 100</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>- Elective – IV</td>
<td>TY</td>
<td>- - -</td>
<td>40 60 100</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>- Elective – V</td>
<td>TY</td>
<td>- - -</td>
<td>40 60 100</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>- Elective – VI</td>
<td>TY</td>
<td>- - -</td>
<td>40 60 100</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CE156</td>
<td>Mini Project</td>
<td>PR</td>
<td>- - -</td>
<td>60 40 100</td>
<td>2</td>
</tr>
</tbody>
</table>

Total Credits 26
### III SEMESTER

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subjects</th>
<th>Category</th>
<th>Periods</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>CE157</td>
<td>Research Methodology</td>
<td>PR</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CE158</td>
<td>Project Phase – I</td>
<td>PR</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td><strong>Total Credits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### IV SEMESTER

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subjects</th>
<th>Category</th>
<th>Periods</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>CE159</td>
<td>Project Phase – II</td>
<td>PR</td>
<td>0</td>
<td>0</td>
<td>36</td>
</tr>
<tr>
<td>-</td>
<td>Professional Development Course – I &amp; II</td>
<td>PR</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td><strong>Total Credits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Students may start satisfying this requirement (refer para: 6.10) even during the first year. However, the assessment will be made in the fourth semester only.

# CA – Continuous Assessment, SE – Semester Examination, TM – Total Marks

* TY – Theory, TCM – Theory with a Mini Project, LB – Laboratory, PR – Practice
### LIST OF ELECTIVE SUBJECTS

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subjects</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE51</td>
<td>Air and Water Quality Modeling</td>
<td>TY</td>
</tr>
<tr>
<td>CEE52</td>
<td>Cleaner Production and Environmental management</td>
<td>TY</td>
</tr>
<tr>
<td>CEE53</td>
<td>Ecological Engineering</td>
<td>TY</td>
</tr>
<tr>
<td>CEE54</td>
<td>Energy and Environmental Management</td>
<td>TY</td>
</tr>
<tr>
<td>CEE55</td>
<td>Environment, Health and Safety in Industries</td>
<td>TY</td>
</tr>
<tr>
<td>CEE56</td>
<td>Environmental Biotechnology</td>
<td>TY</td>
</tr>
<tr>
<td>CEE57</td>
<td>Environmental Geotechnology</td>
<td>TY</td>
</tr>
<tr>
<td>CEE58</td>
<td>Environmental Impact Assessment</td>
<td>TY</td>
</tr>
<tr>
<td>CEE59</td>
<td>Environmental Policies and Legislation</td>
<td>TY</td>
</tr>
<tr>
<td>CEE60</td>
<td>Environmental Reaction Engineering</td>
<td>TY</td>
</tr>
<tr>
<td>CEE61</td>
<td>Environmental Risk Assessment and Management</td>
<td>TY</td>
</tr>
<tr>
<td>CEE62</td>
<td>Fundamentals of Sustainable Development</td>
<td>TY</td>
</tr>
<tr>
<td>CEE63</td>
<td>Industrial Wastewater Management</td>
<td>TY</td>
</tr>
<tr>
<td>CEE64</td>
<td>Principles of Environmental Science</td>
<td>TY</td>
</tr>
<tr>
<td>CEE65</td>
<td>Project Formulation and Appraisal</td>
<td>TY</td>
</tr>
<tr>
<td>CEE66</td>
<td>Remote Sensing and GIS Applications in Environmental Engineering</td>
<td>TY</td>
</tr>
<tr>
<td>CEE67</td>
<td>Solid and Hazardous Waste Management</td>
<td>TY</td>
</tr>
<tr>
<td>CYE53</td>
<td>Environmental Pollution Monitoring Techniques</td>
<td>TY</td>
</tr>
</tbody>
</table>
SYLLABUS (Core Subjects)
**Department**: Mathematics  
**Programme**: M. Tech. (Environmental Engineering)  
**Semester**: One  
**Category**: TY  

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours /Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA151</td>
<td>Mathematics for Environmental Engineering</td>
<td>3 1 0</td>
<td>4</td>
<td>40 60 100</td>
</tr>
</tbody>
</table>

**Prerequisite**

- To introduce the ideas of linear programming problem.
- To familiarize students with Basic statistics.
- To introduce methods sampling techniques.

**Objectives**

- Understands LPP.
- Gain knowledge on Statistical methods.
- Able to apply Sampling techniques.

**Outcome**

- To introduce the ideas of linear programming problem.
- To familiarize students with Basic statistics.
- To introduce methods sampling techniques.

**UNIT – I**  
**Statistics**  
Hours : 09  
Measures of central tendencies- variance-Regression lines – correlation and rank correlation

**UNIT – II**  
**Linear Programming Problem**  
Hours : 09  
Graphical solution- Simplex method-Big M and Two phase methods-Transportation and assignment problems.

**UNIT – III**  
**Applied Statistics I**  
Hours : 09  
Curve fitting by the method of least squares – fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations

**UNIT – IV**  
**Applied Statistics II**  
Hours : 09  
Small samples: Test for single mean, difference of means and correlation coefficients – test for ratio of variances – Chi–Square test for goodness of fit and independence of attributes.

