Biju Patnaik University of Technology, Orissa
Rourkela

Syllabus
of
M.Tech

in

CIVIL ENGINEERING

(Specialization: Water Resource Engineering & Management / Water Resource Engineering)

From 2014 -2015 Academic Session

Syllabus for Water Resource Engineering & Management/Water Resource Engineering

1st Semester				2nd Semester			
Theory (Compulsory)				**Theory (Compulsory)**			
Code	**Subject**	**Contact Hours (L-T-P)**	**Credit**	**Code**	**Subject**	**Contact Hours (L-T-P)**	**Credit**
WRPC101	Advanced Fluid Mechanics	4-0-0	4	WRPC 201	Water Resources System and management	4-0-0	04
WRPC102	Applied Hydrology	4-0-0	4	WRPC 202	Free Surface Flow	4-0-0	04
WRPC103	Ground water Hydrology	4-0-0	4				
Professional Elective-I (any One)				**Professional Elective-III (any One)**			
WRPE 101	GIS and Remote Sensing	3-0-0	03	WRPE 201	Design of Irrigation Structure	3-0-0	03
WRPE 102	Water Supply Systems	3-0-0	03	WRPE 202	Integrated Watershed Management.	3-0-0	03
WRPE 103	Enviornmental Systems Engineering	3-0-0	03	WRPE 203	Environmental impact assessment and auditing	3-0-0	03
Professional Elective-II (any One)				**Professional Elective-IV (any One)**			
WRPE 104	Computational method and Computer Programming	3-0-0	03	WRPE 204	Fluvial Hydraulics	3-0-0	03
WRPE 105	Modelling Simulation and Optimization	3-0-0	03	WRPE 205	Irrigation and Drainage	3-0-0	03
WRPE 106	Advanced Numerical Methods	3-0-0	03	WRPE 205	Hydro Power Engineering	3-0-0	03
Credits (Theory)			**18**				
				Professional Elective-V (any One)			
				WRPE 206	Advance Construction Materials	3-0-0	03
				WRPE 207	Finite Element Analysis of Structures	3-0-0	03
				WRPE 208	Neuro Fuzzy Application in Civil Engineering	3-0-0	03
				Credits (Theory)			**17**
Practical/Sessionals				**Practical/Sessionals**			
`WRPR 102	Hydraulic and Hydrologic Engineering Laboratory	0-0-3	02	WRPR 201	Design of Hydraulic System.	0-0-6	04
WRPR 101	Software Laboratory	0-0-3	02	WRCV 201	Comprehensive Viva	0-0-3	02
WRPT 101	Technical Seminar	0-0-3	02	WRPT 201	Technical Seminar	0-0-3	02
Credits(Practicals/Sessionals)			**06**	**Credits(Practicals/Sessionals)**			**08**
Total Semester Credits			**24**	**Total Semester Credits**			**25**
Total Cumulative Credits			**24**	**Total Cumulative Credits**			**49**
3rd Semester				**4th Semester**			

OE	**Open Electives (any ONE)**						
WROE 301	Disaster Management and Mitigation.	3-0-0	03				
WROE 302	Non Conventional Energy	3-0-0	03				
WROE 303	Project Planning and Management	3-0-0	03				
Credits (Theory)			**03**	**Credits (Theory)**			**00**
Practical/Sessionals				**Practical/Sessionals**			
WRPT 301	Thesis Part - I	0-0-3	14	WRPT 401	Thesis Part - II	0-0-6	20
Credits (Practical/Sessional)			**14**	WRPT 402	Technical Seminar	0-0-3	02
Total Semester Credits			**17**	WRCV 401	VIVA	0-0-3	02
				Credits (Practical/Sessional)			**24**
				Total Semester Credits			**24**
				Total Cumulative Credits			**90**

Advanced Fluid Mechanics

Description of fluid flow: with reference to translation, rotation and deformation concept of continuum, control mass & control volume approach, Reynolds transport theorem. Steady flow and uniform flow.

Velocity field, one & two-dimensional flow analysis, circulation and vorticity, stream function and velocity potential function, potential flow, standard flow patterns, combination of flow patterns, flow net.

Dimensional Analysis as a tool in design of experiments, identification of non-dimensional numbers and their significance, dimensional analysis methods.

Equations of motion for laminar flow of a Newtonian fluid - Viscous flow – Navier-Stoke's equations, simple exact solutions.

Boundary Layer Theory-Formation, growth and separation of boundary layer-Integral momentum principles to compute drag and lift forces-Mathematical models for boundary layer flows.

Turbulence, Origen of turbulence universal velocity distribution laws of turbulence, smooth rough and transitional turbulent flow in pipes, pipe resistance equation for pipes design of pipe networks.

Diffusion and dispersion of pollutants in natural streams.

