FACULTY OF ENGINEERING

M.E (Environmental Engineering)
Chemical Engineering
(W.e.f 2008-2009)

UNIVERSITY OF PUNE
# COURSE STRUCTURE FOR M.E. (Chemical - Environmental Engineering)  
(For 2008 Course) (W.e.f. June – 2008)

## SEMESTER I

<table>
<thead>
<tr>
<th>CODE</th>
<th>SUBJECT</th>
<th>TEACHING SCHEME</th>
<th>EXAMINATION SCHEME</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lect.</td>
<td>Pr</td>
<td>Paper</td>
</tr>
<tr>
<td>509131</td>
<td>Applied Statistics for Environmental Engineers</td>
<td>3</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>509132</td>
<td>Environmental Geosciences</td>
<td>3</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>509133</td>
<td>Environmental Chemistry</td>
<td>3</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>509134</td>
<td>Elective I</td>
<td>3</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>509135</td>
<td>Elective II</td>
<td>3</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>509136</td>
<td>Lab Practice I</td>
<td>-</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>509137</td>
<td>Seminar I</td>
<td>-</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total of First Term</strong></td>
<td></td>
<td>15</td>
<td>10</td>
<td>500</td>
</tr>
</tbody>
</table>

## SEMESTER II

<table>
<thead>
<tr>
<th>CODE</th>
<th>SUBJECT</th>
<th>TEACHING SCHEME</th>
<th>EXAMINATION SCHEME</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lect.</td>
<td>Pr</td>
<td>Paper</td>
</tr>
<tr>
<td>509138</td>
<td>Wastewater Treatment &amp; Design</td>
<td>3</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>509139</td>
<td>Solid Waste Management</td>
<td>3</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>509140</td>
<td>Industrial Waste Treatment</td>
<td>3</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>509141</td>
<td>Elective III</td>
<td>3</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>509142</td>
<td>Elective IV (Open)</td>
<td>3</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>509143</td>
<td>Lab Practice II</td>
<td>-</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>509144</td>
<td>Seminar II</td>
<td>-</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total of Second Term</strong></td>
<td></td>
<td>15</td>
<td>10</td>
<td>500</td>
</tr>
</tbody>
</table>
## SEMESTER III

<table>
<thead>
<tr>
<th>CODE</th>
<th>SUBJECT</th>
<th>TEACHING SCHEME</th>
<th>EXAMINATION SCHEME</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lect.</td>
<td>Pr</td>
<td>Paper</td>
</tr>
<tr>
<td>609107</td>
<td>Seminar III (Based on Project)</td>
<td>-</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>609108</td>
<td>Project Stage I</td>
<td>-</td>
<td>18</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total of Third Term</strong></td>
<td></td>
<td>-</td>
<td>22</td>
<td>-</td>
</tr>
</tbody>
</table>

## SEMESTER IV

<table>
<thead>
<tr>
<th>CODE</th>
<th>SUBJECT</th>
<th>TEACHING SCHEME</th>
<th>EXAMINATION SCHEME</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lect.</td>
<td>Pr</td>
<td>Project</td>
</tr>
<tr>
<td>609109</td>
<td>Project Stage II</td>
<td>-</td>
<td>18</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total of Fourth Term</strong></td>
<td></td>
<td>-</td>
<td>18</td>
<td>-</td>
</tr>
</tbody>
</table>

* The Term Work of Project stage II of semester IV should be assessed jointly by the pair of internal and external examiners. Along with the oral examination of the same.

**Note** - The Contact Hours for the calculation of load of teacher Seminar- 1 Hr / week / student & Project - 2 Hr / week / student

## LIST OF ELECTIVES

<table>
<thead>
<tr>
<th>Elective I</th>
<th>Elective II</th>
<th>Elective III</th>
<th>Elective IV</th>
</tr>
</thead>
</table>

Open Elective
EMPIRICAL STATISTICS: Measures of Central tendency, dispersion, skewness and kurtosis - Principle of least squares - Correlation and regression - rank correlation.