**UNIT – V**  
**Analysis Of Variance**  
Hours : 09  
Design of experiments - Analysis variance for one factor and two factor analysis

**Total Contact Hours : 45**  
**Total Tutorials : 15**  
**Total Practical Class :**  
**Total Hours : 60**

**Text Books**


**Reference Books**

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY151</td>
<td>Environmental Chemistry and Microbiology</td>
<td>4 0 0 4</td>
<td>40 60 100</td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**
- To know about the fundamental concepts of following domains related to Environmental Engineering:
  - General Chemistry
  - Physical Chemistry
  - Environmental Chemistry
  - Organic and Biochemistry
  - Microbiology and Ecotoxicology

**Objective**
- Clear understanding of Fundamental concepts of:
  - General Chemistry
  - Physical Chemistry
  - Organic Chemistry
  - Biochemistry.

**UNIT – I** Basic Concepts of General Chemistry
- Valency Oxidation State and Bonding, Oxidation and Reduction Equations, Gas Laws, Equilibrium and Le Chatelier’s Principle, Shifting of Equilibrium

**UNIT – II** Basic Concepts of Physical Chemistry
- Osmosis, Dialysis, Colloids, dispersion of colloids, general and electrokinetic properties of colloids, colloidal solution and mixtures

**UNIT – III** Environmental Chemistry
- CNP cycles under aerobic and anaerobic reactions, concept of Hardness, BOD, COD, TOC, Chemistry involved in water treatment process - coagulation, softening, fluorination, defluorination, iron and manganese removal, demineralization, analysis of pesticide and heavy metals. Reactivity of organic functional groups in the interest of Environmental Engineers, Enzymes, and Classification enzymes catalyzed reaction, Mechanism and factors influencing enzymatic reaction, Breakdown and synthesis of carbohydrates, fats, proteins under aerobic and anaerobic reactions.

**UNIT – IV** Basic Concepts of Environmental Microbiology
- Introduction of microbiology, haeckel’s classification and characterization of microorganisms viruses. 2. morphology and structure of bacteria, nutrient requirement, growth of bacteria - prokaryotic, eukaryotic, structure, characteristics, nucleic acids-DNA, RNA, replication. Culturing of microorganisms-Environmental factors influencing microbial growth Distribution of microorganisms - Toxic and Nontoxic microorganisms -Water, Air and Soil, Indicator organisms, coliforms—fecal coliforms, E. coli, Streptococcus, Clostridium, Significance in water. Algae in water supplies—problems and control.MPN and MFT, Virus-concentration techniques

**UNIT – V** Microbiology and Ecotoxicology

**Text Books**

**Reference Books**
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE151</td>
<td>Principles of Physico–Chemical and Biological Treatment Systems</td>
<td>3 1 0 4</td>
<td>40 60 100</td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

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

**Objectives**

- Apply the acquired potential skill on the design and operation of physico-chemical treatment units employed for water and wastewater treatment systems.
- To visualize the theoretical limits on practical applications for physical understanding of the design principles.

**Outcome**

- Apply the acquired potential skill on the design and operation of physico-chemical treatment units employed for water and wastewater treatment systems.
- To visualize the theoretical limits on practical applications for physical understanding of the design principles.

**UNIT – I**

Introduction


**UNIT – II**

Physical Treatment Principles


**UNIT – III**

Chemical Treatment Principles


**UNIT – IV**

Biological Treatment Principles


**UNIT – V**

Advanced Treatment Principles


**Text Books**


**Reference Books**

Department : Civil Engineering  
Programme: M. Tech. Environmental Engineering

Semester : One  
Category : TY

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours/Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE152</td>
<td>Air Pollution Control Engineering</td>
<td>3 1 0 4 40 60 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Prerequisite

Objectives

- To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends.
- To educate theoretical principles and operational control techniques employed in industrial pollution control engineering.

Outcome

- To apply the acquired knowledge gained out of theoretical understanding to the practical application involving air pollution control under industrial units and manmade systems.
- Ability to design and visualize the sizing and operational control under air pollution control in industrial units and manmade systems.

UNIT – I

Introduction


UNIT – II

Control of Particulates

Objectives – Filters, gravitational, centrifugal – multiple type cyclones, prediction of collection efficiency, pressure drop, wet collectors, Electrostatic Precipitation theory-particle charging-particle collection –ESP design procedure.

UNIT – III

Gaseous Pollutant Control


UNIT – IV

Control Measures for Industrial Applications

Control methods – Processes based control mechanisms – mineral products – asphaltic concrete, cement plants and glass manufacturing plants; Thermal power plants, Petroleum refining and storage plants, Fertilizers, Pharmaceuticals and wood processing industry. Field Study.

UNIT – V

Indoor Air Quality Management

Noise Standards; measurement, control and preventive measures, indoor air quality measures and management.