References:

1. Som S. K and Biswas G "Introduction to Fluid Mechanics and Fluid Machines",TMH
2. Schlichting: "Boundary Layer theory", International Text – Butterworth
3. Fox R.W., Pitchard P.J, and Mcdonald A "Fluid Mechanics" Wiley India.
4. Rouse, H. "Advanced Fluid Mechanics", John Wiley & Sons, N York
5. White, F.M. "Viscous Fluid Flow", McGraw Hill Pub. Co, N York
6. Yalin, M.S. "Theory of Hydraulic Models", McMillan Co.
7. Mohanty A.K. "Fluid Mechanics", Prentice Hall of India, N Delhi.

Applied Hydrology

Introduction: Hydrologic Cycle, Systems Concept, Hydrologic model classification. Hydrologic Processes: Reynolds Transport Theorem. Atmospheric circulation: Water Vapour, Precipitable water, Thunderstorm cell

model. Evaporation: Energy balance method and Aerodynamic method. Evapotranspiration. Subsurface water: unsaturated flow, Richard's equation. Infiltration: Horton's and Phillip's equations. Green-Ampt Method, Ponding time. Surface Water: Hydrograph Analysis, SCS method, Effective Rainfall, Runoff, Runoff Components, Direct Runoff Hydrograph.

Unit Hydrograph Theory: Linear Time Invariant System, Response Functions of Linear Systems, Derivation of Non Parametric Unit Hydrograph From Single Storm and Multi Storm Events, S - Curve Hydrograph, Instantaneous Unit Hydrotherapy.

Rainfall – Runoff Analysis: Review of Rational Methods, Conceptual Models, Parametric Unit Hydrograph, Clarke, Nash and Dooge Models, Hydrologic Simulation Models, Stanford Watershed Model, Derivation of Unit Hydrograph for Ungagged Catchments, Synthetic Unit Hydrograph.

Hydrologic Time Series Analysis: Independent and Autocorrelated Data, Structure of a Hydrologic Time Series, Trend, Jump and Seasonality, Stationarity and Ergodicity, Autocovariance and Auto Correlation Function, Correlogaram Analysis, Spectral Analysis, Analysis of Multivariate Hydrologic Series. Modelling of Hydrologic Time Series: Data Generation Techniques, Linear Stochastic Models, Autoregressive, Moving Average, ARMA Models, Modelling of Nonstationary and seasonal Series, Thomas – Feiring Model, ARIMA Models.

Hydrologic Flood Routing: Reservoir Routing, Channel Routing, Estimation of Parameters of Flood Routing Models, Flood estimation and flood frequency studies, Real Time Flood Forecasting.

References:

1. Chow, V.T., Maidment, D.R. and Mays, L.W. "applied Hydrology", McGraw Hill Inc. N York
2. Singh, V.P. "Hydrologic Systems,", Prentice Hall Inc., N York
3. Haan C.T., "Statistical Methods in Hydrology", East West Press, New Delhi
4. Viessman, W., Lewis, G.L. and Knapp, J.W. "Introduction to Hydrology", Harper & Row Publications Inc., Singapore.
5. Ponce, W.F. "Engineering Hydrology", Prentice Hall Inc. N York.
6. Kottegoda "Stochastic Processes in Hydrology", Prentice Hall, Inc., N Jersey
7. Patra K.C "Hydrology and Water resources Engineering", Narosa publishing house, New Delhi

Ground Water Hydrology

Well Hydraulics: Aquifers and Aquifer Parameters, Darcy's law, Hydraulic Conductivity and its Characteristics, Dupuit Equation, Groundwater Flow Direction Steady Groundwater Flow, Groundwater Flow Equation, Estimation of Aquifer Parameters from Pumping Test Data, Graphical Techniques and their

Limitations, Groundwater Well Losses, Interference among Wells, Potential Flow, Image well theory and its Application in Groundwater Flow.

Water Well Design and Well Drilling: Well Screen, Development and Completion of Well, Rotary Drilling and Rotary Percussion Drilling, maintenance of Wells.

Hydrogeology: Porosity and Permeability of Rocks, Groundwater in Igneous, Metamorphic, Sedimentary Rocks and Non Industrated Sediments, Hydrogeological Regions of India.

Surface and Subsurface Geophysical methods for Groundwater Explorations.

Groundwater Management: Conjunctive Use, Alternative Basin Yields, Artificial Recharge of Groundwater, Groundwater Quality. Groundwater Modelling: Groundwater Flow, mathematical, Analog and Digital modeling, Regional Groundwater Modelling.

