Structure of M.Tech Civil (Water Resources Engineering) (2023-24)

Semester I
Total Duration: 24 hrs/week
Total Marks:500
Total Credits: 20

Subjects	Teaching Scheme (Hrs) Hrs./Week		Examination Scheme (Marks)						Credits
	L	P	Theory	Internal Assessment	TW	PR	Oral	Total	
Open Channel Flow	04	--	50	50	-	--	--	100	04
Advanced Hydrology	04	--	50	50	-	--	--	100	04
Computational Techniques in Water Resources	04	--	50	50	--	--	--	100	04
Open Elective - I	04	--	50	50	--	--	--	100	04
Lab Practice - I	--	04	--	--	25	--	25	50	02
Lab Practice - II	--	04	--	--	25	--	25	50	02
	16	**8**	**200**	**200**	**50**	--	**50**	**500**	**20**

Semester II
Total Duration: 24hrs/week
Total Marks :500
Total Credits: 20

Subjects	Teaching Scheme (Hrs) Hrs./Week		Examination Scheme (Marks)						Credits
	L	P	Theory	Internal Assessment	TW	PR	Oral	Total	
Advanced Hydraulic Structures	04	--	50	50	--	--	--	100	04
Irrigation and Drainage System	04	--	50	50	--	--	--	100	04
Hydraulics of Alluvial Rivers	04	--	50	50	--	--	--	100	04
Open Elective - II	04	--	50	50	--	--	--	100	04
Lab Practice - III	--	04	--	--	25	--	25	50	02
Lab Practice - IV	--	04	--	--	25	--	25	50	02
Total	**16**	**8**	**200**	**200**	**50**	--	**50**	**500**	**20**

Semester III Total Duration: 08hrs/week **Total Marks :250** **Total Credits: 20**									
Subjects	**Teaching Scheme (Hrs) Hrs./Week**		**Examination Scheme (Marks)**						**Credits**
	L	**P**	**Theory**	**Internal Assessment**	**TW**	**PR**	**Oral**	**Total**	
Seminar	--	02	--	--	50	--	50	100	05
Dissertation Stage - I	--	06	--	--	100	--	50	150	15
Total	**--**	**08**	**--**	**--**	**150**	**--**	**100**	**250**	**20**

Semester IV Total Duration: 08hrs/week **Total Marks :250** **Total Credits: 20**									
Subjects	**Teaching Scheme (Hrs) Hrs./Week**		**Examination Scheme (Marks)**						**Credits**
	L	**P**	**Theory**	**Internal Assessment**	**TW**	**PR**	**Oral**	**Total**	
Dissertation Stage - II	--	08	--	--	150	--	100	250	20
Total	**--**	**08**	**--**	**--**	**150**	--	**100**	**250**	**20**

List of Self Learning Courses, Department Electives and Open Elective

Open Elective - I	**Open Elective - II**
Water Resources Systems	Ground Water Hydrology
Integrated Watershed Management	Water Power Engineering
Basics of Climate Change	Coastal Engineering

Note – Internal Assessment will consist of any of the following on each Unit (10 marks each)

1 Tutorial/ Test on each unit
2 Assignment on each unit
3 Design problem
4 Case study report
5 Project based learning

Programme: M. Tech. (Civil Water Resources Engineering) Sem. –I

COURSE: Open Channel Flow		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04 Hours / Week	End Semester Examination: 50 Marks Internal Assessment: 50 Marks	Theory: 04 Credits
		Total: 04 Credits

Course Pre-requisites: The students should have knowledge of	
1	Elementary Fluid Mechanics concepts.
Course Objective:	
	To identify and define fundamental concepts in hydraulics;
	To analyse channel system performance and characteristics
	To study characteristics of different fluid flows;
Course Outcomes: The student will be able to	
1	Demonstrate the basic concepts in open channel flow
2	Interpret boundary layer theory and its importance
3	Analyse the uniform and non uniform flows
4	Categorise of spatially varied flow
5	Categorize the Unsteady flow

Course Content:

Unit-I	Basic concepts: Energy and momentum equation and their application. Critical flow, channel controls, and transitions. Uniform flow and flow resistance, sheet flow; surface roughness, theoretical uniform flow equations;	**(08 Hours)**
Unit-II	Concepts of boundary layer, boundary layer characteristics, laminar boundary layer, turbulent boundary layer, boundary layer separation and it's control	**(08 Hours)**
Unit-III	Instability of uniform flow; Gradually varied flow; Flow profile classification and computation methods; Flow profiles in natural channels, Flow Profiles in Divided Channels, Hydraulic Jump, Jumps on a Sloping Floor.	**(08 Hours)**
Unit-IV	Spatially varied flow, spatially varied flow with Increasing Discharge, spatially varied flow with Decreasing Discharge, Side Weir, Bottom Rack	**(08 Hours)**
Unit-V	Unsteady flow: Continuity equation, Dynamic equation; Wave propagation; Method of characteristics; Rapidly varied unsteady flow; Surges; Dam-break problems	**(08 Hours)**

