Modified Course Structure of M. Tech. Programme
in
Environmental Engineering
Department of Civil Engineering

<table>
<thead>
<tr>
<th>Course No</th>
<th>Course Title</th>
<th>Credits (L-T-P-C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester – I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE 521</td>
<td>Process Chemistry for Water and Wastewater Treatment</td>
<td>3-0-2-8</td>
</tr>
<tr>
<td>CE 522</td>
<td>Physico-chemical Processes in Environmental Engineering.</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 523</td>
<td>Air and Noise Pollution</td>
<td>3-0-2-8</td>
</tr>
<tr>
<td>XX xxx</td>
<td>Elective – I: <em>One course from Elective Group – A</em></td>
<td>3-0-0-6</td>
</tr>
<tr>
<td></td>
<td><em>Total in Semester – I</em></td>
<td>12-0-4-28</td>
</tr>
<tr>
<td>Semester – II</td>
<td></td>
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</tr>
<tr>
<td>CE 524</td>
<td>Biological Processes in Environmental Engineering</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 525</td>
<td>Solid and Hazardous Waste Management</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>XX xxx</td>
<td>Elective – II: <em>One course from Elective Group – B</em></td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>XX xxx</td>
<td>Elective – III: <em>Another course from Elective Group – B (excluding the course already selected as Elective II).</em></td>
<td>3-0-0-6</td>
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<tr>
<td></td>
<td><em>Total in Semester – II</em></td>
<td>12-0-0-24</td>
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<tr>
<td>Semester – III</td>
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</tr>
<tr>
<td>CE 527</td>
<td>Design of Environmental Engineering Systems</td>
<td>0-0-2-2</td>
</tr>
<tr>
<td>CE 690</td>
<td>M Tech Project – I</td>
<td>0-0-24-24</td>
</tr>
<tr>
<td>Semester – IV</td>
<td></td>
<td></td>
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<tr>
<td>CE 691</td>
<td>M Tech Project – II</td>
<td>0-0-24-24</td>
</tr>
<tr>
<td></td>
<td><em>Total</em></td>
<td>24-0-54-102</td>
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</table>

Elective Group – A

<table>
<thead>
<tr>
<th>Course No</th>
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<th>Credits (L-T-P-C)</th>
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<tbody>
<tr>
<td>CE 601</td>
<td>Numerical Methods</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 602</td>
<td>Optimization Methods</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 560</td>
<td>Computational Methods in Hydraulics and Environmental Engineering applications</td>
<td>3-0-0-6</td>
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</tbody>
</table>

*Or any other course as approved by DPPC.*

Elective Group – B

<table>
<thead>
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<th>Course No</th>
<th>Course Title</th>
<th>Credits (L-T-P-C)</th>
</tr>
</thead>
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<tr>
<td>CE 661</td>
<td>Air Quality Modeling</td>
<td>3-1-0-8</td>
</tr>
<tr>
<td>CE 662</td>
<td>Environmental Systems Engineering Laboratory</td>
<td>1-0-4-6</td>
</tr>
<tr>
<td>CE 568</td>
<td>Environmental Management</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 663</td>
<td>Principles of Water Quality and Legislations</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 664</td>
<td>Industrial Wastewater Pollution Control</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 665</td>
<td>Water Distribution and Wastewater Collection System Design</td>
<td>3-0-0-6</td>
</tr>
</tbody>
</table>

*Or any other course as approved by DPPC.*
Detailed Curriculum

The detailed curriculum along with text and reference books are given below.

**Semester – I**

**CE 521: Process Chemistry for Water and Wastewater Treatment (3-0-2-8)**

Basic Principles: Chemical equations and thermodynamic equilibrium; Acid Base Equilibria: Alkalinity and acidity, Buffering in water system; Solubility Equilibria; Water stabilization: Corrosion, Langlier saturation Index, Cadwell-Lawrence diagram; Equilibria governing iron and manganese solubility; Oxidation Reduction Equilibria; Application of redox chemistry; Fundamentals of process kinetics: Reaction rates and order, Reactor design; Fundamentals of surface and colloidal chemistry; Adsorption – physical versus chemical adsorption, factors influencing adsorption, Adsorption isotherms, Design of adsorption column.

Laboratory: Works related with Water and Wastewater Quality Parameters.

