Course Objective
The student will have complete knowledge of Environmental pollution sources, analysis and monitoring; Legislation and Acts, Environmental attributes and systems, Environmental ethics related to Sustainable development with Remediation and Forensics.

Student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Explain various Environmental pollution / contamination issues, code of practice, and Environmental legislation.</td>
</tr>
<tr>
<td>CO2</td>
<td>Describe urban land use pattern pollutant pathways and protection in urban ecosystems.</td>
</tr>
<tr>
<td>CO3</td>
<td>Describe Environmental attributes, different types of sanitation and pollution control concepts</td>
</tr>
<tr>
<td>CO4</td>
<td>Discuss various aspects of Environmental systems, Biodiversity, natural resources &amp; Environmental sanitation.</td>
</tr>
<tr>
<td>CO5</td>
<td>Discuss emerging Environmental problems, preventive measures and forensics.</td>
</tr>
</tbody>
</table>

COURSE CONTENT

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
<th>Number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td><strong>Urban and Rural Ecosystems</strong> - Land use pattern and Landscape, Zoning regulation for different land users and externalities caused by mixed land uses, Special Economic Zone (SEZ), Coastal Regulation Zone (CRZ), Urban green belt concept – Biological species for Carbon Sequestration, Importance of lung space. Neighbourhood concepts. <strong>Rain Water Harvesting</strong> - necessity and types.</td>
<td>10</td>
</tr>
<tr>
<td>CO</td>
<td>COURSE CONTENT</td>
<td>Number of hours</td>
</tr>
<tr>
<td>----</td>
<td>--------------------------------------------------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>3</td>
<td><strong>Environmental Attributes and Parameters</strong> - Air, Water, and Soil Pollution -</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>control at Source, Media and Receptor. Water supply and treatment, Domestic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and industrial wastewater – Collection, Treatment and Disposal. Ionizing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Radiation and Control. Noise – Urban, Rural, and Industrial sources. Solid</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><strong>Environmental Systems</strong> - Assimilative, Supportive and Carrying Capacity,</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>NCR. Environmental Indices – AQI. WQI, NQI. Environmental Sustainability –</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Resource depletion and Environmental degradation – Control strategies. Biodiversity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Concept and Importance. Renewable and Non- Renewable Natural Resources.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Environmental Public Health and Sanitation</strong> - Urban and Rural. Swimming</td>
<td></td>
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<td></td>
<td>pool, Water theme parks, Public bathing Ghats; Institutional Sanitation and</td>
<td></td>
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<tr>
<td></td>
<td>Standards. Mass Balance concepts.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><strong>Recent Trends</strong> - Emerging Environmental problems, Responsibility and Degrees</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>of freedom. Prevention of Significant Deterioration. Pollution prevention</td>
<td></td>
</tr>
<tr>
<td></td>
<td>hierarchy. Environmental cost, Proactive and Passive Environmental management.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Priority contaminants and hazardous substances. Critical thinking on sustaining</td>
<td></td>
</tr>
<tr>
<td></td>
<td>water resources. Remediation. Environmental Forensics. Sustainable development.</td>
<td></td>
</tr>
</tbody>
</table>

**Total hours of Teaching** | **52**

**Text books**


**Reference books**

Course Objective
The student will be able to comprehensively gain knowledge on various aspects of Chemistry, its importance and application in Environmental Engineering practice.

Student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand significance of chemistry and properties of chemical compounds in Environmental Engineering.</td>
</tr>
<tr>
<td>CO2</td>
<td>Synthesize the information on physical &amp; equilibrium chemistry relevant to Environmental issues.</td>
</tr>
<tr>
<td>CO3</td>
<td>Address issues related to Colloidal Chemistry and Biochemistry for application in Environmental Engineering.</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the characteristics of organic compounds and apply the concept of Chemical Thermodynamics in Environmental Engineering Problems.</td>
</tr>
<tr>
<td>CO5</td>
<td>Obtain knowledge on pollution parameters of significance in Environmental Engineering and recent trends in green chemistry.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
<th>Number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction - Scope and Significance of Environmental Chemistry.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Properties of Chemical Compounds - Molecular weight, Equivalent weight, Molecular volume, Critical volume, Boiling point, Melting point, Density - Numerical exercises.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Colloidal Chemistry - Colloidal dispersion in water and air attributes.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Biochemistry - Enzymes, Cofactors, Biochemistry of Carbohydrates and Proteins, Biochemical Pathways, Enzyme reactions.</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>COURSE CONTENT</td>
<td>Number of hours</td>
</tr>
<tr>
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</tr>
<tr>
<td></td>
<td><strong>Total hours of Teaching</strong></td>
<td>52</td>
</tr>
</tbody>
</table>

**Text Books**


**References**

ENVIRONMENTAL FLUID MECHANICS – I

EV 330
4 h/wk
CIE: 50 Mks
SEE: 100 Mks

Course Objective
The student will have a strong understanding of Fluid Mechanics in terms of theoretical knowledge of fluid properties. Flow characteristics hydrostatics and flow measurement as applied to environmental engineering aspects.

Student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Discuss the properties of fluids and their significance with respect to Environmental Engineering.</td>
</tr>
<tr>
<td>CO2</td>
<td>Discuss about pressure and its measurements in open &amp; closed conduits.</td>
</tr>
<tr>
<td>CO3</td>
<td>Evaluate hydrostatics, kinematics of fluids under different flow conditions and dimensional analysis.</td>
</tr>
<tr>
<td>CO4</td>
<td>Explain the concepts of Euler’s &amp; Bernoulli’s Equation and its applications.</td>
</tr>
<tr>
<td>CO5</td>
<td>Analyse impacts of Jets on different type of plates.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
<th>Number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Fluid Properties and Classification</strong> - Fluids and Continuum, properties of Fluids, Newtonian and non-Newtonian fluids: applications, Capillarity. Newton’s law of Viscosity, Surface Tension – Numerical exercises.</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td><strong>Fluid Pressure and Measurement</strong> - Pressure at a point, Pascal’s law, Hydrostatic pressure law, Pressure-density-height relationship. Absolute and Gauge pressure, Manometers and types - Numerical exercises.</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td><strong>Hydrostatics</strong> - Pressure - Equation for hydrostatic force, depth of centre of pressure on plane surfaces (vertical and inclined), inclined surfaces, vertically submerged and curved surfaces - Numerical exercises.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>Dimensional analysis and model similitude</strong> - Units, Scale effects, Dimensional Homogeneity, Methods of Analysis, Model Studies, Similitude, Dimensionless parameters. Froude’s and Reynold’s models - Numerical exercises.</td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>COURSE CONTENT</td>
<td>Number of hours</td>
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</tr>
<tr>
<td>4</td>
<td><strong>Dynamics of Fluid Flow</strong> - Concept of Inertia, derivation of Euler’s and Bernoulli’s equations - limitations, modification of Bernoulli’s equation - problems and applications of Bernoulli’s equation - Pitot tube and Venturimeter, Momentum equation - Numerical exercises.</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td><strong>Impact of Jets</strong> - Introduction, force exerted by the jet on plates - stationary vertical, inclined and curved. In the direction of jet - moving flat vertical plate, inclined plate and curved plate. Unsymmetrical moving curved plate when jet strikes tangentially at one end of the tip, a series of flat and curved vanes. Numerical exercises.</td>
<td>8</td>
</tr>
</tbody>
</table>

**Total hours of Teaching** 52

**Text books**


**Reference books**

Course Objective

The course will expose the student to various facets of construction engineering, conventional, non-conventional and eco friendly engineering materials and their functional properties.

Student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Discuss naturally available material for construction and differentiate between coarse and fine aggregate based on properties.</td>
</tr>
<tr>
<td>CO2</td>
<td>Describe relevant building materials based on engineering properties.</td>
</tr>
<tr>
<td>CO3</td>
<td>Explain allied materials and application in construction.</td>
</tr>
<tr>
<td>CO4</td>
<td>Explain the construction procedures and describe the mixing proportions for different construction materials.</td>
</tr>
<tr>
<td>CO5</td>
<td>Apply the knowledge of Green building construction materials, waste resource recovery and reuse in construction.</td>
</tr>
</tbody>
</table>

### COURSE CONTENT

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
<th>Number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Building Stones</strong> - Common building stones - Quarrying, Dressing, Deterioration, and Preservation techniques. <strong>Aggregates</strong> - Coarse and Fine aggregates (M sand) – properties.</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td><strong>Bricks</strong> - Types and classification, Manufacturing and testing. <strong>Tiles</strong> - Types, quality and testing. <strong>Timber</strong> - Types, properties, defect sand tests. Methods of Seasoning, Plywood and alternate materials – preservatives. <strong>Lime</strong> - Types and properties. <strong>Cement</strong> - Types, composition and properties, and tests.</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td><strong>Construction Engineering</strong> - Earthwork and foundation in different types of soils; Scaffolding-types and materials. <strong>Mixing proportions</strong> - stone and brick masonry; Lime and Cement mortar. Cement concrete, ready mix concrete, Reinforced concrete, pre-stressed concrete, fiber reinforced concrete; Plastering, flooring-different types, painting; Roof types; Low cost construction-types and materials.</td>
<td>12</td>
</tr>
<tr>
<td>CO</td>
<td>COURSE CONTENT</td>
<td>Number of hours</td>
</tr>
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</tr>
<tr>
<td>5</td>
<td>Recent trends – Green Building materials, fabricated timber, Floating concrete and permeable pavements. Wastes reuse in construction – fly ash, construction debris, sludge, tyres, plastics, etc. Prefabricated Package units for environmental applications.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td><strong>Total hours of Teaching</strong></td>
<td><strong>52</strong></td>
</tr>
</tbody>
</table>

**Text Books**


**Reference books**

**Course Objective**
The student will gain the knowledge and importance of surveying and its applications in Environmental Engineering practice.

