Savitribai Phule Pune University
Faculty of Engineering
Board of Studies (Civil Engineering)

Curriculum for
M.E – Water Resource and Environmental Engineering
Structure for ME Civil Engineering (Water Resources and Environmental) with effect from academic year 2017 – 2018
ME Civil (WREE) 2017 course

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Elective I: Design of Hydraulic Structures (501085 A), Irrigation and Drainage (501085 B), Remote Sensing-GIS (501085 C)

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Elective II: Air pollution and control (501090 A), Industrial Wastewater Treatment (501090B), Solid and Hazardous waste Management(501090C)
## SEMESTER - III

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Open Elective: Concrete Technology (601095A), Wave Mechanics (601095B), Project planning (601095C)

## SEMESTER - IV

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EXAMINATION SCHEME

A) Compulsory Subjects: Credits 4

Total marks: 100

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B) Elective Subjects: Credits 5

Total marks: 100

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M.E FIRST YEAR – SEMESTER-I

Planning and Management of Water Resources (501081)

Teaching Scheme
Credits: 4
Lectures: 4 Hrs/week

Examination Scheme
In Sem Assessment: 50 Marks
End Sem Assessment: 50 Marks
Total :100 Marks

Unit 1: Introduction
Objectives: of water resource planning and management, its Necessity, Aspects of water resources planning, water resource development; needs and opportunities; social goals

Unit 2: Characteristics Of Water Resources
Spatial and temporal characteristics of water resources, constraints for its development like non-reversibility; planning region and horizons.

Unit 3: Management of Surface Water Resources
Characteristics and functions of reservoir; reservoir sedimentation; conservation storage; conflict among uses, Reservoir operation studies - effect on river regime; long term simulation; reliability; resiliency and vulnerability assessment

Unit 4: Management of Ground-Water Resources
Ground water evaluation; conjunctive use of surface and ground water, Ground water and well
hydraulics, interference and specific yield of wells, construction and maintenance of artificial wells

**Unit 5: Economic Planning** (8Hrs.)

studies of single and multipurpose projects— multi objective planning models, financial analysis of water resources projects, allocation of cost of multipurpose projects; repayment of cost. Demand for drinking water; irrigation, hydropower; navigational; planning for flood control.

**Unit 6: Benefit Cost Analysis** (8Hrs.)

Discounting techniques; benefit cost parameters; estimation of benefits and costs; appraisal criteria; social benefit cost analysis. Basin planning; inter-basin transfer of water

**Text books:**


Water Management System Application-A.K.Biswas

**Reference Books:**


Principles of Water Resources planning-by Goodman.

Water Resources Planning and Management by-O.J. Helwege.

Water resource Engineering- Linsley and Franzini, Mc Graw-Hill

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**Environmental Chemistry and Microbiology (501082)**

**Teaching Scheme**

Credits: 4

Lectures: 4 Hrs/week

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**Examination Scheme**

In Sem Assessment: 50 Marks

End Sem Assessment: 50 Marks

Total Marks:100

**Unit 1: Chemistry of pollutants in the Atmosphere** (8 Hrs.)


Air pollutant sampling technique in ambient air and stack monitoring system. Automobile pollution sampling technique causes of automobile pollution and control technique.

**Unit 2: Chemical Reaction** (8 Hrs.)

Different types of chemical reaction, reactor and their characteristics. Basics of mass transfer, absorption and adsorption process, various laws in mass transfer. Conduction, convection and radiation heat transfer and their application. (Including numerical)

**Unit 3: Physico–Chemical methods for analysis of environmental pollutants and their concentration.** (8 Hrs.)


**Unit 4: Instrumental method of pollutant analysis.** (8 Hrs.)

Fundamental of lights, heat, velocity, acceleration, noise and their application in instrument design. Various law for design of environmental instruments. Study of various instruments used in pollution analysis such as pH meter, colorimeter, flame photometer, noise meter, accelerometer, turbidity meter, spectrophotometer single and double beam, AAS, HPLC,G C

**Unit 5: Bio kinetics and its applications** (8Hrs.)

Bio kinetic coefficients, determination of bio kinetic coefficient in lab, application of bio kinetic constant, application of bio kinetic constant in ASP, Trickling filter, Lagoon , Oxidation ponds, UASB, Anoxic treatment, anaerobic digester, septic tank. Design of landfill bioreactor and leachate control in solid waste management. (Including numerical)

**Unit 6: Micro organism and micro biology in environmental engineering** (8 Hrs.)
Bacteria: classification and characteristics of bacteria, cell morphology, growth rate curve, culture techniques, gram staining, microscopic methods, Moond’s Expression, Plate count and membrane filter techniques, Algae: classification, symbiosis, factors affecting algal growth, control of algae, fungi, moulds, protozoa, population dynamics, role of microbes, substrate utilization in biological waste treatment, significance of F/M ratio, acclimatization of bacteria, bioassay tests, aerobic and aerobic metabolism. Structure of prokaryotic and eukaryotic cells.

