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**

| SEMESTER -I | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SR. NO. | SUBJECT CODE | SUBJECT | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
| | | | Lect./P | Paper | | TW | Oral/ Presentation | Total | |
| | | | | In Semester Assessment | End Semester Assessment | | | | |
| 1 | 501081 | Planning and management of water resources | 4 | 50 | 50 | - | - | 100 | 4 |
| 2 | 501082 | Environmental Chemistry and Microbiology | 4 | 50 | 50 | - | - | 100 | 4 |
| 3 | 501083 | Fluid Mechanics | 4 | 50 | 50 | - | - | 100 | 4 |
| 4 | 501084 | Advanced Water Treatment | 4 | 50 | 50 | - | - | 100 | 4 |
| 5 | 501085 | Elective-I | 5 | 50 | 50 | - | - | 100 | 5 |
| 6 | 501086 | Lab Practice-I | 4 | | | 50 | 50 | 100 | 4 |
| | | **Total** | 25 | 250 | 250 | 50 | 50 | 600 | 25 |

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

| SEMESTER -II | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SR. NO. | SUBJECT CODE | SUBJECT | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
| | | | Lect./P | Paper | | TW | Oral/ Presentation | Total | |
| | | | | In Semester Assessment | End Semester Assessment | | | | |
| 1 | 501087 | Hydrology | 4 | 50 | 50 | - | - | 100 | 4 |
| 2 | 501088 | Open Channel Hydraulics | 4 | 50 | 50 | - | - | 100 | 4 |
| 3 | 501089 | Advanced Wastewater Treatment | 4 | 50 | 50 | - | - | 100 | 4 |
| 4 | 501090 | Elective-II | 5 | 50 | 50 | - | - | 100 | 5 |
| 5 | 501091 | Lab Practice-II | 4 | - | - | 50 | 50 | 100 | 4 |
| 6 | 501092 | Seminar-I | 4 | - | - | 50 | 50 | 100 | 4 |
| | | Total | 25 | 200 | 200 | 100 | 100 | 600 | 25 |

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

| SEMESTER -III | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SR. NO. | SUBJECT CODE | SUBJECT | TEACHING SCHEME | EXAMINATION SCHEME | | | | | CREDITS |
| | | | Lect./P | Paper | | TW | Oral/ Presentation | Total | |
| | | | | In Semester Assessment | End Semester Assessment | | | | |
| 1 | 601093 | Optimization Techniques | 4 | 50 | 50 | - | - | 100 | 4 |
| 2 | 601094 | Research Methodology | 4 | 50 | 50 | - | - | 100 | 4 |
| 3 | 601095 | Open Elective | 5 | 50 | 50 | - | - | 100 | 5 |
| 4 | 601096 | Seminar-II | 4 | - | - | 50 | 50 | 100 | 4 |
| 5 | 601097 | Project Stage-I | 08 | - | - | 50 | 50 | 100 | 8 |
| | | Total | 25 | 150 | 150 | 100 | 100 | 500 | 25 |

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

| SEMESTER -IV | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SR. NO. | SUBJECT CODE | SUBJECT | TEACHING SCHEME | EXAMINATION SCHEME | | | | CREDITS |
| | | | Lect./P | Paper | TW | Oral/ Presentation | Total | |
| 4 | 601098 | Seminar-III | 5 | - | 50 | 50 | 100 | 5 |
| 5 | 601099 | Project work Stage-II | 20 | - | 150 | 50 | 200 | 20 |
| | | Total | 25 | - | 200 | 100 | 300 | 25 |

**EXAMINATION SCHEME**

**A) Compulsory Subjects: Credits 4**

**Total marks: 100**

| **To be done at Institute Level** | | **University Exam** | |
|---|---|---|---|
| **In semester assessment Units 1-4** | | **End-semester assessment** | |
| Class tests | 30 Marks | Units 1-4 | 18Marks |
| Assignments /Mini Project | 20 Marks | Unit 5 | 16 Marks |
| | | Unit 6 | 19 Marks |
| Total | 50 Marks | Total | 50 Marks |