Total Contact Hours : 45  
Total Tutorials : 15  
Total Practical Class :  
Total Hours : 60

Text Books


Reference Books

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours /Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE153</td>
<td>Environmental Chemistry And Microbiology Lab</td>
<td>0 0 3 2</td>
<td>60 40 100</td>
<td></td>
</tr>
</tbody>
</table>

**Objectives**
- To acquire knowledge in environmental chemical and microbiological analysis of air, water and soil.
- To acquire analytical skill in assessing the pollution potential for environmental control.

**Outcome**
- Ability to apply the acquired analytical skill on the pollution control of air, water and soil.
- Ability to visualize the practical application under field condition.

**Chemistry Laboratory Practice**
Sampling and characterization of water and wastewater by gravimetric, volumetric and colorimetric methods – Sampling and analysis of ambient air for SPM, SO$_2$, Oxides of nitrogen – Good laboratory practice – Analytical quality control.

**Microbiology Laboratory Practicals**

**Air Pollutants And Leachate Analyses**
Instrumental methods of analyses for particulates, HC, CO, NOx, SO$_2$, bioaerosols, TCLP and leachate tests for solidwastes.

**Text Books**

**Reference Books**
Department: Civil Engineering  
Programme: M. Tech. Environmental Engineering

Semester: Two  
Category: TY

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours/Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE154</td>
<td>Transport of Water and Wastewater</td>
<td>3 1 0 4 40 60 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Prerequisite

Objectives

- To educate the students in detailed design concepts related to water transmission mains, water distribution system.
- To educate and give analytical skill for solving sewer networks and storm water drain by computer application on design.

Outcome

- Apply the ability gained from theory to the practical design and sizing of water distribution system.
- Apply the ability gained from theory to the practical design and sizing of sewer lines and wastewater treatment system.

UNIT – I  
General Hydraulics and Flow Measurement  
Hours: 09

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

UNIT – II  
Water Transmission and Distribution  
Hours: 09

Need for Transport of water and wastewater-Planning of Water System –Selection of pipe materials, pipe thickness calculations. Design of intake works - Water transmission main design- gravity and pumping main; Selection of Pumps- characteristics-economics; Specials, Jointing, laying and maintenance, water hammer analysis.

UNIT – III  
Water Distribution Systems  
Hours: 09


UNIT – VI  
Wastewater Collection and Conveyance  
Hours: 09

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

UNIT – V  
Storm Water Drainage  
Hours: 09

Necessity - combined and separate system; Estimation of storm water runoff Formulation of rainfall intensity duration and frequency relationships- Rational methods. Use of computer software in storm water design.

Total Contact Hours: 45  
Total Tutorials: 15  
Total Practical Class:  
Total Hours: 60

Text Books


Reference Books

Department : Civil Engineering  
Programme: M. Tech. Environmental Engineering  

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours /Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE155</td>
<td>Design and Operation of Water and Wastewater Treatment Systems</td>
<td>3 0 2 4 50 50 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Prerequisite

Objectives

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

Outcome

- To apply the design knowledge on the practical design and operation of water and wastewater treatment units.
- Ability to visualize the validation of the capacity and sizing of wastewater treatment units with practical limits.

UNIT – I  
Design of Municipal Water Treatment Plants  
Hours : 09


UNIT – II  
Design of Wastewater Treatment Plants  
Hours : 09


UNIT – III  
Design of Industrial Water Treatment Plants  
Hours : 09


UNIT – IV  
Sludge and Residual Management  
Hours : 09


UNIT – V  
Mini Project – Case Studies  
Hours : 09

Design, Drawing and detailing of Water/ Wastewater systems, Retrofitting Case studies, CDM and carbon credit assessments.

Total Contact Hours : 45  
Total Tutorials :  
Total Practical Class : 30  
Total Hours : 75

Text Books


Reference Books

2. Manual on “Sewerage and Sewage Treatment” CPHEEO, Ministry of Urban Development, Government of
India, New Delhi, 2013.
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE156</td>
<td>Mini Project</td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Description**

In the mini project, student will be encouraged to visualize field condition and perform a field oriented design in the core area of the subject including analysis, design and validate it with real system. By this exercise student will get field exposure and capability in solving potential problems and issues.
**Department**: Civil Engineering  
**Programme**: M. Tech. Environmental Engineering  
**Semester**: Three  
**Category**: PR

<table>
<thead>
<tr>
<th>Subject code</th>
<th>Subject</th>
<th>Hours/week</th>
<th>Credit</th>
<th>Maximum marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>CE157</td>
<td>Research Methodology</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
</tbody>
</table>

**Prerequisite**  
-  

**Objectives**  
- To educate students to methods of selection of research problems  
- To expose students to different research methods

**Outcomes**  
- Students will be capable to identify and narrow down to the area of research on the basis the requirements of industrial and global requirements  
- Students will exhibit the domain skill to choose suitable research methods to execute research effectively  
- Students will possess knowledge to further their academic program, namely, Ph.D program.

- **Characteristics of research**: Various functions that describe characteristics of research such as systematic, valid, verifiable, empirical and critical approach.  
- **Types of research**: Pure and applied research. Descriptive and explanatory research. Qualitative and quantitative approaches.  
- **Research procedure**: Formulating the Research Problem, Literature Review, Developing the objectives, Preparing the research design including sample. Design, Sample size.  
- **Considerations in selecting research problem**: Relevance, interest, available data, choice of data, Analysis of data, Generalization and interpretation of analysis.  

