Structure of M.Tech (Civil-Water Resources Engineering) 2020
Based on Credit Pattern

Semester I									**Total Duration: 20 hrs/week** **Total Marks :500** **Total Credits: 18**		
Subjects	**Teaching Scheme (Hrs) Hrs./Week**		**Examination Scheme (Marks)**						**Examination Scheme (Credits)**		**Total Credits**
	L	**P**	**Theory**	**Unit Test**	**Attendance**	**Tutorial/assignments**	**TW**	**Pract/ Oral**	**TH**	**TW/PR /OR**	
Advanced Fluid Mechanics	04	02	60	20	10	10	25	25	04	01	05
Irrigation Water Management	04	02	60	20	10	10	25	25	04	01	05
Computational Methods in Hydraulic Engineering	04	--	60	20	10	10	-	-	04	-	04
Hydrology	04	--	60	20	10	10	-	-	04	-	04
Total	**16**	**04**	**240**	**80**	**40**	**40**	**50**	**50**	**16**	**02**	**18**

Semester II									**Total Duration: 20 hrs/week** **Total Marks :500** **Total Credits: 18**		
Subjects	**Teaching Scheme (Hrs) Hrs./Week**		**Examination Scheme (Marks)**						**Examination Scheme (Credits)**		**Total Credits**
	L	**P**	**Theory**	**Unit Test**	**Attendance**	**Tutorial/assignments**	**TW**	**Pract/ Oral**	**TH**	**TW/PR/OR**	
Sediment Transport & River Engineering	04	02	60	20	10	10	25	25	04	01	05
Hydraulic Structures	04	--	60	20	10	10	--	--	04	-	04
Open Channel Flow	04	--	60	20	10	10	--	--	04	-	04
Optimization in Hydraulics	04	02	60	20	10	10	25	25	04	01	05
Total	**16**	**04**	**240**	**80**	**40**	**40**	**50**	**50**	**16**	**02**	**18**

Semester III						**Total Duration: 28 hrs/week** **Total Marks : 475** **Total Credits: 40**					
Subject	**Teaching Scheme (Hrs) Hrs./Week**		**Examination Scheme**						**Examination Scheme (Credits)**		**Total Credits**
	L	**P**	**Theory**	**Unit Test**	**Attendance**	**Tutorial/assignments**	**TW**	**Pract/ Oral**	**TH**	**TW/PR /OR**	
Elective –I	04	02	60	20	10	10	25	25	04	01	05
Elective –II	04	02	60	20	10	10	25	25	04	01	05
**Self-Study Paper-I	* 04	--	60	20	10	10	-	-	04	-	04
Dissertation Stage –I	-	07	-	-	---	--	25	--		21	21
Seminar	-	05	-	-	--	--	25	25	-	05	05
Total	**12**	**16**	**180**	**60**	**30**	**30**	**100**	**75**	**12**	**28**	**40**

Elective – I	**Elective - II**
• Coastal Engineering • Hydraulic Modeling Techniques	• Water Power Engineering • Environmental Fluid Mechanics • Numerical Methods in Hydraulic Engineering

Semester IV									**Total Duration: 14hrs/week** **Total Marks : 325** **Total Credits: 34**		
Subject	**Teaching Scheme (Hrs)** **Hrs./Week**		**Examination Scheme**						**Examination Scheme** **(Credits)**		**Total Credits**
	L	**P**	**Theory**	**Unit Test**	**Attendance**	**Tutorial/ assignments**	**TW**	**Pract/ Oral**	**TH**	**TW/PR /OR**	
**Self-Study Paper-II	* 04	--	60	20	10	10	-	-	04	-	04
Dissertation Stage –II	-	10	-	-	--	-	150	75		30	30
Total	**04**	**10**	**60**	**20**	**10**	**10**	**150**	**75**	**04**	**30**	**34**

List of Self Study Papers

Sr.No	**SELF STUDY PAPER- I** **(SEM-III)**	**SELF STUDY PAPER- II** **(SEM-IV)**
1	Water Resources Planning and Management	Offshore Structures
2	Ground Water Hydrology	Urban Water Management
3	Instrumentation in Hydraulics	River Engineering
4	Disaster Management	Planning of Ports
5	Operation and Maintenance of Hydraulic Structures	Soil conservation and Watershed Management
6	Application of Remote Sensing To Water Resources	Reservoir Sedimentation
7	Floods and Flood management	Tides and Tidal Hydraulics
8	Environmental Impact assessment for Water Resources Projects	Dam break analysis

SEMESTER I

1: ADVANCED FLUID MECHANICS

TEACHING SCHEME
Lectures : 04 Hrs/Week
Practical : 02 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Term Work : 25 Marks
Oral. : 25 Marks
Credits : 5

Prerequisites
Basic Fluid mechanics and graduate level mathematics

Course outcomes

After post graduation students should be able to

1 Explain the concept of kinematics of flow.
2 Derive Laplace equation and solve it by different methods
3 Apply energy and momentum equation to various fluid flow problems
4 Describe laminar flow and its governing equation.
5 Explain the concept of boundary layer and its application.
6 Explain the concept of turbulent flow and its governing equations.

