Faculty of Engineering

Syllabus of

M.E. Civil (WATER RESOURCES AND ENVIRONMENTAL ENGINEERING)

2012-2013

COURSE STRUCTURE FOR M. E. CIVIL (Water Resource and Environmental Engg.)

SEMISTER –I

CODE	Subject	Teaching Scheme		Examination Scheme					Credits
		Lect.	Pr.	Paper	TW	Oral	Pr.	Total	
501601	**Environmental Chemistry & Microbiology**	3	--	100	--	--	--	100	3
501602	**Environmental Management**	3	--	100	--	--	--	100	3
501603	**Advance Fluid Mechanics**	3	--	100	--	--	--	100	3
501604	**Elective –I**	3	--	100	--	--	--	100	3
501605	**Elective –II**	3	--	100	--	--	--	100	3
501606	**Lab Practice –I**	--	6	--	50	--	--	50	3
501607	**Seminar –I**	--	4	--	50	--	--	50	2
Total of First Term		**15**	**10**	**500**	**100**	**--**	**--**	**600**	**20**

SEMISTER -II

CODE	Subject	Teaching Scheme		Examination Scheme					Credits
		Lect.	Pr.	Paper	TW	Oral	Pr.	Total	
501608	**Optimization Technique**	3	--	100	--	--	--	100	3
501609	**Open Channel Hydraulics**	3	--	100	--	--	--	100	3
501610	**Advance Waste Water Treatment**	3	--	100	--	--	--	100	3
501611	**Elective –III**	3	--	100	--	--	--	100	3
501612	**Elective –IV**	3	--	100	--	--	--	100	3
501613	**Lab Practice –I**	--	6	--	50	--	--	50	3
501614	**Seminar –I**	--	4	--	50	--	--	50	2
Total of Second Term		**15**	**10**	**500**	**100**	**--**	**--**	**600**	**20**

SEMISTER -III

CODE	Subject	Teaching Scheme		Examination Scheme					Credits
		Lect.	Pr.	Paper	TW	Oral	Pr.	Total	
501615	**Seminar III (Based on Project)**	--	4	--	50	--	--	50	2
501616	**Project Stage –I**	--	18	--	50	--	--	50	6
Total of Third Term		**--**	**22**	**--**	**100**	**--**	**--**	**100**	**8**

SEMISTER –IV

CODE	Subject	Teaching Scheme		Examination Scheme					Credits
		Lect.	Pr.	Paper	TW	Oral	Pr.	Total	
501617	**Project Stage –II**	--	18	--	150*	50	--	200	12
Total of Fourth Term		**--**	**18**	**--**	**150**	**50**	**--**	**200**	**12**

*Term Work of Project Stage II of Semester IV should be assessed jointly by the pair of internal and external examiner during oral examination.

Note : The contact hrs for the calculation of load of teacher for

Seminar :- 1Hr/Week/Student
Project :-2Hr/Week/Student

LIST OF ELECTIVES

Elective I	Elective II	Elective III	Elective IV (Open)
Ground water contamination and Transport	Unit Operation in Environmental Engineering	Computational Method in Water Resources	Dam Engineering
Hydrology and Groundwater	Advance Water Treatment and Water Supply Engineering	Noise Pollution and Control Technique	Energy and Environment
Air Pollution Engineering	Remote Sensing and GIS System for Water Resources Management	Ground Water Modeling	Closed conduit Flow
Solid and Hazardous Waste Management	Planning and Management of Water Resources	Industrial Waste Management	Research Methodology and Intellectual Property Right

SEMESTER– I

ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY (501601)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1

Chemistry of pollutants in the Atmosphere: Solid, liquid, gaseous and radioactive pollutants in the atmosphere, formation of physical processes of pollutants in the atmosphere, Effects of temperature, solar radiation and wind currant on the various pollutants, Effect of gravitational force and rain scrubbing on air pollutants, Chemical properties of air pollutants chemisorptions, effect of solar radiation on acidic basic characteristics, reducing, oxidizing properties of air pollutants.

Unit 2

Chemistry of pollutants in the water (Hydrosphere), Characteristics of water as a solvent, Interaction of water with organic, Inorganic species, (Natural & Anthropogenic), determination of water quality parameters, physical, chemical, biological and physiological parameters.

Unit 3

Physico–Chemical methods for analysis of environmental samples: Physico-chemical parameters; Definition and determination of conductivity, pH, emf, COD, BOD, Viscosity, surface tension, estimation of various elements at major, minor trace, ultra trace level concentrations; Choice of a technique; Principle, merits and demerits of the techniques –

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

Unit 4

Chemistry of Various Organic and Inorganic Compounds: Carcinogenic compounds and their effects. Hydrocarbons: Chemistry of hydrocarbon decay, environmental effects, effects on macro and micro organisms.

Surfactants: Cationic, anionic and nonionic detergents, modified detergents.

Pesticides: Classification, degradation, analysis, pollution due to
pesticides and DDT problems.

Synthetic Polymers: Microbial decomposition, polymer
decay, ecological and consideration, Photosensitize additives.