**B) Elective Subjects: Credits 5**

**Total marks: 100**

| **Module 1 (Credits-4)** | | | |
|---|---|---|---|
| **In semester assessment Units 1-4** | | **End-semester assessment** | |
| Class tests | 15 Marks | Units 1& 2 | 12Marks |
| Assignments | 10 Marks | Unit 3& 4 | 14Marks |
| | | Unit 5 | 12 Marks |
| | | Unit 6 | 12 Marks |
| Total | 25 Marks | Total | 50 Marks |

| **Module 2 (Credit 1)** | |
|---|---|
| **In semester assessment** | Units 1 - 2 |
| **Class Tests/ Assignments** | **25 Marks** |

## 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** **(8Hrs.)**
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** **(8Hrs.)**
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** **(8Hrs.)**
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** **(8Hrs.)**
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:**

Bhave P.R., "Water Resources Systems", Narosa Publications, New Delhi. .

Water Resources System Planning – by M.C.Chaturvedi.

Water Management System Application-A.K.Biswas

**Reference Books:**

Economics of Water Resources Planning - by James, L .D., and Lee, R. R., Mc GrawHill.

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

## Environmental Chemistry and Microbiology (501082)

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

Sources of air pollutant in atmosphere. Characteristic of air pollutant. Zoning of atmosphere, effects of temperature, lapse rate solar radiation and wind currant (wind rose digram) on the various pollutants. 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.)**

Introduction to various physico-chemical parameters, their method of detection in water, waste water, solid waste and in soil. Water quality, Indian standards, quality control method. Various organic and inorganic compound such as surfactant, pesticides, synthetic polymers. Toxicity test on hazardous waste. Waste generation rate and energy recovery from SWM. Method for determination concentration of pollutant in air, liquid ,solid and hazardous waste. Chemical process calculations. Various method of determination of pollution concentration.

**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,GC

**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:**

Chemistry for Environmental Engineering and Science by Sawyer C.N., McCarty P.L. and Parkin G.F.- Tata McGraw Hill Publishing Company Ltd., New Delhi.

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:**

Microbiology by Pelczar M.J., Chan E.C.S.,Krieg N.R. -Tata McGraw Hill Education Ltd., New Delhi.

Environmental Microbiology by E. Gaudy and Gaudy - Tata McGraw Hill Education Ltd., New Delhi.

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** **(8 Hrs.)**

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** **(8 Hrs.)**

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** **(8 Hrs.)**

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** **(8 Hrs.)**

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** **(8Hrs.)**

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** **(8 Hrs.)**

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:**

Hydraulics and Fluid Mechanics - P. N. Modi and S. N. Seth Standard book house
Fluid Mechanics and Hydraulic Machines – Sukumar Pati, Tata McGraw-Hill
Introduction to fluid Mehanics and fluid machines – S.K.Som, Gautam Biswas, Suman Chakraborty - McGraw-Hill – 2013 ed.

**Reference books:**

Fluid Mechanics - Streeter, Wylie and Bedfordn Tata McGraw Hill
Fluid Mechanics by White – Mc-Graw Hill
Fluid Mechanics-Fundamentals and Applications- Cengel and Cimbala, McGraw- 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, Floatation, Coagulation, Flocculation, Filtration, Disinfection.

**Unit 2: Filtration (8 Hrs.)**
Filtration: General Features of Rapid Sand and Pressure Filters, Filter Media, Different Operating Parameters Affecting the Filtration Performance, Hydraulics of Filtration and Backwashing Cycles, Removal Mechanisms of Filtration, Design of Rapid Sand and Pressure Filters.

**Unit 3: Adsorption and Softening (8 Hrs.)**
Adsorption: Different Types of Adsorption, factors influencing adsorption, Adsorption Isotherms(including Numerical), Adsorption Kinetics in Batch Reactors, Breakthrough Curve and Design of adsorption column. Chemical Precipitation, Hardness Removal- Lime Soda, ion exchange, zeolite process.(Including numerical).