**Total contact hours**: -  
**Total tutorials**: -  
**Total practical classes**: 15  
**Total hours**: 15

**Reference books**:
1. Dawson, Catherine, Practical Research Methods, UBS Publishers and Distributors, New Delhi, 2002  
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE158</td>
<td>Project Phase - I</td>
<td>-</td>
<td>24</td>
<td>150</td>
</tr>
</tbody>
</table>

**Description**

The project work will start in semester III and the duration would be six months. Project phase - I includes introduction including objectives, limitations of study, Literature Survey, background to the research, Problem statement and methodology of work, Theoretical contents associated with topic of research, Field Applications, case studies, Data collection from field/organizations or details of experimental work/analytical work. The evaluation of the dissertation will be as per the regulations.
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>CE159</td>
<td>Project Phase - II</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Description**

It is the continuation of the Project phase-I. It includes a detailed experimental work/ analytical work, results and discussion, conclusions and future research work. The project is to be submitted at the end of fourth semester. The evaluation of the dissertation will be as per the regulations. The findings/outcome of the dissertation work shall be published in standard journals/symposia etc. Publication may be completed before the viva-voce examination.
SYLLABUS (Elective Subjects)
### Subject: Air and Water Quality Modelling

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours/Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE51</td>
<td>Air and Water Quality Modelling</td>
<td>3 1 0 4</td>
<td>40 60 100</td>
<td></td>
</tr>
</tbody>
</table>

#### Prerequisite
- To introduce the fundamentals of mathematical models for water quality and the importance of model building.
- To acquaint with various water flow models and their kinetics.
- To educate about the water parameters modelling and various ground water quality modelling.

#### Objectives
- Ability to visualize the modeling and behavior of air and water quality systems
- To visualize the physical limits on the air and water quality systems through modeling and software systems.
- Ability to validate the findings of modeling on the ground reality under air, water, soil systems.

#### Outcome
- Ability to visualize the modeling and behavior of air and water quality systems
- To visualize the physical limits on the air and water quality systems through modeling and software systems.
- Ability to validate the findings of modeling on the ground reality under air, water, soil systems.

#### UNIT - I
**Modelling/Concept**

Water and air quality management – Role of mathematical models; systems approach – systems and models – kinds of mathematical models – model development and validation effluent and stream standards; ambient air quality standards.

#### UNIT – II
**Surface Water Quality Modelling**


#### UNIT – III
**Air Quality Modelling**

Transport and dispersion of air pollutants – wind velocity, wind speed and turbulence; estimating concentrations from point sources – the Gaussian Equation – determination of dispersion parameters, atmospheric stability; dispersion instrumentation – Atmospheric traces; concentration variation with averaging time; Air pollution modeling and prediction – Plume rise modeling techniques, modeling for non-reactive pollutants, single source – short term impact, multiple sources and area sources, model performance and utilization, computer models.

#### UNIT – IV
**Groundwater Quality Modelling**

Mass transport of solutes, degradation of organic compounds, application of concepts to predict groundwater contaminant movement, seawater intrusion – basic concepts and modeling

#### UNIT – V
**Computer Models**

Exposure to computer models for surface water quality, groundwater quality and air quality.

### Text Books

### Reference Books
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE52</td>
<td>Cleaner Production and Environmental Management</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>100</td>
</tr>
</tbody>
</table>

**Prerequisite**

- To understand the importance of Material Science as a subject that revolutionized modern day technologies
- To understand the significance of material science in the development of new materials and devices for all branches of Engineering.

**Objectives**

- Ability to apply the acquired knowledge under the cleaner practices in industrial, production systems. Ability to apply the acquired knowledge in environmental management system.
- Ability to prepare environmental assessment and preparation of reports under cleaner production and environmental management.

**Outcome**

- Ability to apply the acquired knowledge under the cleaner practices in industrial, production systems. Ability to apply the acquired knowledge in environmental management system.
- Ability to prepare environmental assessment and preparation of reports under cleaner production and environmental management.

**UNIT – I**

**Introduction**

- Sustainable Development – Indicators of Sustainability – Sustainability Strategies
- Barriers to Sustainability – Industrial activity and Environment – Industrialization and sustainable development
- Industrial Ecology – clean development mechanism, Cleaner Production (CP) in Achieving Sustainability – Prevention versus Control of Industrial Pollution – Environmental Polices and Legislations – Regulations to Encourage Pollution Prevention and Cleaner Production – Regulatory versus Market-Based Approaches.

**UNIT – II**

**Principles Cleaner Production**


**UNIT – III**

**Cleaner Production Project Development and Implementation**


**UNIT – IV**

**Life Cycle Assessment and Environmental Management Systems**


**UNIT – V**

**Case Studies**

- Industrial applications of CP, LCA, EMS and Environmental Audits, green energy and green process management.