Unit-I (08 Hours)

Kinematics of Flow: Flow visualization, stream lines, streak lines, pathlines, continuity equation in cartesian and cylindrical polar coordinatessystem, accelerations, rotation, vorticity.

Unit-II (08 Hours)

Velocity potential and stream function, flow-net, Laplace equation and itssolution by graphical and relaxation methods, simple flow patterns.

Unit-III (08 Hours)

Dynamics of Flow: Integration of Euler's equation along streamline and in Cartesian coordinate system. Bernoulli's equation, momentum equation, applications of energy and momentum equations to different problems.

Unit-IV(08 Hours)

Navier-Strokes equations for incompressible fluids, Strokes law, creeping flow, Helle-shaw motion, flow between parallel plates, flow near suddenly accelerated plate, flow in a circular pipe. Review of dimensional analysis, drag on immersed bodies.

Unit-V(08 Hours)

Boundary layer on flat plate, b. L. equations, Blasius solution, Karman's momentum and Integral equation, laminar and turbulent boundary layers, transition mechanisms, b.L.separation

Unit-VI (08 Hours)

Turbulent Flow: Nature of turbulence, scales of turbulence, different averages, Reynolds rules of averaging, Reynolds equations, statistical approach, isotropic and homogeneous turbulence, spectrum of turbulence.

Term work will consist of Following Assignments

1. Experimental study of continuity equation and computation of acceleration, rotation, vorticity and velocity potential, stream function
2. Experimental study of drag on immersed bodies.
3. Experimental study of energy and momentum equations.
4. Experimental study of laminar and turbulent flow
5. Assignment on boundary layer theory.
6. Assignment on dimensional analysis

Text Books / References

Shames, "Mechanics of Fluids",McGraw Hill
Rouse H. Ed, "Advanced Fluid Mechanics",John Wiley, 1959
Schlichting H., "Boundary Layer Theory",McGraw Hill series in Mechanical Engineering
Garde R. J., "Turbulent Flow",New Age Publisher, New Delhi, 1994
Garde R. J., Mirajgaoker A. G., "Engineering Fluid Mechanics",SciTech Publisher, Chennai, 2004

Syllabus for Unit Test

Unit Test 1 Units I , II& III
Unit Test 2 Units IV, V& VI

2: IRRIGATION WATER MANAGEMENT

TEACHING SCHEME
Lectures : 04 Hrs/Week
Practical : 02 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
T. W. : 25 Marks
Or. : 25 Marks
Credits : 5

Course Prerequisites – Water Resources Engineering

Course Objectives
The students will be able to
1 Explain soil water plant relationship and its significance.

2 Describe various surface and sub surface irrigation methods.
3 Design components of drip and sprinkler irrigation system.
4 Explain various methods of measurement of irrigation water
5 Explain surface and underground water distribution system
6 Explain quality of irrigation water and methods of reclamation of salt affected land.

Unit – I (08 Hours)

Soil Plant water relationship-Water relation of soils, Soil moisture and plant growth,estimating water requirement of crops, evapotranspiration and consumptive use, soil water availability to plants..

Unit – II (08 Hours)

Water Application methods- Surface and sub surface irrigation methods, Border Irrigation, Check basin, Furrow, Sprinkler and drip irrigation. Prospective new methods of irrigation

Unit – III (08 Hours)

Design of drip and sprinkler irrigation systems-Hydraulic design of various Components of Drip and sprinkler Irrigation

Unit – IV (08 Hours)

Measurement of Irrigation Water-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..

Unit – V (08 Hours)

Scheduling of irrigation , time of irrigation ,frequency and interval of irrigation ,Water conveyance and control-Surface water distribution system, underground Pipe line Irrigation distribution system.

Unit VI (08 Hours)

Study 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, Case studies.

Practical and Term work will consist of following

1 Computation of consumptive use by using Pennman Method for a given crop..
2 Comparative study of different methods of irrigation.
3 Hydraulic design of drip / sprinkler irrigation system.
4 Study of different methods of measurement of irrigation water.
5 Study of scheduling of Irrigation
6 Case study on reclamation of salt affected land and water-logged areas

Text Books / References

Irrigation Theory and Practice –A.M.Michael, Vikas Publishing House.