**The student will be able to:**

<table>
<thead>
<tr>
<th>CO</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Explain basic principles and different types of survey and its measurements techniques and application of surveying in Environmental Engineering.</td>
</tr>
<tr>
<td>CO2</td>
<td>Describe the application of chain surveying using different instruments and accessories to measure linear distance.</td>
</tr>
<tr>
<td>CO3</td>
<td>Apply the concepts of compass surveying &amp; traversing for their application in water distribution networks and Water - wastewater Treatment plant and other Environmental Engineering applications.</td>
</tr>
<tr>
<td>CO4</td>
<td>Describe the concepts of levelling using dumpy level &amp; Theodilites and their application in water and wastewater engineering</td>
</tr>
<tr>
<td>CO5</td>
<td>Draw contour lines for the project areas and to use advanced surveying techniques to take decisions.</td>
</tr>
</tbody>
</table>

**COURSE CONTENT**

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
<th>Number of classes (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Introduction</strong> - Surveying, Classification and uses of Surveys. Units of Measurements, Maps, Survey of India topographical Maps and their numbering. Basic principles of surveying, Errors, Precision and accuracy. Applications in Environmental Engineering.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>Measurement techniques:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Horizontal distance</strong> - Chains and tapes, Electromagnetic Distance Measurement devices, Ranging of lines, Direct and Indirect, Measurement of distances over sloping grounds, Chain and Tape corrections – Numerical exercises.</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td><strong>Chain Surveying</strong> - Accessories, Selection of stations and lines, Offsets and types, setting out of right angles, Working principle and use of optical square, prism square, cross staff. Field book, conventional symbols, Obstacles in chain survey, Errors in chain survey and precautions, Numerical exercises.</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td><strong>Compass Surveying</strong> - Meridians and bearings, Principle and use of Prismatic compass and Surveyor’s compass, Dip and Declination, Accessories required for compass surveying. Traverse - closed and open traverse, Computation of bearings and included angles, Local attraction, determination and corrections, Dependent and independent co-ordinates, Checks for closed traverse.- Numerical exercises.</td>
<td>8</td>
</tr>
</tbody>
</table>
| 4 | **Levelling** - Principles and basic definitions, dumpy level-types, adjustments and its types, Sensitiveness of bubble tube, Curvature and refraction correction, Types of levelling.  
**Reduced Level** - Booking of levels, Rise and fall method and Height of instrument method, Comparison and arithmetic checks, Fly levelling, Errors and precautions. Introduction to Theodolites. | 8 |
|---|---|---|
| 5 | **Contouring** - Contours - Types, characteristics, methods and uses, Interpolation techniques, Numerical exercises.  
**Recent Trends** - Total station, Laser measurement instrument, GIS and GPS. Household survey for designing water supply and sewerage projects, solid waste management facilities. Condition Assessment survey basic concept. | 5  
10 |

**Total hours of Teaching** 52

**Text Books**


**Reference Books**

ENVIRONMENTAL CHEMISTRY LABORATORY

EV 36L  CIE: 50 Mks
3 h/wk

Course Objective
The laboratory course provides practical experience to students on various qualitative and quantitative analytical techniques for analysis of surface and groundwater samples with due consideration for safety precautions in the lab.

Student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>EXPERIMENTS</th>
<th>Number of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Acquaint with lab layout, apparatus and instruments, chemicals and reagents measurement techniques for various water quality parameters and standards</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>Apply relevant analytical procedure for measuring various physico - chemical water quality parameters and trace contaminants</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>Develop the ability to analyse, interpret and infer the laboratory analytical data</td>
<td></td>
</tr>
</tbody>
</table>

Analysis of water (Surface and Ground)

1. Sampling techniques and preservation  3

2. Physical:
   a. Temperature and DO.
   b. Color (Apparent and true) and Turbidity
   c. Total Solids, Suspended solids, Dissolved and Volatile solids.
   d. Dissolved organic matter (DOM) and Natural organic matter (NOM).  9

3. Chemical:
   a. pH, Alkalinity and Hardness.
   b. Chloride, Conductivity, Sulphate and TDS.
   c. Sodium and Potassium.
   d. Iron and Manganese.
   e. Ammonia, Nitrite and Nitrate.
   f. Sulphate and Phosphate.
   g. Fluoride.
   h. Arsenic.
   i. Boron and Selenium.
   j. Trace contaminants (Heavy metals and pesticides).  24

Total hours of Teaching  36

References
SURVEYING PRACTICE

EV 37L CIE: 50 Mks
3 h/wk

Course Objective
The surveying practice provides an opportunity to the student to practically apply the theoretical aspects of engineering survey using various survey instruments and accessories.

Student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>CONTENT</th>
<th>Number of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Practice linear and angular measurement by setting different geometrical sections using chain, tape and compass</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>Know appropriate instruments for determining difference in elevation as well as distance between two inaccessible points</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>Plot profile and block levels using levelling instrument and demo of Theodolite, Total Station, GPS</td>
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</table>

<table>
<thead>
<tr>
<th>CO</th>
<th>CONTENT</th>
<th>Number of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Distance between two points using direct ranging. Setting perpendiculars using cross staff, Optical Square and tape</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Setting out of rectangle, hexagon using tape/chain</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>To set out rectangles, pentagons, hexagon, using tape/chain and Compass.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>To measure distance between two inaccessible points using Chain/tape and compass.</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>To determine the difference in elevation between two points using fly Leveling technique, booking of levels using HI and Rise &amp; Fall methods.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>To determine difference in elevation between two points using reciprocal Leveling and to determine the collimation error.</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>To conduct profile leveling for water supply/sewage line and to draw the Longitudinal section to determine the depth of cut and depth of filling for a given formation level.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Household survey for water supply and sanitation. Conditional survey for water supply and sanitation.</td>
<td></td>
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</tbody>
</table>

Demonstration Instruments:
1. Theodolite
2. Total Station
3. GPS

Total hours of Teaching 36

References
Course Objective
The student gains knowledge on different sources of pollution, sampling types and characteristics of variety of pollutants, importance of flow diagrams. Characteristics of various sources in different attributes and its application to Environmental Engineering with recent trends.

Student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
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</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Comprehend information on - Sources of pollutants/contaminants in various attributes and understand Units of expression and conversions in Environmental Engineering applications.</td>
</tr>
<tr>
<td>CO2</td>
<td>Evaluate concepts underlying Environmental sampling and Classification of Environmental contaminants / pollutants.</td>
</tr>
<tr>
<td>CO3</td>
<td>Discuss Point and Non-point sources (NPS) of pollution, and Characteristics of Noise Pollution from point and NPS.</td>
</tr>
<tr>
<td>CO4</td>
<td>Explain sub-surface pollutant sources and characteristics of radio-active materials.</td>
</tr>
<tr>
<td>CO5</td>
<td>Describe the Characteristics of rural and urban solid wastes and recent trends in Environmental Forensics, and NPS prevention and control.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sources of Pollutants and Contaminants Under Various Attributes - Natural and manmade, actions and consequences. Man’s atrocities on fragile environment. Environmental foot prints. Effect of mixed land use on pollutant / contaminant levels. Online monitoring.</td>
</tr>
<tr>
<td>2</td>
<td>Environmental Sampling - liquid, solid and gaseous components, preservation and sample holding. Sampling and Characterisation to generate flow schemes for treatment – concepts (field component – lab analysis).</td>
</tr>
<tr>
<td></td>
<td>Classification of Environmental Contaminants and Pollutants - Combustion products, Industrial emissions, and other sources; Transportation, construction and mining activities; Process and manufacturing industries. Pollutant-soil interactions.</td>
</tr>
</tbody>
</table>

Number of hours

<table>
<thead>
<tr>
<th>Number of hours</th>
<th>5</th>
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</thead>
<tbody>
<tr>
<td>CO 1</td>
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<td>CO 2</td>
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<td>CO 3</td>
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<td>CO 4</td>
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<td>CO 5</td>
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<td>2</td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>COURSE CONTENT</td>
</tr>
<tr>
<td>----</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>3</td>
<td><strong>Point Sources and Non-Point Sources of Pollution</strong> - Air, water and land attributes – Pollutant / contaminant interactions between attributes and externalities. NPS prevention &amp; control. Nutrients and pesticides.</td>
</tr>
</tbody>
</table>
|    | **Characteristics of Noise Pollution from Point and Non-Point Sources** - Transport network, construction and mining activities, Industrial Noise.; L
  eq concepts, background noise, standards. Power, pressure and Intensity of noise (field component). Noise characteristics – simple problems. | 5               |
| 4  | **Characteristics of Water Pollutants and Contaminants** - Construction and mining activities, process and manufacturing industries; agricultural practices. Proactive and reactive approaches for quality control. | 5               |
|    | **Sub-surface Pollutant Sources** - Septic tanks soak pits, and dispersion trenches. Low cost sanitation systems. SLF leachate, Oil and chemical storage tanks. | 6               |
|    | **Characteristics of Radio-active Materials** - Rare earth materials, Nuclear power plants, Health-care facilities and Industries. | 6               |
| 5  | **Wastewater Characteristics** - Point sources and characteristics of domestic and industrial wastewaters, healthcare wastewaters – parameter values, grouping and control. | 5               |
|    | **Characteristics of Solid Wastes** - Rural and urban, commercial, institutional and industrial sources. Biomedical and pharmaceutical wastes. | 6               |
|    | **Recent Trends** - Environmental forensics and feedback. Planning and management practices of NPS prevention and control. |                 |

**Total hours of Teaching**: 52

**Text Books**


**Reference Books**


...
Course Objective
This course provides the student the basics as well as application aspects of both microbiology and environmental ecological systems for Environmental Pollution Control.