**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 (8Hrs.)**
Introduction: Definition of groundwater, role of groundwater in hydrological cycle, classification of aquifers, flow and storage characteristics of aquifers, Darcy's law, anisotropy and heterogeneity. Wells and Well Hydraulics: Different types of wells, construction of wells, steady and unsteady state solutions for confined, unconfined and leaky aquifers, effect of boundaries, method of images, pumping test analysis. Groundwater Quality: General problem of contamination of groundwater, sources, remedial and preventive measures, seawater intrusion in coastal aquifers.

**Unit 6: Membrane (8 Hrs.)**
Theory of Membrane separation, mass Transport Characteristics, Cross Flow filtration, Membrane Filtration, Flux and Pressure drop. Membrane Fouling, Control of Fouling, Pretreatment methods, monitoring of Pretreatment, Langlier Index, Silt Density Index, Chemical cleaning. Microfiltration principles and applications, Ultra filtration principles and applications, Nano Filtration principles and applications, Reverse Osmosis: Theory and design of modules and applications, Electro dialysis and Ion exchange Theory and design.

**Text books:**
Water Supply Engg by Dr. B.C. Punmia ,Laxmi Publicaiton
Water supply Engg. By S.K. Garge, Khanna Publication.
Raju, B.S.N., "Water Supply and Wastewater Engineering", Tata McGraw Hill Pvt Ltd., New Delhi.

**Reference books:**
Fair, G.M., Geyer J.C and Okun, Water and Waste water Engineering" Vol II, John Wiley Publications.
Montgomery, water treatment principles and design, Johnwiley and sons, New York..
Walton, W.C., "Ground Water Resources Evaluation", McGraw Hill. 1970
Driscoll, F.G., "Ground Water and Wells", Johnson Division. 1986.

# 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 glacis 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 Engineering and Hydraulic Structures- Garg S.K- Khanna Publishers N.D. 13th ed, 1998.
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
Hydraulic Structures, Vol. 1. & Vol. 2- Grishin M.M- Mir Publishers, Moscow, 1982.
Water Management – Jasapal Singh, M.S.Achrya, Arun Sharma – Himanshu Publication Press
Irrigation and Water Resources Engineering- Asawa G.L- New Age International (P) Ltd. Publishers, first ed, 2005

**Module II**

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

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

**Unit 1:** **(6Hrs.)**
Assignment on design of weir or barrage
**Unit 2** **(6Hrs.)**
Assignment on design of any one type of CD works

## 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** **(8Hrs.)**
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** **(8Hrs.)**
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** **(8Hrs.)**
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** **(8Hrs.)**
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** **(8Hrs.)**
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** **(8Hrs.)**
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:**
Irrigation Engineering and hydraulic structures – S.R.Sahasrabudhe- Catson books, Delhi, 2014-3ed.
Irrigation Engineering - S. K. Garg.
Irrigation, Water Resources and water power engineering- Dr. P. N. Modi Publ Standard book house.

**Reference books:**

Irrigation, Michael, B.A.M., Vikas Publishing House Pvt. Ltd. New Delhi, 1990
Theory & design of irrigation structures Vol.I, II, III Varshney Gupta and Gupta Nemchand and brothers publication
Water Management – Jasapal Singh, M.S.Achrya, Arun Sharma – Himanshu Publication Press

**Module II**

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

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

**Unit 1:** **(6Hrs.)**
Assignment on design of lift Irrigation Scheme

**Unit 2** **(6Hrs.)**
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

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

**Unit 1: Introduction to Remote Sensing and EMR** **(8Hrs.)**
Introduction of Remote Sensing – Energy sources and Radiation principles, Energy equation, EMR and Spectrum, EMR interaction with Atmosphere scattering, Absorption, EMR interaction with earth surface features reflection, absorption, emission and transmission, Spectral response pattern , vegetation, soil, water bodies- Spectral reflectance. Aerial photography and photogrammetry, height determination contouring - photographic interpretations - stereoscopy – parallax bar- Flight Planning- Photo Interpretation.

