College of Engineering, Pune

(An Autonomous Institute of Govt. of Maharashtra, Permanently Affiliated to S.P. Pune University)

Department of Civil Engineering

Environmental and Water Resources Engineering (2010)

Earlier 'Hydraulic Engineering' (1952)

Curriculum Structure & Detailed Syllabus (PG Programme)

M.Tech. - EWRE

(Effective from: A.Y. 2015-16)

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Programme Educational Objectives (PEOs)

I. Graduates of the programme will have in-depth knowledge to identify and formulate challenging environmental andwater resources problems, apply appropriate research methodologies, use modern engineering tools and provide technically sound,economical and sustainable solutions.

II. Graduates will have ability for higher studies and undertake high value research on environmental,water resources and other related issues.

III. Graduates of programme will have sound analytical and lateral thinking ability to engage in lifelong learning for professional advancement to cope up with multidisciplinary and changing technologies in environmental and water resources engineering.

IV. Graduates of the programme will have sense of social responsibility, will demonstrate ability to communicate and work effectively as a team member in an ethical way, and will play leadership roles in their profession, public services and community.

Programme Outcomes (POs)

On completion of the Programme, students will be able to

1. Apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude, independently carrying out research /investigation and development works.
2. Write and present a substantial technical report / document.
3. Demonstrate a degree of mastery in environmental and water resources engineering. The mastery should be at a level higher than the requirements in the appropriate bachelor Programme.
4. Gain knowledge / skill in integrating environmental and water resources concepts for collaborative multidisciplinary solutions and carry out planning and management of projects as a member and a leader in a team considering economic and financial factors.
5. Recognize the need for and have ability in lifelong learning independently for professional advancement, demonstrate professional ethics, work culture and understanding of responsibility to contribute to community for sustainable development of society.
6. Recognize the need for and have ability in lifelong learning independently for professional advancement, demonstrate professional ethics, work culture and understanding of responsibility to contribute to community for sustainable development of society.

Correlation between the PEOs and the POs

Programme Educational Objectives (PEOs)	**Programme Outcomes(POs)**				
	1	2	3	4	5
I	√			√	√
II			√	√	
III			√	√	√
IV		√		√	√

Note: The cells filled in with✓indicate the fulfilment/correlation of the concerned PEO with the PO.

List of Abbreviations

Abbreviation	**Title**
MLC	**Mandatory Learning Course**
SLC	**Self-Learning Course**
LLC	**Liberal Learning Course**
SBC	**Skill Based Course**
PCC	**Programme Core Course**
DEC	**Department Elective Course**
LC	**Laboratory Course**

Semester I

Sr. No.	Course Type/Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	OEC	Numerical Methods [To be offered to other Programmes]	3	--	--	3
2.	PCC	Advanced Treatment of Water and Waste Water	4	--	--	4
3.	PCC	Advanced Hydraulics and Hydrology	4	--	--	4
4.	DEC	Elective – I 1. Channel and River Hydraulics 2. Ground Water Hydrology 3. Application of Geoinformatics in Water Resources & Environmental Engineering 4. Land and Water Management	3	-	-	3
5.	DEC	Elective – II 1. Transport of Water and Waste Water 2. Principles of Water and Air Quality and Legislations 3. Ecology and Stream Sanitation 4. Design of Reactors and Environmental Chemistry	3	-	-	3
6.	LC	Lab Practice I	--	--	4	2
7.	LC	Seminar	--	--	2	1
8.	MLC	Research Methodology	1	--	--	--
9.	MLC	Humanities	1	--	--	--
		Total	**19**	**--**	6	**20**

Semester II

Sr. No.	Course Code/Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	PSMC	Stochastic Hydrology	3	1	--	4
2.	PCC	Urban Hydrology and Drainage	4	--	--	4
3.	PCC	Environmental Impact Assessment	4	--	--	4
4	DEC	Elective – III 1. Irrigation and Drainage. 2. Computational Fluid Dynamics. 3. Water Resources Systems Planning and Management. 4. Integrated Water Resources Management.	3	-	-	3
5	DEC	Elective – IV 1. Solid and Hazardous Waste Management. 2. Water and Air Quality Models. 3. Industrial Wastewater Management. 4. Decentralized Waste Water Management.	3	-	-	3
6.	LC	Lab Practice II	--	--	4	2
7.	LC	Mini Project	--	--	2	1
9.	MLC	Intellectual Property Rights	1	--	--	--
10.	LLC	Liberal Learning Course	--	--	--	1
		Total	**18**	**1**	**6**	**22**

Semester-III

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	Dissertation	Dissertation Phase – I	--	--	--	10
2	PCC	Economics, Planning and Management of Systems	3	1	-	4
		Total	**--**	**--**	**--**	**14**

Semester-IV

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	Dissertation	Dissertation Phase – II	--	--	--	18
		Total	**--**	**--**	**--**	**18**

[OEC-I CE5501/IS-501-23]Numerical Methods

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each
End-Sem Exam – 60 marks

Course outcomes:

At the end of the course, students will demonstrate the ability to:

1. To solve numerical problems related mathematical models mentioned in the course content
2. Apply partial differential equations in water and environment
3. Application of finite element in groundwater studies

Syllabus Contents:

System of linear algebraic equations, Computational techniques for basic operations, Triangular matrices methods, Cramer's rule, Gauss elimination, Gauss – Jordan, LU Decomposition, Iterative methods, Jacobi's Gauss – Siedel method, Over relaxation method, Eigen value method Non – linear algebraic equations, Bisection method, Newton Raphson – Secant Method, Roots of polynomials, Applications. Ordinary differential equations, Taylor's series approach, Euler's method, Range - Kutta methods, Simulation of higher order differential equations. Finite difference methods and interpolation, Difference operators, Fitting polynomials to observed data, Estimating missing data, Newton Gregory methods, Interpolation by Lagrange, Bessel, Sterling's approach, Initial and boundary value problems of finite difference method. Partial differential equations, Time integration, Solution of elliptic, parabolic and hyperbolic type equations, steady and unsteady problems, Method of characteristics, Examples of partial differential equations in water and environment. Finite element method, Solution of discrete problems – Steady state and time dependent continuous problems, Application of finite element in groundwater studies

Neural networks, Difference between conventional methods and neural network approach, Feed forward and recurring networks, Back propagation and other learning methods

Fuzzy logic - sets, numbers, relations, Basic fuzzy operations, Fuzzy arithmetic - theory of uncertainty and information, reasoning, interface and control, Applications.

References:

1. Akai T.J. "Applied Numerical Methods for Engineers", John Wiley Inc. New York
2. Press W.H., Flannery B.P., TenklskySA. and Vetterling W.T. "Numerical Recipes – The Art of Scientific Computing", Cambridge University Press, Cambridge
3. Kosko B. "Neural Networks and Fuzzy Systems", Prentice Hall of India, New Delhi
4. Venkataraman M.K. "Numerical methods in science and Engineering", National Publisher company

[CORE-II EW-501]Advanced Treatment of Water and Wastewater

Teaching Scheme
Lectures: 4 hrs./week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course outcomes:
At the end of the course, students will demonstrate the ability to

1. Analyze quality of water and waste water
2. Select appropriate technology for treatment of water and wastewater.
3. Design a treatment facility for treatment of water and wastewater.

Syllabus Contents:
Water Quality – Physical, chemical and biological parameters of water, Water quality requirement, Potable water standards, Waste water effluents standards, Waste water effluent standards, Water quality indices. Water purification systems in natural systems – Physical, chemical and biological processes, Primary, Secondary and Treatment - Unit operations and unit processes, Design of primary, secondary and tertiary treatment units. Mixing, clarification – Sedimentation, types of sedimentation units, Aeration and gas transfer, Coagulation and Flocculation, Coagulation processes – stability of colloids, Destabilization of colloids, Transport of colloidal particles, Clariflocculation. Filtration – theory of granular media filtration, Classification of filters, Slow sand filter and rapid sand filter, Mechanism of filtration, Modes of operation and operational problems, Negative head and air binding, Dual and multimedia filtration. Adsorption, Adsorption equilibrium, Adsorption isotherms, Disinfection- Chlorine dioxide, Chloramines, Ozonation, UV radiation. Ion exchange processes, Application Membrane Processes, Reverse Osmosis, Ultra filtration, Electrodialysis

References:

1. Weber W.J. “Physicochemical processes for water quality control”, John Wiley and Sons, New York
2. Peavy H.S., Rowe D.R. and Tchobanglous G. “Environmental Engineering”, McGraw Hills, New York
3. Metcalf and Eddy “Waste water Engineering, Treatment and Reuse”, Tata McGraw-Hill

[EW-15001] Advanced Hydraulics and Hydrology

Teaching Scheme:
Lectures: 4 hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course Outcome:
At the end of the course, students will demonstrate the ability to

1. Perform hydrological modeling based on the mechanisms of various components of
2. hydrologic cycle related to precipitation, surface flow and subsurface flow and the concept of unithydrograph.
3. Carry out the flood estimation and routing by various techniques.

