Department of Civil Engineering
M TECH IN WATER RESOURCES ENGINEERING
Teaching Scheme (2011 onwards)

1. FIRST SEMESTER

S.No.	Couse No.	Course Title	L	T	P	C
1.	CE-600	Advanced Hydrology	3	0	0	3
2	CE-601	Free Surface Flow	3	0	0	3
3	CE-602	Advanced Fluid Mechanics	3	0	0	3
4		Programme Elective-1	3	0	0	3
5		Programme Elective-2	3	0	0	3
6	CE-603	Hydraulics Lab - I	0	0	3	2
Sub Total			15	0	3	**17**

2. SECOND SEMESTER

S.No.	Course No.	Course Title	L	T	P	C
1.	CE-604	Water Resources Planning & Management	3	0	0	3
2	CE-605	Groundwater Engineering	3	0	0	3
3	CE-606	River Mechanics and Sediment Transport	3	0	0	3
4		Programme Elective-3	3	0	0	3
5		Open Elective-1 (from other Dept)	3	0	0	3
6	CE-607	Hydraulics Lab - II	0	0	3	2
Sub Total			15	0	3	**17**

3. THIRD SEMESTER

S.No.	Course No.	Course Title	L	T	P	Hours	Credits
1.	CE-799	Self Study	0	0	0	3	2
1.	CE-800	Seminar	0	0	0	3	2
2.	CE-801	Dissertation	0	0	0	24	12
Sub Total							**16**

4. FOURTH SEMESTER

S. No.	Course No.	Course Title	L	T	P	Hours	Credits
1.	CE-801	Dissertation (Con. from 3rd sem)	0	0	0	40	20
Sub Total							**20**
Total							**70**

PROGRAMME ELECTIVE COURSES

	Course No	Course Title	L	T	P	C
Common for all stream	CE-701	Fuzzy logic, artificial intelligence and neural network	3	0	0	3
	CE-702	Optimization Methods	3	0	0	3
	CE-703	Construction planning and scheduling	3	0	0	3
	CE-704	GIS and its application in civil engineering	3	0	0	3
	CE-705	Finite Element Method	3	0	0	3
WATER RESOURCE ENGINEERING	CE-706	Hydro Power Engineering	3	0	0	3
	CE-707	Environmental Impact Assessment	3	0	0	3
	CE-708	Computational Techniques in Water Resources	3	0	0	3
	CE-709	Soil Water Conservation	3	0	0	3
	CE-710	Watershed Management	3	0	0	3
	CE-711	Climate Change and Water	3	0	0	3
	CE-712	Modelling of Ground Water Flow and Transport	3	0	0	3
OPEN ELECTIVES FOR OTHER DEPARTMENT						
CE-751		Climate Change and Water	3	0	0	3
CE-752		Environmental Impact Assessment	3	0	0	3

DETAILED SYLLABUS

CE-600 Advanced Hydrology 3+0+0

Advanced study and analysis of the basic processes of hydrology of watershed including the theory, measurement and application of mathematical, statistical and graphical techniques associated with each of phenomena; Runoff hydrographs and unit Hydrographs for complex storms; synthetic and instantaneous hydrographs; flood routing; prediction of peak flow and snowmelt; yields from basins; instrumentation in hydrometeorology.

CE-601 Free Surface Flow 3+0+0

Surface water flows and their properties; Energy and momentum principles; critical flow computations and applications; Uniform flow-its development, formula and design computation; Boundary layer concept; Surface roughness, velocity distribution and instability of uniform flow; gradually varied flow theory and analysis; method of computations; practical problems; spatially varied flow; rapidly varied flow; Unsteady flow gradually varied and rapidly varied flow.