**Text Books**


**Reference Books**

**Department:** Civil Engineering  
**Programme:** M. Tech. Environmental Engineering

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours /Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE53</td>
<td>Ecological Engineering</td>
<td>4 0 0 4 40 60 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

- To know about the environment
- To understand about environmental pollution
- To apply the knowledge in understanding various environmental issues and problems

**Objectives**

- To apply the acquired knowledge and skill on the ecological control of air, water and soil systems,
- Ability to solve environmental problems and issues under ecological engineering,
- Ability to visualize the application of control principles on the ecological control of natural and manmade systems.

**Outcome**

- To apply the acquired knowledge and skill on the ecological control of air, water and soil systems,
- Ability to solve environmental problems and issues under ecological engineering,
- Ability to visualize the application of control principles on the ecological control of natural and manmade systems.

**UNIT – I**  
**Introduction to Ecology and Ecological Engineering**  
Hours : 12

Aim – scope and applications of Ecology, Ecological Engineering and Ecotechnology and their relevance to human civilization – Development and evolution of ecosystems – Principles and concepts were pertaining to communities in ecosystem – Energy flow and material cycling in ecosystems – Productivity in ecosystems.

**UNIT – II**  
**Systems Approach in Ecological Engineering**  
Hours : 12

Classification of ecotechnology – Principles and components of Systems and Modeling – Structural and functional interactions in environmental systems – Human modifications of environmental systems.

**UNIT – III**  
**Ecological Engineering Processes**  
Hours : 12


**UNIT – IV**  
**Ecotechnology for Waste Treatment**  
Hours : 12


**UNIT – V**  
**Case Studies**  
Hours : 12

Case studies of integrated ecological engineering systems.

**Text Books**


**Reference Books**

Subject Code: CEE54  
Subject: Energy and Environmental Management

<table>
<thead>
<tr>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Prerequisite**

1. To study about the Energy principles and procedure for energy audit.
2. To have a knowledge on the impact of various developmental Projects on environment and to decide appropriate technologies to quantify the impact.
3. To have a knowledge on the various mitigation measures and to prepare the BIS and EMP.

**Objectives**

1. To study about the Energy principles and procedure for energy audit.
2. To have a knowledge on the impact of various developmental Projects on environment and to decide appropriate technologies to quantify the impact.
3. To have a knowledge on the various mitigation measures and to prepare the BIS and EMP.

**Outcome**

- An ability to identify and quantify the impacts due to various projects on environment and plan, mitigation measures; to safeguard the environment.
- An ability to quantify the energy utilization under various applied environmental management system.

**UNIT – I Energy Systems**

- Energy sources; coal oil, natural gas; nuclear energy; hydro electricity; other fossil fuels; geothermal; supply and demand; depletion of resources; need for conservation; uncertainties; national and international issues.

**UNIT – II Energy Requirements and Utilization**

- Forecasting techniques; energy demand; magnitude and pattern; input and output analysis; energy modeling and optimal mix of energy sources. Energy; various forms; energy storage; structural properties of environment; Bio-geo-chemical cycles; society and environment population and technology. Energy and evolution; growth and change; patterns of consumption in developing and advanced countries; commercial generation of power requirements and benefit.

**UNIT – III Power and Production System**

- Bio-geo-chemical cycles; society and environment population and technology. Energy and evolution; growth and change; patterns of consumption in developing and advanced countries; commercial generation of power requirements and benefit.

**UNIT – IV Environmental Management**


**UNIT – V Legal aspects in Environmental Management**


**Text Books**


**Reference Books**

Department: Civil Engineering  
Programme: M. Tech. Environmental Engineering

Semester:  
Category: TY

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>CEE55</td>
<td>Environment, Health and Safety in Industries</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Prerequisite**

- To learn and understand the safety measures and issues in industrial scenarios involving process and risk operations.
- To impart knowledge under various aspects of environmental health and safety practiced in various industrial sectors.

**Objectives**

- Ability to apply and monitor the safety measures in industries under health and environmental protection perspectives.
- Ability to visualize and forecast the damages under safety measures under worst industrial pollution scenarios.

**UNIT – I**  
Introduction  
Hours: 09


**UNIT – II**  
Occupational Health And Hygiene  
Hours: 09


**UNIT – III**  
Workplace Safety And Safety Systems  
Hours: 09

Features of the satisfactory design of work premises HVAC, ventilation. Safe installation and use of electrical supplies. Fire safety and first aid provision. Significance of human factors in the establishment and effectiveness of safe systems. Safe systems of work for manual handling operations. Control methods to eliminate or reduce the risks arising from the use of work equipment. Requirements for the safe use of display screen equipment. Procedures and precautionary measures necessary when handling hazardous substances. Contingency arrangements for events of serious and imminent danger.

**UNIT – IV**  
Techniques Of Environmental Safety  
Hours: 09


**UNIT – V**  
Education And Training  
Hours: 09

Requirements for and benefits of the provision of information, instruction, training and supervision. Factors to be considered in the development of effective training programmes. Principles and methods of effective training. Feedback and evaluation mechanism.