4. Analyze problems related to laminar flow and boundary layer theory.
5. Determine the various losses and other parameters in pipe flow problems.

Course Content:

I.Hydraulics:

a)Laminar flow, Navier's-Stokes equation of motion for laminar Flow; Laminar flow between two parallel plates, laminar flow through pipes, Dimensional Analysis & Modal Studies.

b)Boundary Layer Theory: Introduction, Development of boundary layer over a flat plate, boundary layer thickness, displacement, momentum and energy thicknesses, Application of momentum equation to boundary layer flow, local and mean drag coefficients, Hydro-dynamically rough and smooth surfaces, boundary layer separation and its control.

c)Pipe Flow Problems: Losses in pipe flow, pipes in series, pipes in parallel, branching pipes, siphons, multi-reservoir problems, pipe networks, unsteady flow in pipes, water hammer analysis.

II.Hydrology:

a)Atmospheric hydrology; Hydrologic processes, precipitation, evaporation, surface flow, sub-surface flow, and groundwater flow.

b)Water availability, Meteorology, Probable maximum precipitation, Depth area duration relationships, Frequency of point rainfall, Intensity Duration frequency relationship.

c)Flood estimation and flood routing: General, Design flood, estimation for un-gauged and gauged water sheds, probable maximum flood, Routing classification, Reservoir routing, Hydrological Channel routing

d)Unit Hydrograph, Concept of Unit Hydrograph, Methods of Estimation of Unit Hydrograph, Derivation and application., Instantaneous Unit Hydrograph, S-curve Technique.

e)Ground Water Hydrology, Definitions, Types of Aquifers and Wells, Occurrences, Distribution, Darcy's law and its limitations, Well hydraulics.

References:

1. K. Subramanya, "Engineering Hydrology", TMH, New Delhi, India.
2. Chow V.T, "Hand book of Applied Hydrology", Mc Graw-Hil, N.Y., USA.
3. D.K Todd, "Groundwater Hydrology", John Wiley, N.Y., India.
4. A.K. Jain "Mechanics of fluids", Khanna Publisher., Delhi.
5. P.N. Modi and S.M. Seth, "Hydraulics and Fluid Mechanics including Hydraulics Machines", Rajsons Publications Pvt. Ltd.

[EW(DE)-15001]Channel and River Hydraulics

Teaching Scheme:

Lectures: 3 hrs/Week

Examination Scheme

T1, T2 – 20 marks each,

End-SemExam – 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the

1. Ability to analyze & Calculate parameters governing the flow through open-channels and types of water surface profiles.
2. Compute flow profiles in channel transitions and due to hydraulic structures Analyze gradually-varied flow, rapidly-varied flow, unsteady flow and sediment transport in open channel
3. Design stable channels, erodible and lined channels for clear and sediment flows.

Course Content:

Basic concepts of free surface flow, Flow regimes, Velocity and Pressure distribution, Energy principles and its applications, Specific energy, Critical flow computations, Momentum equations and its applications, Specific force diagram, Theoretical concepts of surface roughness, Velocity equation, Uniform flow computation. Steady gradually varied flow, Dynamic equation, Characteristics of flow profile and methods of computation, Practical problems, gradually varied flow classification, analysis and computations, Compound channels, Canal delivery problem, Channel networks. Steady rapid varied flow, Hydraulic jump analysis and location, Jump in sloping channels and Oblique jump, Surge analysis, Design of spillways, Energy dissipaters, Channel transitions. Unsteady rapidly varied flow, Monoclinal rising wave, Dam break problem, Moving hydraulic jump, Positive and Negative surges, Hydraulic flood routing. Fluvial hydraulics, Basic characteristics of river beds and sediments, Initiation of motion, Bed load, suspended load, total load and sediment measurements, Regimes of flow, Plan form and stream bed variations of rivers, Sediment control. Design of stable channels, Design of erodible and lined channels for clear and sediment – laden flows – CBI & P method, Regime method, Tractive force methods, Reservoir sedimentation, Erosion and deposition, Sediment transport in pipes. Similitude and models, Dimensional analysis and similitude, Scale ratios, Fixed – bed and movable bed models.

References:

1. Chow V.T. “Open Channel Hydraulics”, McGraw Hill, Inc. New York.
2. Henderson “Open channel flow”, McMillan Pub. London
3. Subramanya K. “Flow in Open Channels”, Tata McGraw Hill Pub.
4. Garde and RangaRaju K.G. “Mechanics of sediment transportation and Alluvial Stream Problems”, Wiley Eastern, New Delhi
5. Chaudhry M.H. “Open – Channel Flow”, Prentice Hall of India, New Delhi
6. French R.H. “Open Channel Hydraulics”, McGraw Hill Pub Co., New York

[EW(DE)-18001]Groundwater Hydrology

Teaching Scheme:
Lectures: 3 hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course outcomes:

At the end of the course, students will demonstrate the ability to

1. Demonstrate the different terminologies related with groundwater hydrology
2. Identify suitable method of determination of aquifer parameters

3. Choose suitable ground water exploration techniques and assess ground water potential
4. Compare and contrast suitable ground water quality management methods and ground water model

Syllabus Contents:

1. Occurrence and movement of groundwater, origin, age and distribution, Well hydraulics, Aquifers and aquifer parameters, Darcy's law, Hydraulic conductivity and its characteristics, General flow equations, unsaturated flow, Dupuit equation. Groundwater flow direction, Steady and unsteady radial flows in aquifers (confined, unconfined and leaky),
2. Multiple well systems, Interference among wells, Partially penetrating wells, Characteristic well losses, Specific capacity, Potential flow, Image well theory and its applications in groundwater flow, Estimation of aquifer parameters from pumping test data.
3. Water well design and well drilling, Well screen, Development and completion of wells, Yield tests, Protection and Rehabilitation of wells, Rotary drilling and rotary percussion drilling, Maintenance of wells Artificial recharge of groundwater modelling – concepts, recharge methods, recharge mounds, induced recharge, Ground subsidence
4. Hydrogeology – porosity and permeability of rocks, Groundwater in igneous, metamorphic and sedimentary rocks, Hydro geological regions of India, Surface and subsurface geophysical explorations, electrical resistivity, seismic refraction, gravity and magnetic methods, Various logging techniques.
5. Groundwater quality – measures, water samples, Pollutant transport in groundwater, chemical and transport processes, Modeling of pollutant transport in the unsaturated zone, Optimization models for management of groundwater quantity and quality, Sea water intrusion in coastal aquifers, Salinity Concepts of basin management, Groundwater basin investigations, Conjunctive use, Alternative basin yields
6. Groundwater modeling – Mathematical, analog and digital modeling, Analog – direct electric analogy, viscous flow analogy and other analogy, Application of finite difference and finite element methods for regional groundwater modeling.

References:

1. Waltin W.C "Groundwater Resources Evaluation", McGraw Hill Inc. N York
2. Todd D.K. "Groundwater hydrology", John Wiley&Sons, Singapore
3. Johnson E.E. "Groundwater", E. Johnson Inc. WashingtonS
4. Raghunath H.M. "Groundwater", Wiley Eastern Ltd, New Delhi
5. Bear J. "Hydraulics of groundwater", McGraw Hill
6. Davis S.N, De Weist R.J.M. "Hydrogeology", John Wiley & Sons, New York
7. Domenico "Concepts and Models I Groundwater hydrology", McGraw Hill NYork
8. Garg S.P. "Groundwater and Tube wells", Oxford and IBH Publishing Co. New Delhi

[EW(DE)-18002] Applications of Geoinformatics in Water Resources and Environmental Engineering

Teaching Scheme:
Lectures: 3 hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course outcomes:
The student should be able to:

1. Gain a sound fundamental understanding of the remote sensing, GIS, GPS technologies become familiar with the GIS-based analytical and problem-solving techniques
2. Understand the basic principles underlying the RS-GIS based modeling of the hydrological systems.
3. Apply the geo informatics tools for sustainable planning and management of water resources and environmental issues.