The student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>Course Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Classify micro-organisms, understand nutritional requirements and growth kinetics.</td>
</tr>
<tr>
<td>CO2</td>
<td>Know the importance of heavy metal uptake metabolism, Biocatalysis and Enzyme regulation</td>
</tr>
<tr>
<td>CO3</td>
<td>Provide theoretical concepts of microbial indicators, identification techniques and their importance as Biomarkers.</td>
</tr>
<tr>
<td>CO4</td>
<td>Discuss inter relationships of abiotic and biotic components of ecosystems, understand the ecological pyramids and related models.</td>
</tr>
<tr>
<td>CO5</td>
<td>Assess pollution inputs to lakes and to apply the knowledge of various diversity and dominance indices for water quality assessments.</td>
</tr>
</tbody>
</table>

### COURSE CONTENT

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
<th>Number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Microbiology and its Environmental Significance, Microbial Diversity in the Environment - Bacteria, Fungi, Algae, Protozoa and Virus, Metal munching microbes for pollution abatement, Microbial Infectious Disease.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Bacterial growth curve – Monod’s equation and Michali’s - Menton equation with numerical exercises, Microbial interactions, industrial applications.</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Bioindication of Surface and Ground Water quality - Indicator microorganisms, TC, FC, FS, EC, algae and fungi. Indicator organisms and their testing - Plate count, MFT and MTFT - Determination of MPN using Thomas formula and comparison with MPN table (Lab component).</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Metabolism, Catabolism and Anabolism - Microbial metabolism of Heavy metals and Pesticides. Bio-catalysis - Enzymes and Enzymatic reactions for Environmental applications.</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Microbial diversity in Natural Ecosystem - fresh water, estuaries, oceans, terrestrial and air environment, Ecological Relationships among Microorganisms, indoor microbial environment - air changes per hour (Lab component), Eutrophication of lakes: prevention and control. Externalities of GEMS. Symbiotic Interactions of microbes, Microbial Communication, Activities, and Interactions with Environment and Nutrient Cycling. Algal blooms, aquatic weeds and control, Bio-accumulation, Bio-concentration, Bio-magnification and Bio-concentration factor (BCF) – numerical exercises.</td>
<td>6</td>
</tr>
<tr>
<td>CO</td>
<td>COURSE CONTENT</td>
<td>Number of hours</td>
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<tr>
<td>4</td>
<td><strong>Scope of Ecology, sub-divisions, Ecological Terminology, Ecosystems</strong> – Classification, biotic and abiotic components, elementary cybernetics of ecosystems, energy flow, Eltonian pyramids. Lotic and Lentic Ecosystems, Lindeman’s model, productivity and measurement.</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td><strong>Lake Stratification, Limiting factors, Nutrients, Liebig’s law, Shelford's law of tolerance, Diversity, dominance and similarity indices – numerical exercises, Systems Ecology and Ecosystems’ modelling. Biodiversity and ecological perspective – human benefits, threats, conservation, preservation and protection.</strong></td>
<td>10</td>
</tr>
</tbody>
</table>

**Total hours of Teaching** 52

**Text Books**

**Reference Books**
ENVIRONMENTAL FLUID MECHANICS – II

EV 430
4 h/wk
CIE: 50 Mks
SEE: 100 Mks

Course Objective
Fluid Mechanics II provides knowledge on open channel hydraulics, dimensional analysis as applied to model studies, surge analysis, concepts of pumps and turbines.

Student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Explain the closed conduit and open channel hydraulics, derivative conditions for various economical geometric sections, specific energy curve and hydraulic jump</td>
</tr>
<tr>
<td>CO2</td>
<td>Derive discharge equations and determine hydraulic co-efficient for flow devices and their application</td>
</tr>
<tr>
<td>CO3</td>
<td>Analyse and evaluate the need for dimensional consistency of the equations, scale effects, model studies and importance of water hammer analysis</td>
</tr>
<tr>
<td>CO4</td>
<td>Describe the Impact on Jets at different conditions.</td>
</tr>
<tr>
<td>CO5</td>
<td>Discuss the priming of pumps, characteristic curves and types of turbines and their applications</td>
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COURSE CONTENT

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
<th>Number of hours</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Flow through Channels - Closed and open channel flow, Geometric properties. Chezy’s and Manning’s equations. Hydraulic flow Characteristics for different cross sections, Derivations and Numerical exercises. Specific energy curve and its applications, Minimum specific energy and Maximum discharge, Critical flow, Hydraulic jump in rectangular channels, Derivation with Froude number concept, Conjugate depth relationships - Numerical exercises.</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Flow through pipes - Flow through pipes, Hydraulic and Energy gradients, Major and Minor losses in pipe flow, Head loss due to friction -Friction factor for commercial pipes, Head loss due to sudden expansion and contraction. Pipes in Series and Parallel, Equivalent pipe – Numerical exercises, Moody diagram for Pressure drop/ Flow rate computation. Electronic sensors for water and Wastewater flow measurements.</td>
<td>6</td>
</tr>
<tr>
<td>CO</td>
<td>COURSE CONTENT</td>
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<tr>
<td>4</td>
<td><strong>Water Hammer in Pipes</strong> - Pressure rise due to gradual and Sudden closure of valves in rigid and Elastic pipes, Control techniques – Types and functions, related Numerical exercises.</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td><strong>Turbines and Pumps</strong> - Types of turbines, draft tubes- Types, Cavitation and Control. Types of pumps, Working principle, Characteristic curves, Priming, work done and efficiency, Cavitation in Centrifugal pumps, Submersible pumps, Multistage pumps, Sludge pumps, Booster pumps. Numerical exercises.</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td><strong>Recent Trends</strong> - Electronic Pressure Sensors, Energy efficient pumps, Solar pumps.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><strong>Total hours of Teaching</strong></td>
<td>52</td>
</tr>
</tbody>
</table>

**Text books**


**References**

Course objectives:
The course deals with the significance of hydrologic cycle, global and Indian water resources, influencing natural processes, urban and groundwater hydrology and modern tools for water resources management.

Student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>Course Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Explain hydrologic cycle and its importance in water resource management; discuss in detail the importance of precipitation and its data analysis.</td>
</tr>
<tr>
<td>CO2</td>
<td>Explain the influencing factor and methods of estimating evaporation, infiltration and surface runoff.</td>
</tr>
<tr>
<td>CO3</td>
<td>Apply hydrograph theory in estimating overland runoff; explain the concepts of flow routing and analyse for low flow</td>
</tr>
<tr>
<td>CO4</td>
<td>Explain various methods of measuring flow in a stream; explain well hydraulics and apply basic equations to estimate well discharge from confined and unconfined aquifers</td>
</tr>
<tr>
<td>CO5</td>
<td>Explain erosion impacts on reservoir; hydrologic aspects of irrigation system and identify design inputs and outputs of GIS applications in water resource management.</td>
</tr>
</tbody>
</table>

### COURSE CONTENT

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
<th>Number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Introduction</strong> - Water resources and issues - Global, National, and Regional. Hydrologic cycle and significance. National water policy.</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td><strong>Precipitation</strong> - Forms and Types, Measurement. Estimation of average and Missing rainfall data, Mass curve, Hyetograph, Moving average curve, Intensity-duration-frequency curves; Precipitation indices-related Numerical exercises.</td>
<td></td>
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<tr>
<td>2</td>
<td><strong>Evaporation</strong> - Influencing factors, Measurement and Estimation- Numerical exercises.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td><strong>Infiltration</strong> - Influencing factors and Measurement, Infiltration indices - related numerical exercises.</td>
<td></td>
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<tr>
<td></td>
<td><strong>Runoff</strong>: Catchment, Influencing factors, Water budget equations, Rainfall-runoff relationship</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>Hydrographs</strong>: Components – Types and Derivation; Base flow separation - Numerical exercises.</td>
<td>12</td>
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<tr>
<td></td>
<td><strong>Hydrologic Routing</strong>: Channel and Flood routing–concepts, Low flow analysis.</td>
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<tr>
<td>CO</td>
<td>COURSE CONTENT</td>
<td>Number of hours</td>
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<tr>
<td>4</td>
<td><strong>Stream Gauging</strong> - A-V method, Weir method, Chemical method, Advanced</td>
<td>10</td>
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<tr>
<td></td>
<td>techniques (Electromagnetic, ultrasonic etc)</td>
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<tr>
<td></td>
<td><strong>Groundwater Hydrology</strong> - Basic flow equations; Aquifers - Unconfined</td>
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<td></td>
<td>confined, Perched; Wells – Types, Design. Artificial recharge techniques.</td>
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<tr>
<td>5</td>
<td><strong>Reservoir</strong> - Types and Storage zones; Evaporation control; Erosion and</td>
<td>12</td>
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<tr>
<td></td>
<td>Its control, Sediment yield. Water allocations for multiple uses. Drinking</td>
<td></td>
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<td></td>
<td>water policies <strong>Recent trends</strong> - Application of GIS and Remote sensing in</td>
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<tr>
<td></td>
<td>water resource management</td>
<td></td>
</tr>
</tbody>
</table>

**Total hours of Teaching** 52

**Text Books**


**Reference books**

Course Objective
The student gains knowledge on fundamentals of geology, geological formations, engineering properties, its importance and application in Environmental engineering. The course also substantiates the need for geotechnical engineering emphasizing on types of soil its properties, environmental geotechniques and its application to Environmental engineering.