SAMPLING DISTRIBUTIONS AND ESTIMATION: Sampling distributions - Point and interval estimates for population proportions, mean and variance – Maximum likelihood estimate method - Method of moments.

TESTING OF HYPOTHESIS: Sampling distributions - Tests based on Normal, t, Chi-square and F distributions - Analysis of variance – one-way and two-way classifications.

DESIGN OF EXPERIMENTS: Completely randomized design - Randomized block design – Latin square design - 2 power 2 factorial design.

LINEAR PROGRAMMING: Basic concepts - Graphical and Simplex methods - Transportation Problem - Assignment Problem.

Reference Books
509132 Environmental Geosciences

Teaching scheme
Lecture: - 3h/week

Examination Scheme
Theory: - 100 Marks


Earth’s Processes and Geological Hazards: Earth’s processes; concepts of residence, time and rate of natural cycles. Catastrophic geological hazards. Study of floods, landslides, earthquakes, volcanism and avalanche. Perception of the hazards and adjustments to hazardous activities.

Mineral Resources and Environment: Resources and Reserves, Minerals and population. Oceans and new areas for exploration of mineral resources. Ocean and recycling of resources. Environmental impact of exploitation, processing and smelting of minerals.


Acid Mine Drainage: Formation of AMD, Chemistry of AMD, Microbiology of AMD, Iron Oxidation, Effect of AMD


Reference Books:

Concept and Scope of Environmental Chemistry: Definition and explanation for various terms, segments of environment. 26 principles and cyclic pathways in the environments.

Chemistry of Biologically Important Molecules: Chemistry of Water: Unusual physical properties, hydrogen bonding in biological systems, unusual solvent properties, changes in water properties by addition of solute. Protein structure and biological functions, enzymes, enzyme metabolism, biosynthesis of DNA and RNA, mutations and Gene control during embryogenesis.

Soil Chemistry: Formation, constituents and properties of soils, adsorption of contaminants in soil.


Physico–Chemical methods for analysis of environmental samples: Physico-chemical parameters: Definition and determination of conductivity, pH, emf, COD, BOD, Viscosity, surface tension, estimation of various elements at major, minor trace, ultra trace level concentrations; Choice of a technique; Principle, merits and demerits of the techniques – Neutron Activation Analysis, isotope dilution analysis, calorimetric, colourimetry, Atomic Absorption Spectroscopy, Gas chromatography, HPLC, Ion exchange Chromatography and Polarography.

Reference Books:
1. Environmental Pollution Analysis: Khopkar
3. Chemistry for Environmental Engineers by C.D. Sawyar Mcgraw Hill (latest edition)
Elective I
509134 Modeling of Environmental systems

Teaching scheme  Examination Scheme
Lecture: 3h/week  Theory: 100 Marks

Definition, Classification, Examples and Models of Environmental Systems. Modeling objectives and choices, sensitivity analysis and sources of error, introduction to numerical methods, reaction type and orders of reactions, conservation of mass, energy and momentum, river/stream quality.

Introduction to air quality models; Air pollution meteorology; Atmospheric turbulence; Gaussian Plume model and Modifications; Simulations of special meteorological and topographic conditions; urban diffusion models, Model Calibration. Sensitivity Analysis, Applications.

Climate change and the Models for Climatic change

Introduction to river, estuarine and lake hydrodynamics, Dissolved Oxygen Models; Temperature Models, prediction of fate of organism and toxic substances.

Models for management applications.

Reference Books
Elective I
509134 Groundwater Contamination and Pollution Transport

Teaching scheme
Lecture: - 3h/week

Examination Scheme
Theory: - 100 Marks


Hydrologic Cycle And Flownet: Flow nets-Graphical construction-Flow nets by numerical simulation, steady state Regional Ground water Flow-Steady state hydrologic-budgets-Fluctuations in ground water levels.


Reference Books :
Introduction: Role of national, international, and UN agencies in dealing with the environmental aspects. Standards and setting criteria.


Related Issues: Principles of sustainable development and implications of finite biosphere and complexities for engineering design and decision-making. Design of controlled environments to enhance health and protection of natural resources for sustainable development. Resource problems and design with ecological, economic, demographic and social dimensions. Techniques to integrate knowledge and define policy.