Lead and its compounds: Physical and chemical properties, behavior, human exposure, absorption, influence. Aflatoxin occurrence, chemical composition and properties metabolism, acute toxicity, carcinogenicity

Unit 5

Instrumental methods of pollutant analysis, Spectroscopic techniques, AAS, NAA, GCMS, HPLC, Electro analytical techniques, EEM-608, Industrial waste management and environmental audit, environmental sensing techniques.

Unit 6

Bacteria: classification and characteristics of bacteria, cell morphology, growth rate curve, culture techniques, Gram staining, microscopic methods, MPN, Plate count and membrane filter techniques,

Unit 7

Algae: classification, symbiosis, factors affecting algal growth, control of algae, Fungi, moulds, protozoa , population dynamics, role of microbes, in biological waste

treatment, significance of F/M ratio, acclimatization of bacteria, bioassay tests, aerobic and aerobic metabolism.

Unit 8

Structure of prokryotic and eukryotic cells, Types and metabolic classification of micro organisms, Microbial metabolism, respiration and energy generation, ; enzyme kinetics and regulation; Bacterial genetics; structure of DNA and RNA ; transcription and translation; Gene expression and regulation; Gene transfer and recombinant DNA technology.

Reference Books

1) Chemistry for Environmental Engineers - Swayer and McCarty
2) Outlines of Biochemistry - Conn and Stump
3) Microbiology - Pelzar and Reid
4) Microbiology for Sanitary Engineers - Ray MaKinney

ENVIRONMENTAL MANAGEMENT (501602)

Teaching Scheme: Examination
Lecture: 3 Hrs. / Week Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1

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

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

Unit 2

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

Unit 3

Pollution Taxes, Efficiency properties of a tax on emissions, problems with pollution taxes, Tradable Pollution Permits, Basic theory of tradable pollution permits, issues in tradable permits, Transboundrary pollution problem, international organizations for environmental protection. WTO agreements on environment. Agrochemical pollution and measures undertaken: national and inter national scenario, bio-diversity and economy.

Unit 4

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

Historical aspects: major legislations: USEPA 1969 to Clean Water and Air Act, Significant legislations in developing and developed countries.

Legislations in Indian context: Indian Forest Act 1950, 1980, and amendments. Acts related to air and water pollution.

Unit 5

Norms & Standards: OHSHAS 18001 & its significance, ISO 14000 & its significance, other acts in ESE and case studies, Feasibility Studies and Management issues. **Related Issues**: Principles of sustainable development and implications of finite biosphere and complexities for engineering design and decision-making, Design of controlled environments to enhance health and protection of natural resources for sustainable development, Resource problems and design with ecological, economic, demographic and social dimensions, Techniques to integrate knowledge and policy.

Unit 6

Introduction, Principles and Elements of Successful environmental management: ISO Principles, EMS, Creating an environmental management system in line with ISO 14000, Benefits of an environmental management system, Principles and elements of successful environmental management: Leadership, Environmental management planning, Implementing an environmental management system, Measurement and evaluations required for an environmental management system, Environmental management reviews and improvements, Legal and regulatory concerns, Integrating ISO 9000 and ISO 14000

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

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

Reference Books

1. W. Canter "Environmental Impact Assessment" McGraw Hill (1996).
2. Peter Watten (Eds.) - `Environmental Impact Assessment Theory and Practice', Unwin Hyman, London (1988)
3. John G. Rau and David C. Woolen (Eds.) `Environmental Impact Analysis Hand Book', McGraw Hill, (1980).
4. Meyers A. Robert (Eds.) Encyclopedia of Environmental Analysis and Remediation Vol. 1-8, John Wiley & Sons, 1998.
5. Handbook of Accident prevention, ILO Publication, 1998.
6. Encyclopedia of Industrial Safety and Health, 1999.
7. G. M. Masters, Introduction to Environmental Engineering & Science, Prentice Hall, New Delhi, 1997
8. J.G. Henry and G. W. Heike, Environmental Science & Engineering", Prentice Hall International Inc., New Jersy, 1996.

ADVANCE FLUID MECHANICS (501603)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1

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

Unit 2

Laminar Flow: Navier strokes equation-derivation, exact flow between parallel plates-it's exact solution, flow near an oscillating plate & suddenly accelerated plate.

Unit 3

Boundary Layer Theory: Karman's momentum integral equation, Karman Pohlhausen's solution, boundary layer separation.

Unit 4

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

Unit 5

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 and compressible flow around immersed bodies

Recommended books

1. Applied Hydrodynamics – H.R. Vallentine, ELBS Publication
2. Fluid Mechanics-Grade & Mirajgaonkar
3. Fluid Mechanics-Victor L Streeter & E.B. Wylie, Mc-Graw Hill
4. Viscous Fluid Flow-Frank M White, Mc-Graw Hill

ELECTIVE-I

GROUNDWATER CONTAMINATION AND TRANSPORT (501604)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1

Introduction: Ground water and the hydrologic cycles-Ground water as a resource-Ground water contamination-Ground water as a Geotechnical problem-Ground water and geologic processes. Physical properties and principles-Darcy's Law-Hydraulic Head and Fluid Potential piezometers and Nests, Hydraulic conductivity and permeability-Homogencity and Anisotropyporosity and voids Ratio- Unsaturated flow and the water table-Steady state flow and Transient Flow-compressibility and effective stress-Transmissivity and storativity - Equations of Ground water flow-Limitations of Darcian Approach-hydro dynamic dispersion.