**Text books:**
A Textbook of Environmental Chemistry and Pollution Control by Dara S.S.- S. Chand and Company Ltd., New Delhi.
Environmental Chemistry by Manhan, S.E.- Lewis Publishers

**Reference books:**
Environmental Chemistry by De A.K.- New Age International (P) Ltd., New Delhi.
Environmental Pollution Analysis by Khopkar S.M.- New Age International (P) Ltd., New Delhi.
Fluid Mechanics (501083)

Teaching Scheme
Credits: 4
Lectures: 4 Hrs/week

Examination Scheme
In Sem Assessment: 50 Marks
End Sem Assessment: 50 Marks
Total Marks:100

Unit 1: Kinematics I
Revision of concepts in basic Fluid Mechanics such as classification of flows, Equation of continuity for three dimensional flow in Cartesian co-ordinates, equation of continuity for one-dimensional flow along a streamline, types of motion, rotational and irrotational motion velocity potential, stream function and flow net

Unit 2: Kinematics II
Continuity Equation in polar and cylindrical coordinates, solving Laplace equation by graphical method, conformal mapping. Standard two dimensional flow pattern, source, sink, doublet and their combination

Unit 3: Laminar Flow
Euler’s equation of motion along a streamline and its integration, Bernoulli’s equation. Derivation of Navier Stokes’ equations, solution of NS equations for flow between parallel plates a) both plates stationary b) one plate moving, derivation of Hagen Poiseuille’s equation using NS equations

Unit 4: Boundary Layer Theory
Development of boundary layer on a flat plate nominal, displacement, momentum, energy thicknesses, laminar, transitional and turbulent boundary layer, laminar sub layer, Local and mean drag coefficients, Boundary layer equations, Karman’s momentum integral equation, Karman Pohelhausen’s solution, boundary layer separation

Unit 5: Turbulent Flow
Reynolds’ equation of motion, typical solution, Energy and Momentum equation, Statistical theory of turbulence, Isotropic and homogeneous turbulence, probability density function

Unit 6: Fundamentals of Compressible Flow
Compressible fluid flow-fundamental equation, continuity equation, energy equation, velocity of propagation, Pressure, density and temperature in terms of Mach number, Normal shock in one dimensional compressible flow

Text books:
Fluid Mechanics and Hydraulic Machines – Sukumar Pati, Tata McGraw-Hill

Reference books:
Fluid Mechanics - Streeter, Wylie and Bedfordn Tata McGraw Hill
Fluid Mechanics by White – Mc-Graw Hill
Fluid Mechanics and Machinery – C.S.P Oza, R.Berndtsson, P.N.Chandramouli- Oxford University Press
Advanced Water Treatment (501084)

Teaching Scheme
Credits: 4
Lectures: 4 Hrs/week

Examination Scheme
In Sem Assessment: 50 Marks
End Sem Assessment: 50 Marks
Total Marks:100

Unit 1: Introduction to unit operations and processes (8 Hrs.)
Physical and chemical quality of surface and sub-surface waters. 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 Theory and design of physicochemical unit operations: screening, sedimentation, Floationation, Coagulation, Flocculation, Filtration, Disinfection.

Unit 2: Filtration (8 Hrs.)

Unit 3: Adsorption and Softening (8 Hrs.)

Unit 4: Distribution system and Network Analysis (8 Hrs.)
Planning of Water System –Selection of pipe materials, Design of rising main, water hammer analysis, Water distribution pipe networks design, and analysis- Hardy cross method, Newton Raphsons method, Linear method(including numerical); corrosion prevention ,minimization of water losses , leak detection. Theory and Design of water pumping stations.

Unit 5: Ground Water Treatment (8 Hrs.)

Unit 6: Membrane (8 Hrs.)

Text books:
- Water Supply Engg by Dr. B.C. Punmia ,Laxmi Publicaiton

Reference books:
- Montgomery, water treatment principles and design, Johnwiley and sons, New York.
Elective I: Design of Hydraulic structures (501085 A)

Teaching Scheme

Credits: 4
Lectures: 4 Hrs/week
Laboratory Work: NA

Examination Scheme

In Sem Assessment: 50 Marks
End Sem Assessment: 50 Marks
Total Marks: 100

Unit 1: Diversion Head works (8Hrs.)
Weir and Barrage, Gravity and non- gravity weirs, layout of a diversion head works and its components, The diversion weirs and its types, afflux and pond level, the under sluices or scouring sluices, the divide wall, fish ladder, head sluices, silt control devices.

Unit 2: Theories of seepage and design of weirs and Barrages (8Hrs.)
Failure of hydraulic structures founded on pervious foundations. Bligh’s Creep theory for seepage flow, Lane’s weighted Creep theory, Khosla’s theory and concept of flow nets, Design of vertical drop weir on Bligh’s theory, Design of modern weirs and barrages founded on permeable foundations on the basis of Khosla’s theory.

Unit 3: Canal Falls (8Hrs.)
Definition and location of canal falls, Types of falls, Design of a trapezoidal notch fall, Design of syphon well drop, design of simple vertical drop fall, design of Sarda type fall, design of a straight glacsis fall, design of a baffle fall or Inglis fall.

Unit 4: Regulators Modules And Miscellaneous Canal Structures (8Hrs.)
Canal Regulation- Canal regulation works, canal regulators, alignment of the off taking channels, Distributary head regulator and cross regulator, design of cross regulator and head regulator, Canal escapes - types of canal escapes, Metering Flumes – Types of Metering Flumes, Canal Outlets or Modules – Requirements of good Module, types of Modules, Criteria for judging the performance of modules, certain other important definitions connected with modules, types of non-modular outlets, types of semi modules or Flexible outlets, types of rigid modules, Miscellaneous Canal Structures – Cattle crossings, bed bars.

