COURSES OF STUDY

M. Tech. Civil Engineering (Water Management)

(2016 Onwards)

Department of Civil Engineering
SHRI GURU GOBIND SINGHJI INSTITUTE OF ENGINEERING & TECHNOLOGY, VISHNUPURI, NANDED – 431 606 (M.S.)

M. Tech. Civil Engineering (Water Management)
Courses of Study

SEMESTER-I		SEMESTER-II	
CEW501	Numerical Methods (L-T-P) (3-1-0) Credits 4	CEW 508	Water Resources Economics Planning and Management (L-T-P) (3-1-0) Credits 4
CEW502	Surface Water Hydrology (L-T-P) (3-1-0) Credits 4	CEW 509	Systems Engineering & its Applications (L-T-P) (3-1-0) Credits 4
CEW503	Ground Water Engineering (L-T-P) (3-1-0) Credits 4	CEW 510	Watershed Management (L-T-P) (3-1-0) Credits 4
Elective-I	(L-T-P) (3-1-0) Credits 4	CEW 511	Hydraulic Structures (L-T-P) (3-1-0) Credits 4
CEW504(A) CEW504(B) CEW504(C)	Soil Science & Agro-technology Hydraulic Engineering Participatory Irrigation Management	*Elective-III*	(L-T-P) (3-1-0) Credits 4
Elective-II	(L-T-P) (3-1-0) Credits 4	CEW512(A) CEW512(B) CEW512(C)	River Basin Organization Irrigation Engineering Soft Computing Techniques
CEW505(A) CEW505(B) CEW505(C)	Environmental Impact Assessment Water Works Engineering Remote Sensing and GIS	CEW 513	Computation in Water Management (L-T-P) (0-0-2) Credits 1
CEW 506	Water Management Laboratory (L-T-P) (0-0-2) Credits 1	CEW 514	Seminar-II (L-T-P) (0-0-2) Credit 1
CEW 507	Seminar-I (L-T-P) (0-0-2) Credit 1		

Part-III & Part IV

SUBJECT		TEACHING CREDITS			
		L	T	P	Credits
PART-III					
CEW601	Dissertation-I	--	--	24	24
	Sub Total	--	--	24	24
PART-IV					
CEW602	Dissertation-II	--	--	24	24
	Sub Total	--	--	24	24

L-Lecture, T-Tutorial/Seminar/Project, P-Practical.

M.Tech. Civil Engineering (Water Management)
Programme Structure

Credits Course Work	Semester I	Semester II	Semester III	Semester IV	Total
Core Courses	12	16	-	-	28
Electives	08	04	-	-	12
Lab. Courses	01	01	-	-	02
Seminar	01	01	-	-	02
Dissertation	-	-	24	24	48
Total	**22**	**22**	**24**	**24**	**92**

Examination

There would be one midterm examination of 30 marks (one and half hour duration) at the end of 8th week during the semester. At the end of the semester there would be a major examination of 70 marks (two and half hours duration).
The distribution of weightage for each component shall be decided and announced by the course coordinator at the beginning of the course, subject to such stipulations as or given in the scheme of teaching and examination for a given programme with prior approval of DPGPC.
Those courses which have practical component (Term work/Sessional) or which are completely practical (Term work / Sessional) in nature will be evaluated regularly during the regular schedule (50%). It also has end term evaluation (50%). The practical grades shall appear separately on the grade card.

SEMESTER - I

CEW501 NUMERICAL METHODS ***(3-1-0) Credits 4***

Objectives:

i) To provide basic knowledge of various numerical methods
ii) The methods include: root-finding, elementary numerical linear algebra, solving systems of linear equations, curve fitting, and numerical solution to ODE and PDE.
iii) The students would apply the concepts of numerical methods for solving various problems using MATLAB and/or Microsoft Excel /C programming

Curve fitting, System of linear and nonlinear algebraic equation, Ordinary and partial differential equations, Different schemes, implicit and explicit schemes, Accuracy convergence and stability, Method of characteristics, Introduction to computational fluid dynamics and it's applications, Grids and their classification, Convection and diffusion equation, Navier-Stokes equation, Finite difference method: solution to steady and unsteady flows Ground water flow problems, pollutant dispersion, flood wave propagation, tidal model