Irrigation Engineering- G.L. Asawa, Wiley Eastern Ltd.
Irrigation water management- D.K.Majumdar. PHI Pvt. Ltd, 2013

Syllabus for Unit Test
Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

3: COMPUTATIONAL METHODS IN HYDRAULIC ENGINEERING

TEACHING SCHEME
Lectures : 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Mark
Credits : 4

Course Prerequisites
Engineering Mathematics I, II, III

Course Objectives

1) Construct analytic functions by Milne-Thompson method.
2) Apply conformal mapping for various boundary value problems
3) Evaluate numerical solutions of partial differential equation
4) Method of least square to fit various curves for numerical data
5) To analyse numerical data by statistical methods
6) Test the hypothesis for large and small-scale samples

Unit-I (08 Hours)

Complex Variables: Function of complex variables, Analytic function, Cauchy-Riemann equations (Cartesian and polar form), Harmonic functions, Construction of Analytic function, Milne-Thompson method.

Unit-II (08 Hours)

Complex Variables: Transformations or Mapping, Conformal mapping, Bilinear transformations, The Scharwz-Christoffel transformation, Complex Integration, Cauchy's Integral theorem, Cauchy's Integral formula, Residue theorem, Taylor's and Laurent's series. Applications to boundary value problems.

Unit-III (08 Hours)

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.

Unit-IV (08 Hours)

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.

Unit-V (08 Hours)

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).

Unit-VI (08 Hours)

Probability : Classical definition of probability, Addition and multiplication theorem of probability, Conditional Probability, Random variable, discrete and continuous random variables, Binominal, Poisson, Normal, Geometric, 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.

Text Books / References

Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley Eastern Ltd.Mumbai
Wylie C. R., Barret L. C., “Advanced Engineering Mathematics”, McGraw-Hill
B.S.Grewal, “Engineering Mathematics” (Khanna Publications, Delhi)
P.N.Vertikar & J. N. Vertikar, “Applied Mathematics”(Volume I & II) ,
P.V.G.Publications, Pune.
Murray R. Spiegel, “Schaum's Outline of theory and problems of “Complex Variables”, McGraw Hill Book Company
S. C. Gupta & V. K. Kapoor, “Fundamentals of Mathematical Statistics”, S. Chand & Sons , Delhi
S.S. Sastry, “Introductory Methods of Numerical Analysis”,Prentice Hall of India Pvt. Ltd., New Delhi
Irwin Miller & John E. Freund, “Probability & Statistics For Engineers”, Prentice Hall of India Pvt. Ltd., New Delhi

Syllabus for Unit Test

Unit Test 1 Units I , II & III

Unit Test 2 Units IV, V & VI

: HYDROLOGY

TEACHING SCHEME
Lectures : 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits : 4

Corse Prerequisites
Basic Engineering Hydrology

Course Objectives
The students will be able to

1 Explain measurement of precipitation and analysis of precipitation data.
2 Describe methods of measurement of evaporation and infiltration.
3 Describe runoff and data analysis for computation of runoff.
4 Explain unit hydrograph and its use for computation of flood hydrograph.
5 Describe and use different methods of flood routing.
6 Explain different types of aquifer and methods of exploration of ground water.

Unit-I (08 Hours)
Forms of precipitation, hydrologic cycle, climate and seasons in India. Water availability in India and world. Methods of measuring precipitation, location of rain gauge, rainfall mass curve and rainfall hyetograph, intensity-duration-frequency analysis, depth-area-duration analysis, PMP,

Unit-II (08 Hours)
Evaporation , Evaporimeters, empirical evaporation equations, empirical method of evaporation estimation, Evapotranspiration , Measurement of evapotranspiration, evapotranspiration equations , Infiltration , Infiltration capacity, measurement of infiltration, modeling infiltration capacity , infiltration indices.

Unit-III(08 Hours)
Runoff: runoff components, factors affecting runoff, basin yield, runoff-rainfall relations.

Data Analysis: Correlation, regression analysis, transformations, stochastic process, and time series analysis ,auto correlation analysis and synthetic flow generation models using random variates.

Unit-IV(08 Hours)
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.

Unit-V (08 Hours)
.Flood Routing- Introduction , basic equations, Hydrologic/ storage routing in reservoir and channels, Hydraulic methods of flood routing, Simple cases.

Unit-VI(08 Hours)
Ground Water Hydraulics: Types of aquifers, distribution of surface and sub surface water in global and Indian context, Darcy's law, Dupuits assumptions, application of Darcy's law to simple flow systems, differential equation for confined and unconfined aquifers, wells fully and partially penetrating, multiple wells, interference of wells, pumping test with steady and unsteady flow.Ground Water Development: Ground water exploration, types of wells, construction and design of wells, screens, pumping equipment, ground water quality, ground water pollution

Text Books / References
P. Jayarami Reddy, "Textbook of Hydrology", Laxmi Publication, New Delhi
P. Jayarami Reddy, "Stochastic Hydrology", Laxmi Publication, New Delhi
R. H. Mccuen and W. M. Snyder, "Hydrologic Modelin Statistical Methods and Applications" Prentice Hall, New Jersey, U. S. A
K. N. Mutreja, "Applied Hydrology",Tata McGraw Hill Publication
V.T.Chow, "Applied Hydrology", Tata McGraw Hill Publication
Raghunath H. M., "Ground water", New Age International Publication
Linsely ,Kohler ,Pauhlas, Applied Hydrology, Mcgraw hill Publishers.