References:

1. Walton, W.C. “Groundwater Resources Evaluation”, McGraw Hill Inc, n York
2. Todd, D.K. “Groundwater Hydrology”, John Wiley & Sons, Singapore
3. Johnson, E.E. ”Groundwater”, E. Johnson Inc. Washington.
4. Raghunath, H.M. “Groundwater”, Wiley Eastern Ltd, N Delhi
5. Sharma, H.D. and Chawla, A.S. “Manual on Groundwater and Tube Wells”, Technical Report No. 18, CBIP, New Delhi,
6. Davis, S.N. and De Weist, R.J.M. “Hydrogeology”, John Wiley & Sons, N York.
7. Domenico “Concepts and models in Groundwater Hydrology”, McGraw Hill Inc. N York
8. Garg, S.P. “Groundwater and Tube Wells”, Oxford and IBH Publishing C. N Delhi.

GIS and Remote Sensing

Remote sensing- introduction, physics of remote sensing- electromagnetic radiations and their characteristics, thermal emissions, multi-concept in remote sensing, remote sensing satellites and their data products, sensors and orbital characteristics, spectral reflectance curves for earth surface features, methods of remotely sensed data interpretation- visual interpretation, concept of fcc, digital image processing- digital image and its characteristics, satellite data formats, image rectification and restoration, image enhancement- contrast manipulation, spatial feature manipulation, multi-image manipulation

Fundamentals of GIS: introduction, definition of GIS, evolution of GIS, roots of GIS, definition, GIS architecture, models of GIS, framework for GIS, GIS categories, map as a model, spatial referencing system, map projections, commonly used map projections, grid systems, cartographic symbolization, types of maps, typography, map design, map productions, map applications, data management, models and quality issues: conceptual models, geographical data models, data primitives, data types - raster and vector approach, digital terrain modeling , approaches to digital terrain data modeling , acquisition of digital terrain data, data modeling

and spatial analysis, sources of geographical data, data collectors and providers, creating digital data sets, data presentation, data updating, data storage

GIS data processing, analysis and visualization: raster based GIS data processing, vector based GIS data processing, human computer interaction and GIS, visualization of geographic information, principles of cartographic design in GIS, generation of information product, image classification and GIS, visual image interpretation, types of pictorial data products, image interpretation strategy, image interpretation process,

Rainfall runoff modeling using remote sensing inputs, Flood and Drought Studies – Flood plain zoning – inundated areas – evaluation models – Drought assessment and Monitoring. Command Area Studies – Cropping patterns, conditions of crops, irrigation system performance – crop yield estimation.

References:

1. Meijerink A.M.J., H.A.M. de Brouwer, C.M. Mannaerts and C.R. Valenzuela, "Introduction to the use of Geographic Information Systems for Practical Hydrology", ITC Publication, Paris.
2. Lillesand T.M. and Kiefer R.W., "Remote Sensing and Image Interpretation", John Wiley and Sons, N York.
3. Swain P.H., and S.M. Davis, "Remote Sensing – The Quantitative Approach", McGraw Hill Publishing Company, N York.
4. Reddy M.A "Remote Sensing And GIS", , B.S. Publication, Hyderabad
5. Kang-Tsung Chang "Introduction Of GIS" , Tata Mcgraw-Hill, New Delhi
6. Lyon, J.G. and Mc Larthy, J. "Wetland and Environmental Application of GIS", Lewis Publishers, Washington.

Water Supply Systems

Instructions: Water Requirements, Sources of Water, Water Supply Considerations, 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.

Conventional treatment Processes: Sedimentation, Type of Sedimentation, Zone Setting, Filtration, Gravity Granular-Media Filtration, Head Losses, Back Washing and Media Fluidization – Pressure Filters – Slow Sand Filters, Coagulation and Flocculation Coagulants, Coagulants, Coagulant Aids, Rapid Mixing Devices, Disinfection, Disinfection Methods, CI2 handling and Dosage, Control of Thms, Fluoridation, Defluoridation.

Water Softening: Lime soda Process, Variations-Ion Exchange Softening and Nitrate Removal.

Iron and Manganese Removal: Iron Corrosion, Water Stabilization-Cathodic Protection.

Taste and Odour: Methods for Control, Aeration, Adsorption, Control of Algae Growth.

Reduction of Dissolved Salts: Distillation, Reverse Osmosis, Electro dialysis.

Transportation and Distribution of Water: Aqueducts, Hydraulic Consideration, Design of Transportation System, Distribution Reservoirs and Service Storage.

References

1. Viessman Jr., Mark J. Hammer "Water Supply and Pollution Control". Mc Graw Hill International Edition.
2. Peavy, H.S., H.S., Row, D.R. and Tchobanaglous, G. "Environmental Engineering". Mc Graw Hill International Edition.
3. Fair, Geyer, Okun "Water Supply Engineering". John Wiley.
4. Turbuit T H Y "Principles of Water Quality Control", Pergamon Press.

Enviornmental Systems Engineering

Physical phenomena: Transport, Gas Transfer – Two film theory, thermal phenomena, Sedimentation, Continuous Flow Models.