CE- 602 Advanced Fluid Mechanics 3+0+0

CONSERVATION EQUATION OF FLUID FLOW: Conservation of mass, conservation of momentum – stress and strain in fluid flow and their relations ip, conservation of energy, work done due to viscous stress. Navier stokes equations. Three dimensional continuity equation in Cartesian, cylindrical and spherical coordinates. **LAMINAR FLOW OF VISCOUS INCOMPRESSIBLE FLUIDS**: Flow between parallel flat plates, couette flow, plane Poiseuille flow, flow between two co-axial cylinders, flow between two concentric rotating cylinders, unsteady motion of flat plates.

BOUNDARY LAYER THEORY: Boundary layer equation, Blasius solution, shear stress and boundary layer thickness, boundary layer on a surface with pressure gradient, momentum integral theorem for boundary layer, separation and its prevention by boundary layer suction.

TURBULENCE: Concept of linearized stability of parallel viscous flow, transition to turbulent flow, Reynolds equation for turbulent flow, Reynolds stresses, Prandtl's mixing length theory, velocity profile, turbulent flow in pipes, turbulent boundary layer on flat ptate.

INVISCID FLOW: Elementary plane flow solutions, uniform stream, source or sink, vortex. Superposition of plane low solutions, flow over wedge and circular cylinder.

CE-603 Hydraulics lab – I 0+0+3

CE-604 Water Resources Planning and Management 3+0+0

Historical profile on world water resources development, global water resources, hydrologic cycle, watershed, zoning, watershed management, interrelation of water resources with other natural resources and the environment, concept of sustainable water resources development. Water quality and water pollution, water quantity and water budget. Concept of Integrated Water Resources Management (IWRM). Water allocation and water scheduling problem. Techniques for Water Analyses; rainfall analysis, soil water content analysis, evaporation, transpiration and evapotranspiration, flood measurement, flood frequency analysis, runoff analysis, rainfall-runoff analysis, design of flood peak, rational formula, Snyder 's method, reservoir operation study, **Water balance study;** water demand and uses, water supply.

Irrigation water requirement; principle of irrigation, evapotranspiration, crop coefficient, potential evapotranspiration, effective rainfall, **Environmental discourse on dam**

Construction; concept of EIA study to water resource development **Planning and Design of Distribution System** water resource planning, planning concept: preliminary study, feasibility study, detailed planning, water duty, canal design. **Global Efforts;** Think Globally: Act Locally on water resources, Local water organizations; WUGs, WUAs, World water organizations; UN, WWP, WWC, etc.

CE-605 Groundwater Engineering 3+0+0

Hydrologic and Engineering considerations of ground water developments; properties affecting storage and movement; Ground water exploration; Well logging and analysis; Theory of ground water movement; Well hydraulics; well design; Well drilling and construction methods; Selection and installation of well screens; Well point systems: Developing and completing wells; Maintaining well yields; Well corrosion; Salt water encroachment; Artificial recharge and conservation of ground water; Model studies.

CE-606 River Mechanics and Sediment Transport 3+0+0

Sediment Properties; Threshold of particle transport, critical velocity and critical shear stress concepts; Sediment movement in water, bed forms; Channel roughness and resistance to flow; Sediment Load- Different models, Bed load formula of DU Boys, Shields, Meyer Peter, Einstein bed load function, Yalin's formula, Paintals's stochastic approach; Suspended load, diffusion theory; Total sediment load by Kalinake; Design of stable channel, Tractive force method of stable channel design; Erosion, deposition, scour, local scour problems; Principles of transport of solids in pipes; Principles of movement of sediment by waves tides and currents. Latest models in sediment load assessment.

CE-607 Hydraulics Lab – II 0+0+3

CE-701 Fuzzy Logic, Artificial Intelligence and Neural Network 3+0+0

Introduction- Classification of artificial intelligence-expert systems-artificial neural networks-basic concepts-uses in functional approximation and optimization-applications in the design and analysis, building construction.

Fuzzy logic-basic concepts-problem formulation using fuzzy logic-applications

Texts/References

1. D.E. Rumelhart, J.L. McClelland, Parallel distributed processing Vol 1, M I T Press England 1986.
2. Fuzzy logic implementation and applications, M.J. patyra, Mlynek, Wiley Teubner 1996.