Syllabus for Unit Test
Unit Test 1 Units I , II& III
Unit Test 2 Units IV, V& VI

SEMESTER II

5 : SEDIMENT TRANSPORT AND RIVER ENGINEERING

TEACHING SCHEME
Lectures : 04 Hrs/week
Practical : 02 Hrs/week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment :40 Marks
T.W. : 25 Marks
Oral : 25 Marks
Credits : 5

Corse Prerequisites
Water Resources Engineering

Course Objectives
1 Describe properties of sediments and incipient motion of uniform and non-uniform sediments
2 Explain different regimes of flow and their significance
3 Describe different methods computation of bed load and suspended load.
4 Design stable channels by different methods.
5 Describe various methods of measurement of bed load and suspended load
6 Describe hydraulics of alluvial rivers and various methods of river training.

Unit-I(08 Hours)
Introduction: Sediment problems, significant sediment properties, beginning of sediment movement – Shields analysis, critical tractive stress of non-uniform materials. Critical tractive stress for cohesive and cohesionless soils

Unit-II(08 Hours)
Bed Forms and Resistance: Description of bed forms, flow regimes, their significance, resistance analysis, different resistance laws.

Unit-III(08 Hours)
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.

Unit-IV(08 Hours)
Design of stable channels: Regime method, Kennedy's method, Lacey's method, Blench and Simons-Albertson method and tractive force approach.

Unit-V(08 Hours)

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.

Unit-VI(08 Hours)
Hydraulics of alluvial streams: Geomorphic cycle, Dominant discharge, Slope and Shape in cross section and plan, Continuity equation, Meandering, Braided stream, Secondary currents, Local scour for jets, Piers, Hydraulic structures. river training: objectives of river training, methods of rivertraining by guide banks, spurs, levees, cut offs, pitched island and vanes,methods of bank protection.

Practical and Term work will consist of following assignments

1 Study of nature of sediment problem
2 Sieve analysis of given sample of sediment and computation of geometric standard deviation and Crammers uniformity coefficient.
3. Study of incipient motion of sediments.
4. Study of different bed forms and their significance.
5. Computation of bed load and suspended load computation.
6 Design of stable channels by Lacey's, Kennedys theory and Tractive force theory
7 Study of degradation and aggradations in alluvial channels
8 Design of river training works.

Text Books / References

Garde R. J., Ranga Raju K. G., "Mechanics of Sediment Transportation and Alluvial Stream Problems", New Age International (P) Limited, New Delhi, 2004
Garde R. J., "River Morphology",New Age International (P) Limited, New Delhi,2006
Hydraulics of Sediment Transport, by W.H. Graf 3.
Loose Boundary Hydraulics by Raudkivi, A.j.

Syllabus for Unit Test

6: HYDRAULIC STRUCTURES

TEACHING SCHEME
Lectures : 04 Hrs/week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits : 4

Corse Prerequisites
Water Resources Engineering

Course Objectives
The students will be able to

1 Calculate the forces on gravity dams and carryout stability analysis of the dam.
2 Describe various construction techniques of gravity dams.
3 Carry out the stability analysis of earth dam for critical conditions.
4 Explain design and construction of rock fill dams.
5 Carry out hydraulic design of spillway and energy dissipater
6 Describe different types of spillway gates and instrumentation in dams.

Unit-I(08 Hours)
Gravity Dams-Concrete, masonry , Forces acting on a gravity dam, earthquake force-pseudostatic and dynamic response approach, load classification, stabilityanalysis, distribution of shear and normal stresses, principal stresses.

Unit-II(08 Hours)
Stress concentration around opening, foundation treatment, use ofcolgroute masonry in gravity dams, Roller Compacted Concrete Dams:Materials for R.C.C mixture, design concepts, construction methods,advantages.

Unit-III(08 Hours)
Earth Dam: Cross section of earth dam, Seepage through dam and itsfoundation, stability analysis for sudden draw down condition and steadyseepage condition, during construction stages.

Unit-IV(08 Hours)
Seismic effects, pore pressure, protection of upstream and down streamslopes, design of filters. Rock fill Dams: Relevant rock fill characteristic,general design principles, method of construction and compaction.

Unit-V(08 Hours)
Spill ways: Determination of capacity, types of spillways, ogee, siphon,chute, side, shaft,
orifice spillway and stepped spillway, their hydraulic design, crest profile, energy dissipatersand divide walls.