Unit 5: Cross Drainage Works (8Hrs.)
Introduction, types of Cross Drainage Works, selection of suitable type of cross drainage work, various types of aqueducts and siphon aqueducts, design consideration for Cross Drainage Works, determination of maximum flood discharge, Fixing waterway requirements for aqueducts and siphon aqueducts. provision of joints and water bars in R.C.C ducts of aqueducts and super passages

Unit 6: Rivers, Their Behavior, control and training (8Hrs.)
Importance of rivers and necessity of controlling them, types of rivers and their characteristics, classification of the rivers on the basis of the topography of the river basin, Indian rivers and their classifications, Behavior of rivers, straight reaches, bends, meanders, Control and training of rivers, objective of river training, classification of river training, methods of river training, problems related to the river training.

Text books:
Irrigation Engineering and hydraulic structures: S.R.Sahasrabudhe- Catson books, Delhi, 3 ed.
Irrigation, Water Resources and water power engineering- Dr. P. N. Modi Publ Standard book house.

Reference books:
Theory & design of irrigation structures Vol.I, II, III Varshney- Gupta and Gupta Nemchand and br others publication
## Module II

**Teaching Scheme**
- Credits: 1
- Lectures: 1 Hr/week

**Examination Scheme**
- In Sem Assessment: 25 Marks
- Total Marks: 25

### Unit 1
- Assignment on design of weir or barrage

### Unit 2
- Assignment on design of any one type of CD works

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## Elective I: Irrigation and Drainage Engineering (501085 B)

**Teaching Scheme**
- Credits: 5
- Lectures: 5 Hrs/week
- Laboratory Work: NA

**Examination Scheme**
- In Sem Assessment: 50 Marks
- End Sem Assessment: 50 Marks
- Total Marks: 100

### Unit 1: Introduction
- Definition, Necessity of irrigation, Benefits of Irrigation, ill effects of irrigation. Types of irrigation systems. Classification of Irrigation methods, Factors affecting the choice of irrigation methods, quality of irrigation water. Surface and Subsurface irrigation methods, sprinkler irrigation, Micro irrigation (theory only)

### Unit 2: Soil Water-Crop Relationship
- Soil classification, soil moisture and crop water Relationship, Determination of soil moisture, factors governing consumptive use of water, estimation of consumptive use and frequency of irrigation, irrigation efficiencies for economical use of water, assessment water charges, conjunctive use of surface and groundwater, multi-crop irrigation scheduling.

### Unit 3: Lift Irrigation and Drip Irrigation
- Lift Irrigation: General concepts, advantages, disadvantages, elements of lift Irrigation schemes, design considerations involved in intake well, jackwell, rising main, distribution systems, concept of cost economics. Drip Irrigation: Definition and functions, types of drip Irrigation systems, components. Design and installation of drip Irrigation systems, advantages & disadvantages of Drip Irrigation systems, operations & maintenance of Drip assembly.

### Unit 4: Sprinkler Irrigation
- Sprinkler Irrigation: Definition and introduction of Sprinkler Irrigation, advantages and disadvantages of Sprinkler Irrigation, components of sprinkler Irrigation systems (Pumping set, desilting basin and debris screen, main and lateral pipe lines, sprinkler heads, perforated pipes, take off volves and flow control valves, fertilizer applicators), types of sprinklers, design of considerations sprinkler Irrigation systems (preparation of inventory of basic data, criteria for system layout, selection of sprinkler and its spacing, discharge capacity of the pump hydraulic design of sprinkler head, main and lateral pipe sizes)

### Unit 5: Salt affected land and their reclamation
- Salt accumulation in soil water, classification of salts affecting the soils and their characteristics, reclamation of saline and alkaline soils, leaching and salinity control. Water and wind erosion, design of various types of soil conservation measures.

### Unit 6: Drainage of irrigated land
- Need and purpose of drainage, water logging of agricultural lands and its reclamation, steady state and transient designs of surface and sub-surface drainage systems, drainage by wells, Soil Erosion and Conservation.

**Text books:**
Reference books:
Theory & design of irrigation structures Vol.I, II, III Varshney Gupta and Gupta Nemchand and brothers publication

Module II
Teaching Scheme
Credits: 1
Lectures: 1 Hr/week

Unit 1:
Assignment on design of lift Irrigation Scheme

Unit 2
Assignment on design of Drip Irrigation/ Sprinkler scheme

Elective I: Remote Sensing and GIS (501085 C)
Teaching Scheme
Credits: 4
Lectures: 4 Hrs/week
Laboratory Work: NA

Unit 1: Introduction to Remote Sensing and EMR
(8Hrs.)

Unit 2: Data Acquisition and Satellites.
(8Hrs.)

Unit 3: Types of remote sensing and image interpretation
(8Hrs.)

Unit 4: Introduction to GIS
(8Hrs.)
Definitions, Components of GIS, Representation of Geographic features in Vector and Raster Data models, Concept of arc, node, vertices and topology – maps and spatial information, Hardware & Software requirements for GIS.

Unit 5: Data & Processing
(8Hrs.)
Unit 6: Applications of RS GIS in water resources engineering (8Hrs.)
Simple-complex query with two or more tables using SQL. Queries using Union, Intersection, Join etc operations. Types of Models, Conceptual Models of WREE, GIS analysis and Interpretation, Over view of Open sources softwares such as ARC – GIS, Q – GIS.