Course Outcomes:
At the end of this course, the students are expected to

i) demonstrate understanding of common numerical methods and its use to obtain approximate solutions to otherwise intractable mathematical problems
ii) understand the different numerical methods to solve the algebraic equations and to solve system of linear and non linear equations
iii) understand the different numerical methods for regression, solving set of ordinary differential equations and solving of partial differential equation.
iv) be familiar with programming with MATLAB/ EXCEL/ C-programming

Text and Reference Books:

1. Numerical Methods for Engineers — by Chapra S.C and Canale R.P., McGraw Hill Publications
2. Numerical methods in Engineering practice — by Amir Wadi Al-Khafaji, J.R. Tooley, HRW Publication
3. Numerical Methods for Scientific and Computations — by M.K. Jain et al, Wiley Eastern Engineering Publication.
4. Introduction to Methods of Numerical Analysis — by S.S. Sastry, Prentice Hall, New Delhi..
5. Computational Fluid Flow and Heat Transfer — by Murlidhar K and Sundararajan T, Narosa Publishing House.

CEW502 SURFACE WATER HYDROLOGY *(3-1-0) Credits 4*

Objectives:

i) To introduce principles and processes governing movement of water through the hydrologic cycle, including atmospheric moisture flow, surface runoff, and infiltration.
ii) The students would get exposure to the hydrologic statistics and frequency analysis techniques applied to problems of engineering hydrologic design.
iii) The course approaches hydrologic design from perspective of space-time scales associated with different hydro-climatological processes for given water management issues.

Hydrologic processes, Modeling of Hydrological Processes, Analysis of Hydrologic data. Rainfall DAD Analysis, Intensity Duration frequency analysis, PMF, Evaporation and evapotranspiration: empirical relations, Penman equation, Infiltration indices, Infiltration models, Stream flow: Rainfall-Runoff models, dependability, Hydrologic statistics, Floods Synthetic UH, Instantaneous UH Dimensionless UH. Flood frequency studies, design flood, Flood routing, Droughts: Hydrology of droughts. River hydrology, Stochastic Hydrology, Introduction, time series, smoothening of data, stochastic modeling, types of stochastic models.

Course Outcomes:
At the end of this course, the students are expected to

i) get a knowledge of hydrological processes in different terrestrial environments
ii) get a knowledge of hydrological monitoring and modelling techniques and their application in understanding processes and monitoring hydrological dynamics and change
iii) an appreciation of the most significant hydrological water related issues for society and the role of hydrological knowledge in securing safe and sustainable water supplies

Text and Reference Books:

1. Applied Hydrology — by V.T. Chow, Maidment, and Mays, McGraw Hill Pub.,
2. Engineering Hydrology — by K. Subramanya, Tata McGraw Hill, New Delhi.
3. Engineering Hydrology — by CSP Ojha, Berndtsson and P. Bhunya Oxford University Press, 2008
4. Hydrology and Water Resources Engineering — K.C. Patra, CRC Press, 2001

CEW503 GROUNDWATER ENGINEERING *(3-1-0) Credits 4*

Objectives:

i) Students will be exposed to ground water, hydraulics of ground water
ii) To study the groundwater exploration techniques for effective utilization
iii) To assess and simulate groundwater potential and quality using physical, electric analog and numerical models.
iv) To study aquifer remediation techniques

Hydrodynamics, continuity equation, equations of motion, Boundary conditions. Dupuit's approximations. Mapping techniques for confined and unconfined aquifers, Pumping test, interpretation and use of data. Unsaturated flow, Hydraulics of open wells, single & multiple well system, well losses, consideration of non isotropic, non homogeneous medium, Hydrodynamic dispersion, ground water pollution. Conjunctive use system, Future projections, Mathematical modeling. Numerical methods for groundwater systems, analog models, simulation models for problem solving in ground water flow. Ground water availability and flow in hard rock areas.