Unit 2

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

Unit 3

Resource Evaluation: Development of Ground water Resources-Exploration for Aquifers-the response of Ideal aquifers to pumping-Measurement of parameters - Laboratory tests- Piezometer test-pumping tests-Estimation of saturated hydraulic conductivity-Numerical simulation for aquifer yield prediction-Artificial recharge and induced infiltration-Land subsidence-sea water intrusion

Unit 4

Chemical Properties and Principles: Constituents-chemical equilibrium-Association and Dissociation of dissolved species-effects of concentration gradients-Mineral dissolution and solubility- Oxidation and Reduction Process-Ion exchange and Adsorption- Environmental isotopes-Field Measurement of Index parameters.

Unit 5

Solute Transport: Water Quality Standards-Transport Process-Nonreactive Constituents in Homogeneous Media And Heterogeneous Media-Transport In Fracture Media-Hydeochemical behavior of Contaminants-Trace Metals-Nitrogen-Trace Nonmetals Organic Substances-
Measurement of Parameters-Velocity-Dispersivity-Chemical Partitioning-Sources Of Contamination- Land Disposal Of Solid Wastes-Sewage Disposal On Land.

Reference Books

1. Randall J. Charbeneau, " Ground Water Hydraulics and Pollutant Transport "
2. Allen Freeze, R. and John A. Cherry, "Ground Water ". Prentice Hall.Inc.

HYDROLOGY AND GROUNDWATER (501604)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

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

Flow Generation: 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. Darey's Law-itsrange of validity, Dupuit Forchheimer assumption, application of Darcy's law to simple flowsystems governing differential equation for confined and unconfined aquifers, fully & partially penetrating wells, interference of wells, pumping test with steady & unstady 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 ground water.

Unit 6

Ground Water Conservation: Ground water budget, seepage from surface water artificial recharge.

Recommended books

1. Applied Hydrology-Linsley Kolhar & Paulhas (Mc-Graw Hill)
2. Water Resource & Hydrology-S.K. Garg.
3. Engineering Hydrology-K.Subramanya, Tata Mc-Graw Hill.

AIR POLLUTION ENGINEERING (501604)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1

Physics of atmosphere, Solar radiation, Wind circulation, Lapse rate, Inversion, Stability conditions, Pasquil stability model, maximum mixing depth, Wind rose, Plume behavior, Heat island effect, Green house effect, Rain drop formation, Visibility, Photochemical reaction.

Unit 2

Dispersion of pollutants in the atmosphere, eddy diffusion model, the Gaussian dispersion model, point source, Line source, maximum ground level concentration, Determination of stack height, sampling time corrections, Effects of inversion trap.

Unit 3

Indoor air pollution: Causes of air pollution, sources and effects of indoor air pollutants, changes in indoor air quality, control of indoor air pollutants and air cleaning systems.

Odour pollution: Theory, sources, measurement and methods of control of odour pollution.

Air sampling and analysis: Air pollution survey, basis and statistical considerations of sampling sites, devices and methods used for sampling gases and particulars. Stack emission monitoring, iso-kinetic sampling. Analysis of air samples chemical and instrumental methods. Ambient air quality monitoring.

Unit 4

Particulate matter; Definitions of different particulate matter, Distribution and source of SPM, Terminal settling velocity, Hood and duct design, Particulate collection design.

Unit 5

Control equipment for particulate matter; Settling chamber, Cyclone, Wet collectors, Fabric filter, Electrostatic precipitator, Problems on design of equipment, Component detailing collection efficiency.

Unit 6

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

Unit 7

Automobile source; Emission of pollutants from automobiles, Reduction of emissions by different methods, Alternative fuels and their utilizations.

Unit 8

Strategy for effective control of air pollution in India.

Reference Books

1. Air Pollution – Wark and Warner.
2. Air Pollution Vol. I and II– Stern.
3. Air Pollution and Control– Martin Crawford.
4. Air Pollution – H. V. N. Rao and M. N. Rao, TMH, Pub.
5. Air pollution – KVSG Murali krishna.
6. Air Pollution – Perkins.
7. Environmental Engineering – Davis, McGraw Hill- Pub.
8. Environmental Engineering – Peavy and Rowe, McGraw Hill- Pub.

SOLID AND HAZARDOUS WASTE MANAGEMENT (501604)

Teaching Scheme: Examination
Lecture: 3 Hrs. / Week Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1

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

Solid waste generation rate: Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems. Transfer station: Meaning, Necessity, Location, Economic analysis. Transportation of solid waste: Means and methods, Routing of vehicles.