Text books:

Reference books:
Photogrammetry by – Sheford

Module II

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Unit 1:
Assignment on image classification

Unit 2
Assignment using Q-GIS

Lab Practice I (501086)

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The lab practice-I will be based on completion of assignments / practicals / reports of site visits, confined to the course in that semester.
The term work will consist of --
i) Visit reports of minimum two site visits, exploring the field aspects for various subjects
ii) Report on minimum 2 software applications on any subject of thesemester.
iii) Report of laboratory work consisting of following:....
1. Solution of Laplace equation by graphical / relaxation method.
2. Flow past a cylinder using wind tunnel
3. Flow past aerofoil using wind tunnel.
4. Growth of a boundary layer along a flat plate using wind tunnel/air flowbench
5. Determination of friction factor using experimental observations, Darcy-Weishbach equation and Moody’s diagram for different pipes(materials)
6. Assignment based on cost benefit studies of single and multipurpose projects– multi objective planning models, financial analysis of water resources projects.
7. Assignment on basin planning for water management
8. Ambient air quality analysis for RSPM,PM 10, and analysis of automobile exhaust for CO, lead analysis.
Conductivity, Alkalinity and acidity, Hardness, Sulphate, Iron and Manganese, Optimum dose of alum, MPN Number.
10. Determination of cations, anions and any one heavy metal from water.
11. Sample collection methods and standardization of chemicals.

M.E FIRST YEAR - SEMESTER II

Hydrology (501087)

Teaching Scheme
Credits: 4
Lectures: 4 Hrs/week

Examination Scheme
In Sem Assessment: 50 Marks
End Sem Assessment: 50 Marks
Total Marks: 100

Unit 1: Introduction
Hydrologic Cycle, Precipitation, Evaporation, Infiltration, Interception and Depression, Depth area duration analysis, Unit hydrograph theory, IUH, Rainfall runoff models-SWM, Tanks, CLS models

Unit 2: Stochastic processes
Stochastic processes-classification, time series & it’s components, various statistical distributions like binomial, normal, log-normal, Poisson, Beta B, gamma, Pearson type I, II and III & their uses in hydrology, Chi square test, plotting, position, frequency factors, extreme value theory, synthetic generation of yearly and monthly flows in hydrology.

Unit 3: Flood Analysis
Flood estimation by various methods, forecasting of floods, flood frequency analysis, Gumbel’s, Pearson type I, II, and III distribution, Log-normal method, design flood for various hydraulic structures

Unit 4: Ground Water Hydraulics
Definition of Ground Water, aquifers, vertical distribution of subsurface water, Darcy’s Law-it’s range of validity, Dupuit-Forchheimer assumption, application of Darcy’s law to simple flow systems governing differential equation for confined and unconfined aquifers, fully & partially penetrating wells, interference of wells, pumping test with steady & unsteady flow, method of image.

Unit 5: Ground Water Development
Ground water Exploration, well types, well construction & design, screens, perforations & gravel packs, pumping equipment, quality of ground water, pollution of groundwater

Unit 6: Ground Water Conservation
Ground water budget, seepage from surface water artificial recharge, Porous media models, Analog models, Electric analog models, Digital computer models

Text books

Reference books
Applied Hydrology-LinsleyKolhar&Paulhas (Mc-Graw Hill)
Open Channel Hydraulics (501088)

Teaching Scheme
Credits: 4
Lectures: 4 Hrs/week
Laboratory Work: NA

Examination Scheme
In Sem Assessment: 50 Marks
End Sem Assessment: 50 Marks
Total Marks: 100

Unit 1: Uniform Flow (8 Hrs.)
Specific Energy, Specific Force, Critical depth, and its computations, critical flow, critical velocity, section factor, First Hydraulic exponent, Depth Energy relationship, Uniform flow, Flow through prismatic channels

Unit 2: Hydraulic Jump (8 Hrs)
Introduction to Jump, Momentum equation of jump, classification of jump, Characteristics of jump in a rectangular channel, Formations of jump in expanding channel, jump at an abrupt drop and rise, control of jump by baffle blocks, jump in sloping rectangular channels

Unit 3: Gradually Varied Steady Flow (8 Hrs.)
Gradually varied steady flow and rapidly varied steady flow in open channels, surface profiles in GVF analysis, different method of computations, Chow’s methods, standard step method, finite difference method.

Unit 4: Spatially Varied Flow (8 Hrs.)
Differential Equation of spatially varied flow with increasing and decreasing discharge, side weir, bottom rack.

Unit 5: Unsteady Flow (8 Hrs.)
Gradually varied unsteady flow: Continuity equation, dynamic equation, Monoclinal rising waves, dynamic equation for uniformly progressive flow, wave profile of uniformly progressive flow, wave propagation. Rapidly varied unsteady flow: Uniformly progressive flow, positive surge, negative surge.

Unit 6: Flood Routing (8 Hrs.)
Hydraulic and Hydrologic flood routing, Reservoir and channel routing, Differential form of Momentum Equation, Muskinghum method, Finite difference scheme, Method of characteristics.

Text books

Reference books
Open Channel Hydraulics – VenTe Chow, Mc-Graw Hill.
Flow through Open Channel-K.G.Ranga Raju, Tata Mc-Graw Hill.
Open Channel Hydraulics-French, Mc-Graw Hill.