Reference Books:
Elective I  
509134 Air & Noise Pollution Control

Teaching scheme
Lecture: - 3h/week

Examination Scheme
Theory: - 100 Marks

Introduction, Sources, Classification and Effects of Air Pollutants; Sampling and Monitoring Techniques, Indoor & Out door (Industrial and Vehicular Emissions) Air Quality Assessment ; Dispersion Model; Air Pollution Control Techniques. Air Pollution Laws and Regulations.

**Design of Air Pollution Control Systems:** Application of physical and chemical processes in the design of air pollution control systems such as mechanical collectors, filters, scrubbers, cyclone separators, explosion vents, relief valves, electrostatic precipitators, and others; Implication for design. Problems on design of equipment, Component detailing collection efficiency.

General control of Gaseous pollutants, Principles of absorption, Adsorption, Basic design of absorption and adsorption units, Incineration and after burner, Control of sulphuric dioxide, NOx.

Noise Pollution, Characteristics. Sources, their Effects and Control Measures.

**Reference Books :**
3. Noise Pollution by Tripathy, Debipras (latest edition)
Elective II
509135 Membrane Technology in Environmental Engineering

Teaching scheme
Lecture: - 3h/week

Examination Scheme
Theory: - 100 Marks

Introduction to Membrane Processes, Membranes and Modules:
Principles of Membrane processes; Types and uses of membranes; Recent development in membranes; Types and uses of modules; Washing procedures.

Applications of Membrane Processes in Environmental Engineering:
Membrane bioreactors; Prevaporation and its applications; Reverse Osmosis, Ultrafiltration and Microfiltration and their applications; Dialysis and Electrodialysis and their applications; Others.

Preparation of Synthetic Membranes: Introduction, preparation of synthetic membranes, phase inversion membranes, preparation technique for immersion precipitation, preparation technique for composite membranes,

Characterization of Membranes: Introduction, membrane characterization, characterization of porous membranes, characterization of ionic membranes, characterization of non porous membranes.

Module and process design: Introduction, plate and frame model, spiral wound module, tubular module, capillary module, hollow fiber model, comparison of module configurations.

Case studies of Selected Environmental Processes with Membrane Technology

Reference Books :

2. S.P. Nunes, and K.V. Peinemann, membrane Technology in the chemical industry, Wiley-VCH.
Elective II
509135 Environmental Auditing & EMS

Teaching scheme
Lecture: - 3h/week

Examination Scheme
Theory: - 100 Marks

Concepts of Environmental Audit, Objectives of audit. Types of audits, Features of effective auditing, Programme Planning, Organisation of auditing programme, Pre-visit data collection, Audit protocol, Onsite audit, Data Sampling: Inspections, Evaluation and presentation, Exit interview.


Principles and elements of successful environmental management: Leadership, Environmental management planning, Implementing an environmental management system, Measurement and evaluations required for an environmental management system, Environmental management reviews and improvements.

Legal and regulatory concerns. Integrating ISO 9000 and ISO 14000.

Reference Books:
Elective II
509135  Agricultural Pollution and Control

Teaching scheme
Lecture: - 3h/week

Examination Scheme
Theory: - 100 Marks

Environmental issues in agriculture, types of farming systems, agro meteorology, water and nutrients requirement, types of fertilizers, pesticides and other agrochemicals, soil and water conservation practices, water logging and salinity; causes and effects. Wastewater reuse in agriculture, management and control of agricultural waste; recycling and reuse.

Reference Books:
Elective II
509135 Environmental Impact Assessment & Economics

Teaching scheme
Lecture: - 3h/week

Examination Scheme
Theory: - 100 Marks

**Environmental impact assessment:** Introduction, Concepts and aims, Impact statement, Methods and Processes, Mitigation processes. Prediction and assessment of impact on air, water and noise.

**Public participation in environment decision making.** Environment education and awareness, Environmental economics, Economics of Pollution control, Cost benefit analysis.