Course Outcomes:
At the end of this course, the students are expected to

i) understand the porous medium properties that control groundwater flow and transport
ii) apply groundwater flow equations to confined and unconfined aquifers
iii) to provide students with exposure to the systematic methods for solving engineering problems in groundwater engineering.
iv) compare methods for solving groundwater flow equations under a variety of situations,

Text and Reference Books:

1. Groundwater	by Raghunath, Wiley Eastern publication.
2. Dynamics of Fluids in Porous Media	by Bear J., (1972), Elsevier Publications Co. NY
3. Numerical Methods in Groundwater Hydrology	by A.K. Rastogi,
4. Groundwater Hydrology	by D.K. Todd, (1980), John Wiley & Sons, NY

ELECTIVE I: Candidate can opt for any one of the three courses i.e. (CEW504(A) or (B) or (C))

CEW504(A) SOIL SCIENCE AND AGROTECHNOLOGY ***(3-1-0) Credits 4***

Objectives:

i) To understand the basic and applied chemical, physical, and biological properties of soil
ii) To develop an understanding of the management and conservation of soils
iii) To understand soil-water-plant relationship and learn various agricultural management technologies

Classification of soils, characteristics of Indian soils; physical, chemical, Biological, properties of soils and their roles in crop production; Reactions of fertilizers; preparation of soil maps; crop production potential. Principles of crop production, inputs to crop productions; weeds and methods of weed control; soil fertilizer doses; principles of crop physiology; dry land farming; Agro climatology of crop planning, water requirement of crops.

Course Outcomes:
At the end of this course, the students are expected to

i) demonstrate fundamental knowledge of soil components and soil processes
ii) identify critical issues in soil science and to formulate scientific approaches to these issues
iii) be able to solve problems in collaboration with professionals in other disciplines
iv) to understand the soil water plant relationship in a proper way

Text and Reference Books:

1. Fundamentals of soil science	by	Foth, Wiley publication.
2. Soils	by	Donahue, Miller Shicklune,
3. Introduction to agronomy	by	Vaidya, Sahastrabuddhe
4. Manual on Irrigation Agronomy	by	R.D. Misra, M. Ahmed Oxford & IBH

CEW504(B) HYDRAULIC ENGINEERING ***(3-1-0) Credits 4***

Objectives:

i) To identify and define fundamental concepts in hydraulics;
ii) To analyse channel system performance and characteristics;
iii) To study characteristics of different fluid flows;

Basic concepts: Energy and momentum equation and their application. Critical flow, channel controls, and transitions. Uniform flow and flow resistance, sheet flow; concepts of boundary layer, surface roughness, theoretical uniform flow equations; Instability of uniform flow; Gradually varied flow; Flow profile classification and computation methods; Flow profiles in natural channels. Spatially varied flow; Hydraulic Jump; Unsteady flow: Continuity equation, Dynamic equation; Wave propagation; Method of characteristics; Rapidly varied unsteady flow; Surges; Dam-break problems; Dispersion in open channels;
Properties of sediment, Sediment movement; tractive force; Bed load theory; Suspended load theory; Estimation of transported sediment.

Course Outcomes:
At the end of this course, the students are expected to

i) become familiar with open channel cross sections, pressure distribution, sediment transport.
ii) determine water surface profiles for gradually varied flow in open channels.
iii) analyze and design a field open channel system using modern engineering software.

Text and Reference Books:

1. Open Channel Hydraulics	by	V.T. Chow. McGraw Hill Publication.
2. Mechanics of Sediment Transportation and Alluvial Stream Problems	by	Garde, Ranga Raju; Wiley Eastern Publication.
3. Flow through Open Channel	by	K.S. Ranga Raju. TMH Ltd. New Delhi.
4. Engineering Hydraulics	by	Hunter Rouse
5. Hand Book of Applied Hydraulics	by	Calvin Victor Davis and Kenneth E Sorensen

CEW504(C) PARTICIPATORY IRRIGATION MANAGEMENT ***(3-1-0) Credits 4***

Objectives:

i) To study the principles of participatory management with reference to irrigation system model
ii) To understand the role of stakeholders and study the methods of involving stakeholders in improving performance of irrigation system

Principles of management and its functions, management by objectives, Water laws, common property resources, ground water legislation, MWRRA 2005, Irrigation act and CADA act in various states of India. Irrigation system model, irrigation system as socio technical enterprise. Organizational and institutional bottlenecks, information and communication system. Beneficiary's participation, canal committees, water use cooperative society and it's functions. Incentives for WUA, Status of PIM in India, Equity and social justice in water management. Dynamics of social change due to irrigation, farmers organization. Technology transfer methods. Communication, adoption & diffusion, reacting to people and motivation.