Advance Waste Water Treatment (501089)

Teaching Scheme
Credits: 4
Lectures: 4 Hrs/week

Examination Scheme
In Sem Assessment: 50 Marks
End Sem Assessment: 50 Marks
Total Marks: 100

Unit 1: Conventional Sewage Treatment (8Hrs.)

Curriculum for M.E WREE (Civil)14
Activated sludge process, Biological principle, different T.F media & their characteristics

Unit 2: Overview of membrane filtration (8Hrs.)

Unit 3: Membrane filtration Design (8Hrs.)

Unit 4: Heavy Metals Analysis (8Hrs.)

Unit 5: Disposal of Sewage (8Hrs.)

Unit 6: Sludge Treatment and Disposal (8Hrs.)
Anaerobic digester: Principal of anaerobic digestion, stages of digestion, bio – gas production its characteristics & application, factors governing anaerobic digestion, Design of anaerobic digesters. Such as gravity thickener, sludge drying bed, decanters. Methods of sludge treatment and disposal, advantages & disadvantages, Up-flow Anaerobic Sludge Blanket (UASB) Reactor– Principle, advantages & disadvantages, removal of phosphate and nitrate from sludge, various usage of dry sludge as other material (including numericals).

Text books
Water supply engineering by- S.K.Garg
Waste water Engineering by- B. Punmia

Reference books
Water Supply & Sewerage By - Ernest W. Steel (Mc-Graw Hill Book Co.)
Waste Water Engineering Treatment & Reuse bv - Metcalf & Eddy ( Tata Mc-Graw Hill)
Water&Wastewater Technology bv - Mark J.Hammer (Prentice - Hall of India) .."
Manual on Sewerage & Sewage Treatment CPHEEO. Min of Urban Dev. New Delhi
Manual on Membrane filtration under EPA

Elective II: Air Pollution and Control (501090A)

Teaching Scheme
Credits: 5
Lectures: 5 Hrs/week

Examination Scheme
In Sem Assessment: 50
Marks End Sem Assessment: 50 Marks
Total Marks: 100

Unit 1: Air Quality and Standards (8 Hrs.)

**Unit 2: Meteorology**
(8 Hrs.)
Meteorological parameters and their effects on urban air pollution, Wind rose, Atmospheric motion, Lapse rates, Atmospheric stability, Inversions and its effects on pollutants, Atmospheric diffusion of pollutants, Transport, Transformation and deposition of air contaminants; Global air pollution: Acid rain, Ozone layer depletion, Global warming, Greenhouse effect and Trans-boundary pollution, Kyoto protocol, Carbon credit and carbon trading.

**Unit 3: Indoor Air Pollution**
(8 Hrs.)
Indoor air pollution sources, indoor pollutant levels, monitoring instruments; indoor pollution control strategies: source control, control equipment and ventilation; energy conservation and indoor air pollution; effects of indoor air pollution; risk analysis; models for predicting source emission rates and their impact on indoor air environments.

**Unit 4: Air Pollution Control**
(8 Hrs.)

**Unit 5: Air Pollution Modeling**
(8 Hrs.)
Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution – Transport of air Pollutants – Meteorological settling for dispersal of air pollutants vertical structure of temperature and stability, atmosphere, transport and diffusion of stack emission – atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics, Maximum Mixing Depths – Plume rise – Types of dispersion models

**Unit 6: Air Quality Models**
(8 Hrs.)
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 Holland’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.

**Text books:**

**Reference books:**
## Module II

### Teaching Scheme
- **Credits:** 1
- **Lectures:** 1 Hr/week

### Examination Scheme
- **In Sem Assessment:** 25 Marks
- **Total Marks:** 25

#### Unit 1:
Assignment on Gaussian models

#### Unit 2
Assignment on stack height models

### Elective II: Industrial Wastewater Treatment (501090B)

<table>
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<tr>
<th>Units</th>
<th>Teaching Scheme</th>
<th>Examination Scheme</th>
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<tr>
<td></td>
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<td>Lectures: 5 Hrs/week</td>
<td>End Sem Assessment: 50 Marks</td>
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<td><strong>Total Marks:</strong> 100</td>
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**Unit 1:**
(8 Hrs.)
Use of water in industry, sources of wastewater, quality and quantity variations in waste discharge, water budgeting, characterization and monitoring of wastewater flow, stream standards and effluent standards as per CPHEEO. Waste volume and strength reduction, in-plant measure, good housekeeping, process change, leakage prevention, segregation and recycling Neutralization, equalization and proportioning of waste (Including numerical)

**Unit 2:**
(8 Hrs.)
Heavy metal Removal – adsorption – Aerobic and Anaerobic biological Treatment – Sequencing batch reactors – High Rate reactors. (Design and numerical).

**Unit 3:**
(8 Hrs.)
Common Effluent Treatment Plants (CETPs): Common Effluent Treatment Plants (CETPs): Location, Need, Design, Operation & Maintenance Problems and Economical aspects.

**Unit 4:**
(8 Hrs.)

**Unit 5:**
(8 Hrs.)
Acclimatization of bacteria to toxic wastes, process sensitivity, operation and maintenance requirements, Water pollution control act, organizational set up of central and state boards for water pollution control, classification of river on water use, minimal national standards, socio-economic aspects of water pollution control, 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; Pre-vaporation and its applications; Reverse Osmosis, Ultra filtration and Microfiltration and their applications; Dialysis and Electro dialysis and their applications. (Including numerical).