**Unit 2: Data Acquisition and Satellites.** **(8Hrs.)**
Data acquisition –Procedure, Reflectance and Digital numbers- Intensity- Reference data , Ground truth, Analog to digital conversion, Detector mechanism- Spectro- radiometer-Ideal remote sensing system – Characters of real and successful remote sensing system- Platforms and sensors- orbits types – Resolution. Remote sensing satellites: Land observation satellites, characters and applications, IRS series, LANDSAT series and INSAT series.

**Unit 3: Types of remote sensing and image interpretation** **(8Hrs.)**
Introduction- Active, Passive, Optical Remote sensing, sensors and characters. SLAR, SAR Scattrometers,- Altimeter, Characteristics , Image interpretation characters. Introduction to: Image Acquisition And Format, Image Distortion And Rectification, Image Enhancement, Image Classification Image Analysis.

**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.)**

Types of geographic data, levels of measurements. Concepts of space and time, Spatial data models, encoding methods of data input – Keyboard, Manual Digitizing and Automatic Digitizing methods, Linking of Spatial and Attribute data to maps, Metadata Spatial data input: Digitization, error identification. Errors: Types, sources, correction. Editing and topology building.

**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:**

Remote sensing methods & applications – R. Michael Hord, Wily Interscience Publication.

Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York

Kresse, W. and Danko, D. (2002): Springer Handbook of Geographic Information, Springer Drecht, London

Bao, J., Tsui, Y. (2005): Fundamentals of Global Positioning System Receivers, John Wiley Sons, Inc., Hoboken .

**Reference books:**

Remote sensing & image interpretation – Lilleson J.T.M. & Krefer R.W. Wiely, New York.

Photogrammetry by – Sheford

Environmental Systems Research Institute, Inc. (1998): Understanding GIS: The ARC/INFO Method, ESRI Press, Redland

Ahmed, E. L., Rabbany (2002): Introduction to Global Positioning System, Artech House, Boston

**Module II**

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

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

**Unit 1: (6Hrs.)**

Assignment on image classification

**Unit 2 (6Hrs.)**

Assignment using Q-GIS

## Lab Practice I (501086)

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

**Examination Scheme**
TW: 50
Oral Exam : 50Marks
**Total Marks: 100**

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.
9. Physico-Chemical analysis of water Turbidity, Solids: Dissolved, Suspended, pH, Electrical

Conductivity, Alkalinity and acidity, Hardness, Sulphate, Iron and Manganes, 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 (8Hrs.)**

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 (8Hrs.)**

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 (8Hrs.)**

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 (8Hrs.)**

Definition of Ground Water, aquifers, vertical distribution of subsurface water, Darcy's Law-it's range of validity, DupuitForchheimer 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 (8Hrs.)**

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 (8Hrs.)**

Ground water budget, seepage from surface water artificial recharge, Porous media models, Analog models, Electric analog models, Digital computer models

**Text books**

Engineering Hydrology-K. Subramanya, Tata Mc-Graw Hill.
Hydrology- H.M. Raghunath, Wily Eastern, New Delhi.
A text book of Hydrology- Jaya Rami Reddy, University Science Press

**Reference books**

Applied Hydrology-LinsleyKolhar&Paulhas (Mc-Graw Hill)
Water Resource & Hydrology-S.K. Garg.
Stochastic Hydrology-Jaya Rami Reddy, Laxmi Pub., New Delhi.
Applied Hydrology-V.T. Chow, McGraw-Hill Book Company.

## 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**
Flow in Open Channel – K. Subramanya, Tata Mc-Graw Hill.
Hydraulics and Fluid Mechanics by P. N. Modi and S. N. Seth Standard book house
Open Channel Flow: K. G. RangaRaju - Tata McGraw Hill.