Student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
<th>Number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Discuss origin and types of rocks, classification, Weathering of rocks, cause – effects of earthquake, soil erosion, landslides and remedies.</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>Explain the concepts underlying structural geology, and geotechnical engineering issues and in-depth knowledge of all soil properties, importance, analysis and index properties of soil, sieve analysis and limits.</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>Discuss on soil classification, compaction, mineral mass balances and remineralisation and demineralization – water quality control.</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>Explain permeability concepts through soils, application of geosynthetics in Environmental Engineering.</td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>Discuss information on recent trends soil aeration, state of soil health.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>CO</th>
<th>COURSE CONTENT</th>
<th>Number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Introduction to Geology</strong> - Origin of rocks, Classification - Igneous, Sedimentary and Metamorphic rocks. Weathering of rocks – Types.</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td><strong>Structural Geology</strong> - Concepts of Outcrops, Dip and strike, Compass clinometers, Folds, Faults – Applications in Environmental Engineering projects.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><strong>Soil Architecture and Physical Properties</strong> - Phase Diagram - Its importance. Void ratio, porosity and Percent voids. Degree of saturation, Moisture content, Specific gravity, Density (bulk, dry, saturated &amp; submerged) and Inter relationships. SBC of soil.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Index properties of soils</strong> - Water content, Specific gravity, Relative density, Consistency limits and Indices, In-situ density (Lab component), and problem solving. Particle size distribution (sieve analysis). Liquid-limit- Casagrande and Cone penetration methods, Plastic limit and shrinkage limit determination.</td>
<td>12</td>
</tr>
<tr>
<td>CO</td>
<td>COURSE CONTENT</td>
<td>Number of hours</td>
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<tr>
<td>----</td>
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</tr>
<tr>
<td>1.</td>
<td>Dynamics of Soil - Methods and factors influencing compaction. Geological minerals and water quality interlinkages. Mineral mass balances as reactive approaches for real problem solving. Remineralization and demineralization through geo-filtration for water quality control.</td>
<td>6</td>
</tr>
<tr>
<td>2.</td>
<td>Flow of Water through Soil: Darcy's law - Assumptions and Validity, Co-efficient of permeability and factors - Its determination (lab &amp; field component), Permeability of stratified soils, Seepage velocity, Superficial velocity and Co-efficient of percolation, Quicksand and Capillary phenomena.</td>
<td>6</td>
</tr>
</tbody>
</table>

**Total hours of Teaching** 52

**Text Books**


**Reference Books**

ENVIRONMENTAL MICROBIOLOGY LABORATORY

EV 46L
3 h/wk
CIE: 50 Mks

Course Objective

The lab course provides practical exposure to students on various qualitative and quantitative analytical methods for screening, identification, quantification of microorganisms in different contaminated water samples.

Student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>Experiments</th>
<th>Number of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Acquaint with lab layout, apparatus and instruments, chemicals and reagents, measurement techniques for various microbiological parameters and standards</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>Know use different analytical methods for measuring various types of microorganisms and to compare the sensitivity of each method</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>Develop the ability to analyse, interpret and infer the laboratory analytical data</td>
<td></td>
</tr>
</tbody>
</table>

EXPERIMENTS

<table>
<thead>
<tr>
<th>CO</th>
<th>Experiments</th>
<th>Number of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Apparatus/equipment, washing and cleaning techniques, sterilization.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Lab safety aspects. Water samples collection procedure.</td>
<td></td>
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<tr>
<td></td>
<td>Microscopic Identification of different microbial organisms present in air, soil and water.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Identification and characteristics of aquatic weeds</td>
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</tr>
<tr>
<td>2</td>
<td>Culture media – types and preparation.</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Bacteriological tests on water samples for drinking– river water, lake water, tank water, tap water, ground water, canal water(TC,FC &amp; FS) Multiple Tube Fermentation Test, Membrane Filter Technique.</td>
<td></td>
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<td></td>
<td>Tests – Plate count, Staining technique,</td>
<td>6</td>
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<tr>
<td>3</td>
<td>Bacteriological examination of Recreational Water – Swimming pool, bathing ghats, water parks – Rapid detection method</td>
<td>3</td>
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<tr>
<td></td>
<td>Microbial isolation and plate count</td>
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<td></td>
<td>Microbial Cells Immobilization Technique – methods of immobilization and Applications, Bio assay test (Theory and method of analysis)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Detection of fungus in Water &amp; Air</td>
<td>3</td>
</tr>
</tbody>
</table>

Total hours of Teaching 36

References

Course Objective
The lab course provides practical experience to students on various flow measurement techniques, hydraulic coefficient determination, calibration aspects, tests on Centrifugal pumps and demo of selected instruments

Student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>Description</th>
<th>Number of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Calibrate flow measurement devices by conducting experiments under standard conditions using standard procedure.</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Determine minor losses in pipes under various conditions and to carryout tests on centrifugal pumps</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Develop the ability to analyse, interpret and infer the laboratory analytical data</td>
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</table>

**EXPERIMENTS**

<table>
<thead>
<tr>
<th>Number of Hours</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Orifices and Mouthpieces: Determination of hydraulic coefficient of circular orifice, external cylindrical and convergent divergent mouth pieces.</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Calibration of Notches: Rectangular and Triangular notches.</td>
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<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Calibration of Venturimeter and Orifice meter</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Determination of minor losses in pipes due to sudden expansion, sudden contraction, bends and elbows.</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Impact of jet on vanes (flat, inclined and hemispherical).</td>
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<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Test on Centrifugal pumps: Single-stage and multi-stage centrifugal pump.</td>
</tr>
<tr>
<td>3</td>
<td>Demonstration on turbines (Francis, Kaplan and Pelton)</td>
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<tr>
<td></td>
<td>3</td>
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<tr>
<td></td>
<td>Field visit.</td>
</tr>
</tbody>
</table>

**References**

ENVIRONMENTAL IMPACT ASSESSMENT

Sub Code : EV 510
CIE Marks : 50
Credits : 04
Exam Hours : 03
Exam Marks : 100

Plans, projects and externalities - Alternatives. Economic development v/s Environmental quality, planning errors. Baseline data. Evolution of EIA in India and procedural and methodological Limitations of EIA, Subjective EIA.

**EIA:** Definitions, Purpose of EIA, Scope of EIA, Hierarchy in EIA, EIS. EIA as practiced in India and other countries. MOEF guidelines on siting of industries - Schedule - I. Frame work of Impact assessment. The EIA process. Contents of EIA. Environmental Management Plan (EMP) and Disaster Management Plan (DMP).

**Methodologies & Techniques in EIA:**

**Environmental Attributes**
Air, water, land, sound, Socio economic aspects, biodiversity. Standards and Value functions- Graphs and interpretations - Impact significance.

**Public participation in EIA**
Need, objectives, elements and framework for public participation – step by step procedure.

**EIA audit** – Types and auditing procedure


**TEXT BOOKS**

**REFERENCES**
- Journals - Science Direct, acs.org.
- EIA notifications and Publicatons, MoEF, GoI
WATER TREATMENT AND SUPPLY ENGINEERING

Sub Code: EV 520
Credits: 04
CIE: 50
Exam Hours: 03
Exam Marks: 100

Population forecasting methods, limitations and numerical problems.

**Water treatment**
Unit operations and processes, treatment flow sheets for different sources of water.
Design principles of aeration, sedimentation – types of settling, sedimentation with coagulation and flocculation, pulsators, filtration and disinfection.
Miscellaneous treatment- defluoridation, water softening, arsenic removal – numerical problems.

**Water Supply and distribution**
Water demand, design period, peak factor. Water Intakes- types and design aspects.
Pumps and pumping station. Collection and conveyance, gravity and pressure flows, appurtenances. Service reservoirs and service connection (ferrule).
Corrosion- prevention and control – Langelier’s Index.

**Recent trends**
Advanced water treatment, automation intreatment and supply, and economics, Package treatment units and patented material, implications of 24x7 supply, water quality in distribution system

**TEXTBOOKS**

**REFERENCES**
- CPHEEO manual on water supply and treatment (recent edition)
WASTEWATER ENGINEERING - I

Sub Code : EV 530
Credits : 04
CIE : 50
Exam Hours : 03
Exam Marks : 100


Hydraulic design of sewers
Hydraulic formulae, self cleansing and non scouring velocities, hydraulic elements curve, Design of sewers.

Sewer appurtenances
Housedrainage connection, Tee, bends, closets, traps, manholes, inverted siphons. Materials of sewers, laying, joining and testing.

WASTEWATER TREATMENT
Objectives, Unit operations and unit processes, process flow sheets. Reaction kinetics, biokinetic coefficients and types of reactors.

Unit operations
Pumps, screens, equalization, comminutor, grit chamber, oil and grease removal, primary sedimentation tank, design criteria and examples.

Unit processes
Aerobic, Anoxic and Anaerobic systems, Suspended and attached growth systems, activated sludge process and modifications, trickling filters, rotating biological contactors, SBR, secondary sedimentation, design criteria and examples. Waste stabilization ponds, wet lands, aerobic and anaerobic lagoons, septic tanks.

Sludge Treatment
Quantification and characteristics, SVI, CSI, sludge digestion–aerobic and anaerobic, quantification of Methane, sludge thickeners, sludge drying beds, sludge filter press, design criteria and examples.