Textbooks:	
1	Chaudhary, H. M., "Open Channel flow", Springer, 2007(Second Edition).
2	Subramanya, K., "Flow in open channels", Fifth edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2019.
3	Ranga Raju K. G.Flow Through Open Channel Tata McGraw Hill Publication 2003.
Reference Books:	
1	Chow, V. T., "Open Channel Hydraulics", The Blackburn Press, 2009 Edition.
2	Srivastava, R., "Flow through open channels", Oxford Higher Education, Oxford University Press,

	2007.
3	Asawa, G. L., "Fluid Flow in Pipes and Channels", CBS Publishers & Distributors, New Delhi, 2017.
4	H. Chanson, *The Hydraulics of Open Channel Flow*, Elsevier , Numerical application on open channel flow

COURSE: - Computational Techniques in Water Resources		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory:- 04 Hours / Week	End Semester Examination:50 Marks Internal Assessment: - 50 Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of

1	Engineering Mathematics

Course Outcomes

1	Apply partial differential equations to Water resources problems
2	Apply partial differential equations to Water resources problems
3	Apply statistics to various types of data
4	Use probability techniques in water resources problems
5	Use various statistical distributions water resources problems

Course Content:

Unit-I	**Numerical Solution of Partial Differential Equations**: Classification of second order partial differential equations, Solution of Laplace's, Poisson's, heat and wave equations by finite difference methods, Use of method of characteristics for solution of initial and boundary value problems. System of Linear equations- Jacobi, Gauss Seidel, Relaxation methods.	**(8 hrs)**
Unit II	**Numerical Methods**: Curve fitting : Method of least squares, Straight line, Second degree parabola, Exponential curve. Numerical Integration-General Quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule, 12 Weddle's rule, Newton-Cotes Integration formulae, Gauss-Quadrature two point and three points formulae.	**(8 hrs)**
Unit-III	**Statistics**: Measure of central tendency, measures of dispersion, Moments, Skewness and Kurtosis. Coefficient of Correlation and Regression, Multiple and Partial Correlation coefficient, Reliability of regression estimates (standard error of estimates).	**(8 hrs)**
Unit-IV	**Probability** : Classical definition of probability, Addition and multiplication theorem of probability, Conditional Probability, Random variable, discrete and continuous random variables, Binominal, Poisson, Normal, Geometric, Distributions.	**(8 hrs)**
Unit V	**Statistical Distributions**: Exponential Beta, Gamma Distributions, Sampling distributions, Testing of Hypothesis, Large sample tests for means and proportions, small sample tests based on Chi-square test of goodness of fit and independence of attributes .Applications in water resources Engineering.	**(8 hrs)**

Textbooks and References

1 Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Eastern Ltd.Mumbai
2 Wylie C. R., Barret L. C., "Advanced Engineering Mathematics", McGraw-Hill
3 B.S.Grewal, "Engineering Mathematics" (Khanna Publications, Delhi)
4 P.N.Vertikar & J. N. Vertikar, "Applied Mathematics"(Volume I & II) , P.V.G.Publications, Pune.
5 C .T. Hann " Statistical methods in Hydrology

COURSE: - Advanced Hydrology		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory:- 04 Hours / Week	End Semester Examination:50 Marks Internal Assessment: - 50 Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of

1	Fluid Mechanics
2	Water Resource Engineering.

Course Objective:

To provide knowledge of the engineering hydrology for planning water resources projects.

Course Outcomes: The student will be able to

1	Demonstrate basic concepts of hydrology
2	Stastical analysis of hydrological data.
3	Estimation and computation of runoff.
4	Derive hydrograph by different methods
5	Perform reservoir and channel routing

Course Content:

Unit-I	Analysis of precipitation data ,intensity-duration-frequency analysis, depth-area-duration analysis, PMP, Abstractons from precipitation, evaporation, evapotranspiration, infiltration capacity, infiltration models.	**08 hr**
Unit-II	Runoff: runoff components, factors affecting runoff, basin yield, runoff-rainfall relations.Data Analysis: Correlation, regression analysis, transformations	**08 hr**
Unit III	Stochastic process, and time series analysis, auto correlation analysis and synthetic flow generation models using random variates.	**08 hr**
Unit-IV	Unit Hydro graph, S-curve and IUH, Cleark's method of IUH. Synthetic Unit-hydrograph. Floods: Frequency analysis, normal, log-normal and Gumbel's distributions, envelope curves, empirical formulae and regional flood frequency analysis.	**08 hr**
Unit-V	Flood Routing- Introduction , basic equations, Hydrologic/ storage routing in reservoir and channels, Hydraulic methods of flood routing, Simple cases.	**08 hr**