Course Outcomes:
At the end of this course, the students are expected to

i) understand suitability and viability of the PIM approach in improving the efficiency and performance of irrigation systems, including the suitability of various WUA models
ii) conceptualize the involvement of farmers in operation, management, and maintenance of the irrigation systems at secondary and tertiary levels through WUAs
iii) quantify the impacts of PIM w.r.t. irrigation system management, WUAs, the irrigation subsector organizations, and the emerging private-sector service providers

Text and Reference Books:

1. PIM-Paradigm for 21st century Volume I and II	by L. K. Joshi and Rakesh Hooja, India NPIM New Delhi
2. Farmer's managed irrigation system	by R.K. Patil & S.N. Lele, SOPECOM Pune
3. Handbook on PIM compiled	by David Groenfeldt, India NPIM , New Delhi
4. WALMI publication on PIM	WALMI, Aurangabad

ELECTIVE II: Candidate can opt for any one of the three courses (CEW505(A) or (B) or (C))

CEW505(A) ENVIRONMENTAL IMPACT ASSESSMENT ***(3-1-0) Credits 4***

Objectives:

i) To understand the impacts of water resources development projects on ecosystem and methods to quantify the same
ii) To study the interdisciplinary nature of water resources system interacting with ecosystem
iii) To study the various methods to prepare Environmental assessment reports of water resources development projects

Technical and procedural aspects of environmental impact analysis (EIA), environmental impact statement, various methods of EIA, general procedure for characterizing environmental pollution, relative merits and demerits of EIA methods. Socioeconomic impacts, resettlement and rehabilitation of project affected people, world bank policy. Guidelines and legal aspects for environmental protection, role of Ministry of Environment and Forest, role of pollution control board, environmental protection acts, measures of effectiveness of pollution control activities. Total impact assessment, post project audit, inter sector pollutant transfer. EIA case studies of i) Irrigation projects; ii) Pollution of water bodies due to industries; iii) Ground water exploitation.

Course Outcomes:
At the end of this course, the students are expected to

i) develop an understanding of current EIA methods and the techniques and tools used
ii) understand the elements of EIA and processes applied to avoid and prevent adverse environmental consequences of the proposed projects
iii) get confidence to apply the framework of EIA to relevant situations for conflict resolution

Text and Reference Books:

1. Environmental Impact of Water Resource Projects	by S.A. Abbasi, Discovery Publishing House, New Delhi.
2. Environmental Impact Assessment – Scope 5	Edited by Munn Wiley Publication.
3. Environmental Impact of Water Resources Development	by R.S. Goel., (1993), Tata McGraw Hill Publishing Co. New Delhi.
4 Environmental Impact Assessment	by Dee, Duke, Baker, Whitman, Fahringer. McGraw Hill book co., New York
5 Environmental Impact Assessment	by David Lawrence, John Wiley & sons Inc.

CEW505(B) WATER WORKS ENGINEERING *(3-1-0) Credits 4*

Objectives:

i) To understand the role of economics in making decisions in water works
ii) To design and analyze the treatment of waste water for its possible reuse in the domestic sector
iii) To study and design site specific rainwater harvesting systems to develop sustainable system of water supply
iv) To understand the basics of water audit and use of equipments for leak detection in water supply system

Integrated approach to water supply and sanitation, Million Development goals, Estimation of demand, Demand side management, Sources of water for increasing population, Economics of water supply and pricing of water, procedure of fixing water charges.
Basic design considerations, Pre design report.
Design of water treatment plant based on raw water quality parameters. High service pumps and distribution system. Design of distribution system.
Residual processing, recovery of chemicals. Filter backwash, Ultimate disposal, Operation maintenance and troubleshooting.
Water audit, procedure, lessons drawn to improve w/s. Losses and leakages, Reasons, Detection, Measurement and measures to control. Management, legal and institutional aspects.
Rain water harvesting system design, decentralized system, small isolated systems for apartments and industries

Course Outcomes:
At the end of this course, the students are expected to

i) devise cost effective water collection and distribution systems
ii) understand the principals of water treatment and design treatment units
iii) develop skills to solve practical problems in areas of water treatment and management
iv) make an immediate and real contribution to water sector businesses and organisations

Text and Reference Books:

1 Water treatment plant design	by ASCE and AWWA
2 Water treatment principle and design	by J. M. Montgomery
3 IWWA data book	
4 Water works engineering	by Qasim, Motley and Zhu. Prantice Hall of India Pvt. Ltd. Publication, 2004

CEW505(C) REMOTE SENSING AND GIS *(3-1-0) Credits 4*

Objectives:

i) To study the principles of remote sensing and GIS for water resource management
ii) To study the applications of RS and GIS in water management and to use the software available for analysis

Photogrammetry and photo interpretation, Remote Sensing and data analysis, Fundamentals of ideal remote sensing systems, Law governing electromagnetic radiation, spectral signatures, Sensors, platforms and their characteristics, Fundamentals of processing and analysis of remotely sensed data by Analog, Digital and hybrid systems and the equipments required, Digital analysis of CCTS, Supervised and unsupervised classification techniques.