Total Contact Hours: 45  
Total Tutorials: 15  
Total Practical Class:  
Total Hours: 60

**Text Books**


**Reference Books**

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours/Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE56</td>
<td>Environmental Biotechnology</td>
<td>3 L 1 T 0 P</td>
<td>4 C 40 CA 60 SE 100 TM</td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**
- To gain knowledge on biotechnological principles and its application under environmental pollution control engineering involving air, water and soil.
- To understand and acquire knowledge on the kinetics and scale up of the process.

**Objectives**
- Ability to visualize the practical application of biotechnological principles on the environmental pollution control engineering.
- Apply the gained knowledge on the design and implementation of biotechnological control systems.

**Outcome**
- Principles and concepts of environmental biotechnology – usefulness to mankind.
- Microbial Systems for Detoxification of Environmental Pollutants
- Environmental effects and ethics of microbial technology – safety of genetically engineered organisms.

**Text Books**

**Reference Books**
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours /Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE57</td>
<td>Environmental Geotechnology</td>
<td>3 1 0 4 40 60 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**
- To impart knowledge on the geo-environmental principles and apply them under pollution control engineering.
- To understand the behavior of soil pollution interaction systems and to gain knowledge and apply them on the geo-environmental and pollution control techniques for validating underground reality.
- Ability to apply the geo-environmental principles on the environmental pollution control engineering.
- Ability to apply the control techniques on the remediation of soil pollutant laden system.

**UNIT – I Soil- Pollutant Interaction**

**UNIT – II Characterization, Stabilization And Disposal**

**UNIT – III Transport of Contaminants**

**UNIT – IV Detection and Testing Methods**
Methodology- review of current soil testing concepts – Proposed approach for characterization and identification of contaminated ground soil for engineering purposes.

**UNIT – V Remediation of Contaminated Soils**
Rational approach to evaluate and remediate contaminated sites – monitored natural attenuation – ex situ and insitu remediation – solidification, bio – remediation, incineration, soil washing, electro kinetics, soil heating, verification, bio venting – Ground water remediation – pump and treat, air sparging, reactive well- application of geo synthetics in solid waste management – rigid or flexible liners.

**Text Books**

**Reference Books**
Department: Civil Engineering  
Programme: M. Tech. Environmental Engineering

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE58</td>
<td>Environmental Impact Assessment</td>
<td>3 1 0 4 40 60 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Prerequisite

Objectives
- To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment
- To develop the skill to prepare environmental management plan.

Outcome
- Ability to prepare draft and detailed reports under EIA.
- Ability to compare and validate the impacts on real systems under air, water and soil.

UNIT – I  
Introduction  
Hours: 09

UNIT – II  
Components and Methods for EIA  
Hours: 09

UNIT – III  
Socio-Economic Impact Assessment  
Hours: 09

UNIT – IV  
Environmental Management Plan  
Hours: 09

UNIT – V  
Sectoral EIA  
Hours: 09

Total Contact Hours: 45  
Total Tutorials: 15  
Total Practical Class:  
Total Hours: 60

Text Books

Reference Books
2. World Bank –Source book on EIA
Department: Civil Engineering  
Programme: M. Tech. Environmental Engineering

Semester: TY  
Category: TY

Subject Code | Subject | Hours /Week | Credit | Maximum Marks  
-------------|---------|-------------|--------|----------------|
| L | T | P | C | CA | SE | TM |
| CEE59 | Environmental Policies and Legislation | 4 | 0 | 0 | 4 | 40 | 60 | 100 |

Prerequisite

Objectives
- To impart knowledge on environmental policies and legislation under environmental management theme.
- To gain knowledge on current environmental issues; and methods and practices for solving them through the application of environmental policies and legislation.

Outcome
- Ability to apply the environmental policies and legislative measures on the effective management of environmental problems.
- Ability to develop strategies for new environmental reforms and policies for effective environmental management.

UNIT – I  
Introduction  
Hours: 12


UNIT – II  
Water (P&CP) Act, 1974  
Hours: 12

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

UNIT – III  
Air (P&CP) Act, 1981  
Hours: 12

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

UNIT – IV  
Environment (Protection) Act 1986  
Hours: 12

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

UNIT – V  
Other Topics  
Hours: 12

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

Total Contact Hours: 60  
Total Tutorials:  
Total Practical Class:  
Total Hours: 60

Text Books

Reference Books
Department: Civil Engineering
Programme: M. Tech. Environmental Engineering

Semester: Category: TY

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours /Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>CEE60</td>
<td>Environmental Reaction Engineering</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Prerequisite

Objectives
- An ability to identify and address current and future societal problems related to environment within a broader framework of sustainable development.
- An ability to apply a multi-disciplinary approach to conceive, plan, design, and implement solutions to problems in the field of environmental reaction engineering.

Outcome
- Apply the ability gained through multi disciplinary approach on to the implementable solutions involving environmental reaction and process engineering.
- Apply the acquired knowledge for solving environmental pollution problems involving reaction engineering transformations.