Textbooks:

1	P. Jayarami Reddy, "Textbook of Hydrology", Laxmi Publication, New Delhi
2	Subramanyam K. " Engineering Hydrology" McGraw Hill Publication

Reference Books:

1	R. H. Mccuen and W. M. Snyder, "Hydrologic Modelin Statistical Methods and Applications" Prentice Hall, New Jersey, U. S. A
2	K. N. Mutreja, "Applied Hydrology",Tata McGraw Hill Publication
3	V.T.Chow, "Applied Hydrology", Tata McGraw Hill Publication

COURSE: - OPEN ELECTIVE –I WATER RESOURCES SYSTEM		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory:-Hours 04/ Week	End Semester Examination:50Marks Internal Assessment: - 50Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of

1	Water Resources Engineering
2	Engineering Mathematics

Course Outcomes:

1	Appraise system components and its significance
2	Determine economics of water resources project
3	Implement project optimality conditions for the water resources project
4	Apply Dynamic programming techniques for water resources problems.
5	Apply soft computing techniques to optimize water resources problems

Course Content:

Unit-I	Introduction to water resources system and system planning, Systems approach its advantages and limitations.	**09Hours**
Unit-II	Economics of water resources systems Principles of Engineering Economics, Mathematics of economic analysis, Discounting factors and discounting techniques, Feasibility of water resources project, Selection of an alternative projects, Benefit cost analysis, Internal rate of return, Legal consideration in economic analysis, Conditions of project optimality.	**09Hours**
Unit-III	Optimization: Functions of a single variable, Optimization: Functions of multiple variables, Constrained optimization, Kuhn-Tucker conditions, Linear Programming by graphical and simplex methods, Dynamic Programming and Stochastic Optimization techniques, Applications of LP and DPto water resources engineering problems,	**09Hours**
Unit-IV	Dynamic Programming and Stochastic Optimization techniques, Applications of LP and DP to water resources engineering problems,	**09Hours**
Unit-V	Soft computing techniques for water resources, Optimization using fuzzy sets and Fuzzy Logic, Genetic Algorithm and Artificial Neural Network, Applications of Fuzzy Logic, Genetic Algorithm and ANN to water resources engineering	**09Hours**

Textbooks and References

1 Loucks, D. P., Beek, E. V., Stedinger,R. J.., Dijkman, J. P.M., and Villars, M. T., "Water Resources Systems Planning and Management: An Introduction to Methods, Models and Applications".Deltares, UNESCO-IHE, Springer, 2017.

2. James, L. D., and Lee, R. R., "Economic of Water Resources Planning", McGraw Hill, 1971.

3. Vedula, S. and Mujumdar, P. P., "Water Resources System", Tata McGraw Hill Company, 2005.

4. Raju, K.S. and Kumar, D. N., Multicriterion Analysis in Engineering and Management. PHI Learning Pvt. Ltd., 2014.

COURSE: - OPEN ELECTIVE – I INTEGRATED WATERSHED MANAGEMENT		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04 Hrs / Week	End Semester Examination:50 Marks Internal Assessment: - 50 Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Fluid Mechanics
2	Water Resource Engineering
Course Objective: On completion of the course -	
	To provide knowledge of the engineering practices of watershed management for realizing the higher benefits of watershed management.
Course Outcomes: on the completion of course, the student will be able to	
1	explain the watershed and its related issues.
2	evaluate the hydro- geomorphology parameters related to watershed.
3	plan use of various soil conservation practice related to watershed.
4	suggest suitable harvesting techniques for better watershed management.
5	develop different management strategies in watershed project.

Course Content:

Unit-I	**Watershed Concept:** Introduction, characteristics, Need for an Integrated Approach, Watershed development:- problems and prospects, investigation, topographical survey, soil characteristics, vegetative cover, present land use practices and socio-economic factors.	**(08 Hrs)**
Unit-II	**Watershed and hydro-geomorphology:-** Watershed Classifications, Stream classifications, watershed hydrology, Surface water assessment, Rainfall-runoff analysis, Groundwater assessment, infiltration and its measurement.	**(08 Hrs)**
Unit III	**Soil Conservation Practice:** Types of Erosion- causes, factors, effects and control, water erosion: engineering measures for erosion control in agricultural and non-agricultural lands, estimation of soil loss.	**(08 Hrs)**
Unit-IV	**Water Harvesting and Conservation:** Water Harvesting Techniques – Micro-Catchments - Design of Small Water Harvesting Structures: Farm ponds, Percolation Tank, types of storage structure, yield from a catchment.	**(08 Hrs)**
Unit-V	**Watershed Management:** Objectives of Planning Watershed Projects, Guidelines for Project Preparation, Approach in Govt. programmes, people's participation, Watershed management planning, objectives and priorities, socioeconomic survey	**(08 Hrs)**