Application to agriculture and Irrigation: Basic interaction and mechanism of soil, vegetation and water. Land survey, geomorphology, drainage characteristics, erosion hazard, vegetative cover, cropping, water quality and irrigation intensity, Estimation of surface and ground water irrigation potential. Disease detection. Agricultural management and planning. Predicting crop yield through arial photographs and other remotely sensed data, delineation of surface water bodies.

Course Outcomes:
At the end of this course, the students are expected to

i) understand remote sensing sensors and platforms, their properties and calibration
ii) acquire skills in handling instruments, tools, techniques and modeling while using remote sensing technology
iii) develop abilities in RS/GIS from data acquisition and processing through to effective display of results
iv) contribute effectively to use of image analysis and GIS techniques in an industrial/research context

Text and Reference Books:

1. Remote Sensing Methods and Application — by R. Michael Horti, Wiley Interscience Publications.
2. Introduction to Environmental Remote Sensing — by Barett. E.C. and Curtis L.F., Chapman and Hall, London.
3. Remote sensing and Image Interpretation — by Lillesand T.M. and Kiefer R.W., Wiley, New York

CEW506 <u>WATER MANAGEMENT LABORATORY</u> ***(1Credit)***

Objectives:

i) To help develop an ability to use techniques, skills, and modern flow measurement devices
ii) To help develop an ability to use the techniques, skills, in use of water quality assessment
iii) To train students an opportunity to design experimental set up for water resource related field and laboratory studies
iv) To offer students an opportunity to develop spirit as a part of an interdisciplinary team

Following experiments shall be performed in various laboratories of the department

1. Rainfall data collection by natural siphon recording type raingauge and determination of mass curve and hyetograph from obtained data
2. Determination of ϕ index by double ring type infiltrometer
3. Measurement of permeability
4. Determination of rate of evaporation
5. Measurement of water quality parameters
6. Design of rain water harvesting system
7. Calculation of crop water requirement

Term Work: The term work shall be based on the report of experiments performed by the candidate
Practical Examination: It shall be an oral based on the above mentioned term work.

Course Outcomes:
At the end of this course, the students are expected to

i) estimate water quality using current methods
ii) gain ability to design experimental set ups for hydrologic and hydraulic systems

CEW507 SEMINAR I ***(1 Credit)***

Objectives:

i) Gain ability to prepare independently a sound research proposal
ii) Gain capability to carry out review of literature in proposed area of dissertation
iii) Acquire skills of technical report writing and presentation

The seminar should be done on any topic with focus on Water Resource Management to be decided by students and the teachers concerned. Seminar work shall be in the form of report to be submitted by the student at the end of the semester. The candidate will make a presentation before departmental students and faculty on the topic and the assessment will be made by two internal examiners appointed by the DPGPC, one of them will be the supervisor.

Course Outcomes:
At the end of this course, the students are expected to

1. demonstrate professional communication skills, using effective strategies both when writing technical reports, research proposals, and when giving oral or poster presentations to scientific or lay audiences

SEMESTER - II

CEW508 WATER RESOURCES ECONOMICS, PLANNING AND MANAGEMENT

(3-1-0) Credits 4

Objectives:

i) To understand the process of water resource planning with reference river basin/watershed as planning unit
ii) To understand and apply principles of economics to feasibility studies
iii) To study methods and techniques of evaluation of water resources projects
iv) To study the environmental impacts of water resources projects

Planning and decision making process, Systems approach to water resource planning, Water as economic commodity, Principles of economics, discounting techniques, Price theory, Resource allocation, project optimality conditions, Cost benefits studies, Role of benefit cost parameters in project selection, Economic feasibility tests, Decision making under uncertainty and risk, Cost benefit studies of single and multipurpose projects, Economic planning, capacity expansion, Multiobjective planning, Methods of analysis, Stakeholders' participation, Preparation of feasibility report, interstate water disputes, international development on water transfer, Concept of IWRM.

