GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD

(An Autonomous Institute of Government of Maharashtra)

Department of Civil Engineering

Teaching and Evaluation Scheme

ME (Full-Time) in Civil- Water Resources Engineering

SEMESTER-I

THEORY COURSES													
S. No.	**Course Code**	**Subject**	**Scheme of Teaching (Hrs/Week)**			**Total Credits**	**Scheme of Evaluation (Marks)**					
			L	**T**	**P**		**Theory**			**Term Work**	**Practical/ Viva-voce**	**Total**
							Test	**TA**	**ESE**			
1	CE 541	Computational and Statistical Methods	3	1	--	04	20	20	60			100
2	CE 542	Engineering Hydrology and Hydrologic Systems	3	1	--	04	20	20	60			100
3	CE 543	Groundwater Engineering	3	1	--	04	20	20	60			100
4	CE 544	Advanced Fluid Mechanics	3	1	--	04	20	20	60			100
5		Elective-I (CE(R1)545 TO CE(R1)547)	3	1	--	04	20	20	60			100
LABORATORY COURSES												
1	CE 548	Seminar-I			04	02				25	25	50
2	CE 549	Advanced Fluid Mechanics Laboratory			04	02				25	25	50
			15	05	08	24						600

SEMESTER-II

THEORY COURSES												
S. No.	**Course Code**	**Subject**	**Scheme of Teaching (Hrs/Week)**			**Total Credits**	**Scheme of Evaluation (Marks)**					
			L	**T**	**P**		**Theory**			**Term Work**	**Practical/ Viva-voce**	**Total**
							Test	**TA**	**ESE**			
1	CE 550	Hydraulic Structures	3	1		04	20	20	60			100
2	CE 551	Water Resources Systems Planning and Management	3	1		04	20	20	60			100
3	CE 552	Land and Water Management	3	1		04	20	20	60			100
4	CE 553	Channel and River Hydraulic	3	1		04	20	20	60			100
5		Elective-II (CE554 TO CE556)	3	1		04	20	20	60			100
LABORATORY COURSES												
1	CE 557	Seminar-II	-	-	04	02	-	-	-	25	25	50
2	CE 558	Water Resources Software Laboratory			04	02				25	25	50
3												
			15	05	08	24						600

SEMESTER-III

S. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
			L	T	P		Theory			Term Work	Practical/ Viva-voce	Total
							Test	TA	ESE			
THEORY COURSES												
1	CE 611	Institute Elective	03	01	-	04	20	20	60			100
LABORATORY COURSES												
1	CE 612	Dissertation-I			20	10				50	50	100
						14						200

SEMESTER-IV

S. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
			L	T	P		Theory			Term Work	Practical/ Viva-voce	Total
							Test	TA	ESE			
LABORATORY COURSES												
1	CE 613	Dissertation-II			28	14				100	100	200
						14						1600

L-Lectures, T-Tutorials, P-Practicals, TA-Teacher Assessment, ESE-End-Semester Examination

Elective I:

CE 545: Water Supply Systems
CE 546: Irrigation Techniques
CE 547: GIS Applications in Water Resources Engineering

Elective II:

CE 554: Water Power Engineering
CE 555: Environmental Evaluation of Water Resource Development
CE 556: Neuro Fuzzy Applications

CE541: Computational and Statistical Methods

Teaching Scheme		**Evaluation Scheme**	
Lectures-	3 hours/Week	Test	20 Marks
Tutorials	1hour/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Course Objectives:

1. Student will get in depth information about statistical analysis, probability and soft computing skills.
2. Student will be able to execute programmes related to water resources engineering.
3. Student will be able to judge and compare the solution of a field problem.

Unit-1

Numerical Solution of Ordinary Differential Equations: Solution by Taylor's Series, Euler's Method, Runge Kutta Method, Newton Raphson Method, Bisection Method. Gauss-Jordan Method, Method of Leading Coefficient. Relaxation Method

6+2

Unit-2

Regression Analysis : Simple Linear Regression, Evaluation of Regression – Confidence Intervals and Tests of Hypothesis – Multiple linear Regression – Correlation and Regression Analysis. Skewness, Moments and Kurtosis

6+2

Unit-3

Classification and Presentation of data, Basic Concepts of Probability, Probability Axioms, Analysis and Treatment of Data, Population and Samples, Measures of Dispersions, Measures of Symmetry Discrete and Continuous Probability Distribution Functions

6+2

Unit -4

Finite difference methods and its applications to water resources Engineering. Introduction to FEM and its applications to water resources Engineering

6+2

Unit -5

Fuzzy logic, Fuzzy Mathematical Operations, Neural Networks, Mathematical Model of Neuron, Architecture. Introduction to genetic algorithm, Operators, Applications.

6+2

References:

1) Gupta, S. P. (1999). "Statistical Methods", S. Chand & Sons
2) Haan C. T., (1995), "Statistical Methods in Hydrology", East West Press, New Delhi
3) Sastry, S. S. (1995), "Introductory Methods of Numerical Analysis", Prentice Hall of India (p) Ltd., New Delhi
4) Krishnaraju and Muthu, Numerical Methods for Engineering Problems, Second Edition, MacMillan India Ltd, Delhi
5) Rao V and H. Rao, (1996) "$C^{++,}$ Neural Networks and Fuzzy Logic, BPB Publications, New Delhi.
6) Goldberg, D. E. (2000), "Genetic Algorithms in Search, Optimization & Machine Learning", Addison Wesley Longman (Singapore) Pte. Ltd., Indian Branch, Delhi.

CE 542: Engineering Hydrology and Hydrologic Systems

Teaching scheme:		**Evaluation Scheme:**	
Lectures	3 hours/Week	Test	20 Marks
Tutorial	1 hour/Week	Teacher Assessment	20 Marks
		End-Semester Examination	60 Marks

Course Objectives: Students will be able to:

1. Carry out reservoir and channel flood routing.
2. Plan watershed management works by using GIS.
3. Analyze meterological parameters required for water resource management.