Reference Books:

1	Dr. R. Suresh, "Soil and Water Conservation structure", Standard publisher distributor
2	Ghanshyam Das,"Hydrology and soil conservation", Prentice Hall of India Private Limited, New Delhi, 2000.
3	Murthy J.V.S, "Watershed Management", New Age International Publisher

COURSE: -OPEN ELECTIVE I- BASICS OF CLIMATE CHANGE		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory:-04Hrs/ Week	End Semester Examination:50Marks Internal Assessment: - 50Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of

1. Environmental Engineering

Course Objective: On completion of the course -

To realize the impact of climate change on society and its mitigation measures.

Course Outcomes: On completion of the course, the students will be able to:

1	apply basic scientific knowledge about the climate systems
2	analyze the impact of climate change on various sectors
3	analyze of adaptation and mitigation measures.
4	elaborate various clean technology and energy
5	describe various climate change policy.

Course Content:

Unit-I	**THE CLIMATE SYSTEM:** Definitions- Climate, Climate system, climate change, Drivers of Climate change, Characteristics of climate system components, Green house effect, Carbon cycle, Water cycle Wind systems - Trade Winds and the Hadley Cell – Ozone hole in the stratosphere	**(08 Hrs)**
Unit-II	**Impacts of Climate Change:** Impacts of Climate Change on various sectors, Agriculture, Forestry and Eco-system, Water resources, Human Health,Industry, Projected Impacts for different regions – Uncertainties in the Projected Impacts of Climate Change.	**(08 Hrs)**
Unit-III	**Adaptation and Mitigation:** Water-related adaptation to climate change in the fields of Ecosystems and biodiversity, Agriculture and food security, land use and forestry, Human health, water supply and sanitation, infrastructure and Economy (insurance, tourism, industry and transportation) Adaptation, vulnerability and sustainable development Sector-specific mitigation, Carbon dioxide capture and storage (CCS) , Energy use in buildings, Land-use change and management, Cropland management, Afforestation and Reforestation.	**(08 Hrs)**
Unit-IV	**Clean Technology and Energy:** Clean Development Mechanism, Carbon Trading, Examples of future Clean Technology, Biodiesel, Natural Compost, Eco-friendly Plastic, Alternate Energy, Hydrogen, Bio-fuels, Solar Energy, Wind, Hydroelectric Power, Mitigation Efforts in India and Adaptation funding	**(08 Hrs)**
Unit-V	**Climate Change Policy Framework:** Climate change as a problem, Impacts of climate change, Climate variability and natural resources, United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol and the Flexibility Mechanisms, Emission trading.	**(08 Hrs)**

Reference Books:		
1	Das Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007	
2	Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003	
3	IPCC Report Technical Paper VI – Climate change and water , 2008	
4	UNFCC Technologies for Adaptation to climate change, 2006.	

COURSE: ADVANCED HYDRAULIC STRUCTURES

TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04 Hours / Week	End Semester Examination: 50 Marks Internal Assessment: 50 Marks	Theory: 04 Total: 04

Course Pre-requisites: The students should have knowledge of

1	Hydraulic Structures
2	Hydrology and Irrigation Engineering

Course Objective:

	The students will be able to design different hydraulic structures.

Course Outcomes: On completion of the course, the students will be able to:

1	Design and check stability of gravity dams for seismic forces
2	Design and construction of Earth dams and Rock fill dams
3	Design of spillways and Energy dissipaters
4	Design and construction of weirs and barrages
5	Design and construction of river training works

Course Content:

Unit-I	**Gravity Dam& Stability:** Computation of earthquake force-pseudo static and dynamic response approach, distribution of shear and normal stresses, principal stresses. Colgrout masonry in gravity dams, Roller Compacted Concrete Dams: Materials for R.C.C mixture, design concepts, construction methods, advantages. Instrumentation in Gravity dam	**08 Hrs**
Unit-II	**Earthen Dams:** Earth Dam: Seepage through dam and its foundation, stability analysis for sudden draw down condition and steady seepage condition, during construction stages, Rock fill Dams: Relevant rock fill characteristic, general design principles, method of construction and compaction Seismic effects, pore pressure, protection of upstream and downstream slopes, design of filters.	**08 Hrs**
Unit-III	**Spillways:** Spill ways: Determination of capacity, types of spillways, ogee, siphon, chute, side, shaft,orifice spillway and stepped spillway, their hydraulic design, crest profile, energy dissipaters and divide walls. Spillway gates: Vibration, types of gates, radial, drum, vertical lift and automatic gates.	**08 Hrs**
Unit-IV	Weirs and Barrages, and their design on permeable foundation using various theories.	**08 Hrs**
Unit-V	River training works: Design of Guide banks , marginal bunds, levees,spurs and river bank protection works	**08 Hrs**