CE-702 Optimization Methods 3+0+0

Basics of engineering analysis and design, Need for optimal design, formulation of optimal design problems, basic difficulties associated with solution of optimal problems, Classical optimization methods, Necessary and sufficient optimality criteria for unconstrained and constrained problems, Kuhn-Tucker conditions, Global optimality and convex analysis, Linear optimal problems, Simplex method, Introduction to Karmarkar's algorithm. Numerical methods for nonlinear unconstrained and constrained problems, sensitivity analysis, Linear post optimal analysis, sensitivity analysis of discrete and distributed systems. Introduction to variational methods of sensitivity analysis., shape sensitivity, Introduction to integer programming, dynamic programming, stochastic programming and geometric programming, Introduction to genetic algorithm and simulated annealing.

Text/References

1. Kalyanmov Deb, Optimization for engineering design: Algorithms and examples, PHI Pvt Ltd, 1998.
2. J.S. Arora. Introduction to optimum design, McGraw Hill International editions 1989.
3. R.T. Hafta and Z. Gurdal, Elements of structural optimization, third revised and expanded edition. Kluwer academic publishers 1996.

CE-703 Construction Planning And Scheduling 3+0+0

Construction Planning: Objectives and functions, stages in construction, work breakdown structure, pre-tender stage planning, contract stage planning, methods of scheduling, bar charts, limitations of bar charts, milestone charts, preparation of material, equipment, labour, and finance schedule.

Critical Path Method (CPM): Network techniques, element of a network, rules for developing networks, development logics, numbering events, time computations, activity floats, network updating. Resources profile, resources smoothing and resources leveling. Cost versus time, direct cost, indirect cost, total project cost, optimum duration, contracting network for cost optimization.

Programme Evaluation and Review Technique (PERT): Probability concept in network, optimistic time, pessimistic time, most likely time, variance, standard deviation, slack, central limit theorem. probability of achieving completion time.

Precedence Diagram Method (PDM): Precedence networks fundamentals, advantages, logic and precedence networks applications, PDM versus CPM.

Line of Balancing (LOB) technique in the construction scheduling: Line of balance methods of scheduling repetitive construction.

Books

- Chitkara, K.K. "Construction Project Management, Planning scheduling and controlling."
- Moder J.J. Philips, C.R. and Davis, E.W. "Project Management with CPM and PERT, and precedence diagramming"
- Pilcher, R. "Project Cost Control in Construction",
- Brien J.J. CPM in "Construction Management", Mc. Graw Hill

CE-704 GIS And Its Application In Civil Engineering 3+0+0

Basics of remote sensing: Introduction to Remote Sensing, data acquisition and processing, sensor systems, Electromagnetic Radiation (EMR) and its characteristics, Radiation principles, prosperities of solar radiant energy, atmospheric windows. Interaction in the atmosphere, nature of atmospheric interaction, atmospheric effects of visible, near infra-red thermal and microwave wavelengths, interaction at ground surface, interaction with soils and rocks, effects of soil moisture, organic matter, particles, size and texture, interaction with vegetation, spectral characteristics of individual leaf, vegetation canopies, effect of leaf pigments, radiation geometry.

Introduction with GIS: Def. of GIS, Difference between GIS and CAD worlds, utility of GIS, various GIS packages and their salient features, essential components of a GIS, scanners and digitizers.

Map projection and coordinate systems: Introduction, geographic Grid, Map projection, Coordinate systems.

Vector data models and Analysis: vector data and its representation, topological data structure, non topological vector data structure, TIN, Region, vector data editing and analysis.

Raster data models and Analysis: acquiring and handling of raster data storage, function of raster based GIS data analysis.

Engineering applications of GIS: applications of GIS in civil engineering.