Course Outcomes:
At the end of this course, the students are expected to

i) gain knowledge about economic aspects of water and also gain a broader understanding of the complexities of dealing with water resources problems
ii) acquaint themselves in the allocation of resources and financial analysis in the water sector
iii) take a holistic approach in examining the whole system of variables and their interactions and impacts

Text and Reference Books:

1. Water Resources Project Economics by Kuiper, Buttersworth, London.
2. Water Resources System Planning and Management by M.C. Chaturvedi, (1987), Tata McGraw Hill New Delhi.

3. Water Resources Planning and Management	by O.J. Helweg., John Wiley & Sons Inc., USA

CEW509 SYSTEMS ENGINEERING AND ITS APPLICATION ***(3-1-0) Credits 4***

Objectives:

i) to help develop the capability of systems thinking
ii) to introduce classical and advanced systems engineering theory
iii) to help understand methods and tools and apply systems engineering tools to realistic problems.

System concepts, Open and closed systems, system modeling, concavity and convexity of space, systems formulation, dual simplex, primal dual simplex, modified simplex procedures, sensitivity and parametric analysis, Nonlinear programming, quadratic programming, optimization methods and method of calculus, Dynamic programming. Systems applications in water Resources Engineering.

Course Outcomes:
At the end of this course, the students are expected to

i) understand the system behaviours and know how to apply the various optimization techniques to resolve the various socio-technical aspects of water resources systems
ii) identify different types of optimization problems and understanding of different optimization techniques
iii) develop ability to solve various multivariable optimization problems using software solutions and tools

Text and Reference Books:

1. Water Resource, Distribution, Use and Management	by Mather J.R. John – Wiley and Sons publication.
2. A systems approach to Civil Engineering Planning and Design	by Jewell Thomas K., Harper and Row Publication.
3. Water Resources Systems Engineering	by Hall and Dracup, Tata McGraw Hill publication.

CEW510 WATERSHED MANAGEMENT ***(3-1-0) Credits 4***

Objectives:

i) To provide the technical, economical and sociological understanding of a watershed
ii) To provide a comprehensive discourse on the engineering practices of watershed management for realizing the higher benefits of watershed management
iii) To get knowledge about overall concepts of watershed which would help them to comprehend and analyze for better water management.

Watershed types, Rainfall-Runoff relationship, Necessity of soil and water conservation, Soil-Water-Plant relationship, Land use capability classification, soil erosion definition, processes and forms, factors influencing soil erosion, Erosion hazard assessment, effects on water yield, soil and water conservation practices in catchments. Soil and water conservation practice in commands, Agro-forestry, Soil conservation on private land, Watershed development: ridge-to-valley concept, Water harvesting techniques for life saving irrigations, Land Treatment, Drainage line treatment, Role of geology, Design of structures, Estimation of water harvested, impact on environment, Hydrology of micro– watershed, Case studies

Course Outcomes:
At the end of this course, the students are expected to

i) apply the knowledge of overall concepts of watershed which would help to comprehend and analyze for better management
ii) gain ability to design small scale and large scale watershed systems
iii) gain skills to evaluate performance of soil and water conservation measures and suggest remedies for sustainability of these measures.

Text and Reference Books:

1. Soil and Water Conservation Engineering	by Glen O. Schawb Wiley Publication.
2. Soil and Water Conservation	by F.R.Troeh et al Prantice Hall Inc Publication.
3. Soil Conservation	by N. Hudson, Batsford Academic Publication.
4. Soil Erosion and Conservation	by Morgan, R.P.C. Longman scientific Publication.
5. Watershed Hydrology	by V.S.R. Murthy,
6. ICRISAT Manual on Watershed	

CEW511 <u>HYDRAULIC STRUCTURES</u> ***(3-1-0) Credits 4***

Objectives:

i) To introduce the student to developments in design of hydraulic structures
ii) To develop understanding of the basic principles and concepts of analysis and design of hydraulic structures
iii) To formulate and solve multivariable hydraulic design problems

Spillways: Types, general layout elements & basic principles of Hydraulic design. Spillway gates: types such as tainter, drum, vertical left, automatic. General layout, basic principles of design. Determination of Spillway capacity: rating curves, spillway design, flood hydrographs, routing of floods, flood forecasting. Energy dissipaters: types, general layout, basic concept of hydraulic design outlet through dams: types, layout, general arrangements & components, Transitions: Transitions in open channels and closed conduits, design considerations. Design of large dams, Arch and Buttres dam, Reservoir and its planning.