Textbooks:	
1	Novak, “Hydraulic Structures”, Taylor and Francis
2	Garg S.K., “IrrigationEngineering and Hydraulic Structures”, Khanna Pub
3	Bharat Singh,VarshneyR.S.“Engineering of Embankment Dams”, Oxford & IBH Publishing Co
4	Varshney R. S., “Concrete Dams”, Oxford and IBH Publishing Co.
5	Vishcher D. L. and Hager W. H.,“DamHydraulics”,John Wiley & Sons
Reference Books:	
1	Thomas, “The Engineering of Large Dams”, John Wiley & Sons
2	“ColgroutMasonary Works”, Water Resourse Department, GoM Handbook
3	“Guidelines for Instrumentation of Large Dams”, Central Water Comission,Ministry of Water Resources, GoI.
4	“Design and Practice - Rock-Filled Concrete Dam” ,International Commission On Large Dams
5	“Sika RCC DamsHandbook”, Ing. Fabrizio Avallone, Sika Services AG

COURSE: - Irrigation and Drainage System		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory:-Hours 04/ Week	End Semester Examination:50Marks Internal Assessment: - 50Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of

1	Water Resources Engineering

Course Outcomes: On completion of the course, the students will be able to:

1	Estimate crop water requirements
2	Design and describe conventional water application methods
3	Design drip and sprinkler irrigation system
4	Describe various methods of measurement of irrigation water
5	Explain causes of salt problems and remedial measures.

Course Content:

Unit-I	**Soil Plant water relationship**-Water relation of soils, Soil moisture and plant growth,estimating water requirement of crops, evapotranspiration and consumptive use methods to calculate , soil water availability to plants..	**08Hours**
Unit-II	**Conventional Water Application methods-** Surface and sub surface irrigation methods ,Border Irrigation, Check basin, Furrow and their design	**08Hours**
Unit-III	**Modern Water Application methods** :Design of drip and sprinkler irrigation systems-Hydraulic design of various Components of Drip and sprinkler Irrigation	**08Hours**
Unit-IV	**Measurement of Irrigation Water and Scheduling**-Various methods, Weirs, Parshall flumes, orifices, meter gates, tracer method. Irrigation efficiency, components of project irrigation efficiency, efficiency of irrigation practices, water use and operation of irrigation system.. Scheduling of irrigation , time of irrigation ,frequency and interval of irrigation	**08Hours**
Unit-V	**Salt problems in Irrigated Agriculture**-Salt balance, Quality of irrigation water, Plant response to saline and alkali soils, Reclamation and management of salt affected soils, Water logging and its control, Case studies.	**08Hours**

Textbooks:and References

1	Irrigation Theory and Practice –A.M.Michael, Vikas Publishing House.
2	Irrigation Engineering- G.L. Asawa, Wiley Eastern Ltd.
3	Irrigation water management- D.K.Majumdar. PHI Pvt. Ltd, 2013

COURSE: - Hydraulics of Alluvial Rivers		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory:-Hours 04/ Week	End Semester Examination:50Marks Internal Assessment: - 50Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of

1	Water Resources Engineering

Course Outcomes: On completion of the course, the students will be able to:

1	Estimate incipient motion condition for sediments
2	Demonstrate various methods for estimation of sediment load
3	Describe various bed forms and their significance
4	Design stable channels
5	Estimate bed level changes in alluvial rivers

Course Content:

Unit-I	Introduction:Sediment prob lems, significant sediment properties, beginning of sediment movement – Shields analysis, critical tractive stress of uniform and non uniform sediments..	**08Hours**
Unit-II	Modes of sediment transport, bed load transport, Dubuoy's equation. Einstein's approach, Meyer Peter and Muller's equation, suspended load transport, total load transport microscopic and macroscopic methods	**08Hours**
Unit-III	Bed Forms and Resistance: Description of bed forms, flow regimes, their significance, resistance analysis, different resistance laws.	**08Hours**
Unit-IV	Design of stable channels:Regime method, Kennedy's method, Lacey's method, Blench and Simons-Albertson method and tractive force approach.	**08Hours**
Unit-V	Sediment Measurement: Bed load measurement, suspended load measurement, erosion from catchments, aggradation, degradation, silting of reservoirs, scour around bridge piers in uniform and non-uniform sediments .River training	**08Hours**