**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.)**
Sewage treatment: Process flow diagram for sewage treatment, Theory and design off-screen chamber, Grit Chamber and Primary sedimentation tank as per the Manual of CPHEEO. (Including numerical) Theory & design of secondary treatment units: Introduction to unit process and unit operations for secondary treatment. Biological principle, important microorganisms in waste water & their importance in waste water treatment systems, bacterial growth, general growth pattern, growth in terms of bacterial numbers and bacterial mass. Kinetics of biological growth, cell growth, substrate limited growth, cell growth and substrate utilization, effect of endogenous metabolism.

Activated sludge process, Biological principle, different T.F media & their characteristics

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

Introduction- Basic Principles of Membrane Filtration, Microfiltration and Ultrafiltration, Nano filtration and Reverse Osmosis, Membrane Cartridge Filtration, Membrane Pore Size and Filtration Removal Efficiency, Electrodialysis and Electrodialysis Reversal, Membrane Materials, Modules and Systems.Membrane Materials, Membrane Modules, Hollow-Fiber Modules, Spiral-Wound Modules, Membrane Cartridges. Other Module Configurations Types of Membrane Filtration Systems Hollow-Fiber (MF/UF) Systems Spiral-Wound (NF/RO) Systems

**Unit 3: Membrane filtration Design (8Hrs.)**

Basic Principles of Membrane Filtration System Design and Operation, General Concepts-MF, UF, and MCF Processes, NF and RO Processes Hydraulic Configurations, Deposition Mode, Suspension Mode Plug Flow Reactor Model Cross flow Model Continuous Stirred Tank Reactor Model Alternative Configurations Experimental Evaluation.

**Unit 4: Heavy Metals Analysis (8Hrs.)**

Sources of heavy metals and its reduction & effects. Analysis methods for heavy metals. Various methods of removal of heavy metals. Types of adsorbent and their efficiency & low cost adsorbent. . Introduction and theory of Phytoremediation technology for wastewater treatment, Introduction and theory of root zone cleaning system. (Including numerical).

**Unit 5: Disposal of Sewage (8Hrs.)**

Land treatment systems - Fundamental consideration. Irrigation systems - Design objectives. site Selection. Pre-application treatment. loading rates. land requirements. Crop-selection. distribution systems. Rapid - infiltration systems. over land flow systems. land application of sludge. Effluent disposal and Reuse: Receiving water standards. Effluent standards. Disposal bv dilution. Disposal into lakes. Disposal into rivers. Re-oxygenation in rivers. De-oxygenation in rivers. Oxygen sag mode. Disposal into estuaries. Disposal into ocean. Direct and indirect reuse of wastewater.

**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.)**

Air Pollution: Definition of Air Pollution - Sources & Classification of Air Pollutants - Effects of air pollution - Global effects - Air Quality and Emission standards - Sampling of Pollutants in ambient air - Stack sampling. Reactions of pollutants and their effects – Smoke–smog and ozone layer disturbance –Ambient air and stack sampling – pollutant measurement methods– Principles and instruments –Ambient air quality standards, Emission standards, emission inventory, and Acts.

**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 population; risk analysis; models for predicting source emission rates and their impact on indoor air environments.

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

**Control of Particulate Pollutants:** Properties of particulate pollution - Particle size distribution - Control mechanism - Dust removal equipment - Design and operation of settling chambers, cyclones, wet dust scrubbers, fabric filters & ESP. **Control of Gaseous Pollutants:** Process and equipment for the removal by chemical methods - Design and operation of absorption and adsorption equipment - Combustion and condensation equipment.

**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 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.

**Text books:**

Rao, M. N. and Rao, H. V. N., Air pollution, Tata McGraw-Hill Publishing Co; Ltd, New Delhi, 1993.

Nevers, N. D., Air Pollution Control Engineering, McGraw-Hill International Ed., 1993.