**Text books:**

**Reference books:**

**CE 522: Physico-chemical Processes in Environmental Engineering (3-0-0-6)**

Physical and chemical quality of surface and sub-surface waters and wastewater; Theory and design of physicochemical unit operations: screening, grit chamber, equalization, sedimentation, Floatation, Coagulation, Floculation, Filtration, Disinfection; Water softening; Adsorption and Ion exchange; Aeration and gas transfer; Membrane separation processes.

**Text books:**
**Reference books:**

**CE 523: Air and Noise Pollution (3-0-2-8)**

Definitions and scope: Problems and issues, Classification of air pollutants, Sources and effects; Monitoring techniques: Sampling methods and measurements of air pollutants and meteorological parameters, Source monitoring of gaseous and particulate matter, Networking of monitoring stations, Analyses of air pollutants, i.e. analytical techniques; Control: Methods of air pollution control for defined sources; Meteorology: Meteorological parameters and their effects on urban air pollution, Wind rose; Atmospheric stability; Global air pollution: Acid rain, Ozone layer depletion, Global warming, Green house effect and Trans-boundary pollution, Kyoto protocol, Carbon credit and carbon trading; Legislations and regulations: Ambient air quality standards, Emission standards, emission inventory, and Acts; Noise: Definition, Sources, Effects, Noise scales, Decibels and levels, and Noise level monitoring techniques.

Laboratory: Measurement and analyses of primary air pollutants SO$_2$, NOx, and SPM using high volume sampler; Wind speed and wind direction measurements using Anemometer; Wind rose plotting based on the winds measurements; Noise level measurements using Sound level meter.

**Text books:**

**Reference books:**
Semester – II

CE 524: Biological Processes in Environmental Engineering (3-0-0-6)

Microbiological concepts: cells, classification and characteristics of living organisms, reproduction, metabolism – basic metabolic models, microbial growth kinetics; Chemistry of carbohydrates, proteins, fats and lipids; Theory and design of biological unit operations: aerobic suspended growth systems – activated sludge processes and its modifications, ponds and lagoons; aerobic attached growth systems; anaerobic suspended and attached systems; Biological nutrient removal; Sequential Batch Reactors; Theory and design of sludge treatment; Wastewater disposal systems.

Text Books:

Reference Books:

CE 525: Solid and Hazardous Waste Management (3-0-0-6)

Solid Waste: Origin, characteristics, Quantity and Analysis; Effects of Solid Wastes; Storage, Collection, Transportation of Solid wastes; Solid waste transformation; Product recovery processes; Sanitary landfills; Legislation in solid waste.

Hazardous waste: definition, generation, classification; Magnitude of problem; Risk assessment; Environmental Legislation; Characterization and site assessment; Waste minimization and resource recovery; Storage and Transportation of Hazardous wastes; Hazard in processing and treatment; Physical, Chemical, Thermal and Biological processes; Hazardous waste disposal; Landfill disposal and land storage; Ground water contamination; Containment; remedial alternatives.

Text Books:

Reference Books:

Elective Group – A

CE 601 Numerical methods (3-0-0-6)

Linear and nonlinear equations, eigen value problems, Accuracy of approximate calculations, interpolation, differentiation and evaluation of single and multiple integrals, initial and boundary value problems by finite difference method, variation and weighted residual methods, fundamental of statistical distribution.

Text Books:

Reference Books:

CE 602: Optimization Methods (3-0-0-6)

**Text/Reference Books:**

**CE 560: Computational Methods in Hydraulics and Environmental Engineering Applications (3-0-0-6)**

Introduction – computing techniques – numerical methods – finite difference and finite element methods – applications in surface and ground water modeling, solute transport problems, pipe network analysis; artificial intelligence – applications.

**References:**

**Elective Group – B**

**CE 661: Air Quality Modeling (3-1-0-8)**

Air pollution meteorology: Transport, dilution, modification and removal of pollutants; Wind velocity profiles, Atmospheric stability; Pasquill-Gifford stability classes; Inversions; Potential temperature gradient; Plume behavior; Mixing heights; Kinetics of air pollutants: Atmospheric advection-diffusion of pollutants; Fick’s law of diffusion; No-flow boundary effect; Models for no-flow boundary conditions; Reynolds theory of turbulence; Atmospheric boundary layer; Modeling: Classification of air quality models, Gaussian plume model for a point source, Plume rise, Brigg’s and Holand’s equations for estimating plume rise; Dispersion coefficients; Buoyancy and flux parameters for plume rise; Gaussian approach to special cases of point, area and line sources of pollution; Pollutant concentration in the wake of building; Complex terrain effect; Deterministic models; Puff model; Box model; Special application of dispersion models; Advanced techniques in air quality modeling: Artificial Neural Networks (ANN), Hybrid modeling approach, Fuzzy logic theory (FLT), and Environmental wind tunnel (physical) models.