Textbooks:and References

1	Garde R. J., Ranga Raju K. G., "Mechanics of Sediment Transportation and Alluvial Stream Problems" , New Age International (P) Limited, New Delhi, 2004
2	Garde R. J., "River Morphology", New Age International (P) Limited, New Delhi, 2006

COURSE: - Open Elective – II Ground Water Hydrology		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04Hrs / Week	End Semester Examination:50 Marks Internal Assessment: 50 Marks	Theory:04
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Fluid Mechanics
2	Geotechnical Engineering
Course Objective: On completion of the course -	
	Course attempts to provide knowledge and skills for effective ground water management
Course Outcomes: On completion of course, the students will be able to	
1	illustrate types of aquifer and its properties.
2	explain movement of ground water through porous media.
3	Compute yield of an open and tube well.
4	apply various ground water model to solve the problems related to ground water.
5	describe various parameters of ground water quality.

Course Content:

Unit-I	**Introduction:** Ground water occurrence and its role in Hydrological cycle, 09 geological formations such as aquifers; types of aquifers, ground water movement, Hydrogeological Regions of India, Surface and Subsurface Geophysical methods for Groundwater Explorations	**(08 Hrs)**
Unit-II	**Hydrogeology:** Porosity and Permeability of Rocks and its measurement, Hydraulic Conductivity, Storage Coefficient, Transmissivity, Groundwater in Igneous, Metamorphic, Sedimentary Rocks, Darcy‘s law, tracing of ground water movement, Flow net.	**(08 Hrs)**
Unit-III	**Well hydraulics:** Flow into a wells, Dupit’s assumption, Steady radial flow into in unconfined aquifer and confined aquifer, Well losses, Specific Capacity of well, well Efficiency, Interference among wells, Stream-aquifer interaction, Cavity wells, Pumping Test Method:- Theis method, Jacob Method, Chow Method	**(08 Hrs)**
Unit-IV	**Ground Water Modelling:** Physical models, analog models, mathematical modelling, unsaturated flow models. Introduction to numerical models of groundwater flow, finite differential equations, finite difference solution applicable in ground water modelling.	**(08 Hrs)**
Unit-V	**Ground Water Quality and Pollution:** Chemical composition of Ground water, water sampling, water quality for Industrial use and Domestic use, sea water contamination in ground water, ground water pollution.	**(08 Hrs)**

Textbooks/ Reference Books:

1 Garg S.K. ,”Irrigation Engineering and Hydraulic Structures”, Khanna Publisher

2	Dr. P.N. Modi, "Irrigation Water Resource and Water Power Engineering", Standard Book House
3	Raghunath H.M., "Ground Water" , New Age International Publishers
4	Todd D.K., "Ground water Hydrology" , John Wiley and sons
5	A.K. Rastogi, "Numerical Groundwater Hydrology"

COURSE: - Open Elective – II Water Power Engineering		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory:- 04 Hours / Week	End Semester Examination:50 Marks Internal Assessment: - 50 Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of

1	Fluid Mechanics
2	Water Resource Engineering.

Course Objective:

To provide knowledge of the engineering practices of water power engg for realizing the higher benefits of water power.

Course Outcomes: The student will be able to

1	Demonstrate Basic concepts of water power Engineering
2	Classify hydropower plants and access power potential
3	Locate intake structure and its design
4	Design penstock and its accessories
5	Describe and select different types of surge tanks
6	Describe and select different types of turbine

Course Content:

Unit-I	Classification of Hydropower plants, low & high head plants. Run of river plants, High head diversion plants, pumped storage plants, Electrical load on turbines load facter, power factor, capacity factor, load duration curve, firm power ,secondary power.	**08 hr**
Unit-II	Assessment of available power, Essential stream flow data for water power studies flow duration curves, Intakes structures, location and intake type, shape of inlet, aeration in inlets, design of intake, sediment exclusion arrangement.	**08 hr**
Unit III	Penstocks and Accessories, classification of pen stocks, design criteria for penstocks, Economical diameter of penstocks, Anchor blocks, conduit values, Bends & manifolds.	**08 hr**
Unit-IV	Water hammer and surges, channel surges, water hammer, resonance in penstocks. Function of surge tank, Types of surge tanks, Differential surge tanks.	**08 hr**
Unit-V	Turbines- Type of turbines , Hydraulic features, Turbine size, lay out arrangements, Hydraulics of turbines, draft turbines, cavitation in turbines, characteristics of turbines. types of layouts, small scale Hydropower, Potential of small scale Hydropower.	**08 hr**

Textbooks:

1	Dandekar M.M., K.N.Sharma "Water Power Engineering " Vikas Publishing house
2	Varshney R.S."Hydro power Structures" Nemchand & Bros, Roorkey.