Chemical phenomena: Solution Equilibriums, Reaction Kinetics, Carbonate Equilibriums, Colloidal Behavior.

Biologic phenomena: Organic Materials, Microorganisms, Growth Kinetics, Biochemical Oxygen Demand, Aerobic and Anaerobic Decomposition.;

Ecological Systems: Models, Analytical Solutions, Time Domain Simulation, Continuous Flow Microbiological Systems, Pesticide Concentration, Eutrophication.

Natural Transport Systems: Basic Models Dissolved Oxygen System, Streams, and Estuaries.

Planning Factors: Water Quality Criteria and Standards, Radiological Health, Environmental Impact Statements, Population Growth Models, Regional Growth Model, Time Capacity, Expansion of Systems.

Engineered Transport Systems: Pipe Network Analysis, Water Distribution Systems.

Water Treatment systems: Treatment Trains, Lagoon Systems, Individual Household Systems.

References:

1. Rich, L.G. "Environmental Systems Engineering", McGraw Hill Inc.
2. Sincero, A.P. and Sincero, G.A. "Environmental Engineering - A Design Approach", Prentice Hall of India, n Delhi.
3. Peavy H.S. Row D.R. and Tchobanaglous G "Environmental Engineering", McGraw Hill International Edition.
4. Hammer M.J. and Hammer M.J. Jr. "Water & Wastewater Technology", Prentice Hall of India, N Delhi

Computational method and Computer Programming

Numerical Solution of Ordinary Differential Equations-Solution by Taylors's Series-Euler's Method- Runge Kutta Methods. Multistep methods, Predictor corrector methods. Simultaneous and Higher Order Equations-Boundary Value Problems-Applications.Finite Difference Method-Finite Difference. Representation of Differential Equations-Stability-Consistency and Convergence of Partial Differential Equations-Time integration-Finite Difference Methods in Solution of Steady and Unsteady Problem-Jacobi's Method, Gauss Seidel Method. Classification and Presentation of Data – Basic Concepts of Probability – Probability Axioms – Analysis and Treatment of Data – Population and Samples – Measures of Central Tendency – Measures of Dispersion- Measures of Symmetry – Measures of Peakedness.

Probability Distributions – Discrete and Continuous Probability Distribution Functions – Binomial, Poisson, Normal, Lognormal, Exponential, Gamma Distributions, Extreme Value Distributions – Transformations to Normal Distributions, .

Parameter Estimation – Method of Moments, Method of Maximum Likelihood, Least Square Method, Joint Probability Distributions.

Regression Analysis – Simple Linear Regression, Evaluation of Regression – Confidence Intervals and Tests of Hypotheses – Multiple Linear Regression – Correlation and Regression Analysis.

References:

1. Akai, T.J, "Applied Numerical Methods for Engineers", John Wiley Inc., New York.
2. Haan C.T. "Statistical Methods in Hydrology",. East West Press, New Delhi
3. Huyorkon, P.S. and Pinder, G.F.: Computational Methods in Subsurface Flow", Academic Press.
4. Press, W.H., Flannery B.P. and Tenklsky, S.A. and Vetterling, W.T. "Numerical Recipes-The Art of Scientific Computing", Cambridge University Paress, Ccmbridge.
5. Kosho, B "Neural Networks and Fuzzy Systems", Prentice Hall of India, N Delhi.

Modelling, Simulation and Optimization

Systems and Models: Fundamentals of systemic approach, system modeling, classification of models, model structure, Linear, non-linear, time-invariant, time variant models, State-space models, Distributed parameter models, System Synthesis, Direct and inverse problems, Role of optimization, Role of computers, examples from hydrology/water resources engineering

Regression Analysis: Linear and Multiple Regression analysis, analysis of residues, tests of goodness of fit, Parsimony criterion, role of historical data, examples from hydrology / water resources engineering.

Spatial Distribution: Polynomial surfaces, Kirging, Spline functions, Cluster Analysis

Time Series Analysis: Auto-cross correlation analysis, identification of trend, spectral analysis, identification of dominant cycles, smoothening techniques, Filters, time series of rainfall and stream flow.

Random variables: Basic concepts, probability density distribution functions, Expectation and standard deviation of discrete and continuous random variables and their functions, covariance and correlation, commonly used theoretical probability distributions (uniform, normal, binomial, poisson's and negative exponential), Fitting distributions to raw data, Chi-square and Kolmogrov-Smirnov;s tests of the goodness of fit, Central limit theorem, various algorithms for generation of random numbers

Monte Carlo simulation: basic concepts, generation of synthetic observations, statistical interpretation of output, Evaluation of definite integrals,

Optimization: Introduction, Classical methods, Linear Programming, Dynamic Programming, Nonlinear optimization, Constrained optimization techniques

Reference Books

S. No.	Name of Authors/Books/Publishers
1.	Law, A.M. and Kelton, W.D., "Simulation Modeling and Analysis", Tata McGraw Hill.
2.	Daniel, C. and Wood, P.S., "Fitting Equations to Data", John Wiley.
3.	Ljung, L., "System Identification Theory for the Users", Prentice Hall.
4.	Rao S. S., "Engineering Optimization,Theory and Pratice", New Age International Publishers.
5	Deb, K., "Optimization for Engineering design", Prentice Hall of India.
6	Vedula S. and Mujumdar P. P. "Water Resources Systems", Tata McGraw Hill.