Syllabus contents:
Remote Sensing
Fundamental of Remote Sensing, History, Type of Remote Sensing, Remote Sensing platforms and sensors, Data acquisition through various platforms, Cameras and sensor parameters, Elements of satellite images, Concept of bands, pixel, digital number, metadata, Multispectral Remote Sensing, Multispectral image, False color composite, Interpretation of multispectral image, Combination of sensors, Image interpretation parameters, Examples of interpretation key such as color texture, pattern etc. Digital image processing Atmospheric, radiometric, geometric corrections, Histograms, Density slicing, Contrast stretching, Filtering, Principle component analysis, Ground truths.Introduction to GIS, Components of GIS, Hardware and software, GIS functionality, Data capture, management, analysis and visualization, Projections and geo referencing, Concepts of projections, Types of projections and their applications, Topological data model, TIN, spaghetti, polygon structure data models, Digitization, Applications of GIS. Introduction and overview of GPS, Fundamental concepts, Coordinates and reference systems, Components of GPS system, GPS for land navigation and survey reconnaissance, Static / Differential Positioning, Dynamic / Kinematic Positioning, GPS equipment, National GPS applications. Introduction to modelling, Modelling parameters, Mapping of water and environmental features, Watersheds, streams /drainage parameters, Estimation of morphological parameters, Patio-temporal rainfall runoff analysis, Soil and land use mapping, Terrain analysis for hydrological modelling, Flood estimation-SCS, Presentation of modelling results. Applications in water and environment, Agriculture, irrigation, drainage, water logging, salinity affected areas, Drought mitigation, reservoir sedimentation, Ground water, Disaster management-landslides, floods mitigation, Water quality monitoring for water bodies/rivers. Deforestation- deforestation trends detection, Forest fires. Familiarize ARC GIS software, Data pre-processing, Geo referencing, Data sources, input, scanning systems, On-screen digitization, Data editing, errors and quality control, Raster and vector, Data transformation, overlay analysis, Watershed delineation, Estimation of morphological parameters Rainfall –Runoff analysis, GIS Project.

References:

1. Geographic Information Systems and Environmental Modeling by Clarke, Keith C., Bradley O. Parks, and Michael P. Crane. Upper Saddle River, NJ: Prentice Hall, 2002.
2. Principles of Remote Sensing- Edition: ITC Educational Textbook Series 2, Publisher: ITC, nschede Editors: N. Kerle, L.L.F. Janssen, G.C. Huurneman

[DEC] Land and Water Management

Teaching Scheme:
Lectures: 3 hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course outcomes:

After the successful completion of the course student should able to:

1. Identify and implement suitable method of land and water management.
2. Design soil and water conservation structures.
3. Estimate water requirements of crops and decide suitable method of irrigation.
4. Carryout land suitability classification and suggest suitable methods of dry land farming.

Syllabus contents:

Basic concepts of soil erosion; control of soil erosion; Mechanics of wind and water erosion, water and wind erosion control practices; concept of runoff and its estimation, evapotranspiration, methods of evapotranspiration estimation, Design, construction and maintenance of vegetated waterways; Planning, Design, Construction and maintenance of terraces contours and bunds; irrigation and drainage systems for efficient soil and water conservation; cost analysis.Physics of surface irrigation; Design and evaluation procedure for border, check basin and furrow irrigation; Guidelines for operation and maintenance of surface irrigation methods. Description of Quick coupling, dragline and movable sprinkler irrigation systems and center Pivot system; Design installation, operation and maintenance of sprinkler irrigation systems; spray losses and drop size distribution in sprinkler irrigation systems and efficiency evaluation. Suitability of drip irrigation system under Indian conditions. Types of drip irrigation systems; Emitter types; Emitter construction; Discharge principles for emitters; Design of drip irrigation systems; water and salt distribution; Emitter clogging; water treatment; Automation; Field performance and evaluation. Irrigated crops- Irrigated agriculture in relation to crop production; irrigated crops around the world; Soil and climatic condition; selection of irrigation methods for irrigated field condition vegetable and fruit crops; Agronomical practices for major irrigated crops in India, Drainage requirement for irrigated crops, Economic analysis of major irrigated crops, field visit. Watershed Development and Management Concept of watershed development and management; collection of hydrological data; watershed characteristics and hydrologic cycle; problems of land degradation; Land use capability classification and topographical characteristics of watershed; Appropriate soil and water conservation measures for agricultural and non-agricultural lands; Grassland development and management, Legal aspects in water sharing and management – PC-CP - case studies. Techniques for dry land farming based on watershed characteristics; water harvesting techniques for hilly and arid regions; Hydrological and sediment monitoring of watershed; Estimation of peak design runoff rate; Planning, management and

economic evaluation of watershed development projects; case studies. Land suitability classification according to USBR; Land suitability categories according to FAO framework; Land evaluation; Mapping of degraded soil through soil survey; Land degradation in arid and semi-arid regions, Land degradation due to erosion, Land degradation management by conservation practices; Causes, reclamation and management of water logged and salt affected soils; Rehabilitation and management of ravine lands; Selection, Design and management of irrigation and drainage systems in wastelands; Economic evaluation of wasteland development projects.

References:

1. Chatterjee, S. N., Water Resources Conservation and Management, Atlantic Publishers, 2008
2. Murthy, V.V.N., Land and Water Management, Khalyani Publishers, 2004
3. Murthy, J. V. S., Watershed Management, New Age International Publishers, 1998
4. Suresh Rao, Soil and Water Conservation Practices, Standard Publishers, 1998
5. Majumdar, D.K., Irrigation Water Management, Prentice Hall of India, New Delhi, 2000
6. Michael, B.A.M., Irrigation, Vikas Publishing House Pvt. Ltd. New Delhi, 1990
7. Scwabe, G.O., Fangmeir, D.D., and Elliot W.J., Soil and Water Management Systems, John Wiley and Sons, N York, 1996
8. Asawa, G.L. (1996) —Irrigation Engineering ", New Age International Pub. Co. N Delhi.
9. Suresh, R.L. (1999) —Soil and Water Conservation Engineering ", Standard Publishing Co. Delhi.

[DE-I/II]Transport of Water and Wastewater

Teaching Scheme:
Lectures: 3 hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course outcomes:

At the end of the course, students will demonstrate the ability to

1. Design water storage and transmission system including pumping of water
2. Computer applications in distributions network analysis
3. Design of storm drains - storm water inlets.
4. Decide Maintenance requirements of sanitary sewerage and storm drainage systems.

Syllabus Contents:

Water Storage and Transmission - Storage requirements, impounding reservoirs, intakes, pressure conduits, Hydraulics, pumps and pumping units, Capacity and selection of water pumps, Economic design of pumps and economic design of gravity and pumping mains

Materials for pipes - Specification for pipes, pipe appurtenances, Types of loads and stresses, Water hammer - causes and prevention, control devices. Distribution Systems - Principles of design, Analysis of distribution networks, Hardy Cross, equivalent pipe and Newton Raphson methods, Computer applications in distributions network analysis, Optimal design of networks, Maintenance of distribution systems, Methods of control and prevention of corrosion, Storage, distribution and balancing reservoirs.