Unit -1

Introduction: Systems Concept, Linear and Non Linear Systems, Lumped and Distributed Systems, Deterministic and Stochastic Systems, Time Invariant Systems, Unit Hydrograph Theory, S – Curve Hydrograph, Instantaneous Unit Hydrograph

6+2

Unit -2

Rainfall – Runoff Analysis: Review of Rational Methods, Conceptual Model, Clarke and Nash Models, Derivation of Unit Hydrograph for un-gauged Catchments, Synthetic Unit Hydrograph.

6+2

Unit -3

Hydrologic Statistic: Probabilistic Treatment of Hydrologic Data, Frequency and Probability Functions, Statistical Parameters, Frequency Analysis, Annual Maximum and Partial Duration Series Models, Regional Frequency Analysis, Design Flood

6+2

Unit -4

Hydrologic Flood Routing: Reservoir Routing, Channel Routing, Estimation of Flood Routing Models, Flood Forecasting, Analog Models, Real Time Flood Forecasting. Applications of Remote Sensing and GIS in Hydrology: Land Use and Soil Mapping Using Remote Sensing, Watershed Management Using Remote Sensing Techniques, Concepts of Geographical information Systems (GIS) and its Application in Hydrologic Studies.

6+2

Unit -5

Climate Change: Global Circulation Model (GCM), Regional Circulation Model (RCM), Data collection and analysis, downscaling of climate parameters, uncertainty of regional climate projections, climate change impact, adaptation strategies, Risk and Vulnerability of Agriculture, climate forecasting, Soil and Water Assessment Tool (SWAT) Hydrological Model, Socioeconomic scenarios, Policy Initiatives for Climate Change Adaptation in India.

6+2

References:

1. Chow, V.T., Maidment, D.R. and Mays, L.W. (1988), " Applied Hydrology", McGraw Hill Inc. N York
2. Singh, V.P. (1986), "Hydrologic Systems", Prentice Hall Inc., N York
3. Singh, V.P. (1992), "Elementary Hydrology", Prentice Hall of India, N Delhi
4. Haan C.T., (1995), "Statistical Methods in Hydrology", East West Press, New Delhi
5. Viessman, W., Lewis, G.L. and Knapp, J.W. (1989), "Introduction to Hydrology", Harper & Row Publications Inc., Singapore
6. Ponce, W.F. (1987), "Engineering Hydrology", Prentice Hall Inc. N York.

7. Lillesand, T.M. and Kiefer, R.H. (1994) “Remote sensing and Image Interpretation”, John Wiley & Sons.
8. Subramanya, K. (2011), “Engineering Hydrology”, Tata McGraw Hill Education Private Limited, New Delhi.

CE543: Ground Water Engineering

Teaching scheme	**Evaluation Scheme**	
Lectures: 3 hours/week	Test:	20 Marks
Tutorials: 1 hour/week	Teacher Assessment:	20 Marks
Total Credits: 04	End-Semester Examination:	60 Marks

Course Objectives:

1. Student will know the different terminologies related with groundwater hydrology.
2. Student will be able to assess ground water potential.
3. Student will be able to know and plan ground water exploration techniques.

Unit -1

Ground Water: zone of aeration, saturation, soil water, adsorbed water, capillary water, capillary potential, storage coefficients of aquifers, porosity, specific yield, specific retention, unconfined and confined aquifer, fluctuation of water table, fluctuation of the piezometric surfaces, ground water potential in India, geophysical methods for groundwater explorations.

6+2

Unit -2

Well Hydraulics: Darcy's law, permeability and transmissivity, Theim and Dupuit's theory for unconfined and confined aquifers. Groundwater flow potential, Ground water theory for one, two and three dimensional problem, Differential equations governing groundwater flow for steady and unsteady state problems, use of finite difference method to solve simple ground water flow problem.

6+2

Unit -3

Evaluation of aquifer properties: aquifer tests control well, observation well, measurement during test, Theis method, Jacob and Chow's method of determination of aquifer parameters, Theis' recovery method, bounded aquifer, interference among wells, Image well theory and its application in groundwater flow.

6+2

Unit -4

Groundwater well losses, water well design and well drilling: well screen, development and completion of wells, Rotary drilling and Rotary percussion drilling, maintenance of wells. Groundwater Modeling: Groundwater flow, sand models, viscous fluid models, membrane model, thermal model, electric analog model and mathematical models.

6+2

Unit -5

Groundwater development and management: Conjunctive use, artificial recharge of groundwater- different methods, subsurface dam, waste water recharge, recharge by urban storm runoff, ground water storage changes, percolation from tanks, recharge from irrigated fields, dating of ground water, estimation of ground water discharge, ground water resource evaluation in India, groundwater quality.

6+2

References:

1. Todd, D.K. "Ground Water Hydrology", John Wiley & Sons, Singapore.
2. Raghunath, H.M. "Ground Water" New Age International (P) Limited, New Delhi.
3. Karanth, K. R. "Ground Water Assessment Development and Management", Tata McGraw Hill Publishing Company Limited, New Delhi

4. Domenico "Concepts and Models in Groundwater Hydrology", McGraw Hill Inc., NewYork
5. L. Harvil and F. G. Bell, *Ground Water Resources and Development*, Butterworth's, London.
6. Herbert F Wang and Mary P. Anderson "Introduction to Ground Water Modeling", W.H.Freeman and Company, NewYork

CE544: Advanced Fluid Mechanics

Teaching scheme	**Evaluation Scheme**	
Lectures: 3 hours/week	Test:	20 Marks
Tutorials: 1 hour/week	Teacher Assessment:	20 Marks
Total Credits: 04	End-Semester Examination:	60 Marks

Course Objectives Students will be able to:

1. Know concept of source and sink.
2. Design boundary layer thickness and separation.
3. Calculate drag and lift forces.
4. Carry out dimensional and model analysis.