COURSE: Open Elective – II **Coastal Engineering**		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04 Hours / Week	End Semester Examination: 50 Marks Internal Assessment: 50 Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Infrastructural Engineering and Construction Materials
Course Objective:	
	The goal of this course is to provide the student with fundamental knowledge about coastal engineering and related engineering problems with an extension to the design of coastal structures.
Course Outcomes: The student will be able to	
1	Understand basics of ocean **Wave and Tidal Cycle Analysis**
2	Demonstrate **Coastal Processes**
3	Design the coastal structures(RBW), shore protection
4	Apply knowledge about coastal management
5	Demonstrate Application of GIS and Remote Sensing in Coastal surveying and management

Course Content:

Unit-I	**Wave and Tidal Cycle Analysis**	**(08 Hours)**
	Basic understanding of wave mechanics including wave generation, propagation, form and assessment in the surf zone. Statistical and spectral analysis of recorded wave data and prediction in coastal zone. Global tidal cycle, tidal analysis. Types of tides, effect of tides, significance in coastal engineering, Coastal process-erosion/accretion due to waves, littoral drift. Effect of construction of coastal structures on stability of shoreline / beaches, shoreline configuration	
Unit-II	**Coastal Processes**	**(08 Hours)**
	Physico, Chemical and Biological processes in Coastal ecosystems - Salt Marshes, Mangroves, Corals and Sandy and Rocky Beaches - Sediments - Types and Characteristics - Nature of sediment movement and Transportation - Sea water circulations and Sediment dynamics - Beach nourishment through sedimentation - Sediment Budget and analysis - Total Sediment load transportation calculation - Cross Shore Transport - Long shore transport (littoral drift) - Impact of Sediment dynamics on Coastal eco-system with special reference to fisheries and aquaculture activities in coastal areas	
Unit-III	**Coastal Structures-Protection and its Maintenance**	**(08 Hours)**
	Introduction to coastal structures and their types, concept of risk analysis and design waves along with the concept of break water, introduction and necessity of shore protection, methods of shore protection, Design criteria and functional aspects of coastal structures: sea wall, revetment, bulk-head, quay- wall, jetties, breakwater types : rubble-mound,	

	composite, floating and pneumatic types, design of RBWPlanning and management of port and Harbors, Modern trends and techniques in port engineering.- Roll on-Roll off/ Lift on –Lift off etc. Special purpose ports: Concepts of twin /mother port, SBM , outer to outer port etc. Significance of port cost analysis economics. dredging technology: types of dredgers, Radioactive tracers studies for dumping ground for dredged materials-environmental aspects of dredging etc	
Unit-IV	**Coastal Zone Management**	**(08 Hours)**
	Pollution in Coastal zone, disposal of waste/dredged spoils, design criteria of coastal outfall inlets and system. Oil spills and contaminants, coastal zone management: activities in coastal zone, CRZ, Objectives - Basic Principles - : Integrated Coastal Zone Management frame-work. Coastal regulation zone	
Unit-V	**Application of GIS and Remote Sensing in Coastal surveying and management**	**(08 Hours)**
	Coastal Survey - Large scale & Small scale surveying - Various instruments used in surveying – Hydro-graphic survey - Biological survey - GPS - Total stations used in surveying - Topographical surveying - Horizontal control methods - Vertical control methods - LIDAR surveying for digital elevation models - Acoustic Survey - Depth contour lines - Sound waves in water – Echo-sounder & SONAR - Principles & working - Hydrographical survey for fishing Harbour construction. Remote Sensing - Principles - OCEANSAT - Application of Remote sensing in coastal and ocean studies - SST - ISRO and coastal zone management - Digital image processing - Mapping of coastal ecosystem - Mangroves, corals, Sea-grass etc., GIS - Principles - Methods and application in coastal management - GIS software's - Application of GIS and Remote sensing in Indian coastal zone management	

Textbooks:	
1	Basic Coastal Engineering-R.M.Sorensen,2006.
2	Coastal Hydrodynamics-J.S.Mani ,I IT Madras
3	Shore Protection Manual-U.S.Waterways Experiment Station Corps of Engineer
Reference Books:	
1	Shore protection manual, Brunn Per and B. U. Naik, Nio, Goa
2	Port planning, Qeen A. D. Mc Grow Hill Book Co. New York
3	Coastal engineering, Vol-I-II, Silvester Richard, University of Western Australia.
4	Shore Protection Manual, U. S. Waterways Experiment Station Corps of Engineer
5	Costal Engineering Research Center, Vickburg and USA1984,Coastal Protection Manual 2002
6	Harbour and Coastal engineering Vol I & II, Ocean and Coastal Engineering Publication.
7	Costal Engineering Research Center, Vickburg and U.S.A.1984.