Sanitary Sewerage - Sanitation technology selection, sanitary sewage flow estimation, Sanitary sewer materials, Hydraulics of flow in sanitary sewers - partial flows, sewer design, sewer layouts, Concept of model-based design - hydraulic fundamentals of design models, Basic properties and model formulations for the design of wastewater of collection system, Transitions in flow of sewage. Storm Drainage - Basic philosophy in storm drainage, drainage layouts, Storm runoff estimation, Rainfall data analysis, Hydraulics of flow in storm water drains, Storm water drain materials and sections, Design of storm drains - storm water inlets. Maintenance requirements of sanitary sewerage and storm drainage systems, Manpower requirement, Equipment requirement, Preventive maintenance - monitoring safety requirements, Corrosion in sewers - prevention and control, Specific problems related to waste water pumping - pumping - pump selection - wastewater pumping networks

References:

1. Mohanty A.K. “Fluid Mechanics”, Prentice Hall of India, New Delhi
2. Tebutt T.H.Y. “Principles of Water Quality Control”, Pergamon Press, Oxford

[DEC] Principles of Water and Air Quality Legislation

Teaching Scheme:
Lectures: 4hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course outcomes:

At the end of the course, students will demonstrate the ability to

1. Know all the laws related to water
2. Determine pollution status of in river basin
3. Analyze quality of water through appropriate models

Syllabus Contents:

Water law – riparian rights, Groundwater ownership, Prior appropriation, Permit systems, acquisition and use of rights, Uncertainty concepts in Water Resources Planning - methods for uncertainty analysis and applications. Water quality monitoring, Water pollution, Sources of pollution, Nature of pollutants, Existing approaches of control/abatement of water quality degradation, Water quality monitoring in river basins Water quality modelling – Modelling and Monitoring, evolution of water quality models, types of water quality models, DO and BOD in streams, Transformation and transport processes, Oxygen transfer, Turbulent mixing, Non – Point source pollution, Modelling approaches for modelling non – point sources Water quality objectives and standards, Water quality control models, Flow augmentation, Waste water transport systems, River and lake water quality models, Groundwater quality models, Wastewater transport systems Water Quality Management in rivers, streams, and other water bodies. Water law – riparian rights, Groundwater ownership, Prior appropriation, Permit systems, acquisition and use of rights, Uncertainty concepts in Water Resources Planning - methods for uncertainty analysis and applications. Legal aspects of environment systems, Principles of law applied to water rights and water allocation, Environmental Protection Law, Water pollution control acts and legislation, Air pollution act, Legislation in India, Control Acts

References:

1. Tebutt T.H.Y. “Principles of Water Quality Control”, Pergamon Press, Oxford
2. Gerard Kiely “Environmental Engineering”, McGraw Hill Publications
3. Viessman W. Jr. and Hammer M.J. “Water supply and Pollution control”, Harper & Row Publications Inc., Singapore
4. Jerald L. Schnoor “Environmental Modelling – Fate and Transport of Pollutants in Water, Air and Soil”, John Wiley & Sons Inc. New York

[DEC] Ecology and Stream Sanitation

Teaching Scheme:
Lectures: 3 hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course outcomes:

At the end of the course, students will demonstrate the ability to

1. Understand ecological energy flows
2. Estimate Environmental effects of disposal, Non-point source pollution.
3. Understand Self-purification processes in stream and decide suitable methods to control.

Syllabus Contents:

Levels of organization in nature, Scope of Ecology, Structure of Ecosystem, Ecosystem function, Photosynthesis and Respiration, Gross and net primary production, Balance in nature. Earth’s energy budget, Ecosystem energy budget, Energy flows through ecosystem, Efficiencies of energy transfer in ecosystem, Pyramids, Food chains and food webs, Material cycles in ecosphere. Population, some general characteristics, Growth of population, Growth patterns, Dominance and stability, The Competitive Exclusion Pattern, Survivorship Curves 24 Hydro graphic Characteristics, Thermal classification of lakes, Stratification in shallow and deep lakes, Temperature cycles in lakes, Eutrophication, Effects and Control Water Quality and health, Disposal of waste water into inland, Environmental effects of disposal, Non-point source pollution. Transport phenomena - Mass transfer, Fick’s laws, Diffusion, Dispersion of pollutants in rivers and Estuaries. Self-purification processes in stream, Oxygen Budget of a river (Oxygenation - Deoxygenation), Aerobic and anaerobic conditions

References:

1. Peavy H.S., Rowe D.R. and Tchobanglous G. “Environmental Engineering”, McGraw Hills, New York
2. Welch E.D. “Ecological effects of waste water”, Cambridge University Press
3. Charles E. Kpelle and Margaret C. Hyland “Environmental Science”, Allyn and Baeon
4. Tebutt T.H.Y. “Principles of Water Quality Control”, Pergamon Press, Oxford

[EW(DE)-15002]Design of Reactors and Environmental Chemistry

Teaching Scheme:
Lectures: 3 hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course objective:
To evaluate the various treatment process and their application to varied condition in order to treat water and wastewater released from domestic, commercial as well as industrial sources.

Course outcomes:
At the end of the course, students will demonstrate the

1. Ability to overcome/minimize the river pollution problem
2. Ability to make decisions regarding the design of storm water line and sewer line
3. Ability to design the various primary waste water treatment units their effectiveness.
4. Ability to design the various aerobic secondary waste water treatment units their effectiveness
5. Ability to understand the various anaerobic secondary units their design criteria.
6. Ability to demonstrate a firm understanding of various emerging technologies for a wastewater treatment and their suitability and in order to provide an effective and efficient and economics; wastewater treatment process

Syllabus contents:
Fundamental of reaction kinetics, rate of reaction, order of reaction, effect of temperature on reaction. Types of reactors batch reactor plug flow reactor, continuous stirred tank reactor packed bed reactor, fluidized bed reactor. Mass balance principle, molar balance equation, Molar balance mass equation for batch reactor, plug flow reactor and continuous stirred tank reactor. Levee spiel plot, sizing of reactor. Analysis of non-ideal flow reactor using tracer, Need for tracer, Analysis of tracer response curve. Ideal plug flow reactor. Continuous stirred tank reactor connected in series, plug flow reactor connected in series. Review on basic concepts in chemistry, chemical thermodynamics, concepts of chemical equilibrium, equilibrium concept and activity, acid, base buffer, solubility product. Electro chemistry and electrochemical cell, Nuclear chemistry, Nernst equation, nitrogen fixation, Henry laws. Chemistry of process in the atmosphere, introduction to Langmuir and freundlitch adsorption isotherm separation factor criteria for the best fit of adsorption, isotherm models and electro coagulation.

References:

1. Octave Leve spiel, “Chemical Reaction Engineering” (3rdEdition),1999, John Wiley & Sons
2. Gilbert. Froment and Kenneth B. Bischoff, “Chemical Reactor Analysis and
3. Design” (2ndEdition),1990, John Wiley Sons H. Scott Fogler, “Elements of Chemical Reaction Engineering” (4thEdition), 2005, Prentice Hall
4. Metcalf and Eddy, “Wastewater Engineering: Treatment and Reuse” (4th Edition),2003, McGraw-Hill

LC: Lab Practice I

Teaching Scheme
Lab Practice: 2 hrs./week

Examination Scheme
End Sem Presentation :100 marks

Course outcomes: at the end of the course, students will demonstrate the ability to

1. Measure the flow through pipe and the calibration of hydraulic structures.
2. Perform the basic as well as advance tests on water and waste water.

Syllabus Contents:

Following experiments have to be performed

Sr. No	Name of Experiment
Part A- Water Resources Engineering	
1	Reynolds Experiment
2	Verification of Bernoulli's Equations
3	Calibration of Venturimeter
4	Calibration of Orifice Meter
5	Study of Uniform Flow of Open Channel
6	Calibration of Standing Wave Flume
7	Study of Hydraulic Jump
Part B- Environmental Engineering	
8	Determination of Sulphate by Gravimetric Method
9	Determination of MPN index (Statistical Method)
10	Determination of IRON by Spectrophotometer
11	Determination of Phosphate by Spectrophotometer
12	Study of Adsorption Column
13	Determination of Color by Colorimeter

[EW-15002]Seminar

Teaching Scheme:
Lectures: 2 hrs/Week

Examination Scheme
End- Sem Exam – 100 marks

Course outcomes:

At the end of the course, students will demonstrate the ability to

1. Identify a topic for study and carry out literature survey
2. Write a technical report related to selected topic
3. Present outcome of the study with the help of ppt.

Course content:

Seminar is to be performed and reported by the end of the first semester.

[EW-15008(PSMC)] STOCHASTIC HYDROLOGY

Teaching Scheme
Lectures: 3hrs/week
Tutorial: 1hr/week

Examination Scheme
T1, T2 – 20 marks each,
End-Sem Exam – 60

Course Outcomes:

1. Analyze hydrological and climatological data using advance statistical methods
2. Perform frequency analysis of extreme values of precipitation, floods, low flow
3. Generate data using various techniques.
4. Perform hypotheses testing, goodness-of-fit testing
5. Learn correlation and perform simple and multiple regression analysis.