Unit -1

Basic principles of fluid motion, role of fluid properties in fluid motion, types of fluids based on rheological diagram, equation of continuity in Cartesian and cylindrical co-ordinate system, kinematics of fluid flow, Lagrangian and Eulerian approach, path lines, streak lines, stream lines and their equations, elements of particle motion, circulation, rotational and irrotational flows, vorticity, angular deformation, stream function, potential function Laplace's equation, flownets.

6+2

Unit -2

Dynamics of fluid flow, Euler's equation of motion in Cartesian and cylindrical co-ordinate system, accelerations, force potential, energy equation, applications of energy equation Two dimensional irrotational flow, uniform flows, source, sink, vortex flows, flow around corners, combination of two or more potential flows, doublet, source in uniform flow, source, sink and uniform flow, doublet, uniform flow and vortex etc. method of images.

6+2

Unit -3

Laminar motion, transformations, Navier-Stokes equation of motion, exact and approximate solutions to Navier-Stokes equation, laminar stability, Reynold's number, analysis of laminar stability, laminar boundary layer theory, boundary layer thickness, displacement, momentum, and energy thickness, boundary layer equations, boundary layer integral momentum equation, Blassius solution.

6+2

Unit -4

Turbulent flow, mean, fluctuating and absolute velocities, Reynold's equation for turbulent flows, energy equations, eddies in fluid motion, integral equations of momentum, role of mixing length theories, Prandtl's mixing length theory, Taylor's vorticity transfer theory, Karman's similarity hypothesis, Boussinesq hypothesis, boundary layer separation, flow behind bluff bodies, wakes, concept of lift and drag forces of immersed bodies

6+2

Unit -5

Dimensional and model analysis, homogeneity of equations, basic principles, Raleigh's and Buckingham's pi methods, model analysis, dimensionless numbers and their significance, similarities, undistorted models, tilted models, river and channel distortion, tidal rivers, estuaries

6+2

References:

1. S. Narsimhan (1973) "Engineering Fluid Mechanics", Orient Longman
2. Douglas J.F, GasiorekSwaffield J.A. (2003) "Fluid Mechanics", Pearson Education (Singapore) Pvt. Ltd. Indian office at 482 F.I.E. Patparganj, Delhi.
3. Hohanthy A.K. (! 994) "Fluid Mechanics, Prentice Hall of India, New Delhi

CE545: Elective -I (Water Supply Systems)

Teaching scheme:		**Evaluation Scheme:**	
Lectures	3 hours/Week	Test	20 Marks
Tutorial	1 hour/Week	Teacher Assessment	20 Marks
Total Credits: 04		End-Semester Examination	60 Marks

Course Objectives: Student will be able to:

1. Explain design concept of different water treatment units.
2. Identify suitable method of treatment to be used for removal of impurity.
3. Design conventional water treatment plant.
4. Analyze water distribution system.

Unit -1

Introduction: Water quality, drinking water standards, secondary standards — toxic water pollutants, quality criteria for surface water, purpose of water treatment — selection of Water Processes, Water — processing sludges, reuse of waste water and grey water, treatment of grey water for irrigation

6+2

Unit -2

Conventional Treatment Processes: Sedimentation, Type of Sedimentation, Zone Setting, Filtration, Gravity Granular — Media Filtration, Head Losses, Back Washing and Media Filtration, Head Losses, Back Washing and Media Fluidization — Pressure Filters — Slow Sand Filters, Coagulation and Flocculation Coagulants, Theory of coagulation and flocculation process, coagulation kinetics, coagulant Aids, Rapid Mixing Devices, Disinfection, Disinfection Methods, Fluoridation, De-fluoridation.

6+2

Unit -3

Taste and Odor: Methods for Control, Aeration, Adsorption: equilibrium and isotherms, Langmuir, Freundlich, Control of Algae Growth. Reduction of Dissolved Salts: Distillation, Reverse Osmosis, Electrolysis.Water Softening: Lime soda Process, Variations- Ion Exchange Softening and Nitrate Removal. Iron and Manganese Removal: Iron Corrosion, Water Stabilization- Cathodic Protection.

6+2

Unit -4

Water distribution systems, major and minor losses, head — discharge relationships, formulation of equations, pipe network analysis, Hardy cross method, Newton Raphson method, linear theory method, and finite element method.

6+2

Unit -5

Node flow analysis, optimization techniques in pipe networks, hydraulic design of water supply systems, pumping systems, distribution Reservoirs and Service Storage.

6+2

References

1. Viessman Jr., Mark 3. Hammer (1990) Water Supply and Pollution Control. McGraw Hill International Edition.
2. Peavy, H.S., Row, D.R. and Techbanaglous, G.(1995) Environmental Engineering. McGraw Hill International Edition.
3. Fair, Geyer, Okun (1990) Water Supply Engineering. John Wiley.

4. Turbuit T H Y (1998) "Principles of Water Quality Control", Pergamon Press.
5. Bhave P.R. (!994) "Water Distribution Systems", Mc-Graw Hill Publication , NY

CE546: Elective -I (Irrigation Techniques)

Teaching scheme:		**Evaluation Scheme:**	
Lectures	3 hours/Week	Test	20 Marks
Tutorial	1 hour/Week	Teacher Assessment	20 Marks
		End-Semester Examination	60 Marks

Course Objectives: Student will be able to:

1. Justify a process of irrigation system.
2. Design micro irrigation system.
3. Compare different irrigation system.

Unit -1

Water Conveyance System: Open channel, Lined and unlined channels, types of lining, economics of lined channels. Cross drainage works, Regulating structures, Types of CD works, Aqueduct, Super passage, siphon, culverts etc. Layout and design concepts

6+2

Unit -2

Head Regulator, Cross regulator, their layout, and hydraulic design, Conveyance through closed conduit system, elements, Controlling devices, general design concepts.