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

Unit 2

Composting of solid waste: Principles, Methods, Factors affecting, Properties of compost, Vermicomposting. Energy recovery from solid waste: Parameters affecting, Biomethanation, Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options.

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

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

Unit 3

Legal and Organizational foundation: Definition of solid waste - waste generation in a technological society - major legislation, monitoring responsibilities, sources and types of solid waste - sampling and characterization

Unit 4

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 5

Hazardous waste treatment technologies - Design and operation of facilities for physical, chemical and thermal treatment of hazardous waste - Solidification, chemical fixation and encapsulation, incineration. 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

Reference Books

1)Manual on municipal solid waste management – Government of India publication.
2)Integrated solid waste management – George Tchobanoglous. Mcgraw Hill
3) Solid waste management handbook– Pavoni
4) Gorge Techobanoglous et al “Integrated solid Waste Management” Mc Graw Hill Publication 1993.
5)Charles A Wentz “ Hazardous Waste Management “Mc Graw-Hill Publication 1995.

ELECTIVE II

UNIT OPERATIONS IN ENVIRONMETNAL ENGINEERING (501605)

Teaching Scheme:	Examination
Lecture: 3 Hrs. / Week	Paper: 100 Marks
	Paper Duration: 3 Hrs.

Unit 1

Pumps and Compressor: study of different type of pumps such as positive and non positive displacement pump, non positive displacement pump such as reciprocating pump, gear pump, centrifugal pump etc. Types of compressor, selection of compressor, power calculation, types of compressor

Unit 2

Valves & Actuators: Study of different types of valves such as pressure control valve, flow control valve, direction control valve, their application, symbols used in hydraulic and pneumatic circuits, Different type of actuators used in hydraulic and pneumatic circuits.

Unit 3

Vibration and Seismic analysis for pipe and pipe support structure: Elements of seismology – terminology, structure of earth , causes of earthquake, plate tectonic theory, elastic boundary theory , seismic wave, magnitude , intensity, method of measurements. Fundamental of vibrations, free and forced vibration of single degree of freedom system, single degree of freedom, earthquake response of SDOF system, mode, shape function, accelerometer.

Unit 4

Heat exchanger: Basic of heat transfer, dimensional analysis in heat transfer, heat transfer in Laminar and Turbulent flow, heat exchanger design, multiple heat exchanger

Unit 5

Diffusion (Mass Transfer Operation)and Distillation: Ficks law, molecular diffusion, gas and liquid study state diffusion, Concept of distillation, vapour phase equilibrium, Gibb's Phase rule, degree of freedom, boiling point diagram, vapour – liquid equilibrium diagram, Herry's Law, Raoult's Law, types of distillation

Unit 6

Drying and Filtration Operation: Humidification and de humidification, types of dryers, Introduction to filter press, types of filtration, design of hydraulic filter press

Reference Books

1. Dynamics of structure theory and application to earthquake engineering, By A.K. Chopra- Prentice Hall Publication.
2. Structure Dynamic by Mario Paz CBS Publication
3. Unit Operation by G.K. Ghavane
4. Water and Waste Water Engineering by Metcalf Eddy – Tata Mc Graw Hill Publication
5. Water and Wastewater Engineering-Vol. II Fair, Geyer & Okun Wiley Toppan

Co. Ltd. Tokyo.
6. Handbook of applied hydraulics -C.V. Davis. International Students' Edition McGraw Hill Book Co., New York.
7. Operation and Control of Water Treatment processes C.R. Cox WHO Monograph Series No.49.
8. Manual of Water Supply and Treatment Ministry of Urban Development
9. Operation and control of water treatment processes - C.R. Cox WHO Monograph no.49
10. Water supply for rural areas and small communities - Wagner and Lanoix. WHO Monograph no.42.
11. Water supply and pollution control-Clark, Viessman Jr. & Hammer International Textbook Co. London.

ADVANCE WATER TREATMENT & WATER SUPPLY ENGINEERING

(501605)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1

Gas transfer: Aeration systems, Energy requirement, Design of aeration systems.

Unit 2

Membrane filtration: Terminology, Process classification, Membrane configurations, Membrane operation for micro filtration, Ultra filtration and Reverse osmosis, Area requirement, Membrane fouling and its control, Application of membranes. Electro dialysis: Theory, Area and power requirement, Disposal of concentrate waste streams.

Unit 3

Grit removal: Types of grit chambers, Characteristics, quantities, processes and disposal of grit, Design of grit chambers, Flotation: Objective, Types of flotation systems, Design considerations. Chemical precipitation for removal of phosphorous, heavy metals and dissolved inorganic substances, Mass transport processes, Mass balance analysis, types of reactions, reaction kinetics, Configurations of ideal and non-ideal reactors, principles of ideal reactor design. Basic principle of mass transfer, Gas-liquid mass transfer, Two film theory Introduction to process selection, Coagulation processes, stability of colloids and destabilization, coagulants Flocculation theory, orthokinetic and perikinetic Design of slow and rapid mixers, Sedimentation, particle settling theory, types of settling and related theory, types of clarifier, high rate clarification, design of clarifiers.