Recent Trends in Wastewater Treatment
Decentralized wastewater treatment Systems – DWATS, Tertiary and advanced wastewater treatment systems.

TEXT BOOKS

REFERENCES
- CPHEEO Manual on Wastewater Treatment (Recent Edition)
ENVIRONMENTAL SYSTEMS’ OPTIMIZATION

Sub code: EV 540  
Hrs /Week: 04

CIE : 50  
Exam Hours: 03  
Exam Marks: 100

Definition and Engineering Applications of Optimization.Statement of an Optimization Problem, Classification of Optimization Problems.

Classical Optimization Techniques
Single and Multivariable Optimization with no Constraints, with equality Constraints and with inequality Constraints. Problems

Linear programming
Graphical Method, Simplex and Two-phase Method, Big-M Technique, Duality in Linear programming, Sensitivity analysis and Parametric analysis. Problems

Transportation Problem
Applications of Transportation Model. Chinese postman’s method. Solution of the Transportation problem, North West Corner Rule and Vogel’s Approximation Methods, Application to Wastewater Reuse and Solid Waste Management.

Application of Linear Programming
Problems on Air Pollution Control, Water Treatment, Distribution and Sewer Network.

Numerical Search Methods
Elimination Methods, Dichotomous Search and Fibonacci Methods.

Simulation

TEXT BOOKS

REFERENCES
MUNICIPAL AND BIOMEDICAL WASTE MANAGEMENT

Introduction

Engineering Principles
Waste generation rates, frequency, storage and refuse collection, processing at source, physical and chemical composition, quantity of waste, engineering properties of MSW waste prediction, modeling concepts.

Collection and Transport

4R – Reduce, Recovery, Recycle and Reuse

Biomedical Wastes (BMW)
Health care systems, sources, categories, generation and handling of BMW. Segregation, BMW (Management and Handling) Rules 2011/12

Treatment Options for MSW and BMW
Composting, Vermi composting, bio-gasification, Thermal processing – combustion, incineration, pyrolysis, - types and design criteria, Plasma technique. Radio active waste containment

Disposal options
Engineered Sanitary land fills – gases and leachate control, Opportunity costs, siting considerations and design, problems. Sharps and needles disposal.

Recent trends
Community based waste management, Waste as a Resource concept, Public private partnership (PPP) in MSW and Biomedical Waste Management.

TEXT BOOKS
- Flintoff F., (1976), “Management of Solid Wastes in Developing Countries”, WHO Regional Publications, South East Asia, New Delhi

REFERENCES
- CPHEEO manual on Municipal solid waste management (recent edition)
DISASTER MANAGEMENT

Sub code: EV 560
Hrs /Week: 04
CIE : 50
Exam Hours: 03
Exam Marks: 100

Introduction
Natural and man-made disasters, causes and impacts.

Types of Disasters
Natural disasters - Drought, Floods, Earth Quake, Volcanoes, Land Slides, Cyclones, Tsunami
Manmade - Air accidents, Rail and Road accidents, Industrial, Chemical, Biological. Accidental oil spills on land and water. Nuclear and Space Debris

Disaster Assessment & Preparedness
Vulnerability assessment. Pre disaster planning for earthquakes, cyclones, epidemics outbreak, drought and famine. Disaster resistant constructions, rehabilitation and reconstruction.

Coping mechanism and relief assistance, disaster continuum, warning and management. Flood forecasting, flood control systems.

Disaster Prevention and Mitigation
Earthquake mitigation, Cyclone mitigation, Landslide hazard mitigation, Flood preparedness and response, building bye-laws and adaptation. Environmental Management Plans (on site and off site) and Disaster Management Plans (DMP).
Role of Information Technology in Disaster Management – Simulation studies. GIS for Disaster Management.

Legal Framework
Disaster Management Act and Code, National Policy on Disaster Management.

Case studies
Bhopal gas tragedy, Meuse valley, Chernobyl, Fukushima, Surat municipal solid waste management, Tsunami, Forest fires, Gujarat earthquake, Gulf of Mexico Oil Spill and recent episodes.

TEXT BOOKS

REFERENCES

DESIGN AND DRAWING OF ENVIRONMENTAL SYSTEMS - I

Sub code: EV 57 D          CIE : 50
Hrs /Week: 03              Exam Hours : 03
Exam Marks : 50

Introduction to scales – graphical and numerical scales, scales on CAD.

Design and drawing of the following:

Water supply system for a two storey building – using plumber’s chart - layout of water supply system – and ferrule connection.

Bell mouth canal and river / reservoir intakes.

Gravity type circular cascade aeration unit

Parshall flume.

Plain sedimentation tank.

Clari-flocculator. Rapid sand filters.

Sump/GLSR.

Hydraulic flow diagram of typical/designed water treatment scheme.

Typical drawing of water distribution system.

Deflourodation tank

REFERENCES

ENVIRONMENTAL PROCESS LAB – I

Sub Code : EV 58 L
Hrs/Week : 03
CIE: 50
Exam Hrs: 30
Exam Marks: 50

Process Laboratory - equipment / instruments and applications.
Precision and Accuracy, Significant numbers. Samples’ preservation techniques
Aeration Process for Fe and Mn removal, algae removal
Determination of dissolved oxygen.
Adsorption – PAC and GAC, Natural Adsorbents- Isotherms and Break through curve
Water Softening Process.
Jar Test for Optimum coagulant dose
Types of Settling - Column Test
Filtration Process - Single Media and Dual Media Filters.
Chlorine demand, Available chlorine, Residual chlorine and Break Point curve, ozonization
Particle size distribution analysis, Effective Size, Uniformity Coefficient
Household Water Treatment Units– Reverse Osmosis
Bottled water quality analysis

REFERENCES

- NEERI Laboratory Manual
- Unit Operations and Unit Processes Laboratory Manual.
QUANTIFICATION AND RATES
Earthwork - volume by cross-section, spot levels and contour – construction of mass diagram, calculation of haul, over haul and economic haul, lead and lift.

Cement mortar, cement concrete, brick and stone masonry, flooring, plastering, RCC works, doors, windows and ventilators.

SPECIFICATIONS
For coarse aggregates, cement, mortars, plain and reinforced concrete, brick masonry, stone masonry, roofing, flooring, plastering, wood work, earthwork and surfing,
water supply distribution lines. Surface and sub-surface drainage line - stone-ware pipes, other materials such as RCC, Steel, PVC, HDPE, etc.

ESTIMATION
Types of estimates, Methods of working out quantities
Preparation of detailed and abstract estimates for cascade aerators, venturi-flume, septic tank, manhole, pump house, store room.
Quantification of Steel for various basic components - I concrete and BS slabs, chejja and lintels.

Working out quantities for water supply and sewer network systems, and storm water drains. Use of current Schedule of Rates and tendering.

Principles of VALUE ENGINEERING

FINANCIAL ASPECTS
Purpose. Cost, price, value – different forms of value

Capital cost – fixed and variable, time value of money, NPV, IRR,

depreciation – methods, sinking fund, cost fixation on the produced commodity.
Debt equity (DE), debt service coverage ratio (DSCR).

FISCAL INCENTIVES AND PENALTY FOR ENVIRONMENTAL PROTECTION
Tax rebate, Investment and Depreciation allowance, exemption from Tax to capital gains, rebate in cess levied on water consumption and energy.
TEXT BOOKS


REFERENCES

- Annual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, Gol, New Delhi,
- Current Schedule of Rates (SR) of PWD, KUWS&DB, Irrigation.
Advanced Wastewater Treatment Systems
Residuals in treated wastewater and their removal
Gas Stripping, DAF, Advanced Oxidation, Electrodialysis, Ion Exchange & Adsorption, Micro and Ultra Filtration

Hybrid Wastewater Treatment Systems
Need for upgrading treatment plants, Possible Combinations of Physico chemical and Biological Processes.
Electrochemical coagulation, UASB and Anaerobic filters, multistage anaerobic filters

Nutrients’ Removal from Wastewaters
Nitrification and denitrification, physicochemical and biological phosphorus removal, SBR.

Sludge
Chemical Sludge – Sources and generation, types, characterization, recovery of metals, alternate uses, and disposal options.
Biological sludge – Sources and generation, characterization, utilization possibilities

Recent Trends
Environmental Biotechnology - genetically engineered microorganisms for wastewater treatment, bio remediation, bio sensors, membrane bio reactors (MBR), power generation from wastewater.

TEXT BOOKS

REFERENCES
Remote Sensing (RS)

**Basics of remote sensing:** Passive and active remote sensing; Radiation sources and radiation principles; Electromagnetic radiation spectrum; Energy interactions with atmosphere and Earth’s surface; Spectral reflectance curves

**Remote Sensing Systems**

Ideal RS system, Platforms and orbits; Satellite system parameters, spectral bands of sensors; spectral, radiometric, spatial, and temporal resolutions of satellites; multi-spectral thermal and hyper-spectral sensing; remote sensing satellite

**Data acquisition and interpretation**

Types of pictorial data products, image interpretation strategy, elements of image interpretation

**Digital Image Processing**

Preprocessing, image registration, image enhancement, spatial filtering, image transformation, image classification

**Geographical Information System (GIS)**

**Introduction**

Origin and importance of GIS; scale; coordinate and projection systems, Linkage of Remote Sensing to GIS

**Data Models and Structures**

Spatial data models – Raster, vector; spatial and attribute data.

**Spatial Data Input and Editing**

Encoding methods of data input: keyboard, manual digitizing, scanning and automatic digitizing methods. Electronic data transfer, GPS, remote sensing Data Editing: locations error, spatial data accuracy standards, topological and non-topological errors.