COURSE: - Lab Practice -I

TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Practical-Hours 04/ Week	TW 25 marks Oral 25 marks	02
		Total: 02

Course Outcomes: students will be able to

1 Verify concepts of Open Channel flow in laboratory

2 Apply basics of Hydrology for practical problems

Course Content:

1 Development of uniform flow in open channel

2 Establishment of subcritical, critical and supercritical flows in open channel, plotting of specific energy diagram. Characteristics of hydraulic jump in open channel.

3Characteristics of hydraulic jump in open channel.

4 Measurement and computation of gradually varied flow profiles in open channel.

5Development of Synthetic Unit Hydrograph and flood hydrograph using CWC method

6 Assignment on channel routing and reservoir routing

7 Statistical analysis of given hydrology problem

COURSE: - Lab Practice -II

TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Practical-Hours 04/ Week	TW 25 marks Oral 25 marks	02
		Total: 02

Course Outcomes: students will be able to

1 Apply HEC RAS software for open channel flow problems

2 Apply SWMM software in Hydrology .

Course Content:

1 Use of HEC RAS for various applications in open channel flow.

a) Use of HEC RAS for one dimensional steady flow water surface profile computations;

b) One-dimensional and/or two-dimensional unsteady flow simulation;

2 Application of SWMM software in Hydrology

a) Storm water drain design

COURSE: - Lab Practice -III

TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Practical-Hours 04/ Week	TW 25 marks Oral 25 marks	02
		Total: 02

Course Outcomes: students will be able to

1Determine sediment Characteristics based on theory.

2 Design Hydraulic Structures

Course Content:

1Determination of sediment parameters for given sample of sand by sieve analysis
2 Experimental studies for incipient motion of uniform and non uniform sediment.
3 Experimental study for regimes of flow.
4 Experimental study on scour around bridge piers
5 Assignment on reservoir sedimentation
6 Assignment on design of stable channels using different methods
7 Assignment on computation of bed load
8Hydraulic design of different types of spillway

COURSE: - Lab Practice -IV		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Practical-Hours 04/ Week	TW 25 marks Oral 25 marks	02
		Total: 02

Course outcomes: students will be able to

1 Apply GIS software for various problems in water resources .

2 Prepare a case study report on water recourses

Course Content:

1 Applications of GIS software in water resources engineering

a) 1 Delineation of Water shed

b) Land use land cover analysis

c) Surface mapping of water resources;

d) Monitor coastal process;

e)Groundwater recharge zone

2 A report on case study / Field study on water resources project

COURSE: - Seminar		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Practical-Hours 02/ Week	TW 50 marks Oral 50 marks	05
		Total: 05
Course Outcomes: students will be able to		
1 Present advanced Knowledge of topic through literature review 2 Use of audio-visual aids for effective presentation. 3 Prepare an effective written technical report intended for technical oral presentation.		
Course Content:		
Seminar on one specific topics based on subjects of the semester are to be prepared in consultation with the faculty advisor and a typed report is to be submitted.		

COURSE: - Dissertation Stage -I		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Practical-Hours 06 Week	TW: 10 0 marks Oral :50 marks	15
		Total: 15
Course outcomes: students will be able to		
1 Identify and investigate problems related to water resources. 2 Conduct the comprehensive literature review. 3 Identify research gap and decide objectives of research work. 4 Propose a methodology for solving the identified problem. 5 Plan experimental and/or numerical investigation to meet the objective.		
Course Content:		
Dissertation stage -I should clearly identify the goals/objectives and scope of the dissertation work taken up by the student. Details of data identification and field surveys should be clearly highlighted. The study approach and literature review should be discussed. A report shall be submitted at the end of the semester, which shall be assessed.		

COURSE: - Dissertation Stage -II

TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Practical-Hours 08 Week	TW: 15 0 marks Oral :100 marks	20
		Total:20

Course Outcomes: students will be able to

1 Examine the preliminary results and possible modifications in proposed methodology.

2 Conduct extensive analytical / modelling / experimental / field work.

3 Propose an effective sustainable solution for the identified problem.

4Analyse the data with advanced tools and synthesize the outcomes.

5Prepare comprehensive dissertation report.

Course Content:

Develop model for experimental or computer programme using advanced tools for analysis and arrive the results. Obtain the result of the work carried out, discuss the results, infer the conclusions from the results with respect to the subject and report preparation. Discuss the research work, infer the conclusions and submit the dissertation. The dissertation report shall be submitted at the end of the semester, which shall be assessed as per the guidelines fixed by the Institute.