Pandey V., Noise Pollution, Meerut Publishers, 1995.

**Reference books:**

Wayne T. D., Air Pollution Engineering Manual, John Wiley & Sons, 2000.

Rao, C. S., Environmental Pollution Control Engineering, New Age Int. Pubs, 1991, Reprint, 2005.

Barratt, R., Atmospheric Dispersion Modeling, Earthscan Publication Ltd, 2003.

Rau J. G. and Wooten D. C., Environmental Impact Analysis: Handbook, McGraw Hill Publications, 1985.

Khare, M. and Sharma P., Modeling the Vehicular Exhausts Emission, WIT press, UK, 2002.

**Module II**

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

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

**Unit 1:** **(6Hrs.)**
Assignment on Gaussian models
**Unit 2** **(6Hrs.)**
Assignment on stack height models

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

**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:** **(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.)**
Water Quality monitoring of Streams, Self-purification of streams, B.O.D. reaction rate, D.O. sag curve and D.O. deficit calculations. Miscellaneous methods of dissolved solids removal, sludge disposal methods. Different types of waste treatment & their selections, Development of treatment flow diagram based on characteristics of waste Manufacturing processes in major industries, water requirements, wastewater sources, composition of wastes, Viz. sugar, distillery, dairy, pulps, paper mill, fertilizer, tannery, chemical, steel industry, alternative methods of treatment, factors affecting efficiency of treatment plant (Including numerical).

**Unit 5:** **(8Hrs.)**
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; Prevaporation 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:**

Waste Water Engineering, Metcalf Eddy McGraw Hill Publications.
R. Rautanbach and R.Albrecht, Membrane Process, John Wiley & Sons
R.Y.M. Huang, Perevoparation Membrane Separation Processes, Elsevier.
J.G. Crespo, K.W. Boddekes, Membrane Processes in Separation and Purification, Kluwer

**Module II**

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

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

**Unit 1:** **(6Hrs.)**
Assignment on design of water distribution system

**Unit 2** **(6Hrs.)**
Assignment on Introduction to water gems software by Bentley

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

**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: Introduction & basic data** **(8Hrs.)**
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** **(8Hrs.)**
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 /localityand population.

**Unit 3: Disposal methods** **(8Hrs.)**
Principles, Methods, Factors affecting, Properties of compost, Vermicomposting. Energy recovery from solid waste: Parameters affecting, Bio-methanation. Landfills: Definition, Essential components, Site selection, Land filling methods, Leachate and landfill gas management.Technical and economic aspects and incinerator operations, components and unit operation for waste incinerator operation problems, high temperature

**Unit 4: Solid waste system** **(8Hrs.)**
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** **(8Hrs.)**
combustion,gasification, anaerobic digestion, pyrolysis all 4 in detail with designing

Legal Foundation-major legislation, monitoring responsibilities, sources and types of solid waste - sampling and characterization.Definition and identification of hazardous wastes - sources and characteristics - hazardous wastes in Municipal Waste - Hazardous waste regulations -minimization of Hazardous Waste-compatibility, handling and storage of hazardous waste - collection and transport.

**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 ManojDatta

**Reference books-**

Solid Waste Engineering Principles, Tecobanoglous G.
Handbook of Solid Management, Frank Kreith, McgrawHill,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

**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 --

i) Visit reports of minimum two site visits, exploring the field aspects for various subjects
ii) 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($NH_3$)
9. Determination of heavy metal from Waste Water (any heavy metal)
10. Determination of phosphate, sulphates and nitrate
11. Determination of pH, moisture content of solid waste.