**Spatial Analysis**

Raster and Vector overlay analysis; Terrain modeling; Spatial interpolation; Buffering and Neighborhood function, Networks

**Applications of RS and GIS**

Resource mapping, Watershed management; Rainfall-runoff modeling; Flood mapping; Environmental monitoring, Groundwater vulnerability modeling; Optional routing of solid wastes collection system of an urban area; Environmental siting and zoning atlas development.
TEXT BOOKS


REFERENCE BOOKS


Introduction

Sources and Classification of Air Pollutants
Natural and Anthropogenic, Units of measurements of air pollutants. Simple problems on unit conversion.
Primary and Priority Pollutants, Photochemical Oxidants, - Characteristics, Smoke and its measurement

Effects of Air Pollution
Effects on human, plants and animals, materials and structure/ monuments. Visibility and other related atmospheric problems, Acid rain, Wet Deposition, Green house effect. Global warming. Ozone depletion and Heat island effect.

Air Pollution Meteorology
Role of meteorology in air pollution and its control. Meteorological factors – Solar radiation, temperature, lapse rate, wind velocity profile, humidity, precipitation, Maximum/ Mean mixing depths, atmospheric stability conditions, wind rose diagram.
Inversion – types, plume behaviour under different atmospheric stability conditions, Pasquill – Gifford atmospheric stability classification. Effect of topography on pollutant dispersion. Land/ sea breeze effects,

Atmospheric Dispersion of Stack Emissions
Plume rise, effective stack height, plumerise formulations, guidelines for fixing stack height, problems on plume rise calculations.

Measurement of Air Pollutants
Criteria for station selection, Measurement of various gaseous(CO, HC, NOx, SOx, etc) pollutants, particulate matter and microbial, sampling devices, sampling train, sampling methods/ techniques, stack sampling techniques.

Air Pollution Control Regulations
Air pollution laws/ acts, air quality and emission standards, air pollution indices - determination of air pollution index by different methods.

Air Pollution Control Equipment
General methods, control by process changes
Particulate Matter Control – settling chambers, inertial separators, cyclones, fabric filters, scrubbers, wet collectors, electrostatic precipitators.
Control of gaseous pollutants – adsorption, absorption, combustion and condensation.

Noise Pollution
Sources of noise, effects of noise pollution, units and measurement of noise, control of noise, standards - equations and applications.
TEXT BOOKS


REFERENCES


- Emission Regulations 1, 2, 3, CPCB.
Chemical Kinetics: types of reactions, reaction order, rate of reaction, types of reactors, reactors’ analysis, Scale up designs

Design Fundamentals – Mass Balance approach, Conservation of Mass in reactors, Influencing parameters

Isothermal and Non-isothermal Reactors – Design criteria, batch, semi and continuous systems and rate equations

Laboratory Reactors – Homogeneous and Heterogeneous Reactors, Structure of Reactors

Design of Fixed Bed and Fluidized Reactors

TEXT BOOKS


REFERENCES


ENERGY AND ENVIRONMENT


Indian Energy Scenario: Energy Consumption, needs and crisis, energy sources and availability.

Biomass: introduction, energy plantation, agricultural residue, urban organic waste, biomass conversion technologies (wet and dry process).

Hydropower: Site selection for hydroelectric power plants, classification of hydroelectric power plants, submergence, ecological imbalance, advantages and disadvantages of hydroelectric power plants, catchment area assessment.

Tidal Energy: OTEC (Ocean Thermal Electric Conversion), methods of ocean thermal electric power generation, site selection. Energy from tides – basic principles of tidal power, components of tidal power plant.


Geo-thermal Energy: introduction, nature of geothermal fields, geo-thermal sources, binary fluid geo-thermal power system and arrangement for hybrid plants.

Nuclear Energy: necessity, general components of nuclear reactors, different types of reactors, breeding reactors, location of nuclear power plants, disposal of nuclear wastes, Associated Environmental Effects.

Natural gas: classification and comparison of different gas turbine power plants, Associated Environmental Effects.

TEXT BOOKS


REFERENCES


- The Energy Research Institute (TERI), New Delhi, Publications.

- Ministry of Environment and Forests, Government of India, Annual Reports.
HAZARDOUS WASTE TECHNOLOGY  
(ELECTIVE I)

Sub Code : EV 653  
Hrs/ Week : 04  
Exam Hours: 03  
Exam Marks: 100


Regulations: Basal Convention, HSW (Management & Handling and trans-boundary movement) Rules, CERCLA, Super fund Amendments and Reauthorization Act (SARA), Superfund law, National Priority law (NPL), Hazard Ranking System (HRS), National Contingency Plan (NCP), RCRA, Cradle to grave concept, Assessment of Hazardous waste sites. E-waste (management & handling) rules.


Transportation of Hazardous wastes: Regulations for hazardous materials, Bulk and Non-bulk transport, Hazardous substances emergency response.

Physico-chemical and Biological Treatment: Air stripping, soil vapor extraction, carbon adsorption; steam stripping, Solidification and Stabilization, Thermal methods - combustion, Incineration, Biological methods - conventional treatment, in-situ bio-remediation, slurry phase treatment and solid phase Treatment.

Land Disposal: Landfill operations, site selection, liner and leachate collections systems, Cover systems, Contaminant transport through landfill barriers, landfill stability, closure and post closure care, other types of disposal facilities.

e-waste: Dismantling, recovery, reuse and recycle, treatment and disposal, as per regulations.

Site remediation: Site inspection, assessment, and remedial action, monitoring of disposal sites.
TEXT BOOKS


REFERENCES


- CPCB guidelines for Hazardous Wastes
OPERATION AND MAINTENANCE OF ENVIRONMENTAL FACILITIES
(ELECTIVE II)

Subject Code: EV 661
Hrs/ Week : 04

OPERATION, MAINTENANCE & MANAGEMENT
Aims, Basic Principles, Data Base Facilities, Drawings, Detailed Plans, Record Keeping, Organizational Structure, Work Planning and Scheduling, Operation Manuals
Training needs and planning. Automation in O & M of Water and wastewater systems.

WATER SUPPLY FACILITIES
Operational Problems and Corrective Measures for Intakes, pumps, rising mains, Distribution System - Loss of carrying capacity in pipes, Projection of Pipe Break Rates, Leak Detection and control.
Appurtenances – Valves, Hydrants and Fittings.

WATER TREATMENT FACILITIES
Operational Problems and Corrective Measures for Screens, Aeration Unit, Sedimentation Tank, Clariflocculator, Pulsators, Filtration, Disinfection units and other treatment units, if any.

WASTEWATER COLLECTION FACILITIES
Operational Problems and Corrective measures in Sewer Network, Inspection Methods, Safety Methods, Appurtenances and pumps.

WASTEWATER TREATMENT FACILITIES
Operational Problems and Corrective Measures for Screening, Grit chamber, aeration tanks, trickling filters and bio-towers, settling tanks, Sludge Thickener, sludge digesters, sludge drying beds, Disinfection units.

AIR POLLUTION CONTROL FACILITIES
O & M for sanitary landfills and hazardous waste disposal sites.
TEXT BOOKS


- Training Manual on O&M for Municipal Staff”, Asian Development Bank, Government of Karnataka


REFERENCES


- Manual on Solid waste Management” – CPHEEO (Recent edition)
LIFE CYCLE ANALYSIS AND ENVIRONMENTAL RISK ASSESSMENT  
(ELECTIVE II)

Subject Code: EV 662  
Hrs/ Week : 04  
CIE Marks : 50  
Exam Hours : 03  
Exam Marks : 100

Life Cycle Approach
Definitions and Terminology, A model of Risk assessment
Modeling Methods for Release Assessment - Failure – Mode and Effects Analysis (FEMA) and Related methods, Fault – Tree Analysis, Event- Tree Analysis, and Related Methods, Discharge Models, Strengths, Limitations
Effects of Risk Agents on Human Health – Cancer, Reproductive and Developmental Effects, Clinical Effects, Subclinical Effects.
Modeling Methods for Assessing Health Consequences


Modeling Methods for Assessing Environmental Consequences –

Risk Estimation – Composite Risk Model, Methods for Estimating and Analyzing Uncertainty,


TEXT BOOKS


REFERENCES

NON POINT SOURCES - POLLUTION AND MANAGEMENT
(ELECTIVE II)

Subject Code: EV 663
Hrs/ Week : 04
CIE : 50
Exam Hours : 03
Exam Marks : 100

Introduction
Problem and magnitude, Surface Water Problems, WasteAssimilative
Capacity and In-stream and Effluent Discharge standards.Total Maximum
Daily Load (TMDL).

Hydrologic Considerations
Introduction, Precipitation–Runoff Relationship.OverlandRouting of the
Precipitation excess, Interflow, Groundwater flow. Pollution from the
Atmosphere – Atmospheric Input (wet deposition).

Groundwater Pollution
Sources of Groundwater Contamination, and Groundwater Movement.

Pollution from impervious urban areas
Urban storm water quantification, Depositionand accumulation of pollutants
on impervious surfaces.Removal of Solids from street surfaces and porous
pavement.

FUGITIVE AIR EMISSIONS - Area, line sources
Pollution from agricultural and mining areas -Quantification and qualitative
analysis.

Non-point Pollution Simulation Models
Basic Concepts, Brief Description of Non-point Pollution Simulation Models
Best Management Practices of Non-point sources of pollution control.

TEXT BOOKS
  Van Nostrand Reinhold Environmental Engineering Series.