Unit 4

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

Unit 5

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

Unit 6

Ion exchange, exchange materials, exchange capacity, ion exchange chemistry and reactions, applications for hardness and TDS removal, design of ion exchange softener, Disinfection, modes of disinfection, mechanisms, factors influencing, ideal disinfectant, chemistry of chlorination, ozone chemistry, estimation of ozone dosage, UV disinfection, Estimation of UV dose, Corrosion processes, electrochemical nature of corrosion, types of corrosion, methods of corrosion control, Water flow distribution by hardy cross method study and analysis of network

Reference Books

1. Wastewater Engineering treatment and reuse– Metcalf Eddy
2. Theory and Practice of water and Wastewater treatment – Ronald Droste
3. Physico-chemical processes of water purification – Weber
4. Wastewater Treatment for Pollution Control – Soli Arceivala

REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM FOR WATER RESOURCES MANAGEMENT (501605)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1: Basic principles of photogrammetry and photo interpretation, Introduction and classification of remote sensing and data analysis Fundamental of sensing systems, Concept of Analog and Digital systems. Equipments required.

Unit 2: Introduction to G.I.S. Data collection and input processing in G.I.S. Types of database – Spatial database, Attribute database, Data quality and errors in G.I.S.

Unit 3: Role of remote sensing data in G.I.S. – Raster analysis, Applications of R.S. & G.I.S. in irrigation and drainage surface runoff estimation, crop yield and land use management, wet land management, watershed management etc.

Reference Books

1. Remote sensing methods & applications – R.Michael Hord, Wihly Interscience Publication.
2. Remote sensing & image interpretation – Lilleson J.T.M. & Krefer R.W. Wiely, New York.
3. Photogrammetry by – Sheford.
4. Remote sensing in Civil Engineering – J.M. Kennie & M.C. Mathews.

PLANNING AND MANAGEMENT OF WATER RESOURCES (501605)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1

Introduction:

Objectives: of water resource planning and management, its Necessity, Aspects of water resources planning, of water resource development; needs and opportunities; societal goals

Unit 2

Spatial and temporal characteristics of water resources, constraints for its development like non-reversibility; planning region and horizon.

Unit 3

Economic Planning: Cost benefit 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.

Unit 3

Demand for drinking water; irrigation, hydropower; navigational; planning for flood control.

Unit 4

Management of 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 5

Management of Ground-Water Resources: Ground water evaluation; conjunctive use of surface and ground water.

Unit 6

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

Recommended books

1. James, L .D., and Lee, R. R., “Economics of Water Resources Planning”, Mc Graw Hill.

2. Modi, P.N., „Irrigation, Water Resources and Water Power Engineering", Standard Book Pub., Delhi.
3. Garg, S.K., “Irrigation Engineering and Hydraulic Structure”, Khanna Publishers.
4. Principles of Water Resources planning-by Goodman.
5. Water Resources System Planning – by M.C. Chaturvedi.
6. Water Resources Planning and Management by-O.J. Helwege.
7. Water Management System Application-A.K. Biswas

HYDRAULICS AND ENVIRONMENTAL LABORATORY – I (501606)

Performing Lab-Work Related to the subjects of Semester I (as proposed in this syllabus)

1. Flow past a cylinder
2. Flow over Weir
3. Growth of a boundary layer along a flat plate
4. Assignment based on drawing of flow-net
5. Collection of Ambient air quality analysis, determination of SPM, CO, NO_x and SO_x, Exhaust gas analysis
6. Water and Waste Water Software
7. Bacterial test such as MPN, E-Coli and B-Coli bacteria
8. Determination of Water Quality Parameter such as alkali earth metal, cations, Anions, sulphates, etc.

SEMINAR-I

SEMESTER– II

OPTIMIZATION TECHNIQUES (501608)

Teaching Scheme:	Examination
Lecture: 3 Hrs. / Week	Paper: 100 Marks
	Paper Duration: 3 Hrs.

Unit 1

System Concepts: System concepts, definitions, needs for system approach, different types of system parameters and variables.

Unit 2

Linear Programming: Revision, Big M Method, duality, sensitivity analysis. Application of Linear Programming for Hydraulics & Water Resource

Unit 3

Non Linear Programming: Unconstrained one Dimensional search methods, Dichotomous search method, Fibonacci, Golden section, multivariable unconstrained, gradient techniques, steepest ascent and descent methods, Newton's methods, Application of Dichotomous search method, Fibonacci & Golden section to the various sectors of Water Resource Engineering, constrained Lagrangian multiplier techniques

Unit 4

Dynamic Programming: Principle of optimality, recursive equations. Application of Dynamic programming to Water Resource Engineering

Unit 5

Stochastic Methods: Queuing theory, simulation technique, sequencing model, Morkov's process

Unit 6

Games Theory.

Reference Books

1. Engineering Optimazation Theory & Practice – S.S. Rao.
2. Operation Research – Taha Hamdey A.
3. Operation Research – Wagner.