6+2

Unit -3

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.

6+2

Unit -4

Drip irrigation, General concept, Advantages, limitations, elements of drip irrigation system, design.

6+2

Unit -5

Sprinkler irrigation, General concept, advantages and limitations, Components of the system, types of sprinklers, design concept.

6+2

References

1. Michael, BAIl. (1990) "Irrigation", Vikas Publishing House Pvt. Ltd. N Delhi.
2. Asawa, G.L. (1996) "Irrigation Engineering", New Age International Pub. Co. N Delhi.

CE547: Elective —I (GIS Applications in Water Resources Engineering)

Teaching scheme:	**Evaluation Scheme:**	
Lectures 3 hours/Week	Test	20 Marks
Tutorial 1 hour/Week	Teacher Assessment	20 Marks
Total Credits 04	End-Semester Examinations	60 Marks

Course Objectives: Students will be able to:

1. Explain various terminologies related with Geographic Information System (GIS).
2. Identify suitable image for carrying out detailed investigations by using GIS.
3. Analyze and plan cropping pattern.

Unit -1

Introduction: Scope of Remote Sensing and GIS in Water Resources and Environmental Systems Geomorphological, Hydrological and Land Use Mapping. Evaluation of Water Resources Potential Rainfall runoff modeling using remote sensing inputs.

6+2

Unit -2

Flood and Draught Studies, Flood plane zoning — inundated areas — evaluation models — Draught assessment and Monitoring. Command Area Studies — Cropping patterns, conditions of crops, irrigation systems performance — crop yield estimation

6+2

Unit -3

GIS, Hydrology and Resources Management — Watershed development, management options, inventory. Remote Sensing in Snow Cover Studies — Snowmelt Runoff.

6+2

Unit -4

Reservoir Sedimentation, Erosion and Deposition — Catchment Area Treatment — Estimation of Sediment Load — Use of models.

6+2

Unit -5

Environmental Applications — Urban Storm water Studies — Solid waste management — wetlands, nonpoint sources pollution.

6+2

References:

1. Lillesand T.M. and Kiefer R.W., (1994), "Remote Sensing and image Interpretation", John Wiley and Sons, N York.
2. Swain P.H., and S.M. Davis, (1987), "Remote Sensing — The Quantitative Approach", McGraw Hill Publishing Company, N York.
3. Lyon, J.G. and Mc Lordly, 3., (1996), "Wetland and Environmental Application of GIS", Lewis Publishers, Washington.

CE548: Seminar-I

Teaching scheme:	**Evaluation Scheme:**	
Lectures 0 hour/Week	Term Work	25 Marks
Tutorial 4 hours/Week	Viva-voce	25 Marks
Total Credits 02		

Course Objectives: Student will be able to:

1. Carry out the literature survey on a particular topic of interest.
2. Compare different methodologies to analyze the given assignment
3. Write a technical report of research analysis and design on any topic of interest.

Seminar shall be a term work submitted in the form of technical report of research, analysis and design on any current topic in the concerned or allied field. It is expected that the students should refer the journals, and proceedings of National and International seminar/conferences. Student should follow International practice of seminar report writing (International journals). The candidate will deliver a talk on the topic and the assessment will be made on the basis of term work and the talk thereon by internal examiner i.e. guide as appointed by the Principal of the institution. Seminar topics from text and reference books will not be accepted

CE549: Advanced Fluid Mechanics Laboratory

Teaching scheme:		**Evaluation Scheme:**	
Lectures	0 hour/Week	Term Work	25 Marks
Practical	4 hours/Week	Viva-voce	25 Marks
Total Credits	02		

Course Objectives: Student will be able to:

i) Interpret the flow around immersed lamina.
ii) Plot flow net.
iii) Analyze various discharge measuring devices.

Performance of experiments based on studies is expected by the candidates during Advanced Fluid Mechanics Laboratory. Students have to perform minimum eight of following experiments in the laboratory.

1. Flow around immersed lamina using Hele shaw model
2. Study on electric analogy apparatus (design experiment)
3. Verification of Bernoulli's equation
4. Study of hydraulic jump
5. Calibrations of at least two hydraulic weirs (design experiment)
6. Study experiment on infiltrometer/evaporimeter
7. Calculation of flow profiles in hydraulic channel(design experiment)
8. Behavior of sediment particles in river model
9. Experiment on wind tunnel
10. Assignment on model analysis (design experiment)

Candidates are required to submit the duly completed journals before the end of semester.

CE550: Hydraulic Structures

Teaching scheme:	**Evaluation Scheme:**	
Lectures 3 Hrs/Week	Test	20 Marks
Tutorial 1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits 04	End-Semester Examinations: 60 Marks	

Course Educational Objectives:

1. Student will know the different terminologies related with hydraulic structures.
2. Student will be able to design different hydraulic structures such as dams and spillways.
3. Student will be able to decide suitability of individual hydraulic structures in different situation.

UNIT-1

Earthen Dams, types of earthen dams, choice of type of dam, causes of failure of earth dams, design criteria for earth dams, selecting a suitable preliminary section for an earth dam, design of earth dams; stability analysis of slopes: shape of slip surface, and method of slices.

UNIT-2

Seepage through Dam Section and its Control: fundamentals of seepage flow, Laplacian equation and flow net. Determination of top flow line and discharge through dam, seepage force and its effects, steady seepage. Drainage of Embankment: horizontal drain, chimney drain, design of filter, use of impervious core in seepage control. Control of seepage trough foundation, cut off trench, partial cutoff and upstream impervious blanket.

UNIT-3

Gravity dams, forces acting, modes of failure, elementary and practical profile, low and high gravity dam, design of gravity dam, drainage gallery, joints in a gravity dam, foundation treatment in a gravity dam, strengthening and raising of gravity dams, deterioration and repairs of concrete dam, deformation measurement of dam body by plumb lines and off dam reference point.