Advanced Numerical Methods

Module 1: Introduction to digital computers & Programming - an overview; Errors - polynomial approximations and interpolations - Numerical differentiation & Integration;

Module 2: Evaluation of single and multiple integrals, Newton's method, variational and weightened residual methods., Matrices – Linear equations, Eigenvalues and Eigenvectors - nonlinear equations,

Module 3: Harmonic and biharmonic equations - solutions, convergence, completeness & stability.

Module 4: Initial and boundary value problems of finite difference method, Implicit & Explicit scheme.

References

1. Jain M.K, SRK Iyenge and RK Jain."Numerical Methods for Scientific & Engg. Computation".
2. Mathews J. H "Numerical Methods for Mathematics, Science and Engineering".
3. Gerld C.F and PO Wheatley "Applied Numerical Analysis".
4. Gupta S.C and V. K. Kapoor "Fundamentals of Applied Statistic", Sultan Chand & Sons.
5. Johnson R.A " Probability and Statistics for Mngineers.

6. Rajeshwaran S, “Numerical Methods in Science & Engineering (A Practical Approach)” , Willey Publication.

Water Resources System and Management

Introduction: General Principles of Systems Analysis to Problems in Water Resources Engineering, Objectives of Water Resources Planning and Development, Nature of Water Resources Systems, Socio Economic Characteristics.

Economic Analysis of Water Resources System: Principles of Engineering Economy, Capital, Interest and Interest Rates. Time Value of Money, Depreciation, Benefit Cost Evaluation, Discounting Techniques, Economic and Financial Evaluation, Socio-Economic Analysis.

Methods of Systems Analysis: Linear Programming Models, Simplex Method, Sensitivity Analysis, Dual Programming, Dynamic Programming Models, Classical Optimisation Techniques, Gradient Techniques, Stochastic Programming, Simulation, Search Techniques, Multi Objective Optimisation.

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, Design of Water Conveyance and Distribution Systems.

References:

1. Loucks, D.P., Stedinger, J.R. and Haith, D.A. “Water Resources Systems Planning and Analysis”, Prentice Hall Inc. N York
2. Chaturvedi, M.C. “Water Resources Systems Planning and Management”, Tata McGraw Hill Pub. Co., N Delhi.
3. Hall. W.A. and Dracup, J.A. “Water Resources Systems”, Tata McGraw Hill Pub. N Delhi
4. James, L.D. and Lee “Economics of Water Resources Planning”, McGraw Hill Inc. n York
5. Kuiper, E. “Water Resources Development, Planning, Engineering and Economics”, Buttersworth, London
6. Biswas, A.K. “Systems Approach to Water Management”, McGraw Hill Inc. N York
7. Major, D.C. and Lenton, R.L., “Applied Water Resources System Planning”, Prentice-Hall Inc, N.Jersey
8. Taha h A, “Operations Research”, Prentice Hall of India, N Delhi.

Free Surface Flow

Basic Concepts of Free Surface Flow, classification of flow, velocity & pressure distribution. Conservation laws: continuity equation, momentum equation,

Velocity and Pressure distribution in channel, Uniform flow, Efficient section, Section of constant velocity, Specific energy, Critical depth, Section factor, First hydraulic exponent M, Second hydraulic exponent N, Compound section

Non-uniform flow, Gradually varied flow, Characteristic of surface profiles, Integration of varied flow equation, Estimation of N and M for trapezoidal channel

Rapid varied flow, Hydraulic jump, classification, location and length of hydraulic jump, jumps in Non-rectangular channel, Jumps as energy dissipater, Surges in open channel, Positive surges, Negative surges

Sharp crested weir, submergence, Ogee spillway: Uncontrolled, Gated, Contraction; Broad crested weir, Sluice gate flow.