## 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** **(8Hrs.)**
Introduction to Optimization techniques, Linear programming basic concepts, graphical method, Simplex method, Big M Method, Two phase method

**Unit 2: Linear Programming II** **(8Hrs.)**
Duality, sensitivity analysis, Transportation Model, Assignment Model

**Unit 3:- Non Linear Programming** **(8Hrs.)**
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** **(8Hrs.)**
Principle of optimality, recursive equations

**Unit 5: Stochastic Methods** **(8Hrs.)**
Queuing theory, simulation technique, sequencing model.

**Unit 6: Games Theory** **(8Hrs.)**
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**
Engineering Optimazation Theory & Practice – S.S. Rao.,Wiely.
Operation Research – TahaHamdey A.
Principles of Operation Research – Wagner, PrenticeHall.

# 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**


1. Research Methodology: concepts and cases, Deepak Chawla and Neena Sondhi, Vikas Publishing House Pvt. Ltd.

2. Research Methods for Business, Sekaran Uma and Rogure Boudie, Wiley, India.

3. Research Methodology: Methods and Trends, by Dr. C. R. Kothari, New Age International Publishers.

4. Research Methods in Education, Louis Cohen, Manion, Morrison, Routledge (Taylor &Francis Group)/ Cambridge University Press India Pvt. Ltd.

5. Research Methodology: An Introduction, Wayne Goddard and Stuart Melville.

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

7. Research in Education, John Best and James Kahn, Prentice Hall of India Pvt. Ltd.


## 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.)**

Cement: Chemical composition, Hydration of cement, structure of hydrated cement. Special cements, testing of cement.
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.)**

Roller compacted concrete, Mass concrete, Fiber reinforced concrete, polymer concrete, Super plasticized concrete, properties and case studies pertaining to environmental and water resource structures.

**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 discuused with reference to case study of water resource or environmental structures)

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

Causes of deterioration of concrete structures, effects of climate, moisture, temperature, chemical, wear, erosion and loading on serviceability and durability, Design and Construction Errors, Causes of Seepage and Leakage in Concrete Structures, Formation of Cracks Including Those Due to Corrosion. Repair Analysis and Design, Repair Materials and Their Desired Properties, Methodologies for Crack and Patch Repair, Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coating and cathodic protection.

**Text books:**

Concrete Technology – Theory and Practice by M.S.Shetty, S.Chand and Company, New Delhi, 1992.
Concrete Technology- Neville, A.M. and Brookes, J.J., Pearson Publishers, New Delhi, 1994.
Properties of Concrete - Neville, A.M., Pearson Publishers, New Delhi, 2004.
Repairs and rehabilitation of concrete structures by P. I. Modi & C. N. Pate, PHI Publication.

**Reference books:**

Concrete Technology by Gambhir, M.L., Tata Mc Graw Hill New Delhi, 1995.
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.ce.gatech.edu/~kkurtis/massconcrete.pdf
https://www.vidyarthiplus.com/vp/thread-24896.html#.WHxU-vS97IU
https://www.usbr.gov/ssle/damsafety/TechDev/DSOTechDev/DSO-98-05.pdf
http://www.wwdmag.com/tank-industry-consultants/protecting-concrete-tanks-water-and-wastewater-treatment-plants.

## Module II

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

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

**Unit 1:** **(6Hrs.)**

Mix design for concrete by any two methods

**Unit 2** **(6Hrs.)**

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

## OPEN ELECTIVE: Wave Mechanics (601095B)

**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: Introduction to Wave Mechanics** **(8 Hrs.)**

Introduction, Generation, Decay, Classification, Measurement, Basic hydrodynamic equations, Wave Forecasting: The Significant Wave, Simplified versus Elaborate Technique, Numerical Wave Modelling (introduction only, no mathematical treatment): Phase resolving models, Phase averaging models, Introduction to Wave watch III, SWAN, MIKE

**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.)**

Wave statistics: Short term wave statistics, Tucker method, Long term wave statistics- Gumbel distribution, Weibull Distribution, Log Normal Distribution, Wave spectrum analysis, wave spectra and statistics, Theoretical spectra: Pierson-Muskowitz Spectrum, Bretschneider Spectrum, JONSWAP Spectrum, Scott Spectrum, Scott-Wiegel Spectrum