**Unit 6:**
(8 Hrs.)
Modern Trends in Environmental Engineering, 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
Anthropogenic Endocrine Disruption, The Scientific Basis of the Endocrine Hypothesis.

**Text books:**
- Industrial Waste Treatment, Nelson Maneroo
- Industrial Waste Treatment, Rao&Datta
- Industrial Waste Water Treatment, A.G. Patwardhan

**Reference books:**
- R. Rautanbach and R.Albrecht, Membrane Process, John Wiley & Sons
- R.Y.M. Huang, Preparation Membrane Separation Processes, Elsevier.

**Module II**

<table>
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<td>Lectures: 1 Hr/week</td>
<td>Total Marks: 25</td>
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**Unit 1:**
Assignment on design of water distribution system

**Unit 2**
Assignment on Introduction to water gems software by Bentley

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**Elective II: Solid and Hazardous Waste Management (501090C)**

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
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<td>Credits: 5</td>
<td>In Sem Assessment: 50 Marks</td>
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<tr>
<td>Lectures: 5 Hrs/week</td>
<td>End Sem Assessment: 50 Marks</td>
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<td>Total Marks: 100</td>
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**Unit 1: Introduction & basic data**
Concept of solid waste management. Objectives, Functional elements, Environmental impact of mismanagement. Characterization of solid waste (Physical, Biological and Chemical); Waste Reduction, community collection methods, Critical appraisal, Rate Variation, Management options for Solid Waste. Typical values for Indian cities. Factors affecting - Storage and collection: General considerations for waste storage at source, Types of collection systems

**Unit 2: Collection and conveyance system**
Volume reduction during and prior collection Transformations and disposal Techniques in detail, Size reduction at all the point and classification collection management systems routing according to area wise and Scheduling, Reuse and recycling for waste production, problems of sorting and separation segregation, types of collection system according to area/locality and population.

**Unit 3: Disposal methods**

**Unit 4: Solid waste system**
Collection and conveyance system drying and incineration systems, dewatering and conditioning systems, refuse derived fuels, land filling, Discussion of solid waste acts, resources and recovery act of other countries rate of solid waste in total environment protection necessity of public awareness and managed solutions to collection and disposal problems, Elements of financial management plan for solid waste system. (Including numerical)

**Unit 5: Energy option & legal foundations**
Combustion, gasification, anaerobic digestion, pyrolysis all 4 in detail with designing

**Unit 6: Hazardous waste treatment technologies** (8Hrs.)
Details related to hazardous waste, Basel convention in detail with basil agreement. Following rules and sign for handling hazardous waste. Hazardous waste landfills: Site selection, design and operation-remediation of hazardous waste disposal sites. Sampling and characterization of Solid Wastes; TCLP tests and leachate studies

**Text Books:**
- Solid Waste Management Collection : A.D. Bhide and B.B. Sudershan
- Solid waste Management- A practical approach by Manoj Datta

**Reference books:-**
- Solid Waste Engineering Principles, Tecobanoglous G.
- Handbook of Solid Management, Frank Kreith, Mcgraw Hill, Inc USA
- Handbook of Solid Waste Management Frank Kreith, Mcgraw Hill, Inc USA
- Manual on Solid Waste Management CPHEEO, GOI
- Waste Management and Resource Recovery by Rhyner, Schwartz & Kohrell

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**Module II**

### Teaching Scheme
- Credits: 1
- Lectures: 1 Hr/week

### Examination Scheme
- In Sem Assessment: 25 Marks
- Total Marks: 25

#### Unit 1: (6Hrs.)
1. Explain Mechanical volume reduction- using compactors and their uses in waste volume reduction.
2. Case study on Dumping of Hazardous Waste in India and related Byelaws.

#### Unit 2 (6Hrs.)
1. Explain various characteristics of hazardous waste and Identify the characteristics of a major hazardous waste generated in your locality.
2. Explain all the Bye laws and relate them with Basel law used for the transportation of hazardous waste.

**Lab Practice II (501091)**

### Teaching Scheme
- Credits: 4
- Laboratory Work: 4 hrs/week

### Examination Scheme
- TW: 50 Marks
- Oral Exam : 50 Marks
- Total Marks: 100

The lab practice-II will be based on completion of assignments / practicals / reports of site visits, confined to the courses in that semester.

The term work will consist of --
1. Visit reports of minimum two site visits, exploring the field aspects for various subjects
2. The laboratory work report of following experiments
   1. Characteristics of Hydraulic Jump in horizontal and sloping channel
   2. Velocity distribution in open channel flow using pitot tube or current meter
   3. Assignment on open channel flow simulation software such as HEC RAS/MIKE-21
   4. Numerical simulation of 1-D open channel flow using MATLAB
5. Assignment on flood forecasting
6. Assignment on ground water hydrology
7. Determination of DO, BOD and COD from Waste Water
8. Determination of organic nitrogen(NH3)
9. Determination of heavy metal from Waste Water (any heavy metal)
10. Determination of phosphate, sulphates and nitrate

Seminar I (501092)

Teaching Scheme
Credits: 4
Laboratory Work: 4 Hrs/week

Examination Scheme
TW: 50 Marks
Presentation : 50 Marks
Total Marks: 100

Seminar I: Shall be on state of the art topic of student’s own choice approved by an authority. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work by the concerned Guide and head of the department/institute.