  Pollution”, “Sources and Management” - Van Nostrand Reinhold
  Company.
DESIGN AND DRAWING OF ENVIRONMENTAL SYSTEMS - II

TYPICAL DRAWINGS
Street Inlet, L, V and Box / Trapezoidal Drains, Manhole. Layout drawing of wastewater treatment plant.

DESIGN & DRAWING OF

- Septic Tank, Dispersion Trench and Soak Pit
- Screens and Grit Chamber
- Primary Settling Tank
- Aeration Tank and Secondary Settling Tank
- Trickling Filter and Rotating Biological Contactor (RBC)
- Aerated Lagoon and Stabilization Pond.
- Anaerobic Digester and Sludge Drying Beds
- Hydraulic Profile of Conventional Wastewater Treatment System.

TYPICAL DRAWINGS OF

- Air Pollution Control Systems – Settling Chambers, Bag Filter, and Cyclone Separator, Electrostatic Precipitator, Adsorber and Absorber

REFERENCES

ENVIRONMENTAL PROCESS LABORATORY – II

Sub Code : EV 68 L
Hrs/ Week : 03
CIE Marks : 50
Exam Hours : 03
Exam Marks : 50

1. Domestic Wastewater Characterization
2. Industrial wastewater Characterization
3. Adsorption Experiments
4. Coagulation and Flocculation Experiments
5. Filtration – Single Media and Dual Media Filters, Down Flow and Upflow
6. Wastewater Polishing Units - Water Hyacinth and Duckweeds
7. Bench Scale Experiments – Aeration, Trickling Filter and Rotating Biological Contactor.
8. Reverse Osmosis.
10. Demonstration of Advanced Instruments - GC, HPLC, ICP, UV-VIS Spectrophotometer

REFERENCES

POPULATION FORECAST PROGRAMS: Arithmetic increase method, geometric increase method and incremental increase method.

WATER SUPPLY AND TREATMENT PROGRAMS: Rising main design, pumping unit, service reservoir capacity calculation, Equations used in water distribution network analysis and design. Water treatment units design — Cascade aerator, mechanical rapid mix unit, plain sedimentation tank, clariflocculator, filters (rapid and slow).

WASTEWATER COLLECTION AND TREATMENT UNITS PROGRAMS: Equations used in Sewer design, wastewater treatment units — Screen and Grit chamber, Aeration tank and Settling tank of ASP, Trickling filter unit, Sludge drying beds and Septic tank.

AQUATIC SYSTEMS PROGRAMS: Water quality models for discharge of conservative and non-conservative waste in rivers, DO models for rivers (Streeter-Phelps equation).

AIR QUALITY PROGRAMS: Effective Stack height calculation, Gaussian Plume Model for gaseous and particulate dispersion from point sources. Design of particulate control devices — Settling chamber and cyclone separators.

(Writing Flow Sheets, ‘C’ programme along with Design Steps & Equations is compulsory).

CAD: Introduction to CAD and its application to Environmental Engineering; Introduction to Computer Graphics – Applications.

INTRODUCTION TO DBMS — Components of DBMS.

INTRODUCTION TO APPLICATION SOFTWARES - RMAIN, WATPLANT, DOWATTS, LOOP, QUALOOP, EPANET, SEWER, STREAM, ISCST/LT, CALINE, MIXING ZONE MODELS

TEXT BOOKS


REFERENCES


INTRODUCTION: History & development, Occupational Safety and Health Act, Occupational Safety and Health Administration, Right to know Laws, Principles of Safety and Safety Triangle.

ACCIDENT CAUSATION: Type of accidents, Causes of accidents, work injuries, deaths in Work Accidents.

THEORIES OF ACCIDENTS: Domino, Human Factor, Petersen’s Accident Incident, Epidemiological, Human Error Model and Combination theory.

ERGONOMICS: Definition, factors associated with physical stress, worksite analysis programme, hazard prevention and control. Specific ergonomic problems and problem solving strategies, economics of ergonomics, visual ergonomics.


TEXT BOOKS


REFERENCES


ENVIRONMENTAL ENGINEERING MANAGEMENT PRACTICES

Subject Code: EV 730
Hrs/ Week : 04
Exam Hours : 03
Exam Marks : 100

CIE : 50


Management Basics & Strategies: Definitions of management, Functions of management - classification, coordination, Types and levels of management, TOWS matrix, TQM and environmental protection, ISO 14000 and 18000 series of Standards.


Project formulation: Bar chart & milestone charts, programme evaluation & review technique (PERT) & time estimates, Critical path method (CPM) and scheduling, decision matrix – problems.

Cleaner technologies: Cleaner production and prevention of pollution in smallbusinesses, CT and their role in environmental management: limitations. Incorporating cleaner production in to EIA. Life cycle assessment in to process, zero emissions-the ultimate goal of cleaner production. CP in select red category industries – mining, breweries, pulp and paper mills.

Environmental communication: Role of institutions, (NGOs, GOs, educational institutions), role of public, media.

Environmental Research: Need, areas of research, applied and advanced research, premier research organizations.
TEXT BOOKS


REFERENCES


Introduction; Sample and Population; Discrete and Continuous; Subdivisions – Descriptive, Inferential and Decision Theory; Collection, Arranging and Presentation of data; Frequency grouping; Frequency and relative frequency distribution; Cumulative frequency; Sturge's rule; Frequency polygon; Ogives; Problems.

Characteristics of Distributions: Central Tendency – Averages: Arithmetic mean (Ungrouped data & Grouped data); Median (Ungrouped data & Grouped data); Mode (Ungrouped data & Grouped data); Skewness; Geometric mean; Weighted mean; Moving averages – equations to river hydraulics; Problems.

Characteristics of Distributions: Dispersion – Range; Interquartile Range; Variance; Standard Deviation (Population & Sample); Bessel's correction; Mean Deviation; Coefficient of Variation; Problems.

Probability: Basic concepts; Types – Classical approach, Relative frequency approach, Subjective approach; Probability rules; Problems.

Probability Distributions: Binomial distribution – derivation; Poisson distribution – derivation; Normal distribution – errors, Gauss function, Area under normal curve, Use of standard normal probability distribution table; Problems.

Sampling and Sampling Distributions: Types – nonrandom and random; Biased samples; Random sampling; Systematic sampling; Stratified sampling; Cluster sampling; sampling from normal populations and non-normal populations; Problems.

Correlation and Regression Analysis: Scatter Diagrams; Correlation coefficient; Multiple correlation coefficient; Simple linear regression; Multiple regression equation; Estimation using regression line; Method of Least Squares; Standard error of estimate; Problems.

Time Series: Variations in time series; Trend analysis; Cyclical variation; Seasonal variation; Problems.
Testing Hypotheses: Concepts basics; Null hypothesis; Level of Significance; Degrees of Freedom; Hypothesis testing of Means; The Chi-Squared test; F distribution; Students t test; Analysis of Variance – within samples and between samples; Problems.

TEXT BOOKS


REFERENCES

ENVIRONMENTAL ECONOMICS AND LEGISLATION  
(ELECTIVE III)

Subject Code : EV 742  
Hours / Week : 04

CIE : 50  
Exam Hours : 03

Exam Marks : 100

Environmental Economics

Introduction to Environmental Economics 02

Externalities – Problem of Social Cost and Formal Analysis 06

Depletion of Non-renewable resources – Economics of Exhaustible resources, Economics of Exhaustible resources 06

Degradation of commons – The tragedy of commons an Institutional approach for common pool resources (CPR) 04

Valuation Techniques – Measuring the benefits and costs of pollution control, contingency valuation and economics 08

Sustainability – Economics perspective, Environmental Accounting – an operational perspective 04

Development and Environment -Poverty and environmental resource base, economics of the green house effect 04

Environmental Legislation

Environmental Policy 02


TEXT BOOKS

REFERENCES


ENVIRONMENTALLY SUSTAINABLE TECHNOLOGIES (ELECTIVE III)

Subject Code : EV 743
Hours / Week : 04

Introduction – Necessity and types of sustainable technologies 02

Sustainable Design/Environmentally Conscious Design –Definition, Sustainable design principles, Bill of Rights for the Planet, Emotionally Durable design 06

Sustainable Planning – Smart Growth theory, co-housing, Transit Oriented Development, Transit-proximate development, Energy-efficient landscaping 08

Sustainable Architecture –Green construction principles, Passive solar building design, IEQ, Green Rating Systems – LEED(USA), BREEAM(UK), CASBEE (Japan), IGBC GRIHA and LEED (India) and Economics 08

Industrial Ecology –Industrial metabolism (material and energy flow studies), Product stewardship/extended producer responsibility, Law of Diminishing returns, Life Cycle-planning, design and Assessment, Eco-Industrial Parks/Industrial symbiosis 06

Cleaner Development Mechanisms (CDMs)–Kyoto Protocol, Carbon Emission Control, objectives, process, clean fossil technologies, Carbon Trading Mechanisms 08

Recent Trends – Biorefineries, Bioconcrete, Green cleaning 04

Renewable polymers – plant oil, olive oil, vegetable oil 04

Hydrogen Fuel Cells – biohydrogen production, photo dissociation, thermal or catalytic splitting of water, hydrogen storage 04

TEXT BOOKS


- “Environmental Technologies” Edited by E. Burcu Ozkaraova Gungor, I Tech Education and Publishing
REFERENCES


ATMOSPHERIC MEASUREMENT LAB

(AIR AND NOISE)

Sub Code : EV 75 L                CIE : 50

Hrs/ Week : 03                   Exam Hours : 03

Exam Marks : 50

1. Introduction to Atmospheric Monitoring: Particulate Sampling – Dust Fall, Pollution, Particulate Matter - PM10, PM2.5 using High Volume Air Sampler (H.V.A.S.).
2. Estimating sulphur oxides in ambient air using H.V.A.S.
3. Estimating nitrogen oxides in ambient air using H.V.A.S.
4. Monitoring and identification of air borne microbes
5. Exercises on auto exhaust analyzer for Petrol Vehicles.
7. Exercises on Lux-meter (Light Intensity measuring Instrument)
8. Demonstration on Wind Monitoring and Analysis of Data for Windrose Diagrams.
9. Stack Sampling Techniques and Demonstration of Stack Monitoring.
10. Exercises on Ambient Gas Monitoring using GASTEC Device.
11. Demonstration / Exercises on Air Pollution Control Devices – Bag Filter, Scrubber, Cyclone and ESP.