Unit-VI(08 Hours)
Spillway gates:Vibration, types of gates, radial, drum, vertical lift andautomatic gates. Instrumentation in Dams: necessity, measurements andtheir purpose, planning of installation of instruments. Weirs and Barrages, water bridges and culverts ,design concepts .

Text Books / References

Bharat Singh,Varshney R.S."Engineering of Embankment Dams",Oxford & IBHPublishing Co.,1995.
Thomas, "The Engineering of Large Dams",John Wiley & Sons
Varshney R. S., "Concrete Dams",Oxford and IBH Publishing Co.
Vishcher D. L. and Hager W. H.,"Dam Hydraulics",John Wiley & Sons
"Design of Small Dams", USBR Oxford IBH Publishers
USBR Monogram -25, Stilling basins.

Syllabus for Unit Test
Unit Test 1 Units I, II & III
Unit Test 2 Units IV, V & IV

7: OPEN CHANNEL FLOW

TEACHING SCHEME
Lectures : 04 Hrs/week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits : 4

Corse Prerequisites
Fundamentals of Open Channel Flow.

Course Objectives

1. Explain basic concepts of open channel flow
2. Enter evaluate shear stress on the boundary of open channel
3. Application of specific energy and critical depth in open channel flow
4. Computation of GVF profiles
5. Describe a rapidly varied flow and its applications
6. Describe unsteady flow in open channels

Unit-I(08Hours)
Basic Concepts of Fluid Flow:Classification of flow, differential form ofcontinuity and momentum equations, energy equation, energy andmomentum correction coefficients, pressure variation in vertical.

Unit-II(08 Hours)
Steady Uniform Flow in Rigid Boundary Channels: Shear stress on theboundary, velocity distribution in the vertical, resistance laws and their limitations, Stickler's equation, conveyance and section factor.

Unit-III(08 Hours)
Specific energy, specific force and critical depth, control section, applications of specific energy and critical depth concepts.

Unit-IV(08 Hours)
Gradually varied flow, governing equations, classification of surface curves, computation of gradually varied flow in prismatic and non-prismatic channels, graphical, direct and numerical integration methods

Unit-V(08 Hours)
Rapidly varied flow and application of momentum equation, hydraulic jump in horizontal and sloping rectangular channels, location and length of jump.

Unit-VI(08 Hours)
Unsteady flows : Waves and classification, celerity of waves, surges , equations of motion, and method of characteristics.

Text Books / References

K .G. Ranga Raju, “Flow Through Open Channels”, Tata McGraw Hill Publication 1993
Chaudhry M.H., ‘Open channel flow’, Spinger, New York, 2007.
F. M. Henderson, “Open Channel Flow”,The McMillan Company, N. Y., 1966
K. Subramanya, “Flow in Open Channels”,Tata McGraw Hill Publication, 1990

V. T. Chow, “Open Channel Flow”,McGraw Hill Publication, 1990
Garde R. J. & Mirajgaokar, “Engineering Fluid Mechanics”,SciTech Publishers, Chennai , 2004

Syllabus for Unit Test

Unit Test 1 Units I, II & III
Unit Test 2 Units IV, V & IV

8: OPTIMIZATION IN HYDRAULICS

TEACHING SCHEME
Lectures : 04 Hrs/week
Practicals : 02 Hrs/week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Marks : 40 Marks
Term Work : 25 Marks
Oral. : 25 Marks

Corse Prerequisites
Basic Engineering Mathematics

Course Objectives

1. Formulate linear programming problems and solve by various methods
2. Apply transportation and assignment problems for optimisation
3. Apply nonlinear programming techniques for optimisation problems
4. Describe applications of genetic algorithm neural networks and fuzzy system in solution of optimisation problem
5. Formulate optimisation models in hydraulic engineering problems

Unit-I(08 Hours)
Concept and need of Optimization; Linear Programming: Formulation of problem, graphical solutions, simplex method, Big M method, Two-phase method, duality.

Unit-II (08 Hours)
Transportation problems-BFS-Optimality test, maximization problems. Assignment Problems - minimization, maximization.

Unit-III (08 Hours)
Nonlinear Programming: Unconstrained one dimensional search methods - Dichotomous search, Fibonacci, golden section;Multivariable unconstrained methods-gradient techniques, steepest ascent, descent methods,Newton's method.

Unit-IV(08 Hours)
Nonlinear Programming :Constrained method : Lagrangian multiplier techniques, Khun- Tuckers conditions, Dynamic Programming: Principle of optimality, recursive equation.

Unit-V (08 Hours)
Introduction to genetic algorithms, simulated annealing, neural networks and fuzzy systems for solving optimization problems.

Unit-VI (08 Hours)
Model formulation and case studies : Conjunctive use of ground water and surface water, hydropower optimization, crop yield optimization, multi-basin and multi-reservoir systems.