References:

1. Chow .V.T. "Open Channel Hydraulics", McGraw Hill . N York
2. Henderson. "Open Channel Flow", McMillan Pub. London..
3. Subramanya, K "Flow in Open Channels", Tata McGraw Hill Pub., 1995
4. Grade and Ranga Raju, K.G. "Mechanics of Sediment Transportation and Alluvial Stream Problems", Wiley Eastem, N Delhi
5. Chaudhry M.H. "Open – Channel Flow", Prentice Hall of India, N Delhi
6. French, R.H. "Open Channel Hydraulics", McGraw Hill Pub Co., N York

Design of Irrigation Structure

Concrete Dams : Investigation and Planning. Forces on Concrete dams, Types of loads, Stability analysis. Safety criteria, Gravity analysis, Internal stress calculation and Galleries. Joints and keys and cooling arrangement. Water stops at joint, closing gaps. Buttress and Arch Dam. Mass concrete for dams: Properties and quality control. Pressure grouting.

Spiilway : Types, Design principles of Ogee spillway, side channel spillway, Chute spillway, Syphon Spillway, shaft Spillway, Gates & Valves. Energy dissipators and stilling basin design. Outlet works.

Earth and rock fill Dams : subsurface explorations methods, cutoff trenches, sheet piling cutoffs, upstream blankets, horizontal drainage blankets and filters, toe drains and drainage trenches, pressure relief well. Seepage through embankments, Stability analysis of slopes of homogeneous and zoned embankment type under different reservoir conditions, Upstream and downstream slope protection measures.

Diversion Head works: Components, Weir, Design of impervious floor, Khosla's theory

Canal Regulations works: Canal Fall, its type and design methods, Canal outlets.

References:

1. Varshney R.S. "Concrete Dams", Oxford & IBH Publication Co..
2. Stewart L., Flayd E. Dominy " Design of Small Dams", Oxford & IBH Publication Co..
3. Punmia B.C. Lal B.B. Pande, Jain A. K. Jain A. K. "Irrigation and Water Power Engineering", Laxmi Publications (P) Ltd.

Integrated Watershed Management

Introduction, concept of watershed, need for watershed management, concept of sustainable development.

Hydrology of small watersheds.

Principles of soil erosion, causes of soil erosion, types of soil erosion, estimation of soil erosion from small watersheds.

Control of soil erosion, methods of soil conservation – structural and non-structural measures.

Principles of water harvesting, methods of rainwater harvesting, design of rainwater harvesting structures.

Artificial recharge of groundwater in small watersheds, methods of artificial recharge.

Reclamation of saline soils.

Micro farming, biomass management on the farm.

References:

1. Chatterjee, S. N., Water Resources Conservation and Management, Atlantic Publishers.
2. Murthy, V.V.N., Land and Water Management, Khalyani Publishers.
3. Muthy, J. V. S., Watershed Management, New Age International Publishers.
4. Suresh Rao, Soil and Water Conservation Practices, Standard Publishers.

Environmental impact assessment and auditing

Sustainable Development.Framework for Environmental Impact Assessment. screening, Scoping and Base line Studies, Significance and Importance of Impacts, Mitigation aspects, Assessment of alternativees, Public Hearing, Decision Making. Assessment of impacts on physical resources, ecological resources, human use values and quality of life values.

Impact assessment methodologies -various methods, their applicability. Strategic Environmental Assessment. Environmental Management Planning. Disaster management planning.

Concepts of environmental audit, objectives of audit. Types of Audits; Features of Effective auditing; Programme Planning; Organisation of Auditing Programme, pre-visit data collection. Audit Protocol; Onsite Audit; Data Sampling - Inspections - Evaluation and presentation; Exit Interview; Audit Report - Action Plan - Management of Audits.

References

1. Larry, W. C " Environmental Impact Assessment" McGraw Hill Inc. Singapore.

2. Riki Therirvel, E.Wilson, S.Thompson, D.Heaney, D. Pritchard. Earthscan "Strategic Environmental Assessment" London.

3. Alan Gilpin "Environmental Impact Assessment-Cutting edge for the 21st century" CUP, London.
4. Peter Wathern, Unwin Hynman "Environmental Impact Assessment-Theory & Practice", Syndeny.
5. Paul, A Erickson "A Practical Guide to Environmental Impact Assessment", Academic Press.

Fluvial Hydraulics

Introduction, nature of sediment problems, origin of sediments, properties of sediment.

Incipient motion, tractive force, critical tractive force of different types of sediments, regimes of flow.

Bed load transport, derivation of bed load transport equation based on dimensional analysis, semi-theoretical equations.

Suspended load transport, general equation of diffusion, sediment distribution equation, total load transport.

Design of stable channels, factors influencing stable channel design, regime flow theories for design of stable channels, tractive force theory method for design of stable channels.

Sediment control, methods of sediment control in canal, river training works for control of sediment in rivers and streams, reservoir sedimentation, best management practices for control of reservoir sedimentation.

Reference Books:

S. No.	Name of Authors/Books/ Publisher
1.	Garde, R.J., "River Morphology", New International Publishers.
2.	Julien, P.Y., "Erosion and Sedimentation", Cambridge University Press.
3.	Jansen, P.P.H., "Principals of River Engineering", VSSD Publications.
4.	Garde, R.J. and Ranga Raju, K.G., "Mechanics of Sediment Transportation and Alluvial Stream Problems", Wiley Eastern Limited.