M.E SECOND YEAR - SEMESTER III

Optimization Techniques (601093)

Teaching Scheme
Credits: 4
Lectures: 4 Hrs/week

Examination Scheme
In Sem Assessment: 50 Marks
End Sem Assessment: 50 Marks
Total marks: 100

Unit 1: Linear Programming I
Introduction to Optimization techniques, Linear programming basic concepts, graphical method, Simplex method, Big M Method, Two phase method

Unit 2: Linear Programming II
Duality, sensitivity analysis, Transportation Model, Assignment Model

Unit 3: Non Linear Programming
Unconstrained one Dimensional search methods: Dichotomous search method, Fibonacci, Golden section, Multivariable unconstrained techniques: Steepest ascent and Descent methods, Newton’s methods, Constrained technique: Lagrangian Multiplier technique

Unit 4: Dynamic Programming
Principle of optimality, recursive equations

Unit 5: Stochastic Methods
Queuing theory, simulation technique, sequencing model.

Unit 6: Games Theory
Theory of games, 2 person zero sum game with and without saddle point, mixed strategies (2 x n games or m x 2 games), 2 x 3 game with no dominance, graphical method

Text books
Operations Research – Premkumar Gupta &D.S.Hira , S.Chand
Problems in Opeartions Research - Premkumar Gupta & D.S.Hira, S.Chand

Reference books
Operation Research – TahaHamdey A.
601094: Research Methodology

Teaching Scheme
Lectures: 4 hours/week
Credits: 4

Examination Scheme
In semester Exam.: 50 marks
End Semester Exam.: 50 marks
Duration of End term. Exam.: 3 hrs

Unit 1: Introduction to Research

Meaning of research, types of research, process of research, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, formulation of research hypotheses. Search for causation. Developing a Research Proposal Format of research proposal, Individual research proposal, Institutional research proposal, Significance, objectives, methodology, Funding for the proposal, Different funding agencies. Framework for the planning

Unit 2: Literature survey

Definition of literature and literature survey, need of literature survey, sources of literature, elements and objectives of literature survey, styles of literature survey, and strategies of literature survey.

Unit 3: Data collection, Measuring, Sampling and Scaling

Classification of data, benefits and drawbacks of data, evaluation of data, qualitative methods of data collection, methods of qualitative research, Sampling, sample size, sampling strategy, attitude measurement and scaling, types of measurements, criteria of good measurements, classification of scales.

Unit 4: Preliminary data analysis

Testing of hypothesis- concepts and testing, analysis of variance techniques, introduction to non-parametric tests. Validity and reliability, Approaches to qualitative and quantitative data analysis.

Unit 5: Advanced data analysis techniques

Correlation and regression analysis, Introduction to factor analysis, discriminant analysis, cluster analysis, multidimensional scaling, Descriptive statistics, Inferential statistics, Multi-dimensional measurement and factor analysis
Unit 6: Report writing

Need of effective documentation, importance of report writing, types of reports, report structure, report formulation, Plagiarism. Research briefing, presentation styles, impact of presentation, elements of effective presentation, writing of research paper, presenting and publishing paper, patent procedure.

References


6. Research Methodology: A Step by Step Guide for Beginners, by Ranjit Kumar


OPEN ELECTIVE (601095)

OPEN ELECTIVE: Concrete Technology ((601095A)

Teaching Scheme
Credits: 4
Lectures: 4 Hrs/week

Examination Scheme
In Sem Assessment: 25 Marks
End Sem Assessment: 50 Marks
Total Marks: 75

Unit 1: Concrete Making materials (8 Hrs.)
Aggregates: Classification, IS specifications, properties, grading, combining aggregates, testing of aggregates.
Admixtures: Water-reducing admixtures, Air entrainment, superplasticisers.

Unit 2: Concrete (8 Hrs.)
Properties of fresh concrete, hardened concrete, strength, elastic properties, creep and shrinkage, thermal properties, variability of concrete strength. Study of Indian standard codes pertaining to properties of concrete used for environment and water resource related structures.

Unit 3: Mix Design (8 Hrs.)
Principles of concrete mix design, Methods of concrete mix design, testing of concrete.(For concrete
used in environment and water resource related structures)

**Unit 4: Special concrete** (8 Hrs.)

**Unit 5: Concreting Methods** (8 Hrs.)
Process of manufacturing of concrete, methods of transportation, placing and curing, extreme weather concreting, special concreting methods (All the topics should be discussed with reference to case study of water resource or environmental structures)

**Unit 6: Concrete deterioration and Repair** (8 Hrs.)

**Text books:**
Repairs and rehabilitation of concrete structures by P. I. Modi & C. N. Pate, PHI Publication.

**Reference books:**
Repair and Strengthening of Concrete structures by FIP guide, Thomas Telford
Testing of Concrete in Structures by J.H.Bungey, S.G.Millard & M.G.Grantham, Taylor & Francis
http://people.cc.gatech.edu/~kkurtis/massconcrete.pdf
https://www.vidyarthiplus.com/wp/thread-24896.html#WxU-vS97IU

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**Module II**

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<td>Credits: 1</td>
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<td>Lectures: 1 Hr/week</td>
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**Unit 1:** Mix design for concrete by any two methods

**Unit 2**
Case study of any two structures with reference to concrete deterioration and repair.

**OPEN ELECTIVE: Wave Mechanics (601095B)**

<table>
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<th>Teaching Scheme</th>
<th>Examination Scheme</th>
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<td>Credits: 4</td>
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<td>Lectures: 4 Hrs/week</td>
<td>End Sem Assessment: 50 Marks</td>
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<td>Total Marks: 75</td>
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</table>

**Unit 1: Introduction to Wave Mechanics** (8 Hrs.)
Unit 2: Wave Theories (8 Hrs.)
wave theories - Linear wave theory, Bottom boundary condition, Kinematic free surface boundary conditions, Dynamic free surface boundary conditions, Solution to linear water wave problem, wave length, wave celerity, classification of waves, wave particle velocities, water particle acceleration, water particle displacement, Wave energy: potential and kinetic energy.