Practical and Term Work is based on following assignments

1. Problems on Linear Programming (Graphical , Simplex, Big M, and Two phase Methods)

2. Problems on Transportation and Assignment

3. Problems on Non-linear Programming (Unconstrained one-dimensional search methods: Dichotomous search, Fibonacci, Golden section; Multivariable unconstrained methods: Gradient techniques, steepest ascent, descent methods, Newton's method)

4. Problems on Constrained Non-linear and Dynamic Programming (Lagrange

multiplier technique and and Dynamic programming)

5. Simple applications of genetic algorithms, simulated annealing, neural networks and fuzzy systems for solving optimization problems.

6. Simple case studies of Conjunctive use of ground water and surface water, hydropower optimization, crop yield optimization, multi-basin and multi-reservoir systems etc.

Text Books / References

Rao S.S., 'Engineering Optimization -Theory and Practice', New Age International(P) Ltd.,1914.
Taha H.A., "Operation Research-An Introduction", Prentice - Hall, 2009.
Wagner, H. M., 'Principles of Operations Research', Prentice - Hall**,** 1975**.**
Vedula S. and Mujumdar P. P.'Water resources engineering',Tata McGraw Hill Education, 2005.
Deb Kalyanmoy. 'Optimization for Engineering Design - Algorithms and Examples' PHI Learning (P) Ltd, 2012.
Louks D. P, Stedinger J. R. and Haith D. A., Water Resources Systems Planning and Analysis, Prentice Hall, Inc. Engelwood Cliffs, 1981.

Syllabus for Unit Test

Unit Test 1 Units I , II, III
Unit Test 2 Units IV, V, VI

SEMESTER III

9 : ELECTIVE I:COASTAL ENGINEERING

TEACHING SCHEME
Lectures : 04 Hrs/week
Practical : 02 Hrs/week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Termwork : 25 Marks
Oral : 25 Marks
Credits : 5

Corse Prerequisites
Basic Coastal Engineering

Course Objectives

1. Describe wave mechanics and statistical analysis of wave data
2. Describe effect of tides on coastal structure and coastal process
3. Design coastal structures such as break water, jetties etc.
4. Describe types of dredgers and dredging techniques
5. Explain process of planning and management of ports and harbours.

Unit-I (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.

Unit-II (08 Hours)

Global tidal cycle, tidal análysis. Types of tides, effect of tides, significance in coastal engineering, Coastal process-erosion/accretion due to waves, estimation of littoral drift, Effect of construction of coastal structures on stability of shoreline / beaches, shoreline configuration

Unit-III (08 Hours)

Introduction to Coastal structures:, 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 RBW , offshore structures: oil platform, design criteria for sub marine pipelines, cables, response of oil platform members , floating structure to wave load –vibration and spacing of piles, forces on piles.

Unit-IV (08 Hours)

Dredging technology: types of dredgers, Radio active tracers studies for feasibility of dumping ground for dredged materials- environmental aspects of dredging etc.

Unit-V (08 Hours)

Planning 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.

Unit-VI (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, Issues related to Integrated coastal zone management. Coastal regulation zone.

TW and Practical will consist of following

1. Statistical analysis of wave train short term analysis -Data of strip chart given.
2. Estimation of life time wave from log normal plot -Data and WRB for two months in monsoon given.
3. Plot of P.M .spectra from the u and f data supplied and computation of wave parameters,.
4. Computation of long shore transport from the data supplied.
5. Design of Rubble mound break water on the basis of computed design wave from above exercises.

Text Books / References

Basic Coastal Engineering-R.M.Sorensen,2006.
Coastal Hydrodynamics-J.S.Mani ,I IT Madras
Shore Protection Manual-U.S.Waterways Experiment Station Corps of Engineer, Coastal ProtectionManual 2002.
Narasinhan and S. Kathiroli, “Harbour and Coastal Engineering”, Vol I&II, Ocean and Coastal Engineering Publication, NIOT, Chennai

Syllabus for Unit Test
Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& VI

9 : ELECTIVE I : HYDRAULIC MODELLING TECHNIQUES

TEACHING SCHEME
Lectures : 04 Hrs/week
Practical : 02 Hrs/week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Term work : 25 Marks
Oral : 25 Marks
Credits 5

Unit-I
Dimensional analysis: Units, dimensions of physical quantities, different methods of btaining dimension less parameters viz., Rayleigh's method, method of repeating variables, Buckingham π theorem ,Reynolds number, Froude number, Mach number, Euler Number and Weber number.

Unit-II (08 Hours)
Determination of scales for models , Necessity of distortion of scales, scale effects. Movable bed models. Construction and operation of hydraulic models. Wind tunnels,flumes-2D,comprehensive models3D .

Unit-III (08 Hours)
Measuring Equipments: Flumes ,Weirs, flow meters, pressure transducers, hot film anemometer, Current meter, Laser doppler , pointer gauges.