Syllabus Contents:

Stochastic hydrology, Need for statistical methods in hydrology Probability axioms, Total probability theorem and Bayes theorem, Independence and independent events, Construction of probability paper, Probability plotting, Flood frequency analysis, Parameter estimation Nature of hydrologic data, Sampling errors, Graphical presentation of data, Random numbers, Discrete distribution, Binomial distribution, Poisson distribution, Continuous distributions used in hydrology, Normal distribution, Lognormal distribution, Exponential distributions, General extreme value distributions, Moments and expectations of distributions, Frequency analysis of hydrologic variables, Sampling distributions, Confidence interval estimation of population parameters, Hypothesis testing, Large sample tests for mean and proportion, Test for goodness of fit of data to probability distributions, Chi – square and K – S test, Curve fitting method of least squares, Regression analysis, Simple and multiple linear regression, Evaluation of regression, Multivariate regression analysis, Correlation coefficient and its significance in regional analysis, Hydrologic time series analysis – nature, Stationarity and ergodicity, Components of time series, Trend

and periodicity, Auto-variance and auto-correlation functions, Cross correlation, Correlogram analysis, Analysis of multivariate hydrologic series, Modelling of hydrologic time series, Data generation techniques, Autoregressive processes and models, Moving average models, ARMA models, Non – stationary models, Thomas – Fiering model, ARIMA models, Modeling the trend, Multi-site modeling, Disaggregation models.

References:

- Charles T. Haan "Statistical Methods in Hydrology", East West Publlishers
- Jayarami Reddy, " Stochastic Hydrology", Laxmi Publications, Second Edition
- Bowker and Liberman "Engineering statistics", Prentice – Hall
- Kottegoda N.T. "Stochastic Water Resources Technology", The Macmillan Press, New York
- Yevjevich V. "Probabilistic and Statistics in hydrology", Water Resources Publications, Colorado
- Yevjevich V. "Stochastic processes in hydrology", Water Resources Publications, Colorado
- McCueen R.H. and Snyder, W.M. "Hydrological Modeling – Statistical Methods &Applications", Prentice Hall Inc. New York

[EW-15007] Urban Hydrology and Drainage

Teaching Scheme:
Lectures: 3 hrs/Week
Tutorial: 1hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Identify factors affecting urban hydrological cycle
2. Flow Estimate urban water demand and urban stormwater quantity.
3. Plan and design stormwater control and disposal system.
4. Develop integrated urban water management system.

Syllabus Contents:

Introduction to urban system, functional elements of urban system, urbanisation effects on water cycle, trends in urbanization, hydrological problems, challenges and issues of urban area. Urban water resources management model, Type of models- Physically based-conceptual based –Urban surface runoff model. Rainfall analysis in urban environment, importance of short duration rainfall and runoff data, urban runoff computations- empirical, Time-area and Unit Hydrograph approaches, rational method, SCS peak flow method runoff modelling. Introduction to urban drainage and sewerage network, Storm water management, Storm Systems- information needs, design criteria, rational method design, hydraulic analysis and designs, Storm water drainage channels- rigid-lined channels, flexible lined channels, Storm water control: street and highway drainage- design considerations, flow in gutters. Storm Water Detention- types of surface detention sizing detention, detention basin routing, subsurface disposal of storm water and best management practices (BMP's). Operation and maintenance in urban

system. Introduction of standard packages such as SWMM, to solve urban storm drainage problems. Urban water supply: introduction, importance and necessity for planned water supplies, Estimates of demand, design period, population data and population growth. Types of water supply system, design of water distribution system, reservoir capacity estimation.

References:

1. Chow, V. T., Handbook of Applied Hydrology: A compendium of water technology, Mc, Hill, NY,1964
2. Hall, M. J., Urban Hydrology, Elsevier Applied Science Publishers, 1984
3. Larry W. Mays. "Water Resources Engineering", John Wiley & Sons, inc NY,
4. ISBN0-471-29783-6
5. Philip B. Bedient and Wayne C. Huber. "Hydrology and flood plain analysis", Addison- Wesley Publication Company, Inc ISBN 0-201-12056-9
6. P. R. Bhave. "Optimal Design of Water Distribution Networks" Narosa Publishing house. ISBN 81-7319-505-6
7. Warren Viessman, Jr. Gary L. Lewis. "Introduction to Hydrology" Eastern Economy Edition, PHI learning Pvt. Ltd. New Delhi. ISBN978-81-203-3368-0
8. Allen P. Davis and Richard H. Mc Cuen" Stormwater Management for Smart Growth", Springer, ISBN 10: 0-387-26048-X, ISBN-13: 9780387275932

[EW-15015] Environmental Impact Assessment

Teaching Scheme:
Lectures: 4 hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Understand the ecological stability and ecological systems concept and formulate the real problem due to manmade developmental activities
2. Select Environmental, Economic and social indicators, collect data and conduct analysis.
3. Select appropriate technique and methodology to carry out Environmental Impact Assessment.

Syllabus Contents:

Environment and its interaction with human activities – Environmental imbalances, attributes, impacts, Indicators and Measurements, Environmental Impact Assessment (EIA) – concepts, objectives of EIA, advantages and limitations of EIA, Screening and scooping, Rapid EIA and comprehensive EIA Environmental Indicators – Indicators of climate, Indicators of terrestrial subsystems, Indicators of aquatic subsystems, Selection of indicators, Socio – economic indicators – basic information, Indicators for economy – social indicators, Indicators for health and nutrition, Cultural indicators – selection Methodologies for carrying Environmental Impact Assessment – Overview of methodologies,

Environmental risk analysis - Adhoc, Checklist, Matrix, Network, Overlays, Fault free analysis, Benefit Cost Analysis, Choosing a methodology, Review criteria, Case studies on EIA Environmental issues in water resources development – Land use, soil erosion, their long term and short term effects, Disturbance and long term impacts, Changes in quantity and quality of flow, Environmental impact assessment of water resource development structures – Case studies

Water Quality Impact Assessment – attributes, Water Quality Impact Assessment of Water Resources Projects, Data requirements of water quality impact assessment for dams, Impacts of dams on environmental, Case studies Environmental Issues in Industrial Development – On-site and Off-site impacts during various stages of industrial development, Long term climatic changes, Greenhouse effect, Industrial effluents and their impact on natural cycle, Environmental impact of Highways, Mining and Energy development

[EW(DE)-18003] Irrigation and Drainage

Teaching Scheme
Lectures: 3hrs/week

Examination Scheme
100 marks: Continuous evaluation
Assignments /Quiz- 40 Marks
End - Sem Exam – 60 Marks

Course Outcomes:

After successful completion of the course, students will be able to:

1. Decide suitable method of irrigation
2. Design micro irrigation.
3. Compare and contrast suitable drainage and salinity control measures.
4. Design and management of drainage system.

Syllabus Contents:

Water Conveyance System: Canals, open channel, lined and unlined channels, canal losses, types of lining, and economics of lined channels. Cross drainage works, regulating structures, Types of cross drainage works, aqueduct, super passage, siphon, culverts etc. Layout and design concepts. Lift Irrigation: General concepts, Elements of lift irrigation system, Design considerations involved in Intake well, Jack well, rising main, and distribution system, Concepts and economics. Drip irrigation, General concept, Advantages, limitations, elements of drip irrigation system, design. Sprinkler irrigation, General concept, advantages and limitations, Components of the system, types of sprinklers, design concept. Drainage and Salinity Control: Factors to be considered in land drainage, combined irrigation and drainage system, water balance equation, drainage survey, effect of field drainage system on agriculture. Salinity in the relation to irrigation and drainage, salt balance of the root zone, Stalinization due to capillary rise, leaching process, reclamation of salt affected soil, bio-drainage. Design and management of drainage system, drainage materials, surface drainage system, their components and applications in sloping areas, subsurface drainage system, mole drainage, management and application of drainage system.

References:

1. Michael, BAIl. "Irrigation", Vikas Publishing House Pvt. Ltd. N Delhi.
2. Asawa, G.L. "Irrigation Engineering", New Age International Pub. Co. N Delhi.
3. 3. Michael A M “Irrigation -Theory and Practice” Vikas Publishing House Pvt. Ltd. N Delhi.2009
4. Murthy, V.V.N. (1999) “Land and Water Management Engineering”, Kalyani Publishers, Ludhiana.
5. Bhattacharya A.K. and Michael A.M. “Land Drainage Principles, Methods and Applications” Konark Publishers Pvt. Ltd, New Delhi, 2003

[DEC]Computational Fluid Dynamics

Teaching Scheme:
Lectures: 3 hrs/Week

Examination Scheme
T1, T2 – 20 marks each
End- Sem Exam – 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Know CFD as an engineering analysis tool.
2. Derive of flow governing equations; turbulence modeling; modeling approaches for multiphase flow; initial and boundaryconditions.
3. Discretize the governing equations using finite difference/volume/element methods; concepts of consistency, stability andconvergence; template for the discretization of a generic unsteady transport equation.
4. Find Solution of discretized equations; direct methods; classical iterative methods; advanced methods for structured matrices; conjugate gradient techniques; multi grid methods.
5. Find Solution of coupled equations: methods for compressible flows; evaluation of pressure in incompressible flows; pressure-velocity coupling algorithms.