**Prediction and assessment of impacts** on the biological, cultural and socio-economic environment, Introduction and basic concepts. Environmental impact assessment of major development projects, industries, mining, thermal power plants, atomic power stations, transport (rail, road, highway), tourism (Hotels, beaches and resorts), EIA of different xenobiotics (chemicals, fertilizers, heavy metals).

**Economy and Environment,** Economic operation and environmental issues, adversities on the economy. Markets and Environmental Assets Incomplete markets, externalities, non-exclusion, non-rivalry and public good, non-convexities, asymmetric information.

**Economic Incentive and Environmental Protection:** (i) Price rationing: Charges and subsidies, (ii) Liability rules: Non-compliance fees, bonds and deposit refunds. (iii) Quantity rationing: Marketable permits. (iv) Evaluation criteria (v) Practical Conditions for use of economic incentives.

**Pollution Taxes,** Efficiency properties of a tax on emissions, problems with pollution taxes.

** Tradable Pollution Permits,** Basic theory of tradable pollution permits, issues in tradable permits. Transboundary pollution problem, international organizations for environmental protection. WTO agreements on environment. Agrochemical pollution and measures undertaken: national and international scenario, bio-diversity and economy.

**Reference Books**


509136 Lab Practice I

Teaching Scheme
Practical: 6 Hrs/Week

Examination Scheme
T.W. : 50 marks

Each student should perform at least 8 experiments/ assignments from the list given below and submit the journal which will form the term-work for the subject:

1. Use of water test kits for the determination of various water pollution parameters
2. To measure common parameters using Ion Selective Methods
3. To measure common parameters using other conventional methods
4. Analysis of water quality
5. Analysis of water samples for metals using AA Spectrometer
6. Analysis of Phosphate by using ascorbic acid method
7. Water analysis for physico-chemical characteristics
8. Analyze and modeling of selected problems and design of algorithms appropriate to their solution
9. Usage of conceptual, mathematical and computational models.
10. Manipulation of environmental data files on a personal computer.
11. Graphical representation of environmental data and to draw inferences from them.
12. To study the differences between analytical and numerical solutions to environmental models.
13. Use of iteration technique in environmental modeling
14. To study the comparison between discrete and continuous models.
15. To validate a model and sensitivity analysis.
16. To understand the concept of spatial dependence and its modeling.
17. Classification and identification of minerals (Museum specimens)
18. Preparation of a climatic maps and diagrams
21. Study of Topological sheets
   23. Measurement of sounds by DB meter in silent, industrial, residential and commercial zones.
24. To analyse the automobile/diesel engine exhaust
Each student is required to deliver a seminar in first semester on the state of the art of the topic of his/her choice, preferably the topic of his/her dissertation and submit it in form of a short report.
SEMESTER II

509138 Wastewater Treatment & Design

Teaching scheme
Lecture: - 3h/week

Examination Scheme
Theory: - 100 Marks

Mass transport processes, Mass balance analysis, types of reactions, reaction kinetics, Configurations of ideal and non-ideal reactors, principles of ideal reactor design. Basic principle of mass transfer, Gas-liquid mass transfer, Two film theory Introduction to process selection.

Coagulation processes, stability of colloids and destabilization, coagulants Flocculation theory, orthokinetic and perikinetic Design of slow and rapid mixers.

Sedimentation, particle settling theory, types of settling and related theory, types of clarifier, high rate clarification, design of clarifiers.

Introduction to depth filtration, filtration processes, principal mechanisms of filtration, filter hydraulics, backwash hydraulics, Rate control patterns and methods, design and operation of slow sand, rapid sand and dual media filters.

Adsorption processes, causes and types of adsorption, influencing factors, adsorption equilibria and development of adsorption isotherms, activated carbon adsorption kinetics, analysis and design of GAC and PAC contactors.

Ion exchange, exchange materials, exchange capacity, ion exchange chemistry and reactions, applications for hardness and TDS removal, design of ion exchange softener,

Disinfection, modes of disinfection, mechanisms, factors influencing, ideal disinfectant, chemistry of chlorination, ozone chemistry, estimation of ozone dosage, UV disinfection, Estimation of UV dose.