Unit-IV (08 Hours)
Application to coastal and tidal problems. Design of Regular & Random (3D and2D) wave modelling techniques , stability of coastal structures, Simulation of littoral drift , Design of sand trap , Distorted scale tidal modelling technique(rigid/movable) for Estuarine Ports,

Unit-V (08 Hours)

Rigid bed models and movable bed models ,bank protection works , barrages and weirs , canal offtakes ,power intakes, gates ,bridges and intakes. Applications for structures in hilly regions – Dams , spillways and energy dissipaters, combination of rigid and movable bed models ,sedimentation and flushing of reservoirs.

Unit-VI (08 Hours)

Introduction to basic mathematical modelling techniques for hydraulic phenomena & processes related to various hydraulic structures, Advantages & limitations for interpretation of the results, need of validation with field /prototype data- Typical case studies using software.

Text Books / References

"Langhaar- Dimensional Analysis"
Hydraulic Modeling", IAHR Bulletin no 7
"Fluid Mechanics", Dr. R. J. Garde Scitech Publications Channai
River behaviour control and training-CBIP Publications (60) revised no (279)
Narasinhan and S. Kathiroli, "Harbour and Coastal Engineering", Vol I&II, Ocean and Coastal Engineering Publication, NIOT, Chennai

Syllabus for Unit Test

Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

10: ELECTIVE II WATER POWER ENGINEERING

TEACHING SCHEME
Lectures : 04 Hrs/week
Practical : 02 Hrs/week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Term work : 25 Marks
Oral : 25 Marks
Credits : 5

Course Prerequisites

Water Resources Engineering

Course Objectives

1 Describe classification of hydropower plants
2 Expalin use of stream flow data in planning hydropower projects
3 Design penstocks , anchor blocks and valves.
4 Describe various types of surge tanks.
5 Describe types of turbines and their characteristics.
6 Explain planning and layout of power houses.

Unit -I (08 Hours)

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.

Unit -II(08 Hours
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.

Unit -III(08 Hours
Penstocks and Accessories, classification of pen stocks, design criteria for penstocks,
Economical diameter of penstocks, Anchor blocks, conduit values, Bends & manifolds.

Unit -IV(08 Hours
Water hammer and surges, channel surges, water hammer, resonance in penstocks. Function of surge tank, Types of surge tanks, Differential surge tanks.

Unit -V(08 Hours
Turbines- Type of turbines , Hydraulic features, Turbine size, lay out arrangements, Hydraulics of turbines, draft turbines, cavitation in turbines, characteristics of turbines.

Unit -V(08 Hours
Planning of power house – Power house structure, under ground power station, components of under ground power house, types of layouts, small scale Hydropower, Potential of small scale Hydropower.

Practical will consist of following Assignments

1. Case studies on Classification of hydropower plants.
2. Use of Flow duration curve for the design of hydropower plant.
3. Design of intake structures.
4. Estimation of economical diameter of the penstock.
5. Computation of water hammer pressure.
6. Study of hydraulics of turbines.
7. Case study on layout of hydropower plant.

Text Books / References

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

Syllabus for Unit Test

Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

10 : ELECTIVE II:NUMERICAL METHODS INHYDRAULIC ENGINEERING

TEACHING SCHEME
Lectures : 04 Hrs/week
Practical : 02 Hrs/week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Termwork : 25 Marks
Oral : 25 Marks
Credits : 5

Unit-I(08 Hours)
Governing equations of 1-D and 2-D unsteady flow : St. Venant equations, Boussinesq equations, groundwater flow equations and boundary conditions.

Unit-2(08 Hours)
Numerical method for one dimensional flow : Method of characteristics, characteristics, initial and boundary conditions, characteristic grid method, method of specified intervals, other numerical methods.

Unit-3 (08 Hours)
Numerical method for one dimensional flow : Finite difference method, explicit finite difference schemes, implicit finite difference schemes, stability.

Unit-4 (08 Hours)
Numerical method for two dimensional flow : Finite difference method, explicit finite difference schemes, implicit finite difference schemes, stability.

Unit-5 (08 Hours)
Numerical method for ground water flow : Explicit finite difference method, Implicit finite difference method, finite element method, application.

Unit-6 (08 Hours)
Applications of unsteady flows using commercial 1-D and 2-D software.

References
Chaudhry M. Hanif, Open Channel Flow, Spinger, 2007.
Abbott M. B.and Minns A. W., Computational Hydraulics, Gower Technical, 1998.

Vreugdenhil, C. B., Computational Hydraulics, 1989.
Fenton , J. , Computational Hydraulics, 2010
Popescu I., Computational Hydraulics, Numerical methods and modelling paperback, IWA Publishing, 2014.
Rastogi A. K., Numerical ground water hydrology, Penram, 2007.
Pinder G. F. and Gray W. G., Finite Element Simulation in Surface and Subsurface Hydrology, 1977.