Course Outcomes:
At the end of this course, the students are expected to

i) judge suitable sites for locating different hydraulic structures
ii) estimate forces to be considered for design of hydraulic structures
iii) understand the recommendations made in IS Code
iv) analyze and design different hydraulic structures

Text and Reference Books:

1. Open Channel Hydraulics	by Chow V.T.
2. Design of Small Dams	USBR Oxford IBH Publishing Company Mumbai
3. Irrigation & Hydraulic Design Vol . I, II, & III	by Leliavisky S
4. Hydraulic Structures	by Grishing, Mir Publishers, Moscow (USSR)

ELECTIVE III: Candidate can opt for any one of the three courses i.e. (CEW512(A) or (B) or (C))

CEW512(A) RIVER BASIN ORGANIZATION ***(3-1-0) Credits 4***

Objectives:

i) To learn how to estimate availability of water resources in a river basin
ii) To learn to work out current and future water requirements for developing and maintaining sustainable livelihoods in the Project region
iii) To get awareness about various existing river basin organizations across the globe
iv) To learn about efficient and integrated use of land and water for sustainable agriculture development

River basin as unit of planning, Water availability studies and demand assessment at basin level, IWRM approach.
Basic functions for water resources management, Water management objectives, Institutional arrangement for performing the functions, Basic indicators at basin level to measure progress and performance, Criteria for developing indicators,
Stakeholder participation, Water allocation, Water resources systems analysis, Pollution management at basin level, Planning for pollution control, Monitoring of water resources systems: Pollution, quality and use.
Economic and financial instruments for RBO, Basin planning process. Implementation of basin plan.

Course Outcomes:
At the end of this course, the students are expected to

i) undertake basin level study with understandings of the geography, meteorology, history of water use of the basin.
ii) learn about various approaches of river basin management that best fits to the basin.
iii) make effort for learning basin level water resources management with technical, and social aspects

Text and Reference Books:

1. IWRM for RBO UNDP manual
2. Integrated River Basin management through decentralization by Kemper, Karin, Springer publication

CEW512(B) IRRIGATION ENGINEERING ***(3-1-0) Credits 4***

Objectives:

i) Understand how to estimate the quantity of water required by crops using manual and computer methods.
ii) Be able to plan and design irrigation and drainage projects.
iii) Understand the computer applications in irrigation and drainage designs.
iv) Design channels and other irrigation structures required for irrigation, drainage, soil conservation, flood control and other water-management projects.

Irrigation Techniques: Gravity Irrigation, Subsurface Irrigation, Tube well Irrigation, Lift Irrigation, Sprinkler Irrigation and Drip Irrigation. Hydraulic design of Gravity, Subsurface, Tube well, Lift, Sprinkler and Drip Irrigation, Assessment of irrigation water, Audit of irrigation water, Preparation of irrigation schedules based on crop water requirement, Different types of irrigation water distribution, Water logging: causes, surface and subsurface drainage design,

Canals: Design, linings and regulation works, operation and maintenance of canal system, canal automation, River training, diversion and protection works.

Course Outcomes:
At the end of this course, the students are expected to

i) understand the design concepts related to sprinkler and drip irrigation
ii) design various types and methods of irrigation using various design principals
iii) plan and design the drainage system in an efficient manner
iv) plan the irrigation project and apply the irrigation management techniques

Text and Reference Books:

1. Irrigation	by Zimmerman, Wiley Toppan Pub.
2. Principles and practice of Irrigation Engineering	by S.K. Sharma, S. Chand and Co. Ltd. New Delhi.
3. Irrigation Theory and practice	by A.M. Michael, Vikas Publishing
4. Canal Automation	CBIP Publication No. 238, New Delhi

CEW512(C) SOFT COMPUTING TECHNIQUES ***(3-1-0) Credits 4***

Objectives:

i) To introduce the basics of soft computing techniques and illustrate its application for solving various problems in water resources engineering.
ii) To introduce the ideas of fuzzy sets, fuzzy logic
iii) To become familiar with neural networks
iv) To familiarize with genetic algorithms useful while seeking global optimum