Corrosion processes, electrochemical nature of corrosion, types of corrosion, methods of corrosion control.

Objectives and fundamentals of biological treatment, types of biological treatment processes. Conventional activated sludge process, process kinetics and design considerations, process control measures, operational problems, Introduction to modifications. Trickling filter, classification, process design considerations. Fundamentals of anaerobic treatment, general design considerations, types of anaerobic reactors.

Reference Books:
Solid waste management: Objectives, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, Types, Composition, Quantities, Physical, Chemical and Biological properties.

Solid waste generation rate: Definition, Typical values for Indian cities, Factors affecting.


Sorting and material recovery: Objectives, Stages of sorting, Sorting operations, Guidelines for sorting for material recovery, Typical material recovery facility for a commingled solid waste.


Landfills: Definition, Essential components, Site selection, Land filling methods, Leachate and landfill gas management.

Indian scenario: Present scenario and measures to improve system for different functional elements of solid waste management system. Elements of financial management plan for solid waste system.

Reference Books:
2) Integrated solid waste management – George Tchobanoglous. Mcgraw Hill
3) Solid waste management handbook– Pavoni.
Teaching scheme
Lecture: - 3h/week

Examination Scheme
Theory: - 100 Marks

509140 Industrial Waste Treatment

Water use in industry, Industrial water quality requirements, Deterioration of water quality, Classification and characterization of Industrial wastewater, Monitoring of wastewater flow in industries, Quality and quantity variations in waste discharge, Water budgeting.


Treatment techniques for removal of specific pollutants in industrial wastewaters, e.g., oil and grease, cyanide, fluoride, calcium, magnesium, toxic organics, heavy metals, radioactivity.


Common Effluent treatment plant: Concept, Objectives, Methodology, Cost benefit analysis, Design, Operation and maintenance.

Classification of industries. Manufacturing processes, Water usage, Sources, Quantities, and characteristics of effluents, Pollution effects, Methods of treatment, utilization and disposal, in industries viz. sugar, distillery, dairy, pulp and paper mill, fertilizer, tanning, steel industry, textile, petroleum refining, chemical and power plant.

Reference Books
1) Theories and Practices of Industrial waste treatment- Nelson Nemerow.
3) IS Standard guide for treatment and disposal of various industries.
Elective III

509141 Ecology and Risk Assessment

Teaching scheme
Lecture: - 3h/week

Examination Scheme
Theory: - 100 Marks

Introduction; Principles and Concepts of Eco-system, Energy in Eco-system, Biogeochemical Cycles; Principles Pertaining to Limiting Factors; Principles and Concepts at the Community and Population Levels; Species in Eco-system; Devolution and Evolution of Eco system; Models in Ecology; Fresh Water Ecology; Marine Ecology; Estuarine Ecology; Terrestrial Ecology; Concepts and Principles in Sustainable Development and Biodiversity; Habitat, Damage Assessment; End Point Definition; Quantification of Uncertainty; Predictive Risk Assessment; Exposure, Organism- level Effects; Case Studies.

Reference Books:

1. Fundamentals of Ecology by Odhum (latest edition)
2. Ecological Engineering by Mitch / Iorgemaker (latest edition)
Elective III

509141 Water Quality Modeling

Teaching scheme
Lecture: - 3h/week

Examination Scheme
Theory: - 100 Marks

Basic Concept of Modeling. Hydrological Considerations in Water Quality Modeling. Low Flow Frequency Analysis. Sources of Pollution and Types of Wastes; Point and Non-point Sources.

General Mathematical Formulation of Water Quality Models for Streams and Rivers; Bod, Do, Bacterial Decay, and Nitrification.


Reference Books:
Elective III

509141 Modern Trends in Environmental Engineering

Teaching scheme            Examination Scheme
Lecture: - 3h/week                      Theory: - 100 Marks

**Emerging fields in ESE:** Cleaner Production Technologies, Environmental Bio-Technology, Bioremediation, Risk Analysis, Software and Information Systems, Global Issues.