Books

- Remote Sensing and Image Interpretation : T.M. Lillensand and R.W. Keifer
- Principles of Remote Sensing : P.J. Curren
- Concept and Techniques of Geographical Information systems : C.P. Lo and albert K.W.Yeung

- Introduction to Geographical Information systems : Kang-tsung Chang
- Geographical Information systems- A Management Perspective : Stan Aromoff

CE-705 Finite element analysis 3+0+0

Principles of discretization, element stiffness and mass formulation based on direct, variational and weighted residual techniques and displacements approach, Shape functions and numerical integrations, convergence, Displacement formulation for rectangular, triangular and isoparametric elements for two dimensional and axisymetric stress analysis. Thin and thick plates and shells. Semi-analytical formulations, Three dimensional elements and degenerated forms. Stiffner elements and modifications such as use of different coordinate systems, use of non-conforming modes and penalty functions. FEM in incompressible and compressible fluid, applications of FEM in thermal problems.

Texts/ References

1. O.C. Zienkiewicz and R.L. Taylor, Finite element methods, Vol I & Vol II, McGraw Hill, 1989, 1992.
2. K. J. Bathe, Finite element procedures, PHI Ltd 1996.
3. R.D. Cook, D.S. Malkus and M.E. Plesha, Concepts and applications of finite element analysis, Third edition, John Wiley and Sons, 1989.

CE-706 Hydro Power Engineering 3+0+0

Planning of Hydropower development; Hydropower potential; Operation of power plants for peak and base load; Characteristics of power market; Integration of various types of plants; Augmentation of power plants; Different types of hydro power plants; Small hydro power plants; Flow duration curve and its characteristics; Classification of modern turbines, efficiency, speed regulation, governors, coupling of turbines and generators. Types of power houses; Silting of reservoir, dead storage and useful life, rate of sedimentation, distribution of reservoir deposits, silt control. Surge tanks and hydraulic transients; Penstocks and pressure shafts; Intakes; Reservoir operation for hydropower generation in multipurpose projects; Basin scale hydropower development; Mathematical models for reservoir sizing and operation.

CE-707 Environmental Impacts Assessment 3+0+0

Environmental properties and processes; Environmental simulation models; Elements of Environmental Impact analysis; Impact assessment methodologies; framework of Environmental assessment; Environmental Impacts of water resources projects; Assessment of Hydrological Hazards; Environmental management; Use of remote sensing and GIS in environmental impact assessment; Case studies.

CE-708 Computational Techniques in Water Resources 3+0+0

Objective functions: Deterministic and stochastic inputs: Linear programming: non-linear programming: geometric programming: dynamic programming: network flow algorithm and goal programming with optimal development of water surface and ground water: optimization by simulation; introduction to modern heuristic methods like genetic algorithm and simulated annealing.

CE-709 Soil Water Conservation 3+0+0

The need of conserve soil and water Resources; A brief history of Conservation; Fundamentals of Hydrology; Water Measurement; Erosion by water; The Universal soil loss equation; Upland Water erosion control; Channel Flow and Erosion Control; Channel Flow and Erosion Control; sediment and Erosion Control in Forestry and Logging; Reclamation of surface Mined Land and Construction sites; Wind Erosion; Sedimentation; Water Pollution from Sediment; Nutrients, and Pesticides; Land use Planning and Land Management; Conservation and management of water Resources; Wetlands; Wetlands Delineation and Protection.

CE-710 Watershed Management 3+0+0

Concept of watershed development, objectives of watershed development, need for watershed development in India, Integrated and multidisciplinary approach for watershed management.

CHARACTERISTICS OF WATERSHED: size, shape, physiography, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology, socio-economic characteristics, basic data on watersheds.

PRINCIPLES OF EROSION: Types of erosion, factors affecting erosion, effects of erosion on land fertility and land capability, estimation of soil loss due to erosion, Universal soil loss equation.

MEASURES TO CONTROL EROSION: Contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control, rockfill dams, brushwood dam, Gabion.

WATER HARVESTING: Rainwater Harvesting, catchment harvesting, harvesting structures, soil moisture conservation, check dams, artificial recharge, farm ponds, percolation tanks.