Unit 3: Wave Propagation (8 Hrs.)
Wave shoaling, wave refraction, wave diffraction, wave reflection, combined effects using numerical solutions, wave breaking, wave set up and set down, wave runup, radiation stresses.

Unit 4: Wave Statistics (8 Hrs.)

Unit 5: Coastal Area and Processes (8 Hrs.)

Unit 6: Littoral Processes (8 Hrs.)

Text books:

Reference books:

Module II

Teaching Scheme
Credits: 1
Lectures: 1 Hr/week

Examination Scheme
In Sem Assessment: 25 Marks
Total Marks:25

Unit 1: Assignment on Wave theories (6Hrs.)
Unit 2: Assignment on Wave statistics (6Hrs.)

OPEN ELECTIVE: Project Planning (601095C)

Teaching Scheme
Credits: 4
Lectures: 4 Hrs/week

Examination Scheme
In Sem Assessment: 25 Marks
End Sem Assessment: 50 Marks
Total Marks: 75

Unit 1: Infrastructure (4 Hrs.)
Definitions of infrastructure, Governing Features, Historical overview of Infrastructure development

Curriculum for M.E WREE (Civil)

**Unit 2: Contracts and Management of contracts** (4 Hrs.)
Engineering contracts and its formulation, Definition and essentials of a contract, Indian contract act 1872, types of contract and clauses of contract, Preparation of tender documents, Issues related to tendering process, Awarding contract. (Case study is required for projects like dams, canals etc.)

**Unit 3: Project Management** (4 Hrs.)
Project life cycle, planning for achieving time, cost, quality, project feasibility reports based on socio-techno-economic-impact analysis, project clearance procedures and necessary documentation for major works like dams, multistoried structures, ports, tunnels. Qualities, role and responsibilities of project Manager, Role of Project Management Consultants, Web based project management.

**Unit 4: Project Risk Management** (4 Hrs.)

**Unit 5: Economics of Project** (4 Hrs.)

**Unit 6: Environmental Impact Assessment** (4 Hrs.)
Legal Aspects of EIA, Objectives of EIA, General Methodology of EIA, Base line Studies, Screening, Scoping, Public Consultation, Data Collection, Environmental Impact Analysis, Mitigation and Impact Management, Case Studies, Environmental Audit. (Case study is required for projects like dams, canals etc.)

**Text books:**
Project Management-Planning and Control—Rory Burkey 4th ed.—Wiley,India.
Modern construction management--.Harris, Wiley India.
Projects Planning Analysis Selection Implementation And Review – Prasanna Chandra.
http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html
http://www.fao.org/docrep/V8350E/v8350e06.htm

**Reference books:**
Project Management – K Nagrajan – New age International Ltd.
Module II

Teaching Scheme
Credits: 1
Lectures: 1 Hr/week

Examination Scheme
In Sem Assessment: 25 Marks
Total Marks: 25

Unit 1: Work breakdown structure for a water resource or environmental structure and its planning in MS Project or Prima vera. (6 Hrs.)

Unit 2: Study of EIA report for any two water resource or environmental structures. (6 Hrs.)

Seminar II (601096)

Teaching Scheme
Credits: 4
Laboratory Work: 4 Hrs/week

Examination Scheme
TW: 50 Marks
Presentation: 50 Marks
Total Marks: 100

The student is required to deliver a seminar in first semester of second year on the topic relevant to latest trends in Water Resources and Environmental Engineering preferably on the topic of sub specialization based on the Electives selected by him/her approved by authority. The student shall submit the seminar report in standard format, duly certified for satisfactory completion of the work by the concerned guide and head of the Department/ Institute.

Project Stage I (601097)

Teaching Scheme
Credits: 8
Laboratory Work: 8 Hrs/week

Examination Scheme
TW: 50 Marks
Presentation: 50 Marks
Total Marks: 100

Project Stage-I is the integral part of the dissertation project. The project should be based on the knowledge acquired by the students during the coursework and should contribute to the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems in an area where the students like to acquire specialized skills. The student shall complete the part of the project that will consist of problem statement, literature review: project overview, scheme of implementation (Mathematical Model/block diagram/PERT chart, etc)and Layout & Design of setup. As a part of project stage I, the student shall deliver a presentation on advancement in Technology pertaining to selected topic. The student shall submit the report of project work completed partly in standard format approved by the University.
### Seminar III (601098)

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<td>Credits: 5</td>
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Seminar III: Shall preferably an extension of seminar II. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

### Project Stage II (601099)

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Project Work Stage-II: In Project Work stage –II, the student shall complete the remaining part of the project which will consist of the fabrication of set up required for the project, work station, conducting experiments and taking results, analysis and validation of results and conclusions.

The student shall prepare the duly certified final report of the project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.