UNIT-4

Arch dams: types and its suitability, equations of cylindrical shells, general concepts about trial load method and elastic shell method. Hollow gravity dam, structural features, Buttress dam, types: flat slab type, massive head type, multiple arch type and prestressing of buttress dams.

UNIT-5

Spillways - Determination of capacity, types, ogee, side channel, chute, shaft and siphon. Basic principles of hydraulic design, energy dissipation arrangements below spillway. Spillway Gates: Types such as Tainter, drum, vertical lift, automatic gates. Outlets through dams: types, hydraulics of outlet works, river intakes and trash rack.

References:

1. William P. Creager, Joel Justin and Julian Hinds "Engineering for Dams" Vol. I, II and III, John Wiley and Sons, Inc. London
2. Sharma, H.D. "Concrete Dams" Metropolitan Printers, Delhi 110153
3. Garg, S.K. "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, Delhi.

CE551: Water Resources Systems Planning & Management

Teaching scheme:	**Evaluation Scheme:**
Lectures 3 Hrs/Week	Test 20 Marks
Tutorial 1 Hrs/Week	Teacher Assessment 20 Marks
Total Credits 04	End-Semester Examinations: 60 Marks

Course Objectives: Students will be able to:

1. Carry out economic analysis of water resources project
2. Solve the optimization problem in water resources engineering
3. Analyze water quantity and quality management

Unit 1:

Introduction: General Principles of Systems Analysis to Problems in Water Resources Engineering, Objectives of Water Resources Systems, Economic Analysis of Water Resources Systems: Principles of Engineering Economy, Capital, Interest and Interest rate, Time Value of Money, Depreciation, Benefit Cost Evaluation, Discounting Techniques, Socio Economic Analysis.

Unit 2:

Methods of Systems Analysis: Linear Programming Models, Simplex Method, Sensitivity Analysis, Dual Programming, Dynamic Programming Models,

Unit 3:

Non-linear Programming, Gradient Techniques, Stochastic Programming, Simulation, Multi Objective Optimization.

Unit 4:

Water Quantity Management: Surface Water Storage Requirements, Storage Capacity and Yield, Reservoir Design, Water Allocations for Water Supply, Irrigation, Hydropower and Flood Control,Reservoir Operations, Planning of an Irrigation System, Irrigation Scheduling, Groundwater Management, Conjunctive Use of Surface and Subsurface Water Resources

Unit 5:

Water Quality Management: Water Quality Objectives and Standards, Water Quality Control Models, Flow Augmentation, Wastewater Transport Systems, River Water Quality Models. Legal Aspects of Water & Environment Systems: Principles of Law Applied to Water Rights and Water Allocation, Water
Laws. Environmental Protection Law

References:

1. Loucks, D.P., Stedinger, J.R. and Haith, D.A. (1982) —Water Resources Systems Planning and
Analysis“, Prentice Hall Inc. N York
2. Chaturvedi, M.C. (1987), —Water Resources Systems Planning and Management“, Tata McGraw Hill
Pub. Co., N Delhi
3. Hall. W.A. and Dracup, J.A. (1975), —Water Resources Systems“, Tata McGraw Hill Pub. N Delhi
4. James, L.D. and Lee (1975), —Economics of Water Resources Planning“, McGraw Hill Inc. N York
5. Kuiper, E. (1973) —Water Resources Development, Planning, Engineering and Economics“,
Buttersworth, London.
6. Biswas, A.K. (1976) —Systems Approach to Water Management“, McGraw Hill Inc, N York.
7. Taha, H.A. (1996) —Operations Research“, Prentice Hall of India, N Delhi.

CE552: Land And Water Management

Teaching scheme:	**Evaluation Scheme:**
Lectures 3 Hrs/Week	Test 20 Marks
Tutorial 1 Hrs/Week	Teacher Assessment 20 Marks
Total Credits 04	End-Semester Examinations: 60 Marks

Unit 1: Soil, Plant, Water and Atmosphere Relationship

Soil and water as vital resources for agricultural production. Water retention by soil, soil moisture characteristics, field capacity, permanent wilting point, plant available water and extractable water.

Soil irrigability classifications, factors affecting profile water storage. Determination of soil water content, computation of soil water depletion, soil water potential and its components, hydraulic head. Field water budget water gains and water losses from soil, deep percolation beyond root zone, capillary rise.

Evapotranspiration (ET) and irrigation requirement, critical stages of crop growth in relation to irrigation. Irrigation scheduling. Plant water relations, concept of plant water potential, significance of osmotic adjustment. Water movement through soil plant atmosphere system. Development of crop water deficit, crop adaptation to water deficit, morpho physiological effect of water deficit. Management strategies to improve crop productivity under limited water supplies.

Unit 2: Hydrology and Soil and Water Conservation

Soil erosion and types of erosion. Soil loss measurement and estimation. Universal soil loss equation and subsequent its modifications, soil and water conservation structures and their design. Gully control structures and their design. Design and construction of farm pond and reservoir. Application of GIS in soil and water conservation.

Unit 3: Watershed Management

Watershed concept, Identification and characterization of watersheds. Hydrological and geomorphological characteristics of watersheds. Land capability and irrigability classification and soil maps. Principles of watershed management. Development of watershed management plans, its feasibility and economic evaluation.

Unit 4: Irrigation Water Management

Crop water requirements. Soil water depletion, plant indices and climatic parameters. Methods of irrigation, surface methods, overhead methods, Pressurized irrigation system such as drip and sprinkler irrigation. Merits and demerits of various methods. Hydraulics of furrow, check basin and border irrigation, Hydraulics and design of pressurized irrigation systems. Irrigation efficiency and economics of different irrigation systems. Agronomic considerations in the design and operation of irrigation projects, Optimum crop plans and cropping patterns in canal command areas. Quality of irrigation water and irrigation with poor quality water. On farm water management, socio-economic aspects of on farm water management. Scope for economizing the use of water. Reuse of waste water, Treatment of wastewater, treatment of Greywater.