Syllabus Contents:

Introduction to Computational Fluid Dynamics and Principles of Conservation: Continuity Equation, Navier Stokes Equation, Energy Equation and General Structure of Conservation Equations, Classification of Partial Differential Equations and Physical Behavior, Approximate Solutions of Differential Equations: Error Minimization Principles, Variation Principles and Weighted Residual Approach, Fundamentals of Discretization: Finite Element Method, Finite Difference and Finite Volume Method, Finite Volume Method: Some Conceptual Basics and Illustrations through 1-D Steady State Diffusion Problems, Boundary Condition Implementationand Discretization of Unsteady State Problems, Important Consequences of Discretization of Time Dependent Diffusion Type Problems and Stability Analysis : Consistency, Stability and Convergence, LAX Equivalence theorem, Grid independent and time independent study, Stability analysis of parabolic equations (1-D unsteady state diffusion problems): FTCS (Forward time central space) scheme, Stability analysis of parabolic equations (1-D unsteady state

diffusion problems): CTCS scheme (Leap frog scheme), Dufort-Frankel scheme, Stability analysis of hyperbolic equations: FTCS, FTFS, FTBS and CTCS Schemes, Finite Volume Discretization of 2-D unsteady State Diffusion type Problems, Solution of Systems of Linear Algebraic Equations: Elimination Methods, Iterative Methods, Gradient Search Methods, Discretization of Convection-Diffusion Equations: A Finite Volume Approach, Discretization of Navier Stokes Equations: Stream Function Vorticity approach and Primitive variable approach, SIMPLE Algorithm, SIMPLER Algorithm, Unstructured Grid Formulation, Introduction to Turbulence Modelling.

References Books:

1. Computational Fluid Dynamics by John D. Anderson.
1. Computational Fluid Flow and Heat Transfer by K. Murlidhar and T. Sundararajan. (The first few chapters are good for introductory approach of Finite volume method. 12th chapter which is about semi-explicit method is written by Prof. Atul Sharma, IITB)
2. Introduction to CFD by SuhasPatankar. (Good for Finite difference method).
3. An Introduction to Computational Fluid Dynamics by HK Versteeg and W Malalasekera.

[DEC] Water Resources System Planning and Management

Teaching Scheme

Lectures: 3hrs/week

Examination Scheme

100 marks: Continuous evaluation
Assignments /Quiz- 40 Marks
End - Sem Exam – 60 Marks

Course Outcome:

At the end of the course, students will demonstrate the ability to

1. Model of water resources systems, Constrained and unconstrained optimization, Linear Programming with applications to reservoir sizing, reservoir operation,
2. Form Dynamic Programming with applications to water allocation, capacity expansion, reservoir operation;
3. Perform Multi - objective optimization, Simulation.

Syllabus Contents:

Introduction, System Components, Planning and management, Economics in water resources, Modelling of water resources systems, Constrained and unconstrained optimization, Linear Programming with applications to reservoir sizing, reservoir operation, Dynamic Programming with applications to water allocation, capacity expansion, reservoir operation.

Multi - objective optimization, Review of probability theory, Uncertainty and reliability analysis, Stochastic optimization - Chance constrained LP, Stochastic DP with applications, Surface water quality control.

Simulation - Reliability, Resiliency and Vulnerability of water resource systems, Multipurpose reservoir operation for hydropower, flood control and irrigation, Groundwater Systems, Water quality modelling, River basin Planning and management, Advanced topics.

References:

1. Loucks D.P, Stedinger J.R and Haith D.A, 'Water Resources Systems Planning and Analysis', Prentice Hall, USA, 1981.
2. Mays L.W and Tung Y-K, 'Hydrosystems Engineering and Management', McGraw Hill, USA, 1992.
3. Vedula S. and Mujumdar P.P., 'Water Resources Systems: Modelling Techniques and Analysis', Tata-McGraw Hill, 2005.
4. Jain S.K. and Singh V.P., 'Water Resources Systems Planning and Management', Elsevier, The Netherlands, 2003.
5. Loucks D.P. and van Beek E., 'Water Resources Systems Planning and Management', UNESCO Publishing, The Netherlands, 2005.

[EW(DE)-17001] Integrated Water Resources Management (IWRM)

Teaching Scheme:
Lectures/Lab: 3 hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course Outcomes:

Students will be able to:

1. Understand and apply the concept of IWRM
2. Quantify various river basin parameters (physical, morphological, hydrological)
3. Schematize water infrastructure in the river basin.
4. Assess and quantify various sources of water supply (Rain, SW, GW)
5. Estimate various consumptive/ non-consumptive water demands
6. Develop integrated water resources management plan for the basin.

Course Content:

Introduction, A holistic examination of methods in river basin management vs traditional, fragmented sectoral approach, Hydrologic cycle, parameters, measurements, instrumentation, water assessment, surface and groundwater; water volume and water quality; supply and demand oriented actions; uses and users, consumptive and non-consumptive demands, competing and conflicting demands, Agriculture and PWS ; economic, social and environmental aspects; institutional and legal issues in water management, government and stakeholders actions; participatory management, modelling, planning, adaptive management, optimization through basin simulation, DSS for implementation.

Lab Work:

Software: Arc GIS- Basin map –registration, digitization, (point, line, polygon), attribute tables, layer generation (boundary, drainage, contour, DEM, hydro met network, water infrastructure, land use / land cover etc.), runoff estimation- Report preparation

Basin planning software: RIBASIM: Study basin, add basin, schematization, data entry, model runs, calibration, base case generation, perspective scenario development, simulation runs, model output results- DSS – Report preparation.

References:

1. Water Resources Systems Planning and Analysis', Loucks D.P, Stedinger J.R and Haith D.A, Prentice Hall, USA, 1981
2. 'Hydrosystems Engineering and Management', Mays L.W and Tung Y-K, McGraw Hill, USA, 1992.
3. 'Water Resources Systems Planning and Management', Loucks D.P. and van Beek E., UNESCO Publishing, The Netherlands, 2005.
4. Water Resources Systems: Modelling Techniques and Analysis', Vedula S. and Mujumdar P.P., Tata-McGraw Hill, 2005.

[EW(DE)-15010]Solid and Hazardous Waste Management

Teaching Scheme:
Lectures: 3 hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course outcomes

1. Ability to identify key sources, typical quantities generated, composition and properties of solid and hazardous waste;
2. Ability to identify transformation techniques and to estimate the typical disposal cost;
3. Ability to decide best alternative for handling solid and hazardous waste;
4. Ability to conduct invasive and non-invasive site investigation solid and hazardous waste disposal.
5. Ability to analyses the hazardous data related with health; and
6. Ability to understand the significance of recycling and reuse options of solid and hazardous waste

Course contents

Solid waste: Definition, types of solid waste, sources of solid waste, Physical and Chemical characteristics of solid waste, classification of hazardous waste, Sources, types and quantity of hazardous waste in MSW, significance of hazardous waste in MSW, Impact of solid waste and hazardous on health, air, water, soil, legislation, Collection of solid waste, Design of transfer station, waste allocation. Treatment of solid waste (Landfill method, incineration, composting), Site selection, Land filling including the area filling, trench filling and depression filling, Elements of closure plan of landfill, occurrence of gases and leachate in landfill, Control of landfill gases, Control and treatment of leachate, Environmental monitoring system, Revegetation on landfill, Factor affecting the growth of revegetation on landfill, Selection of site condition, Design of landfill, Leachate analysis, Introduction to physical/chemical/biological process of hazardous waste management, Onsite technologies for hazardous waste site cleanup, Ground water contamination, Storage tank, Oily waste and oil spills, Hazardous waste management guidelines, Waste minimization, Metal pollution, NOAEL, LOAEL, ADI, RFD, Hazard index, Daily intake, Ecotoxicoloty, Toxikinetics, Control of release of heavy metal.