REFERENCES

Writing programmes in C-language and flow sheets & executing programmes for the following:

1) Exercises on statistical analysis of data – mean, standard deviation and variance for grouped and ungrouped data.
2) Population forecasting: AM, GM, incremental increase methods.
3) Rising main design, pumping unit design.
4) Design of water treatment units (Cascade Aerator, Flash Mixer, Sedimentation Tank, Clariflocculator, Rapid Sand Filters) and wastewater treatment units (Screen chamber, Grit Chamber, Aeration Tank, Settling Tank, Trickling Filter Unit, Sludge Drying Beds, Septic Tank).
5) DO model for rivers (Streeter – Phelps equation) and lakes.
6) Air quality system: Gaussian Plume model for gaseous and particulate dispersion, effective stack height determination and particulate control devices design.

Use of following application software packages:

RMAIN – Economic analysis of pumping main, water hammer analysis and pump set design.
WATPLANT and DOWATTS - Water treatment units design.
LOOP, QUALOOP and EPANET - Water distribution system design.
SEWER – Sewer network design.
SWMM – Storm water management model, STORM.
ISCST / ISCLT (USEPA) versions - Air quality predictions from industrial sources.CALINE (USEPA) model - Air quality near highways due to vehicular emissions.
Mixing Zone Models – River water quality models

Introduction to GIS software
REFERENCES

- CPHEEO Manual on “Sewerage and Sewage Treatment”, MUD, GoI, New Delhi,
- UNDP / UNEP, “Software Package Manuals on BRANCH, LOOP, SEWER”
- USEPA, “Relevant Software Manuals”
TRANSPORT AND FATE OF ENVIRONMENTAL POLLUTANTS

Sub code: EV 810                        CIE : 50
Hrs /Week: 04                           Exam Hours: 03
Exam Marks: 100


Mechanics of Mass Transport: Diffusive and Convective Mass Transport. Ficks Law of Diffusion, Combined Convective-Diffusion Equations for 1, 2 & 3 Dimensions. Analytical Solutions for 1-D & 2-D Cases,

Mixing zone concept – types of outfall and mixing regimes

Description of Water Quality Processes in Natural Water Bodies: Lake (stratified and completely mixed), Estuary and Coastal Regions.

Groundwater Quality: Basic differential equations with analytical solutions for 1-D and 2-D cases.

Air quality modelling: Gaussian plume model – for point source. Gaussian dispersion co-efficient, Downwind ground-level concentration computation, maximum ground level concentration.

TEXT BOOKS


REFERENCES


VARIATIONS IN FLOW AND CONCENTRATION: Monitoring and mass load calculations.

COMBINED TREATMENT: Raw Industrial Wastes and Domestic Wastewater aftermixing partially or fully. Selection of Treatment Methods.

APPROACHES TO WASTE MINIMIZATION - Equalization, Neutralization, Volume Reduction, Strength Reduction and Proportioning.

TOXICITY: Toxicity assays, Biomonitoring of Effluents, Toxicity tests – protocols, test organisms, priority metals – their toxicity levels, decontamination/detoxification of toxic waste streams.

TREATABILITY STUDIES: Bench-scale studies and its input to pilot scale studies leading to real scale implementation. Determination of kinetic coefficients.


4R APPROACH – need, wastewater reduction, reclamation, reuse & recycle applications, zero discharge concept.

TEXT BOOKS

REFERENCES
NATURAL RESOURCES' MANAGEMENT
(ELECTIVE IV)

Subject Code : EV 831
CIE : 50
Hours / Week : 4
Exam Hours : 03
Exam Marks : 100

Natural resources
Classification, Resources Appraisal, Resource problem, Renewable resources flow, destruction versus conservation

Forest Resources
Uses, Ecological and economic significance, types and management, forest resources of the world and India, deforestation and its impact and solution

Water Resources
Hydrologic cycle, global and national water resources, demand and distribution, Management of water resources, Environmental Impact of large dams, River water disputes, water pollution problems

Mineral Resources
Exploration, causes for depletion, environmental impacts and conservation measures.

Food Resources
World food production and problems, food security, agri production, live stock production, modern agri practices, use of pesticides and fertilizers – environmental impact, environmental limits of increasing food production, sustainable agriculture

Energy Resources
Energy resources, world energy demand, Indian resources, renewable, alternate / non-conventional energy resources – solar, tidal, wind, geothermal, hydel, hydrogen, biomass, nuclear, wave (ocean)

Land Resources
Land as a resource, soils – types and degradation- soil erosion and pollution, soil conservation

Biodiversity Resources
Genetic and species diversity, Ecosystem diversity, types of ecosystems- structure and function, symbiotic and synergic relationship, importance of biodiversity, value of biodiversity, hot-spots of biodiversity, threats to biodiversity, conservation of biodiversity

Environmental Legislation for resource management
Legal frame work, organizations and institutions, acts promulgated by India – Wild Life Act, Biodiversity Conservation Act, Environmental (Protection) Act, Forest Act

TEXT BOOKS

ADVANCED ATMOSPHERIC ENVIRONMENTAL ENGINEERING
(ELECTIVE IV)

Subject Code: EV 832  
CIE Marks : 50  
Hrs/ Week : 04  
Exam Hours : 03  
Exam Marks : 100

**General:** Different Terminologies, gases, reaction rates and rate coefficients, stiffsystems.


**Chemistry of Stratospheric ozone depletion:** Stratospheric ozone - mechanism of depletion, Control strategies.

**Atmospheric boundary layer:** Characteristics of atmospheric boundary layer, depth, spectral description of turbulence, intensity, Reynolds stress parameter, spectral density function, integral length scale, inertial sub-range and small scales. Turbulent fluxes of momentum, turbulent fluxes of energy and water vapour, friction velocity, surface roughness lengths, bulk aerodynamic equations for eddy diffusion, Monin-Obukhov similarity theory.

**Modelling:** Modelling of climatic effects of anthropogenic aerosols: Models for carbonaceous and sulphate aerosols, Toomey effect. Time dependent two-dimensional advection diffusion model for area source with variable wind velocity and eddy diffusivity.


**Indoor air pollution:** Indoor air quality (residences and industries), characterization by use of gadgets for monitoring and control, standards. Industrial ventilation systems, hood geometry and design.
TEXT BOOKS


REFERENCES

Introduction: Earth’s climate, climate change, drivers of climate change

Climate models: Models for climate change, GCMs, RCMs, designing climate change experiments with climate models, climate change scenarios; Sector models – water resources, Agricultural, forestry, energy,

Climate change impacts: Impacts of climate change on environment, human, agriculture and energy systems, coastal zone.

Vulnerability/adaptation: Need for vulnerability assessment; generic steps, approaches and tools of assessment; adaptation to climate change by various sectors

Mitigation: Mitigation measures for climate change

Climate change and India, impacts, sectoral and regional vulnerability in India, Evaluation of model simulation over India;

Emission trading
Introduction to emission trading, evolution of emission trading and design features
Cost-effective permit markets, the role of transaction costs, the role of technical change, Consequences of emission trading

The spatial dimensions: difficulties in implementing an ambient permit system, possible alternatives, nature of evidence, borrowing, banking, and environmental target,
Linking emissions and pollutant concentrations. Strategies for controlling seasonal or episodic peaks and allocation approaches

Market power: permit price manipulation, conceptual models, leveraging power between output and permit markets, mechanisms for controlling market power, programmatic design features that affect market power.

Monitoring and enforcement:
Domestic and international enforcement process, economic enforcement, current enforcement practice, program effectiveness
TEXT BOOKS


REFERENCES


WATER AND LAND POLLUTION – PREVENTION AND CONTROL
(ELECTIVE IV)

Subject Code : EV 834
Hours / Week : 04
Exam Hours : 03
Exam Marks : 100

Water Pollution
Fresh water availability, Water Quality Index, parameters influencing water quality
Sources of water pollutants – point and non-point sources, wastewater, industrial wastewater, storm water, atmospheric deposition
Ecological Impact of water pollutants – ecosystems and processes, microbial ecology and ecology of water bodies
Pollutants’ behaviour in natural water bodies – oxygen demanding water bodies, streams, lakes, estuaries and ocean
Environmental risks – risk evaluation and relative risk
Ground water pollution – natural contaminants, ground water pollutants and Sources, control aspects
Thermal pollution – hydro power stations, industries
Marine pollution – oil spills, toxic chemicals, domestic and industrial wastewater discharges, cleaning of oil pollution

Land Pollution
Soil types and characteristics, Role of soil, indicators of soil pollution - sodium absorption ratio (SAR), fertility loss, soil sickness
Sources of soil pollution – industrial wastes, domestic wastes, solid waste pollution, chemical pollution, bacteriological pollution
Air quality impact on soil
Remediation & rehabilitation of contaminated soil – bioremediation, bio-leaching

TEXT BOOKS

REFERENCES