Unit 5: Management of Degraded, Waterlogged and Other Problematic Soils and Water

Water quality criteria and use of brackish waters in agriculture. Excess salt and salt tolerant crops. Hydrological imbalances and their corrective measures. Concept of critical water table depths for crop growth. Agricultural field drainage and theory of flow in saturated soil. Flow net theory and its application. Drainage investigations. Drainage characteristics of various type of soils. Water table contour maps and isobaths maps. Drainage coefficient. Design and installation of surface and subsurface drainage system. Drainage requirements of crops. Drainage in relation to salinity and water table control. Salt-affected soils and their reclamation. Command area development organizational structures and activities. River valley projects, interstate disputes. Water rights and legal aspects. Irrigation water users

association concept and responsibilities. Environmental considerations in land and water resources management.

References:

1. Murthy, V.V.N. (1999) —Land and Water Management Engineering“, Kalyani Publishers, Ludhiana.
2. Scwabe G.O., Fangmeir, D.D. and Elliot W.J. (1996) —Soil and Water Management Systems“, John
Wiley and Sons, N York
3. Michael, B.A.M. (1990) —Irrigation“, Vikas Publishing House Pvt. Ltd. N Delhi.
4. Asawa, G.L. (1996) —Irrigation Engineering“, New Age International Pub. Co. N Delhi.
5. Suresh, R.L. (1999) —Soil and Water Conservation Engineering“, Standard Publishing Co. Delhi.

CE553: Channel and River Hydraulics

Teaching scheme:	**Evaluation Scheme:**
Lectures 3 Hrs/Week	Test 20 Marks
Tutorial 1 Hrs/Week	Teacher Assessment 20 Marks
Total Credits 04	End-Semester Examinations: 60 Marks

Course Objectives: Students will be able to:

1. Carry out energy depth relationship
2. Determine flow profiles in open channel
3. Analyze the hydraulic jump in rapidly varied flow

Unit 1:
Basic concepts of free surface flows: flow regimes, velocity and pressure distribution, kinetic energy and momentum principles, energy-depth relationships, specific energy, critical depth, computation of the critical depth, section factors, hydraulic exponents, specific force diagram, theoretical concepts of channel bed roughness, transitions in channel sections.

Unit 2:
Uniform flow, Chazy‘s equation, Manning‘s formula, roughness coefficients, equivalent roughness, uniform flow computations, gradually varied flow, dynamic equation, classification of flow profiles, GVF in different slopes, Computation methods and analysis: Direct integration, Breese‘s method, Chow‘s method, numerical methods: direct step method, standard step method

Unit 3:
Rapidly varied flow, momentum equation for hydraulic jump, energy loss, classification of jumps, length and location of hydraulic jump in prismatic channel, rolling and ski jumps, energy dissipation works, Flow measurements: thin plate and sharp, broad, round crested weirs, critical depth flumes, Unsteady flows, equation of continuity, equation of motion, uniformly progressive waves, positive and negative surges, flood routing

Unit 4:
Fluvial hydraulics: Origin, ad properties of sediments, size, shape, fall velocity and its effects, orientation, grain size distribution, incipient motion of sediment particles, competency, lift force concept, critical tractive force approach, theoretical and sub theoretical analysis of Shield, White, and Iwagaki, regimes of flow, ripple and dune regime, characteristics,

Unit 5:
Resistance to flow in alluvial streams, basic equations, theories of bed load suspended load, design of stable channels, Lane‘s theory, Kennedy‘s theory, Lacey‘s theory, tractive force methods of design of stable channels, design of stable channels in cohesive soils.

References:
(1) Subramanya K. (1998) —Flow in Open Channels“, Tata Mc Graw Hill Publishing Co.
(2) Chow V.T. (! 979) —Open Channel Hydraulics“, Mc Graw Hill Inc., New York
(3) Garde R, J.and Ranga Raju K.G. (1980) —Mechanics of Sediment Transportation and Alluvial Stream
Problems“ Wiley Eastern Limited, New Age International Limited, New Delhi, Pune
(4) French R.H. (1986) —Open Channel Hydraulics“, Mc Graw Hill Publishing Co., New York

CE554: Elective - II (Neuro Fuzzy Applications)

Teaching scheme:	**Evaluation Scheme:**	
Lectures 3 Hrs/Week	Test	20 Marks
Tutorial 1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits 04	End-Semester Examinations: 60 Marks	

Course Objectives: Students will be able to:

1. Carry out neural network model
2. Determine membership function in fuzzy logic
3. Analyze the neuro-fuzzy computing

Unit 1:

Introduction: Basic concepts of Neural Networks and Fuzzy Logic, Differences between conventional computing and Neuro-Fuzzy computing, Characteristics of Neuro-Fuzzy computing

Unit 2:

Fuzzy Set Theory: Basic definitions and terminology and membership functions œ formulation and parameters, basic operations of fuzzy sets œ complement, intersection, vision, t œ norm and conorm

Unit 3:

Fuzzy Reasoning and Fuzzy Inference: Fuzzy relations, Fuzzy rules, Fuzzy reasoning, Fuzzy Inference Systems, Fuzzy modeling, Applications of Fuzzy reasoning and modeling in Civil Engineering Problems

Unit 4:

Fundamental concepts of Artificial Neural Networks: Model of a neuron, activation functions, neural processing, Network architectures, learning methods.

Unit 5:

Neural Network Models: Feed forward Neural Networks, Back propagation algorithm, Applications of Feed forward networks, Recurrent networks, Hopfield networks, Habbian learning, Self organizing networks, unsupervised learning, competitive learning. Neuro- fuyzzy computing: Hydrologic Modelling Time series Analysis and Modelling, Water Management.