References

1. A. Nag, K. Vizayakumar, “Environmental Education and Solid Waste Management” New Age International Publishers.
2. Donald R. Rowe, George Techobanoglous, Howard S. Peavy, “Environmental Engineering”, McGraw-Hill Book Company.
3. George Techobanoglous, Hilary Thesien, Samual Vigil, “Integrated Solid Waste Management-Engineering Principles and Management Issues” McGraw-Hill Inc.

[DE –I/II]Water and Air Quality Models

Teaching Scheme:
Lectures/Lab: 3 hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Design models for analyzing stream water quality and quantity
2. Develop air quality models under different atmospheric stability conditions
3. Design and analysis of Models for micro-organisms studies.

Course Content:

Physical Phenomena, Transport, Gas transfer, Thermal phenomena, Sedimentation, Chemical phenomena, Solution equilibriums, Reaction kinetics, Carbonate equilibriums, Colloidal behavior Biological phenomena, Organic materials, Growth kinetics, Biochemical oxygen demand, Aerobic and Anaerobic decomposition, Photosynthesis, Enzyme reactions Natural transport systems, Dissolved Oxygen system, D.O. Models for Streams - Dissolved oxygen model for streams - sources and sinks of dissolved oxygen, Estimation of system parameters, Streeter - Phelps model, Oxygen 'sag' curve, Determination of deoxygenating and re-aeration coefficients Bethnal oxygen demand - mass transport mechanisms, Advective and diffusive mass transport - Models by O’Connor, Dobbins and Thomann. Streams, Estuaries, Transport in the Air environment Models for Estuary and Lakes - Physical chemical and biological processes in estuaries, Water quality distribution in estuaries - dispersion coefficient, Modelling estuaries and lakes for water quality, Temperature models for lakes and rivers, Microbiology and Ecology, Types of microorganisms, Models for microorganisms decay, nitrogen and phytoplankton, Metabolism, Ecological Principles, Food chains, Food webs, Ecological pyramids, Pesticide concentration, Eutrophication, Population Growth models . Air quality models - Micrometeorological processes, wind rose, dispersion, coefficients and stability classes, Gaussian and dispersion model, Stack height computation, Regional air quality models, Source inventories and significance.

References:

1. Rich L.G. “Environmental Systems Engineering”, McGraw Hill Inc.
2. Sincero A.P., Sincero G.A. “Environmental Engineering – A Design Approach”, Prentice Hall of India, New Delhi

3. Gerard Kiely “Environmental Engineering”, McGraw Hill Publications
4. Peavy H.S., Rowe D.R., Tchobanglous G., “Environmental Engineering”, McGraw Hills, New York
5. Jerald L. Schnoor “Environmental Modelling – Fate and Transport of Pollutants in Water, Air and Soil”, John Wiley & Sons Inc. New York
6. Gillbert M. Masters “Introduction to Environmental Engineering and Science”, Prentice Hall

[DEC] Industrial Wastewater Management

Teaching Scheme:
Lectures: 4 hrs/Week

Examination Scheme
T1, T2 – 20 marks each,
End- Sem Exam – 60 marks

Course outcomes: At the end of the course, students will demonstrate the ability to

1. Identify key sources, typical quantities generated, composition, and properties of industrial wastes.
2. Identify waste disposal or transformation techniques (landfills and incinerators).
3. Recognize the relevant regulations that apply for facilities used for disposal, and destruction of waste.
4. Conduct invasive and non-invasive site investigation and understand permitting process for constructing landfills.
5. Estimate typical waste disposal costs.

Course content:

Sources of Pollution: Physical, Chemical, Organic and Biological properties of Industrial Wastes – Differences between industrial and municipal waste waters –Effects of industrial effluents on sewers and treatment plants.

Pre and Primary Treatment: Equalization, Proportioning, Neutralization, Oil Separation by Floatation – Waste Reduction - Volume Reduction – Strength Reduction. Waste Water Treatment Methods: Nitrification and De-nitrification – Phosphorous removal – Heavy metal removal – Membrane Separation Process – Air Stripping and Absorption Processes – Special Treatment Methods – Disposal of Treated Waste. Manufacturing process and sources of effluent from the process of industries like chemical, fertilizer, petroleum, petro -chemical, paper, sugar, distillery, textile, tannery food processing, dairy and steel manufacturing .Characteristics and composition of effluent and different methods of treatment & disposal of effluent for the following industries: Steel, Petroleum Refineries, Textiles, Tanneries, Atomic Energy Plants and other Mineral Processing Industries. Common Effluent Treatment Plants (CETPs): Location, Need, Design, Operation & Maintenance Problems and Economical aspects.

Reference Books

1. W. Wesley Eckenfelder Jr., Industrial Waste Water Pollution Control.
2. Arceivala, S. J., Wastewater Treatment for Pollution Control, McGraw-Hill, 1998. 21
3. Frank Woodard, Industrial waste treatment Handbook, Butterworth Heinemann, New Delhi, 2001.
4. M. N. Rao & Datta, Waste water treatment.

5. N. L. Nemerow, Liquid waste of Industry, Addison Wesely. 1996
6. Callegly, Forster and Stafferd, Treatment of Industrial Effluent, Hodder and Stonghton. 1988
7. Hardam S. Azad, (ED), Industrial Wastewater Management Hand Book 1988.
8. Indian standards: IS: 2490 (1963), IS: 3306 (1065).

[EW(DE)-18004] Decentralized Waste Water Management

Teaching Scheme
Lectures: 3hrs/week

Examination Scheme
100 marks: Continuous evaluation
Assignments /Quiz- 40 Marks
End - Sem Exam – 60 Marks

Course Outcomes:

1. Students will be able to learn sanitation practices.
2. Students will be able to understand ecological sanitation.
3. Students will be able to suggest suitable decentralized waste water treatment process based on characteristics of waste water.

Syllabus Contents:

Importance and Need for Better Sanitation Practices, Classification of Toilets and Sanitation, Ecological Sanitation. Types of wastewater, production, quality and quantity of wastewater, discharge of wastewater, types of sewerage systems (separate and single), Rain water harvesting. Technology Options for Sanitation and Liquid Waste Management, Pre-treatment of wastewater, Extensive biological, Types of Sewer Systems for Wastewater Conveyance, Decentralized Wastewater Treatment System. Technology Options for Wastewater Recycling and Its Disposal/Reuse, Soil filters, constructed wetlands, biological ponds, aquacultures, Intensive biological wastewater treatment systems, activated sludge systems, bio discs, bio filters, Sludge treatment. Financial and social considerations about decentralized wastewater management, Legislative requirements for small wastewater systems.

References:

1. Water Technology, N. F. Gray, Butterworth-Heinemann 2002
2. Environmental Engineering - II. P. Venugopala Rao Tata McGraw Hill Publication, 2003
3. Water and Wastewater Technology, Hammer and Hammer, Prentice Hall Publication, 2008
4. Wastewater Treatment for Pollution Control, by Soli J. Arceivala, Tata McGraw Hill Publication, third edition, 2007

[LC] LAB PRACTICE II

Teaching Scheme:
Lectures: 2 hrs/Week

Examination Scheme
End- Sem Presentation – 100 marks

Course outcomes:

At the end of the course, students will demonstrate the ability to

1. Use software's related to environment and water resources
2. Apply software for solution of problems
3. Prepare models based on software

Syllabus Contents:

Following experiments must be performed in Computer lab using software packages such as HEC-1, HEC-2, EPANET, SWMM, MODFLOW, QUAL2EU

1. Watershed Simulation Flood Control
2. Optimization Design of water distribution system
3. Storm drainage design
4. Detention basin design
5. Water quality modelling in rivers
6. Groundwater flow simulations.

References:

1. Jain R.K., Urban L.V. and Stracy G.S. "Environmental Impact Analysis", Van Nostrand Reinhold Co. New York
2. Rau J.G. and Wooten D.C. "Environmental Impact Assessment", McGraw Hill Publications Co. New York
3. UNESCO "Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development", WNESCO/UNEP, Paris
4. Canter L.W. "Environmental Impact Assessment", McGraw Hill Pub. Co. New York

[LC]Mini Project

Teaching Scheme:
Lectures: 2 hrs/Week

Examination Scheme
End- Sem Presentation – 100 marks

Course outcomes:

At the end of the course, students will demonstrate the ability to

1. Identify a topic for study and carry out literature survey
2. Write a technical report related to selected topic
3. Present outcome of the study with the help of ppt.