Irrigation and Drainage

Introduction, objectives of irrigation, type of irrigation and suitability; selection of irrigation method.

Irrigation requirement, water balance, soil water relationships, water storage zone, infiltration.

Flow of moisture through root zone, soil physical and chemical properties, crop evaporative and drainage requirements, irrigation efficiency and uniformity.

Surface irrigation systems, types of surface systems, basin irrigation, border irrigation, furrow irrigation, field measurement techniques, flow measurement, flumes, weirs, irrigation events, advance, wetting, depletion and recession phases.

Infiltration, infiltrometer, ponding methods, soil water, tensiometers, neutron probe, time domain reflectometer, evapotranspiration, crop coefficient, leaf area index, FAO guide lines on evapotranspiration estimation.

Fundamentals of surface irrigation hydraulics, continuity equation, momentum equation Hydrodynamic model, zero inertia model, kinematic wave model.

Drainage principles, need for drainage, steady state equations, Hooghoudt, Kirkham, Dagan and Ernst equations.

Salt balance, water and salt balance of the root zone, salt equilibrium equation and leaching requirement, leaching efficiency.

Reference Books:

S. No.	Name of Authors/Books/Publishers
1.	Walker, W.R., and Skogerboe, G.V., "Surface Irrigation Theory and Practice", Prentice Hall, INC.
2.	Drainage Principles and Applications, "International Institute for Land Reclamation and Improvement", Wageningen.
3.	Michael, A.M., "Irrigation: Theory and Practice", Vikas Publishing House.
4.	Asawa, G.L., "Irrigation Engineering", New Age International Publishers.
5.	Majumdar, D.K., “Irrigation Water Management”, PHI Learning.
6.	Luthin, J.N., "Drainage Engineering", John Wiley.

Hydro Power Engineering

Instruction: Sources of Energy, Status of hydro power in the World. Transmission Voltages and Hydro-power, estimation of water power potential, General load curve, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm power, secondary power, prediction of load.

Classification of Hydel Plants: Run off river plants, general arrangement of run off river plants, valley dam plants, diversion canal plants, high head diversion plants storage and pondage, Pumped storage plants: Types of Pumped storage plants, relative merits of two unit and three unit arrangement. Three unit arrangement, reversible pump turbines, problems of operation, power house, efficiency of P-S plants.

Water Conveyance: Classification of penstocks, design criteria for penstocks, economical diameter of penstock, anchor blocks, conduit valves, types of valves, bends and manifolds, illustrative, water hammer, resonance in penstocks, channel surges, surge tanks. Intakes: Types of intakes, losses of intakes, air entrainment at intakes, inlet aeration, canals fore bay, tunnels.

Turbines: Introduction, types of turbines, hydraulic features, turbine size, constructional features of turbines, layout arrangements, hydraulic of turbines, basic flow equations, draft tubes, cavitations in turbines, governing of turbines, characteristics of turbines, illustrative examples.

Power House Planning: Surface power stations: power house structure, power house dimensions, lighting and ventilation, variations in design of power house.

Underground power station: Location of U.G. power station, Types of U.G. power stations, advantages of U.G. power house, components of U.G. power house, types of layout, limitations of U.G. power house structural design of power house.

Tidal power: Basic principle, location of tidal power plant, difficulties in tidal power generation, components of tidal power plants, modes of generation, single basin arrangement, double basin system.

References:

1. Water Power Engineering by M.M. Dandekar and K.N. Sharma, Vani Educational Books
2. Irrigation and water resources Engg. By G.L. Asawa, New Age international Publishers.
3. Irrigation and water power Engineering by B.C. Punamia, Pande B.B. Lal (Laxmi Publications Private Limited)

Advance Construction Materials

Fresh concrete and its rheology. Mechanical, deformational behavior and microstructure of hardened concrete. Creep and shrinkage. Testing of concrete. mix design and properties of concrete; High strength concrete; High density and lightweight concretes; admixtures.

Industrial waste materials in concrete, their influence on physical and mechanical properties and durability of concrete, Concreting under extreme weather conditions, High strength concrete. Changes in concrete with time, Corrosion of concrete in various environments. Corrosion of reinforcing steel. Ferro-cement, material and properties.

Foams and light weight materials, fibrereinforced concrete. Types of fibres, workability, mechanical and physical properties of fibre reinforced concrete. Polymers in Civil Engineering, Polymers, fibres and composites,

Fibre reinforced plastic in sandwich panels, modeling. Architectural use and aesthetics of composties. Adhesives and sealants. Structural elastomeric bearings and resilient seating. Moisture barriers, Polymer foams and polymers in Building, Polymer concrete composites.