References:

1. Jang, JSR, C.T. Sun and E. Mizutan (1997), —Neuro-Fuzzy and Soft Computing“, Prentice Hall,N J.
2.Simon Haykin, (1994), —Neural Networks, A Comprehensive Foundation“, McMillan College Publishing Company.
3.Kosko, B. (1997), —Neural Networks and Fuzzy Systems“, Prentice Hall of India Pvt. Ltd., NewDelhi.
4.Klir, George J., T.A. Forger, (1995), —Fuzzy Sets, Uncertainty and Information“, Prentice Hall of India, Pvt. Ltd., New Delhi.
5.Rao V and H. Rao,(1996),“C++Neural Networks and Fuzzy Logic, BPB Publications, New Delhi.

CE555: Elective - II (Environmental Evaluation of Water Resources Development)

Teaching scheme:	**Evaluation Scheme:**
Lectures 3 Hrs/Week	Test 20 Marks
Tutorial 1 Hrs/Week	Teacher Assessment 20 Marks
Total Credits 04	End-Semester Examinations: 60 Marks

Unit 1:
Introduction: Environment and its interaction with human activities, Environmental imbalances-Attributes, Impacts, Indicators and Measurements, Concepts of Environmental Impact Assessment (EIA), Environmental Impact Statement, Objectives of EIA, Advantages and Limitations of EIA.

Unit 2:
Principles of environmental engineering, Ecological diversity, its importance and conservation, Ecosystem evaluation, landscape-main ecological elements, Diversity, matrices, patches, corridors, Interrelations of ecological elements in a cultural landscape, Reclamation and environmental engineering, Water resources and ecology, Saving endangered species, International and regional convention on environmental protection.

Unit 3:
Environmental Indicators, Indicators for climate, Indicators for terrestrial subsystems, Indicators for aquatic subsystems, Selection of Indicators, Socio-economic indicators, Indicators for economy, Social indicators, Indicators for health and nutrition, Cultural indicators

Unit 4:
Environmental issues in water resource development œ Land Use œ Soil erosion and their sort and long term effects œ Eco system studies œ Flora œ Fauna œ Aquatic and terrestrial ecosystems, ecosystem balance Disturbance and long term impacts, Changes in quantity and quality of flow Sedimentation œ Environmental impact assessment of water resources development structures œ Case Studies.

Unit 5:
Water Quality Impact Assessment: Attributes to be Considered, Water Quality Impact Assessment of Water Resources Projects, Data Requirement of Water Quality Impact Assessment for Dams, Impacts of Dams on Environment, Case Studies. Methodologies for Carrying Environmental Impact Assessment: Overview of Methodologies Adhoc, Checklist, Matrix, Network, Overlays, benefit Cost Analysis, Choosing a Methodology, Review Criteria.

References:
1. Jain, R.K., Urban, L.V.,Stracy, G.S., (1991), —Environmental Impact Analysis“, Van Nostrand Reinhold Co., New York
2.Rau, J.G. and Wooten, D.C., 91996), —Environmental Impact Assessment“, McGrew Hill Pub. Co.,New York
3.Canter, L.W., (1997), —Environmental Impact Assessment“, McGrew Hill Pub. Co., New York

CE556: Elective - II (Water Power Engineering)

Teaching scheme	**Evaluation Scheme**
Lectures: 3 hours/week	Test: 20 Marks
Tutorials: 1 hour/week	Teacher Assessment: 20 Marks
Total Credits: 04	End-Semester Examination: 60 Marks

Course Educational Objectives:

1. Student will know the different terminologies related with water power engineering.
2. Student will be able to assess hydro power potential.
3. Student will be able to know and plan different structures for hydro power generation.
4. Student will be able to decide suitability of individual power plant in different situation.

Course Educational Objectives:

1. Student will know the different terminologies related with water power engineering.
2. Student will be able to assess hydro power potential.
3. Student will be able to know and plan different structures for hydro power generation.
4. Student will be able to decide suitability of individual power plant in different situation.

UNIT-1

Water Power, sources of energy, status of power in world, place of hydropower in a power system, choice of type of generation. Basic water power equation, estimation of discharge and head available. Classification of hydel plants, run-of-river plant, general arrangement of run off river plant, valley dam plants, diversion canal plants, storage and pondage and illustrative examples.

UNIT-2

Nature of demand: Load curves, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm and secondary power and prediction of load. Intakes: types, elements of an intake, losses in intakes, air entrainment at intakes, inlet aeration, canal, forebay and tunnel.

UNIT-3

Conveyance System: Classification of penstock, design criteria for penstock. Economical diameter of penstock, anchor blocks, conduit valves, and types of valves, bends and manifold, water hammer, Tail Race: Functions, Surge tank: Function, location, types such as simple, restricted orifice and differential.

UNIT-4

Power station: surface power station, power house structure, power house dimensions, lighting and ventilation, variations in design of power house. Underground power station, location of underground power station, type of underground power station, Advantages and limitations of underground power house, Comparison of underground and surface power station and types of layouts.

UNIT-5

Pumped storage plants: concepts, general layout and types. Tidal power stations: concepts, general layout, classification, types. Other types of power plant: depression power plant and

micro power station. Turbines: classification, Francis turbine, Pelton and Kaplan turbines, choice of type. Turbine setting, cavitations, draft tubes: function and principle types.

References:

Dandekar M.M. and Sharma K.N. — "Water Power Engineering” Vikas Publishing. House Pvt. Ltd. New Delhi
Brown, G. Etal — "Hydro electric engineering practice" Vol. I, II and III.