UNIT – I  Introduction  Hours : 09

UNIT – II Pollutants and Reactions in Environment  Hours : 09

UNIT – III Reactors Modelling and Design  Hours : 09
Ideal systems modeling and design, reactor concepts, ideal reactors, reaction rate measurements, hybrid system modeling and design, sequencing batch reactor, reactors in series and reactors in recycle. Non-ideal system modeling and design, non-ideal reactor behavior, RTD analysis, PFDR model

UNIT – IV Mass Transfer and its Applications in Environmental Engineering  Hours : 09
Principles of diffusion and mass transfer between phases, Gas absorption, humidification operations, leaching and extraction, drying of solids, fixed-bed separation, membrane separation process, fluid solid surface reactions, Gas-liquid bulk phase reaction, adsorption.

UNIT – V Biological Reaction Engineering  Hours : 09

Total Contact Hours : 45  Total Tutorials : 15  Total Practical Class :  Total Hours : 60

Text Books

Reference Books
**Department**: Civil Engineering  

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours/Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE61</td>
<td>Environmental Risk Assessment and Management</td>
<td>3 1 0 4</td>
<td>40 60 100</td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

- To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

**Objectives**

- Ability to solve environmental risk assessment in process and chemical industries and allied environmental problems by applying environmental risk principles and mitigative measures.

**Outcome**

**UNIT-I**  
Introduction  
Sources of Environmental hazards – Environmental and ecological risks – Environmental risk assessment framework – Regulatory perspectives and requirements – Risk Analysis and Management and historical perspective; Social benefit Vs technological risks; Path to risk analysis; Perception of risk, risk assessment in different disciplines.

**UNIT-II**  
Elements Of Environmental Risk Assessment  

**UNIT-III**  
Tools And Methods For Risk Assessment  

**UNIT-IV**  
Risk Management  

**UNIT-V**  
Applications  

**Total Hours**: 45  
**Total Tutorials**: 15  
**Total Practical Class**:  
**Total Hours**: 60

**Text books**


**Reference Books**

Department: Civil Engineering  
Programme: M. Tech. Environmental Engineering

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours /Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE62</td>
<td>Fundamentals of Sustainable Development</td>
<td>L 3 T 1 P 0</td>
<td>C 4</td>
<td>CA 40 SE 60 TM 100</td>
</tr>
</tbody>
</table>

**Prerequisite**
- To gain knowledge in sustainable principles and fundamentals and apply them in environmental pollution control and management.
- To gain knowledge for design of environmental sustainable system.

**Objectives**
- Ability to apply the gained knowledge in the design of sustainable management system.
- Ability to visualize the practical issues and the solving complex problems through sustainable principle and design.

**Outcome**

**UNIT – I**  
Principles of Sustainable Development  
Hours: 09

**UNIT – II**  
Indians Judiciary System and Sustainable Development  
Hours: 09

**UNIT – III**  
Sustainable Development and International Contribution  
Hours: 09

**UNIT – IV**  
Socio-Economic Sustainable Development Systems  
Hours: 09

**UNIT – V**  
Agenda for Future Global Sustainable Development  
Hours: 09
Role of developed countries in the sustainable development of developing countries – Demographic dynamics and sustainability – Integrated approach for resource protection and management.

**Text Books**

**Reference Books**
**Department**: Civil Engineering  
**Programme**: M. Tech. Environmental Engineering

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours/Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE63</td>
<td>Industrial Wastewater Management</td>
<td>3 1 0 4</td>
<td>40 60 100</td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

**Objectives**
- To provide knowledge on sources and characteristics of industrial wastewater, techniques and approaches for minimizing the generation.
- To educate the application of physico chemical and biological treatment methods for recovery, reuse and disposal supported with case studies under Indian situations.

**Outcome**
- To apply the ability gained on the practical design and detailing of industrial wastewater treatment systems.
- Ability to design the treatment units for recovery and reuse of valuable resources from industrial effluents and waste sludges.

**UNIT – I**  
**Introduction**  
Hours : 09  

**UNIT – II**  
**Industrial Pollution Prevention**  
Hours : 09  

**UNIT – III**  
**Industrial Wastewater Treatment**  
Hours : 09  

**UNIT – IV**  
**Wastewater Reuse and Residual Management**  
Hours : 09  

**UNIT – V**  
**Case Studies**  
Hours : 09  

**Total Contact Hours**: 45  
**Total Tutorials**: 15  
**Total Practical Class**:  
**Total Hours**: 60

**Text Books**

**Reference Books**

31
Department: Civil Engineering  
Programme: M. Tech. Environmental Engineering  
Semester:  
Category: TY  

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE64</td>
<td>Principles of Environmental Science</td>
<td>4 0 0 4</td>
<td>40 60 100</td>
<td></td>
</tr>
</tbody>
</table>

Prerequisite

Objectives

- Understand the basic concepts of surveying and able to solve problems associated with linear measurements and error correction.
- Gain the basics of compass surveying and able to understand the system of coordinates and angular measurement for the purpose of traversing and learning of various methods of taking levels and reducing levels.

Outcome

- Ability to visualize the fundamental concept of environmental behavior due to various spectrums of pollutants.
- Ability to apply the practical applications for the control of air, water and soil pollution systems.