Course content:

Mini project presentation is to be performed and reported by the end of the second semester

[MLC ML-602]Intellectual Property Right

Teaching Scheme:
Lectures: 1 hrs/Week

Examination Scheme
End- Sem Exam – 50 marks

Course Outcomes:

After learning this course students will be able to

1. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
2. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general & engineering.
3. Understand how IP is an important element of the institutional fabric of an efficiently organized society.
4. Understand that Intellectual property is about preserving the differences between competitors.
5. Understand that Intellectual property right (IPR) is an attempt to safeguard the rights of original contributor of ideas, concept, and creativity of individuals.
6. Understand that how at present, IPR are regarded as a source of national wealth and mark of an economic leadership in the context of global market scenario.
7. Understand the national IP system.
8. Got familiarized with the origins and the development of the international framework of IP
9. Created internal vigilance and enlightenment among students to generate new ideas.
10. Makes students understand that things are dynamic and more complex than they appear which reinforces the motivation of the students to learn
11. Students find answers to many of the whys and why nots.
12. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.
13. As such the importance to emphasize the need of awareness and knowledge. about IPR in engineering students, who are tomorrow's technocrats and creator of new technology.

Syllabus Contents:

1. Introduction: Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.
2. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.
3. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
4. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.
5. Registered and unregistered trademarks, design, concept, idea patenting

Reference:

1. Industrial Design by Mayall, Mc Graw Hill
2. Resisting Intellectual Property by Halbert, Taylor& Francis Ltd,2007

3. Product Design by Niebel, Mc Graw Hill
4. Introduction to Design by Asimov, Prentice Hall
5. Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell, Mark A. Lemley
6. Intellectual Property Rights under WTO by T. Ramappa, S. Chand.

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[EW-16006]Dissertation Phase -I

Teaching Scheme:

Examination Scheme

End- Sem Presentation – 100 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Carry out exhaustive literature survey.
2. Formulate the research problem and methodology.
3. Develop/fabricate experimental set-up (if required) or collect data required
4. Study software required for the research.

The Project work will start in semester III, and should involve scientific research, design, collection and analysis of data, determining solutions and must bring out the individual's contribution. Dissertation-I will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted.

[EW-16001]Economics, Planning and Management of Systems

Teaching Scheme:

Lectures: 3hrs/Week

Tutorial: 1hr/week

Examination Scheme

T1, T2 – 20 marks each,

End- Sem Exam – 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. learn various economic concepts and apply in Water resources planning and management.
2. Determine benefits due to irrigation, flood control, Hydropower, recreation and sedimentation control.
3. Plan and operate reservoir for irrigation, hydropower, flood control and water supply.
4. Select the most economical option from various alternatives available.

Syllabus Contents:

General principles of systems analysis to problems in Water and Environment, Objectives of water resources planning and development, Socio – Economic characteristics, Data requirements and survey - topographical, geological, hydrological, socioeconomic, technological, Market survey, Identification of alternate options, Project feasibility , Demand assessment - planning period and time horizon, Economic-demographic projections, Integrated and disaggregated analysis and model building, Demand resilience and consumer behavior, Basic economic concepts - present worth, future worth, annuities, discounting techniques, depreciation, Production function and cost curves - components of cost curves, long term and short term, Tangible and intangible values, Indifference curves, Economic analysis - Principles of engineering economics and mathematics of economic analysis, price theory and resource allocation, conditions of project optimality, Benefit – cost analysis of projects, Dynamics of project analysis Principles, Water pricing and water allocation, Principles of planning and financing water resources projects, Pricing concepts - oligopolies, Kinked demand curve model, Skimming price and penetration price, Economics of natural resources management, Financial analysis, Economic and financial models, Risk considerations, Capital budgeting and cost allocation. Water quantity management – Surface water storage requirements, Storage capacity and yield, Reservoir design, Reservoir planning for water supply, irrigation, hydropower and flood control, Planning of an irrigation system, Irrigation scheduling, Economic planning for irrigation, flood control, drainage, water supply, hydroelectric power, navigation and environmental conservation projects, Environmental constraints on Water Resources development, Elements of financial analysis - financial feasibility, Cost allocation in multipurpose projects, Costing of environmental impact, Welfare and environmental economics

References:

1. Loucks D.P., Stedinger J.R. and Haith D.A. “Water Resources Systems Planning and Analysis”, Prentice Hall Inc. New York
2. Chaturvedi M.C. “Water Resources Systems Planning and Management”, Tata McGraw Hill Publication Co., New Delhi
3. Hall W.A. and Dracup J.A. “Water Resources Systems”, Tata McGraw Hill Publication Co., New Delhi
4. James L.D. and Lee “Economics of Water Resources Planning”, McGraw Hill Publication Co., New York
5. Kuiper E. “Water Resources Development, Planning, Engineering and Economics”, Buttersworth, London
6. Biswas A.K. “Systems Approach to Water Management”, McGraw Hill Publication Co., New York
7. Major D.C. and Lenton R.L. “Applied Water Resources System Planning”, Prentice – Hall Inc. New Jersy

[EW-16007]Dissertation Phase -II

Teaching Scheme:

Examination Scheme

End- Sem Presentation – 100 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. analyze experimental data / computational work.
2. Analyze the results as decided in the formulation of the research problem.
3. develop competency to work on professional field.

Dissertation – II will be related to work on the topic identified in Dissertation – I. Mid semester presentation, Continuous assessment. There will be pre submission seminar at the end of academic term. After the approval the student has to submit the detail report. Continuous assessment of Dissertation – I and Dissertation – II will be monitored by the departmental committee.

Annexure I

Sample list of Professional Science/Elective courses offered by various departments

Branch Name	Subject Name
Civil Engineering (Construction and Management)	Environmental Impact Assessment
Civil Engineering (Environmental and Water)	Numerical Method
Civil Engineering (Geotechnical Engineering)	Advanced Mathematical Methods
Civil Engineering	Introduction to Coastal Engineering
Civil Engineering	Fortran Programmeming for Engineering Application
Civil Engineering	Housing and Social aspects of planning
Computer/ Information Technology	Financial Computing
Electrical Engineering (Control System)	Matrix and linear Algebra
Electrical Engineering (Power System)	Wind and Solar Energy
Electrical Engineering (Power System)	Engineering Optimization
Electrical Engineering (Power System)	Linear Systems Theory and Design
Electrical Engineering	Industrial Motion Control
Electronics and Telecommunications (Signal Processing)	Mobile Communication
Electronics and Telecommunications	Applied Statistical Physics
Electronics and Telecommunications(VLSI and Embedded)	Image processing and analysis
Electronics and Telecommunications	Artificial Intelligence
Mechanical Engineering	Finite Element and Boundary Element Methods
Mechanical Engineering	Energy Conservation and Management
Mechanical Engineering	Operation Research
Mechanical Engineering	Introduction to Nuclear Energy
Metallurgical Engineering (Physical/Process)	Electronics and Magnetic Materials
Metallurgical Engineering (Physical/Process)	Thermomechanical Processing of Metals
Metallurgical Engineering	Nanotechnology
Town and Country Planning	Quantitative Techniques
Production Engineering (Manufacturing Engineering and Automation)	Microcontroller and Applications
Production Engineering (Manufacturing Engineering and Automation)	Reliability Engineering

Production	Robot Dynamics and Analysis
Production	Commercial Law
Project Management	Project Planning and Control
Applied Physics	Laser Technology
Mathematics	Complex Analysis
Mathematics	Advanced Mathematical Methods (for all except Mech. and Instru.)
Mathematics	Advanced Mathematics
Mathematics	Engineering Mathematics for Problem Solving
Mathematics	Linear Algebra

Annexure-II:

Sample list of Liberal Learning courses offered at Institute level

Course Outcome:

Student will be able to choose and enhance practical learning and application in the subject of his/her choice.

One credit course spread over the semester to enhance practical learning and application

1. **Agriculture (**Landscaping, Farming, etc.**)**
2. **Business (**Management, Entrepreneurship, etc.**)**
3. **Defense (**Study about functioning of Armed Forces**)**
4. **Education (**Education system, Policies, Importance, etc.**)**
5. **Fine Arts (**Painting, Sculpting, Sketching, etc.**)**
6. **Linguistics**
7. **Medicine and Health (**Diseases, Remedies, Nutrition, Dietetics, etc.**)**
8. **Performing Arts (**Music, Dance, Instruments, Drama, etc.**)**
9. **Philosophy**
10. **Social Sciences (**History, Political Sc., Archeology, Geography, Civics, Economics, etc.**)**