LAND MANAGEMENT: Land use and Land capability classification, management of forest, agricultural, grassland and wild land. Reclamation of saline and alkaline soils.

ECOSYSTEM MANAGEMENT: Role of Ecosystem, crop husbandry, soil enrichment, inter, mixed and strip cropping, cropping pattern, sustainable agriculture, bio-mass management, dry land agriculture, Silvi pasture, horticulture, social forestry and afforestation. Planning of watershed management activities, peoples participation, preparation of action plan, administrative requirements.

CE- 711 Climate Change and Water 3+0+0

Climate in the Spotlight, The Earth's Natural Greenhouse Effect -General Overview, The Importance of Water, Greenhouse Gases: An Overview, -The Role of Carbon Dioxide, -The Role of Methane, -Major Uncertainties, CO_2 Emissions -Human Emissions of CO_2, -How Much Carbon in the Ground?, -Different Concerns of Rich and Poor Countries, Climate and Weather: Some Definitions, -The Earth's Climate Machine, The Vital Importance of Monsoon Rains, -Why are there Seasons, Clouds, Storms and Climate -Cloud Formation and Climate,-Hurricanes and Global Warming, Climate Change-Advances in Computer Modeling. Causes of Climate Change -Ocean-Atmosphere Interactions, Climate and CO_2, Recent Rise in CO_2, Recent Global Warming -Climate in the Spotlight, Regional Problems Ahead, Climate Change and the Political Realm -Kyoto and Den Haag, The Link to the Ozone Problem -The Role of Ozone, Ozone Problem, CFC's and Alternatives, Future Energy Use -Attempts to Guess the Future, Future Use of Fossil Fuels, Future of Methane, Future of Nitrous Oxide, Outlook for the Future - and the Role of Research.

CE-712 Modelling of Ground Water Flow and Transport 3+0+0

Sub-surface processes and concepts of groundwater resources evaluation; Unsaturated Zone properties; Soil moisture Levels; Retention curves; flow through unsaturated porous media; infiltration and Wetting front:Ground water contramination:Sources and causes of groundwater pollution: Pollution dynamics: hydrodynamic dispersion: Biodegradation: radioactive decay: Reactive processes; multiphase contamination; NAPLs; VOCs; Site specific groundwater quality problems in Indian Context; Numerical modeling of steady and transient flows in saturated and unsaturated domain; contaminant transport modeling; Regional aquifer simulation; contaminated ground water systems and their rehabilitation; applications of emerging techniques to groundwater management.

OPEN ELECTIVES FOR OTHER DEPARTMENT

CE-751 Climate Change and Water 3+0+0

Introduction Climate and Weather: Some Definitions, -The Earth's Climate Machine, The Vital Importance of Monsoon Rains, Why are there Seasons, Clouds, Storms and Climate -Cloud Formation and Climate,-Hurricanes and Global Warming, Climate Change-Advances in Computer Modeling. Causes of Climate Change -Ocean-Atmosphere Interactions, Climate and CO_2, Recent Rise in CO_2, Recent Global Warming - Climate in the Spotlight, Regional Problems Ahead, Climate Change and the Political Realm -Kyoto and Den Haag, The Link to the Ozone Problem -The Role of Ozone, Ozone Problem, CFC's and Alternatives, Future Energy Use -Attempts to Guess the Future, Future Use of Fossil Fuels, Future of Methane, Future of Nitrous Oxide, Outlook for the Future - and the Role of Research

CE-752 Environmental Impact Assessment 3+0+0

Environment and its components, Concept of Ecological imbalances, carrying capacity and sustainable development. Evolution of environmental impact assessment (EIA), Current screening process in India. A step-by-step procedure for developing EIA. Assessment Methodologies-Matrices, overlays, network analysis. Elements of Environmental Analysis. Public consultation, Post monitoring, Data collection for Air Quality Impact analysis, Water Quality Impact Analysis and energy impact analysis. Impact Case studies of Industrial EIA and Water resources projects. Brief introduction about Environment legislation and Environmental Audit.