OPEN CHANNEL HYDRAULICS (501609)

Teaching Scheme:	Examination
Lecture: 3 Hrs. / Week	Paper: 100 Marks
	Paper Duration: 3 Hrs.

Unit 1
Review and revision of uniform flow formulae and design of channels
Unit 2
Hydraulic Jump: Formations of jump in expanding and contracting channel, jump type, jump control, jump on sloping floors
Unit 3
Gradually Varied Steady Flow: 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: Differential Equation of spatially varied flow, profile computation.
Unit 5
Hydraulic Flood Routing: Muskinghum method, finite difference scheme, channel routing storage, method of characteristics, Differential form of Momentum Equation.
Unit 6
Unsteady Flow: Waves, celerity of wave, boundary conditions, standing and progressive wave, positive and negative surges, Dam break problem, deep water, group velocity, solitary wave.

Reference books
1. Open Channel Hydraulics – Ven Te Chow, Mc-Graw Hill.
2. Flow through Open Channel-K.G.Ranga Raju, Tata Mc-Graw Hill.
3. Flow in Open Channel – K. Subramanya, Tata Mc-Graw Hill.
4. Open Channel Hydraulics-French, Mc-Graw Hill.

ADVANCE WASTE WATER TREATMENT (501610)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1

Introduction: Objectives of waste water treatment, Purpose of advanced wastewater treatment, Wastewater quantity and transport and waste water characteristics, Alternative flowcharts, function and basic principles involved in different units of conventional wastewater treatment plant.

Unit 2

Process Analysis: Reaction and reaction kinetics, Mass balance Reactors and their hydraulic Characteristics, Practical aspects of reactor design

Unit 3

Physical and Chemical Treatment:

Screening, Grit removal, flow equalizations and mixing, Flocculation, sedimentation, flotation. Detailed principles and design aspects of Screening, Grit chamber and Sedimentation tank.

Unit 4

Principles of Biological Treatment: Kinetics of biological growth, introduction to suspended and fixed film reactors, Concepts of gas transfer and solids separation, Nitrogen and Phosphorus removal from waste water, Concepts of aerobic and anaerobic treatment of waste water, Design of Activated Sludge system using biological process dynamics. Complete design details of Activated Sludge Process, Modifications of ASP, Process concepts and design aspects of Trickling Filters, Rotating Biological Contactors (RBC) Fluidized bed reactor/treatment.

Unit 5

Sludge Treatment And Disposal: Aerobic and Anaerobic digestion of sludge, sludge stabilization, dewatering, conditioning and disposal.

Unit 6

Tertiary Treatment: Principles of tertiary treatment, theory of adsorption and factors affecting adsorption, Concepts and different methods of dissolved solids removal, Basic principles of Reverse Osmosis, Ultra-filtration, Electro dialysis, Desalination

Reference Books

1. Wastewater Engineering: Treatment, Disposal & Reuse, By Metcalf & Eddy Inc. Sixth Ed. 2002, McGraw Hill.
2. Introduction to Environmental Engg., By. P.A. Veslind, PWS, Publishing Company, Boston, 1997.
3. Wastewater Treatment and disposal, By S.J. Arceivalla, Marcel Dekker, 1981.
4. Wastewater Treatment Plant Planning, Design and Operation, By S.R. Quasim, Holt, Rinehart & Winston N.Y.
5. Activated Sludge Process: Theory and Practices, By N.F Grey, Oxford

ELECTIVE III

COMPUTATIONAL METHODS IN WATER RESOURCES (501611)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

UNIT 1

Linear system-Solution for Banded and Sparse systems using Gaussian elimination and Gauss, Jordan methods, Gauss seidel method – Nonlinear equations – Regula falsi and Newton- Raphson methods, interpolation – Newton's and Lagrange's interpolation

UNIT 2

Introduction to Finite Differences. Solution of System of Non Linear Algebraic equations using Newton and Picard Method.

UNIT 3

Numerical solution of Ordinary differential equations-Initial and Boundary value problems, Solutions using Euler Method, Modified Euler Method, Fourth –order Runge-Kutta method, predictor –corrector , and shooting methods.

UNIT 4

Introduction to Partial Differential Equations-Elliptic, Parabolic and Hyperbolic equations. Numerical solution using Finite difference Method. Relaxation methods and introduction to Method of Characteristics. Boundary conditions.

UNIT 5

Explicit and Implicit Finite Difference schemes for Advection, Diffusion and Advection-Diffusion equations .Convergence and Stability of difference schemes.

UNIT 6

Introduction to Artificial Neural Networks: Networks and its training-Back propagation algorithm, Conjugate gradient algorithm, Cascade correlation algorithm, Applications of ANN in WRE.

.

Reference Books:

1. Numerical Methods by Chapra and Canale.
2. Neural Network Fundamentals with Graphs, Algorithms, Applications-Bose N.K. & Liang P. McGraw Hill N.Y.
3. Computational Fluid Dynamics by Anderson.