Environmental pollution monitoring sensors. Basic understanding of the interaction of electromagnetic radiation, sound, laser etc. with matter. Familiarization with a variety of sensors and platforms


Unit – IV Land pollution - Definition and scope, necessity and importance, Treatment methods: Various methods of refuse processing, fertilizer, fuel and food values. Sanitary land filling - definition, methodology, trench, area, ramp, pit method, site selection, basic steps involved, cell design, prevention of site pollution, Leachate treatment, gas collection and recirculation.

**Composting** – Aerobic and anaerobic composting, Factors affecting composting indore and Bangalore processes of composting. Incineration - Processes 3Ts to control high temperature incinerators, design approach prevention of air pollution.

**Reference Books:**
Concept of Environmental Biotechnology and Environmental Engineering, scope and importance. Genetic engineering structure of DNA, RNA, Replication of DNA, genetic code, Transcription, Protein synthesis.

Introduction to Genetic Engineering and Recombinant DNA Technology(RDT), Restriction endonucleases, Steps in gene cloning, cDNA and genomic library, Chemical synthesis of gene, Polymerase Chain Reaction (PCR), Vectors and their types, Selection of recombinant clones.

**Microbiology of waste water treatment.** a) Aerobic processes : Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. b) Anaerobic processes : Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactor. Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industry.

Air pollution and its control through biotechnology, Biotechnology in reduction of CO2 emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications.

Microbiology of degradation of xenobiotic in environment – ecological considerations, decay behavior and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Biological detoxification of cyanide, oxalate, urea, petrochemical industry effluents, toxic organics, phenols.

Bioremediation, Types of bioremediations, Bioaugmentation for bioremediation, Bioreactors, Bioremediation of herbicides, pesticides, hydrocarbons, oil spills.

Novel methods of pollution control – Vermitechnology, Methane production,Root zone treatment, Membrane technology, Biodegradable plastics.

**Reference Books :**
3. Biotechnology : A Text Book of Industrial Microbiology, T. D. Brock,
4. Industrial Microbiology : Presscott and Dunn.
509142 Elective IV (Open)
Teaching scheme
Lecture: - 3h/week

Examination Scheme
Theory: - 100 Marks

509143 Lab Practice II

Teaching Scheme
Practical: 6 Hrs/Week

Examination Scheme
T.W. : 50 marks

Each student should perform at least 8 experiments/ assignments from the list given below and submit the journal which will form the term-work for the subject

1. Analysis of soils for pH,

2. Analysis of soil for moisture,

3. Analysis of soil types,

4. Analysis of soil for EC, conductivity,

5. Analysis of soil for NPK, Na, Ca.


7. Designing of plant using software such as EnviroPro / SuperPro

8. Field visit to a water treatment plant

9. Field visit to a wastewater treatment plant

10. To study the performance Ion Exchange Column

11. To study the adsorption Characteristics of the given cation exchange resins.
### 509144 Seminar II

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
<th>Examination Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical: 4 Hr/Week</td>
<td>T.W.: 50 marks</td>
</tr>
</tbody>
</table>

Each student is required to deliver a seminar in first semester on the state of the art of the topic of his/her choice, preferably the topic of his/her dissertation and submit it in form of a short report.

### 609107 Seminar III (Based on Project)

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
<th>Examination Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical: 4 Hr/Week</td>
<td>T.W.: 50 marks</td>
</tr>
</tbody>
</table>

Each student is required to deliver a seminar in third semester on the state of the art of the topic of his/her choice, preferably the topic of his/her dissertation and submit it in form of a short report.

### 609108 Project Stage I

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
<th>Examination Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practicals: 18 Hrs/Week</td>
<td></td>
</tr>
</tbody>
</table>

Students are required to prepare a report based on project of their choice.

### 609109 Project Stage II

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
<th>Examination Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical: 18 Hrs/Week</td>
<td>T.W.:50 marks / Project 200 Marks</td>
</tr>
</tbody>
</table>

Students are required to prepare report on project of their choice. They are required to submit project report and appear for the oral examination.