References

1. Neville A.M., “Properties of concrete”.
2. Gambhir M. L. “Concrete Technology”. TMH

Finite Element Analysis of Structures

Basic principles of structural mechanics, principle of virtual work, energy principles, element properties; relation between nodal degrees of freedom and generalized oordinates , convergence requirements, natural coordinate systems, shape functions, element stiffness matrix.

Isoparametric elements; computation of stiffness matrix for isoparametric elements, direct stiffness method of analysis and solution technique, assemblage of elements, direct stiffness method, boundary conditions and reaction, basic steps in finite element analysis.

Analysis of framed structures; 2 and 3 dimensional truss element, 2 dimensional beam element, stiffness matrix for a two dimensional beam element with 6 d.o.f., element load vector, transformation matrix, computation of stress resultants, shear deformation, plane stress and plane strain analysis, nodal load vector, rectangular elements, 8 noded rectangle, isoparametric elements, axisymmetric solid element.

Three dimensional stress analysis, 8 noded isoparametric solid element, analysis of plate bending, displacement functions, various types of plate bending elements, types of isoparametric elements, analysis of shells; bilinear degenerated shell element strain-displacement matrix, stress-displacement matrix, element stiffness matrix, 8 noded shell element, analysis using finite element computer codes.

Books:

1. C.S.Krishnamoorthy, " Finite element analysis, theory and programming", Tata McGraw Hill 2. Cook R.D., Malkus, D.S. and Plesha, M.E., Concepts and Applications of Finite Element Analysis, Third Edition, John Wiley.
3. O.C. Zienkiewicz, The Finite Element Method, Tata McGraw-Hill.

Neuro Fuzzy Applications in Civil Engineering

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

Fuzzy Set Theory: Basic definitions and terminology and membership functions – Formulation and parameters, basic operations of fuzzy sets – complement, intersection vision, T-norm and T-conorm.

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.

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

Neural network Models: Feed forward Neural Networks, Back propagation algorithm, Applications of Feed forward networks, Recurrent networks, Hopfield networks, Hebbian learning, Self organizing networks, unsupervised learning, competitive learning.

Neuro - Fuzzy Modelling: Neuro-Fuzzy inference systems, Neuro-Fuzzy control

Applications of Neuro-Fuzzy computing: Hydrologic Modelling time series Analysis and modeling, Remote sensing, Environmental Modelling, Construction Management, Fault detection and rehabilitation of structures, Water Management, Prediction of Pile capacity, Transportation/ Traffic planning.

References:

1. Jang, JSR, C.T. Sun and E. Mizutani “Neuro-Fuzzy and Soft Computing”, Prentice Hall, N J.

2. Haykin, S., “Neural Networks, A Comprehensive Foundation”, McMillan College Publishing Company.
3. Kosko, B. ”Neural Networks and Fuzzy Systems”, Prentice Hall of India Pvt. Ltd., New Delhi.
4. Klir, George J., T.A. Forger, “Fuzzy Sets, Uncertainty and Information”, Prentice Hall of India, Pvt. Ltd., New Delhi.
5. Rao V and H. Rao, “C++” Neural Networks and Fuzzy Logic, BPB Publications, New Delhi.

HYDRAULIC AND HYDROLOGIC ENGINEERING LABORATORY

1. Measurement of velocity profile in straight and meandering open channel;
2. Experiments on velocity distribution and Boundary shear in rough and smooth channels,
3. Discharge measurement by weir;
4. Measurement of rainfall, evaporation, infiltration, laboratory and field tests.
5. Characteristics of Hydraulic Jump in horizontal and Sloping Channels
6. Determination of Manning’s N for Composite Sections
7. Velocity Distribution in Open Channels
8. Rainfall – Runoff Studies
9. Determination of Water Quality and Wastewater Parameters
10. Water Softening by Lime – Soda Process
11. Determination of BOD And COD of a Wastewater
12. Collection of Ambient Samples and their Analyses
13. Determination of Infiltration Characteristics

Software Lab

Study of different types of satellite data products
Visual interpretation of satellite images of different resolutions.
Extraction of thematic information from satellite images Mapping of Land use and land cover
Geological and structural features
Digitization of Points and Lines Editing Map Elements

Attribute Data Entry and Manipulation

Cleaning, Building and Transformation

Data Analysis – Overlay, Buffer

Map Generation with Patterns and Legends

Any software related to modeling of surface water, ground water, catchment

Design of Hydraulic Systems Lab

Determining storage capacity of a reservoir

Development of storage-yield-reliability relationship for a reservoir

Developing optimal operating policy for a single and multi-reservoir system

Crop planning and irrigation scheduling

Water quality management in a river

Optimal design of water distribution networks

Simulation of operation of a reservoir

Simulation of an aquifer

Performance evaluation of an irrigation system