1. Artificial Neural Networks
Development of ANN, Types of ANN structure, Properties of Neural Network, Components of Neural Network, Neurons, Layers, Input and output weights, Threshold, Types of transfer functions, Learning with neural network, Types of learning, Stability and convergence, Fundamentals of Error backpropagation learning, Generalized delta rule, EBP algorithm, Data normalization, Selection of learning rate and momentum factor; Application of ANN in hydrology and water management problem

2. Fuzzy Logic
Introduction, fuzzy system, classical set and fuzzy sets, operation and properties of classical and fuzzy set. Classical relation and fuzzy relations, crisp relations, operations on fuzzy relations, various types of binary fuzzy relations, fuzzy relations equations, The extension principle and its applications, tolerance and equivalent relation, value assignment, application of fuzzy logic for various problems encountered in hydrology and water recourses management.

3. Genetic Algorithm
Introduction to fundamentals of techniques and applications of genetic algorithms.

Course Outcomes:
At the end of this course, the students are expected to

i) learn about soft computing techniques and their applications
ii) identify and select a suitable soft computing method to solve the problem; construct a solution and implement it
iii) analyze various neural network architectures and implement these to solve various problems
iv) analyze the fuzzy systems, genetic algorithms and their applications

Text and Reference Books:

1. Neural Networks, Fuzzy Logic, and Genetic Algorithms — by S. Rajasekaran and G.A. Vijayalakshmi Pai, PHI publications.
2. Neural Networks: A Compressive foundation — by S. Haykin, McMillan Publications
3. Understanding neural networks and fuzzy logic basic concepts and applications — by Kartalopoulos S.T., Prentice Hall (2000).

CEW513 COMPUTATIONS IN WATER MANAGEMENT ***(1 Credit)***

Objectives:

i) To help develop an ability to use the techniques, skills, and modeling software tools necessary for water resource planning and management
ii) To help develop an ability to interface with modern water and wastewater quality assessment (environment engineering) and flow measuring devices
iii) To develop the ability among students to synthesis data and technical concepts for application in Integrated Water Resources Management.
iv) To provide students an opportunity to work as a part of an interdisciplinary team.

Application of Software Laboratory

1. GIS Tool in Watershed Development
2. HEC-HMS Software
3. WaterCAD Software
4. Artificial Neural Network Problem
5. Surface Water Modeling System
6. Groundwater Modeling System

Term Work: The term work shall be based on the report of experiments performed by the candidate
Practical Examination: It shall be an oral based on the above mentioned term work.

Course Outcomes:
At the end of this course, the students are expected to

i) develop an ability and expertise to use various modeling software tools
ii) improve computing knowledge for applications in water resources management

CEW514 SEMINAR II ***(1 Credit)***

Objectives:

i) Gain ability to prepare independently a sound research proposal
ii) Gain capability to carry out review of literature in proposed area of dissertation
iii) Acquire skills of technical report writing and presentation

Methodology:

a) Faculty of the department shall deliver few lectures on various research areas demonstrating research methodology and report writing
b) Students shall carry out review of literature of at least five international journal papers
c) Students shall prepare a report on review of literature and problem statement of his/her proposed area of dissertation
d) Students shall demonstrate the acquired skills through presentation
e) Seminar guide shall supervise the process

Course Outcomes:
At the end of this course, the students are expected to

i) identify and understand assumptions, theses, and arguments that exist in the work of authors
ii) evaluate and synthesize evidence in order to draw conclusions consistent with the text
iii) deliver polished presentations meeting time, content, and interactive requirements

SEMESTER – III and IV

CEW601 DISSERTATION - I ***(24 Credits)***
and CEW602 DISSERTATION - II ***(24 Credits)***

Candidates will have to undertake research work independently on a topic related to water management and submit a detailed report of the same. He/She will have to defend the work carried out at the Institute practical Examination. He/She will have to submit monthly progress report of the work to the department, till the completion of the project work.

Course Outcomes:
At the end of this course, the students are expected to

i) develop ability to choose and use research methodologies applied to water resources management
ii) develop ability to design and construct hardware and software water resource system components or processes to meet desired needs within realistic constraints
iii) develop ability to use the techniques, skills, and modern modeling software tools necessary for water resource planning and management