**Text books:**

**Reference books:**

CE 662: Environmental Systems Engineering Laboratory (1-0-4-6)

Detailed laboratory exercises related with physico-chemical and biological processes in Environmental Engineering: Sedimentation, Jar Test, Filtration, Chlorination, Adsorption and Ion Exchange (Batch and Column), Gas Transfer, Reaction Kinetics; Activated Sludge, Batch Anaerobic Reactor etc.

Text/References:

CE 568: Environmental Management (3-0-0-6)

Environmental management- principles, problems and strategies; Review of political, ecological and remedial actions; future strategies; multidisciplinary environmental strategies, the human, planning, decision-making and management dimensions; environmental impact assessment (EIA), definitions and concepts, rationale and historical development of EIA, sustainable development, Initial environmental examination, environmental impact statement, environmental appraisal, environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, status of EIA in India; Environmental audit, definitions and concepts, environmental audit versus accounts audit, compliance audit, methodologies and regulations; introduction to ISO and ISO 14000; Life cycle assessment; Triple bottom line approach.

Text Books:

Reference books:

**CE 663: Principles of Water Quality and Legislation (3-0-0-6)**

Physical, chemical and biological quality of natural surface water and groundwater; Organic and inorganic pollutants in water and wastewater; water quality criteria for drinking, municipal, industrial, agricultural, recreational, wildlife and aquatic organisms; specific refractory substances in water and its impact on water usage; effluent discharge standards; Water quality Index; water quality related legislations.

**Texts/Reference Books:**

**CE 664: Industrial Wastewater Pollution Control (3-0-0-6)**

Industrial wastewater versus municipal wastewater; Effects of industrial wastewater on receiving water bodies and municipal wastewater treatment plant; Bioassay test; Sampling techniques; Stream protection measures; Volume reduction, strength reduction, Neutralization, Equalization, Proportioning; Combined treatment of raw industrial wastewater with domestic sewage; Zero discharge concepts; Removal of specific pollutants in industrial effluents, e.g. oil & grease, phenol, cyanide, toxic organics, heavy metals; Characteristics and treatment of various industrial effluents.

**Text Books:**

**Reference Books:**

CE 665: Water Distribution and Wastewater Collection System Design (3-0-0-6)

Components of water supply systems; Water use and demand estimation; Design period, population data and flow rates for water supply systems; Factors affecting water consumption and variation in demand; Design of water distribution systems, methods of analysis for optimal distribution network design; Types of reservoirs and design parameters and methods; Design of water pumping stations.

Design principles of wastewater collection systems: separate, combined and semi-combined sewers; Estimation of dry weather flows; Sewer pipe hydraulics: sizing of pipes and design; Manhole chambers and storm water overflows; Pumping stations, screens and inverted screens.

Maintenance of water supply and wastewater systems.

Text Books:

Reference Books:

CE 527: Design of Environmental Engineering Systems (0-0-2-2)

It is expected that the student will learn complete design of Environmental Engineering Systems – be it in the area of water treatment, wastewater treatment, solid waste management and/or air pollution control. In the beginning of the semester (preferably within 2 weeks of the semester), the students will choose a design project in consultation with faculty members of the Environmental Engineering. Once the design project is selected, the students are required to develop the complete project including design calculations, appropriate detailed drawings and estimation of quantities. The students will be required to make periodic presentation for the purpose of evaluation of the course. This course will also help in improvement of communication and presentation skills.

CE 690: M Tech Project – I (0-0-24-24)

The third semester is completely devoted to dissertation work. It is expected that the student has carried out substantial research work including exhaustive literature survey, formulation of the
research problem, development/fabrication of experimental set-up (if any required) and testing, and analysis of initial results so obtained. The progress made during the semester may be evaluated through progress seminar(s). At the end of the semester, the students are required to submit written report followed by presentation and oral examination as per the Institute rules.

CE 691: M Tech Project – II (0-0-24-24)

The fourth semester is also completely devoted to dissertation work. It is expected that the student has completed most of the experimental/computation works and analyzed the results so obtained as decided in the formulation part of the research problem. The progress made during the semester may be evaluated through progress seminar(s). The students will be required to submit the research work in the form of dissertation as per the Institute rule. The final examination (presentation as well as oral) will be conducted by a duly constituted examination panel.