CE557: Seminar-II

Teaching scheme:	Evaluation Scheme:
Practical : 2 hours/Week	Term Work: 25 Marks, Practical Exam: 25 Marks

Course Objectives: Student will be able to:

1. Carry out the literature survey on a particular topic of interest.
2. Compare different methodologies to analyze the given assignment
3. Carry out model formulation and model analysis

Topic of the seminar II shall be decided in such a way that it will enhance the knowledge of the student in a particular topic which is not covered in the syllabus. It is expected that the students should refer the journals, and proceedings of National and International seminar/conferences. Student should follow International practice of seminar report writing (International journals). The candidate will deliver a talk on the topic and the assessment will be made on the basis of term work and the talk thereon by internal examiner i.e. guide as appointed by the Principal of the institution. Seminar topics from books will not be accepted.

CE 558: WATER RESOURCES SOFTWARE LABORATORY

Teaching scheme:

Practical: 2 hrs/week

Evaluation Scheme:

Term Work : 25 Marks

Practical Exam: 25 Marks

Course Objectives: Student will be able to:

i) Learn different software related to water resources engineering
ii) Analyze optimization models using different softwares
iii) Solve real problems using these softwares

Learning of software and solving examples is expected by the students during software laboratory work. Minimum TWO of the following are required to perform in the software laboratory.

1. Study on Fluid Flow software
2. Study on Kanal ++ software
3. Working on GRAM++ software
4. Application of MATLAB and its toolboxes
5. Arc GIS & SWAT model for water resources
6. Working in LINGO environment for water resources application
7. Working in SPSS for water resources application
8. Study on HEC-6 model
9. Study on Aquifer Well test
10. Application of ground water vistas
11. Study on DAMBRK software
12. Study on River CAD model

Students are required to submit the duly completed journals at the end of semester.

GE 611 : Research Methodology (Institute Elective)

Teaching scheme	**Evaluation Scheme**
Lectures: 3 hours/week	Test: 20 Marks
Tutorials: 1 hour/week	Teacher Assessment: 20 Marks
Total Credits: 04	End-Semester Examination: 60 Marks

Unit-I

Objectives of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem, Selecting the Problem, Technique Involved in Defining a Problem, Research Design, Important Concepts Relating to Research Design, Developing a Research Plan, Literature review.

Unit-II

Data analysis, Types of data, process of data analysis: sampling, cleaning etc. Classification and Presentation of data, Basic Concepts of Probability, Probability Axioms, Analysis and Treatment of Data, smoothening of Data, Population and Samples, Measures of Central Tendency, Measures of Dispersions, Measures of Symmetry, Measures of Peakedness. Regression Analysis – Simple Linear Regression, Multiple linear Regression, Correlation.

Unit-III

Optimization Techniques: Linear Programming, Simplex Method, Dual Simplex, Sensitivity Analysis. Artificial Variable Technique, Dynamic Programming, Introductory concepts of non-linear programming.

Unit-IV

Fuzzy logic: Introduction, Concepts, Basic Fuzzy Mathematical Operations, Fuzzy databases, Membership Functions, Fuzzy Linear Programming, Neural Networks: Artificial Neural Networks, architectures and algorithms, Basic neuron models, Neural network models, Learning algorithms, Genetic Algorithms: Introduction to genetic algorithm, Operators, Applications.

Unit-V

Interpretation and Report Writing: Meaning of Interpretation, Techniques of Interpretation, Significance of Report Writing, Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report

References:

1. S.P.Gupta, " Statistical Methods", S. Chand & Sons.
2. Kothari C.R.(2011), " Research Methodology-Methods and Techniques", New Age International Publishers, New Delhi.
3. Gupta S.L. and Gupta Hitesh (2011), “Research Methodology-Text and cases with SPSS applications” International Book House Pvt. Ltd., New Delhi.
4. Rao V and H. Rao, (1996), “C^{++}, Neural Networks and Fuzzy Logic”, BPB Publications, New Delhi.

5. Goldberg, D.E. (2000), “Genetic Algorithms in Search, Optimization & Machine Learning”, Addison Wesley Longman (Singapore) Pte. Ltd., Indian Branch, Delhi.
6. George J. Klir and Bo Yuan (2010), “Fuzzy Sets and Fuzzy Logic”, PHI Learning Pvt. Ltd, New Delhi

CE612: Dissertation Part-I

Teaching Scheme:

Practical : 24hours/Week

Evaluation Scheme:

Term Work : 50 Marks

Practical exam: 50 Marks

The dissertation shall consist of research work done by the candidate or a comprehensive and critical review of any recent development in the subject or a detailed report of project work consisting of experimentation /numerical work, design and or development work that the candidate has executed.

In part I of dissertation it is expected that the student should refer national and international journals, proceedings of national and international seminar/ conferences. Emphasis should be given to introduction of topic, literature reviews, objectives of the study along with some preliminary work/experimentation carried out on dissertation topic.

Student should submit part I dissertation report (soft bound in three) copies covering the content discussed above and highlighting the features of work to be carried out in part II of the dissertation. Student should follow International practice of dissertation writing (International journals).

The candidate will deliver a talk on the topic and the assessment will be made on the basis of term work and talks thereon by internal examiner i.e. guide as appointed by the Principal of the institution.

CE613: DISSERTATION PART – II

Teaching scheme:
Practical: 24 hours/Week

Evaluation Scheme:
Term Work: 50 Marks,
Viva Voce: 150 Marks

The part – II of dissertation will be continuation of part-I. After completion of work satisfactorily the examinee shall submit the dissertation in soft bound two copies to the head of the department. The examinee shall present the pre-synopsis of dissertation work before two internal examiners out of which one will be the guide. The suggestions given by these two examiners should be incorporated before submitting the final four copies to the head of the institution. The term work marks should be submitted to the controller of the examinations by the internal guide, he should take into account the opinion of other two examiners who were present at the time of pre-synopsis.

Viva-voce examination shall consist of defense presented by the examinee on his/ her work in the presence of other teachers and students and two examiners appointed by the head of the institution, one of whom will be the guide and second will be external examiner.