NOISE POLLUTION AND CONTROL TECHNIQUES (501611)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1

Introduction, Noise pollution, Nature of noise, Characteristics of noise, NEI, Sound pressure level and propagation of noise

Unit 2

Source of noise, Types of sources of noise, (mobile and non mobile) comparison of noise and Air pollution standards, Assessment and measurement of sound control facilities, Monitoring procedures

Unit 3

Effects of noise on people and various protective equipments Like earplugs, earmuffs, etc. Basic principles of noise control, general noise control factors sources of vibrations.

Unit 4

Noise in Home & its control, control of Existing noise outside the home, Noise from construction and Civil Engineering works and its control, Noise from industry and its control

Unit 5

Road traffic noise and its control subjective rating of Automotive vehicles noise Characteristics of vehicle guidelines for vehicular noise, relation between noise and engine combustion system Aircraft and Airport noise

Unit 6

Legal Aspects of noise pollution, prediction and Assessment of Impacts on the noise Environment due to stationery and mobile noise sources, Existing legal provisions for controlling noise, International noise level standards

Reference Books

1) Noise Pollution - P. R. Trivedi, Gurdeep Raj
2) Environmental Noise Pollution and its Controls - G. R. Chatwal, M. C. Mehra, M. Satake

GROUNDWATER MODELLING (501611)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

UNIT 1

Groundwater Occurrence & Movement: General Introduction

UNIT 2

Numerical modeling of groundwater flow - Review of differential equations, finite difference solution, direct problem, inverse problem.,

UNIT 3

Planning of groundwater development-water balance, assessment of recharge, utilizable recharge, Groundwater estimation norms in India, Constraints on groundwater development.

UNIT 4

Groundwater modeling using finite element method

Reference Books

1. Remson, I., Hornberger, G.M., and Molz. F.J., Numerical methods in subsurface hydrology, Wiley Inter Science.
2. Rushton, K.R. and Redshaw, S.C., Numerical analysis by analog & digital methods, John Wiley.
3. Todd, D.K., Groundwater Hydrology, John Wiley, 1980.
4. Groundwater modeling by Anderson.

INDUSTRIAL WASTE MANAGEMENT (501611)

Teaching Scheme: Examination
Lecture: 3 Hrs. / Week Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1

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

Unit 2

Waste volume and strength reduction, in-plant measure, good housekeeping, process change, leakage prevention, segregation and recycling Neutralization, equalization and proportioning of waste

Unit 3

Water Quality monitoring of Streams, Self purification of streams, B.O.D. reaction rate, D.O. sag curve and D.O. deficit calculations

Unit 4

Miscellaneous methods of dissolved solids removal, sludge disposal methods

Unit 5

Different types of waste treatment & their selections, Development of treatment flow diagram based on characteristics of waste

Unit 6

Manufacturing processes in major industries, water requirements, wastewater sources, composition of wastes, Viz. sugar, distillery, dairy, pulps, paper mill, fertilizer, tannery, chemical, steel industry, power plants, textile Treatment flow sheets, alternative methods of treatment, factors affecting efficiency of treatment plant

Unit 7

Acclimatization of bacteria to toxic wastes, process sensitivity, operation and maintenance requirements

Unit 8

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

Reference books

1 Waste Water Engineering Metcalf Eddy Mc Graw Hill Publications.
2 Industrial Waste Treatment Nelson Meneroo
3 Industrial Waste Treatment Rao & Datta

ELECTIVE IV (*Open Elective*)

DAM ENGINEERING (501612)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1

Gravity Dams: Forces acting on the gravity dams earthquake force-pseudostatics and dynamic response approach, load classifications, stability analysis, distribution of shear and normal stresses, principle stresses, Stress concentration around openings, foundation treatments, Design of concrete dam. Reservoir operation

Unit 2

Arch Dams: General concepts of trail load theory, elastic shell methods, thick cylinder theory

Unit 3

Earthen Dams: Seepage through dam and its foundations, stability analysis for sudden drawdown condition, steady seepage condition, end of constructions, seismic effects, pore pressures, protection of upstream and downstream slopes.

Unit 4

Rockfill Dams: Relevant rockfill characteristics, general design principal method of construction and compaction.

Buttress Dam: Concepts and Design.

Unit 5

Spillways: Determination of capacity, types of spillways e.g. ogee, siphon, chute, side shaft, their hydraulic design, crest profile, energy dissipater and divide walls

Unit 6

Spillway Gates: Vibration, types of gates-trainer, drum, vertical lift and automatic gates.

Reference Books

1. Concrete Dams – R.S. Varsheny
2. Irrigation Water Resources & Water Power Engineering P.N. Modi
3. Earth Dams – J.L. Sherard.

ENERGY AND ENVIRONMENT (501612)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit1

Energy Crisis: Historical events, energy requirement of society in past and present situation, availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability.

Unit 2

Non-conventional energy sources: Hydro power plant, tidal energy, biomass energy, wind energy, Hydrogen as a source of energy, energy conversion technologies, their principles, equipment and suitability in context of India. Environmental impacts of these technologies.

Unit 3

Solar Energy Option: Sun as source of energy, direct methods of solar energy collection, process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and application, environmental impacts of solar energy.