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

Overview of Coastal Engineering, The Coastal Area, The Beach and Nearshore System, Dynamic Beach Response to the Sea, page, Causes of Shoreline Erosion, Coastal Protection Methods and Navigation Works

**Unit 6: Littoral Processes** **(8 Hrs.)**

Introduction of Littoral process, Littoral Materials, Littoral Wave Conditions, Nearshore Currents, Littoral Transport, Role of Foredunes in Shore Processes, Sediment Budget, Engineering Study of Littoral Processes

**Text books:**

Dean, R. G., Darlymple R. A. (1991). "Water Wave mechanics for Engineers and Scientists", World Scientific

Sorensen, R. M. (1997). "Basic Coastal Engineering", Springer

Mani, J.S., (2012), "Coastal Hydrodynamics", PHI Learning Pvt. Ltd, New Delhi

**Reference books:**

Sarpkaya, T., Issacson, M. (1981). "Mechanics of Wave Induced Forces on Offshore Structures", Van Nostrand Reinhold.

Army Corps of Engineers. (2002). "Coastal Engineering Manual", U.S. Army Corps of Engineers, Washington,D.C

WMO. (1988), "Guide to Wave Analysis and Forecasting", Pub. NO. 702, World Meteorological Organization, Secretariat of WMO, Geneva

**Module II**

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

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

**Unit 1:** **(6Hrs.)**

Assignment on Wave theories

**Unit 2** **(6Hrs.)**

Assignment on wave statistics

## 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

in INDIA. Various Agencies associated with infrastructure development in India as regards various sectors. Public Private Partnership (PPP) in Infrastructure, Draft Concession Agreement for PPP projects, Escrow Agreement. Provisions made for Infrastructure Development in the 12th and 13th five year plans of the planning commission Government of India. Formation of the Indian Infrastructure Development Corporation.

**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, Prepration 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.)**

Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks. dealing with uncertainties: Sensitivity analysis, scenario analysis simulation, decision tree analysis.

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

Infrastructure Project Budgeting and Funding, Regulatory Framework, Sources of Funding. Cost planning techniques, Cost control during design and Construction, Depreciation, Various Appraisal Criteria Methods. Break-even analysis, Cash flow analysis, Risk Analysis and Management Practice, benefit cost ratio for public projects.

**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.
Construction Engineering & management of Projects( For Infrastructure & Civil Works) by S. C. Sharma, Khanna Publishers, 2nd Edition, 2011
Construction Project Management Theory & practice --- Kumar Neeraj Jha, Pearson,2012
Modern construction management--.Harris, Wiley India.
Projects Planning Analysis Selection Implementation And Review – Prasanna Chandra.
Construction Management & PWD Accounts --- D Lal, S. K. Kataria & Sons, 2012
http://www.cag.gov.in/sites/default/files/cag_pdf/ppp-project.pdf
http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html
http://www.moef.nic.in/sites/default/files/ngrba/EIA%20Report(DraftFinal).pdf
http://www.cwc.gov.in/main/downloads/esmf_full_report.pdf
http://www.fao.org/docrep/V8350E/v8350e06.htm

**Reference books:**

Project Management – K Nagrajan – New age International Ltd.
The Indian Contract Act (9 of 1872), 1872- Bare Act- 2006 edition, Professional Book Publishers.
Project Risk Analysis And Management Guide By John Bartlett APM Publishing Limited, 2004 2nd Edition
Fundamentals of Engineering Economics—Pravin Kumar, Wiley, India.

**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. **(6Hrs.)**

## 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.

**M.E SECOND YEAR - SEMESTER IV**

## Seminar III (601098)

**Teaching Scheme**
Credits: 5
Laboratory Work: 5 Hrs/week

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

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)

**Teaching Scheme**
Credits: 20
Laboratory Work: 20Hrs/week

**Examination Scheme**
TW: 150 Marks
Oral Exam : 50 Marks
**Total Marks:200**

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.