UNIT – I  
Introduction  

UNIT – II  
Biological Systems  

UNIT – III  
Microbiology of Environment  

UNIT – IV  
Chemistry of Aquatics  

UNIT – V  
Chemistry of Atmosphere  

Total Contact Hours: 60  
Total Tutorials:  
Total Practical Class:  
Total Hours: 60

Text Books


Reference Books

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE65</td>
<td>Project Formulation and Appraisal</td>
<td>3 L 1 T 0 P 4</td>
<td>40 CA 60 SE 100 TM</td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

- To study and understand the formulation, costing of construction projects, appraisal, finance and private sector participation.

**Objectives**

- On completion of this course the students will be able to know the formulations of projects, projects costing, appraisal and financing.

<table>
<thead>
<tr>
<th>UNIT – I</th>
<th>Project Formulation</th>
<th>Hours : 09</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th>UNIT – II</th>
<th>Project Costing</th>
<th>Hours : 09</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th>UNIT – III</th>
<th>Project Appraisal</th>
<th>Hours : 09</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th>UNIT – IV</th>
<th>Project Financing</th>
<th>Hours : 09</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th>UNIT – V</th>
<th>Private Sector Participation</th>
<th>Hours : 09</th>
</tr>
</thead>
</table>

Private sector participation in Infrastructure Development Projects – Environmental pollution control systems BOT, BOLT, BOOT - Technology Transfer and Foreign Collaboration - Scope of Technology Transfer – Emerging environmental management techniques and strategies.

**Text Books**


**Reference Books**

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>T</td>
<td>P</td>
<td>C</td>
<td>CA</td>
</tr>
<tr>
<td>CEE66</td>
<td>Remote Sensing and GIS Applications in Environmental Engineering</td>
<td>3</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

**Prerequisite**

- To educate the students on the principles and applications of Remote sensing and GIS in environmental management

**Objectives**

- To apply the gained knowledge in the application of remote sensing and GIS application in environmental pollution control assessment and monitoring.

**UNIT I**

**Remote Sensing**


**UNIT II**

**Emr Interaction with Atmosphere and Earth Materials**


**UNIT III**

**Optical and Microwave Remote Sensing**


**UNIT IV**

**Geographic Information System**


**UNIT V**

**Miscellaneous Topics**


**Text Books**


**Reference Books:**

### Subject Code: CEE 67
Subject: Solid and Hazardous Waste Management

<table>
<thead>
<tr>
<th>Hours /Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Prerequisite

- 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.
- To impart skill for design of solid and hazardous treatment systems.

#### Objectives

- Ability to design the collection and treatment units for the management of municipal and hazardous waste.
- Ability to design and detail out the energy recovery and reuse systems for sustainable management of solid waste.
- Ability to solve the emerging issues and problems due to solid waste disposal.

#### Outcome

- Ability to design the collection and treatment units for the management of municipal and hazardous waste.
- Ability to design and detail out the energy recovery and reuse systems for sustainable management of solid waste.
- Ability to solve the emerging issues and problems due to solid waste disposal.

#### UNIT – I
Title: Municipal Solid Waste Management
Hours: 09


#### UNIT – II
Title: Collection and Transport of Solid Waste
Hours: 09


Transfer and Transport: Need for transfer operation, transport means and methods, transfer station types and design requirements. Landfills: Site selection, design and operation, drainage and leachate collection systems – control of leachate in landfills, designated waste landfill remediation – Integrated waste management facilities.

#### UNIT – III
Title: Hazardous Waste Management
Hours: 09


#### UNIT – IV
Title: Hazardous Waste Treatment and Design
Hours: 09

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

#### UNIT – V
Title: Laboratory Practice
Hours: 09

Sampling and characterization of Solid Wastes; TCLP tests and leachate studies.

**Total Contact Hours:** 45  |  **Total Tutorials:**  |  **Total Practical Class:** 15  |  **Total Hours:** 60

#### Text Books

#### Reference Books
3. Management of Municipal Solid Waste: Delhi: CPCB.
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>CYE53</td>
<td>Environmental Pollution Monitoring Techniques</td>
<td>3 1 0 4</td>
<td>40 60 100</td>
<td></td>
</tr>
</tbody>
</table>

**Prerequisite**

- To make the student to understand the basic principles of environmental pollution problems through instrumental monitoring and assessment.
- To impart knowledge to access the magnitude of pollutants emerging through various industrial and artificial sources.

**Objectives**

- Ability to quantify the magnitude and distribution of pollutants obtained through various sampling methodologies and techniques.
- Ability to validate the magnitude and effect of pollutants on real systems involving various manmade sources.

**Outcome**

- Basic principles of Volumetric Analysis, Gravimetric analysis, Basic principles and instrumentation of pH measurement, Conductometry, Potentiometry.
- Analysis of CO(x), NO(x), SO(x), Hydrocarbon, particulates in air. Atomic Absorption Spectroscopic method of Determination of Arsenic, Chromium, Copper, Mercury (AES), Spectrophotometric method of determination of Arsenic, Chromium, Copper, Mercury, Iron, Manganese.

Total Contact Hours : 45
Total Tutorials : 15
Total Practical Class : 15
Total Hours : 60

**Text Books**


**Reference Books**