Unit 4

Biomass Energy: Concept of biomass energy utilization, types of biomass energy, conversion processes, biogas production, biomass gasification process and technologies, environmental impacts of biomass energy.

Unit 5

Energy Storage: Types of energy storage, devices for sensible and latent heat storage, energy storage in dry batteries, nickel-cadmium batteries, secondary heat storage, chemical storage, environmental consequences of energy storage systems.

Unit 6

Energy recovery systems: Approaches to waste Energy Utilization, Equipment, Utilization System, objective, principles of heat transfer, Gas to Gas heat transfer, Gas to Liquid heat transfer, Recovery of waste heat in coil coating, Non-conventional liquid fuels, Heat recovery by Cogeneration.

Reference Books

1. Bewik M.W.M. - Handbook of organic waste conversion.
2. Bokris J.O. - Energy, the solar hydrogen alternative.
3. Rai G.D - Non-conventional Energy Sources.
4. Sukhatme S.P.- Solar Energy.
5. Kiang Y. H.- Waste Energy Utilization Technology.

CLOSED CONDUIT FLOW (501612)

Teaching Scheme:
Lecture: 3 Hrs. / Week

Examination
Paper: 100 Marks
Paper Duration: 3 Hrs.

Unit 1

Steady flow in pipelines: Pump characteristics, pipeline analysis water Hammer, Fundamental equations, elastics waves in conduits, boundary effects, numerical and graphical methods.

Unit 2

Surge Tank: Differential equation for surge tank, method of solution, simple, and differential surge tanks with expanded chambers

Unit 3

Pipe network analysis (steady state & transient): Tree type networks, closed loop systems, general pipe system, computer analysis, use of PIPE2000(KYPIPE) and related programs, transient flow in pipe systems, introduction to SURGE program.

Unit 4

Open Channel Hydraulics: Classification of open channel flows, gradually varied flows, water surface profiles, floodplain hydraulics, use of HEC_RAS(HEC2) program, use of Pipe2000-SWMM program.

Reference Books

1. Open Channel Flow – Ven Te Chow, Mc- Graw Hill.
2. Engineering Fluid Mechanics – K.L. Kumar, Eurasia Publication.
3. Principles of Fluid Mechanics – M.K. Natrajan, Oxford & IBH Publication.

RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS
(501612)

Teaching Scheme:	Examination
Lecture: 3 Hrs. / Week	Paper: 100 Marks
	Paper Duration: 3 Hrs.

UNIT 1

Introduction: Nature and objectives of research. Methods of Research: historical, descriptive and experimental, research process, research approaches, criteria for good research. Meaning of research design, need of research design, features of good design, different research designs, and basic principles of experimental designs, design of experiments.

UNIT 2

Data collection, Analysis and Processing: Types of data, methods and techniques of data collection, primary and secondary data, meta analysis, historical methods, content analysis, devices used in data collection, pilot study and pretest of tools, choice of data collection methods. Use of statistics for data analysis, measures of central tendency, dispersion, skewness and relationship. Sampling distributions, sampling theory, determination of sample size, chi-square test, analysis of variance, multiple regression analysis,

UNIT 3

Decision making techniques: Application of various decision making techniques such as Analytical Hierarchy Process (AHP), TOPSIS, neural networks, graph theory, simulated annealing, genetic algorithms, data envelope analysis (DEA).

Interpretation and report writing: Techniques of interpretation, precautions in interpretation, significance of report writing, different steps in report writing, layout of research report, mechanics of writing research report.

UNIT 4

Introduction to Intellectual Property Rights: Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 5

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Recent Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Softwares etc. Traditional knowledge Case Studies, IPR and IITs.

Reference Books

1. C.R Kothari, Research Methodology, Wishwa Prakashan
2. P.G Triphati, Research Methodology, Sultan Chand & Sons, N.Delhi
3. Fisher, Design of Experiments, Hafner
4. Stoufferetal, Measurement and Prediction, Wiley, N.York
5. J.W Bames, Statistical Analysis for Engineers and Scientists, McGraw Hill, N.York

6. Donald Cooper, Business Research Methods, Tata McGraw Hill, N.Delhi
7. Bhanwar Lal Garg, Renu Kavdia, Sulochana Agrawal and Umesh Kumar Agrawal, "An Introduction to Research Methodology", RBSA Publications,
8. Rao S. S., "Optimization", Wiley Eastern, New Delhi, 1995.
9. Montgomery D.C., "Design and analysis of experiments", Wiley publications.
10. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007
11. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New"

HYDRAULICS AND ENVIRONMENTAL LABORATORY – II

Performing Lab Work Related to the subjects of Semester II (as proposed in this syllabus)

1. Characteristics of Hydraulic Jump in horizontal and sloping channel
2. Velocity distribution in open channel flow
3. Use of open channel flow simulation software like HEC
4. Numerical simulation of 1-D open channel flow using MATLAB
5. Determination of BOD and COD from Waste Water
6. Determination of organic nitrogen (NH_3)
7. Determination of heavy metal from Waste Water
8. Determination of phosphate and nitrate

SEMINAR-II