Syllabus for Unit Test
Unit Test 1 Units I , II & III
Unit Test 2 Units IV, V & VI

10 ELECTIVE II:ENVIRONMENTAL FLUID MECHANICS

TEACHING SCHEME
Lectures : 04 Hrs/week
Practical : 02 Hrs/week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Termwork : 25 Marks
Oral : 25 Marks
Credits : 5

Unit-I(08 Hours)
Global wind currents, atmospheric boundary layer, simulation of boundary layer in wind tunnel and applications to forces on structures, use of wind tunnel for studying dispersion, diffusion. Cyclones, anti cyclones, and tornadoes, Tsunami.

Unit-II(08 Hours)
Waves, deep and shallow water waves, braking of waves, littoral drift and sediment transport by waves, dispersion and diffusion in coastal waters, ocean out falls.

Unit-III(08 Hours)
Vortex formation at intakes, similarity criteria, hydraulic design of sumps ,design of water intakes.

Unit-IV(08 Hours)
Heated water disposal in reservoirs and channels, mathematical considerations, solution techniques, physical modeling.

Unit-V(08 Hours)
Thermal plumes, dispersion and diffusion in atmosphere.

Unit-VI(08 Hours)
.
Dam break Problem and numerical solution

Text Books / References

Fisher H. B., List E. J., Imberger J. and Brooks N.H., “Mixing of Inland and Coastal Waters, Academic Press, NY,1979
Bernard Le, Mehaute, “Introduction to Hydrodynamics and Water Waves, Springer– Verlag”, NY,1996
Khauss J., “Swirling Flow Problems at Intakes, Hydraulic Structure Design Manual-

I”, IAHR,Ed. 1987
Fredsoe J and Deigaard R., “Mechanics of Coastal Sediment Transport”

Syllabus for Unit Test
Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

11 SELF STUDY PAPER I

12 SEMINAR

TEACHING SCHEME
Practical : 01 Hrs/week

EXAMINATION SCHEME

Term work : 25 Marks:
Oral : 25 Marks
Credits : 5

Each student will select a topic in the area of Hydraulic Engineeringkeeping track of the recent technological trends and developments.Students will make a seminar presentation using audio visual aids andsubmit the seminar report in the form of bound journal.

13 DISSERTATION STAGE I

TEACHING SCHEME
Practical : 02 Hrs/week

EXAMINATION SCHEME

Term work : 25 Marks
Credits : 21

Dissertation stage-I will include identification of problem, preparation ofsynopsis literature survey and formulation of problem.

SEMESTER IV

14 : SELF STUDY PAPER II

15 : DISSERTATION STAGE II

TEACHING SCHEME
Practical : 04 Hrs/week

EXAMINATION SCHEME

Term work : 150 Marks
Oral : 75 Marks
Credits : 30

Dissertation stage-II will include experimentation, data analysis and submission of final report.

11 : SELF STUDY PAPER I: WATER RESOURCES PLANNING AND

MANAGEMENT

TEACHING SCHEME
Lectures : 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits : 4

Course Prerequisites
Water Resources Engineering.

Course Objectives

1 Explain availability of water resources in the country.
1 Describe the process of planning water resources project
2 Explain integrated and conjunctive use of water for irrigation
3 Describe the methods of augmentation and conservation of water resources
4 Explain various parameters of quality of irrigation water.
5 Describe water logging and methods to reclaim water logged lands.

Unit-I(08 Hours)
Water Resources of India: Land resources of India, water sources per capitawater availability, Irrigation potential, methods of assessment of waterresources.

Unit-II (08 Hours)
Water Resources Development: Objectives, planning for water resourcesdevelopment, water resources system design, economics of waterresources development, micro and macro economics, discounting factors,discounting techniques – present worth, rate of return, benefit cost analysis,annual cost methods, profitability analysis.

Unit-III(08 Hours)
Integrated and conjunctive use of water, allocating water for various uses.Irrigation water management, constraints in irrigation development.National water policy.

Unit-IV(08 Hours)
Augmentation of water resources: Conservation of water, augmentation ofwater resources, method of artificial recharge.

Unit-V
(08 Hours)
Water quality: Quality of water for irrigation and municipal use, waterpollution and it s co ntrol. Development of water resources andenvironment. Environmental impacts of water storage reservoirs.

Unit-VI(08 Hours)
Water logging and land reclamation:Causes of water logging, anti loggingmeasures, factors responsible for formation of saline and alkali soils, illeffects of salinity and alkalinity, land reclamation methods.

Text Books / References
Ray K. Linsley, Joseph B. Franzini, “Water Resources Engineering”,McGraw HillPublication
R. K. Sharma, T. K. Sharma, “Hydrology and Water Resources Engineering”,Dhanpat Rai Publication
P. P. Mujumdar, Vedula, “Water Resources Engineering”, Tata McGraw HillPublications.

Syllabus for Unit Test

Unit Test 1 Units I , II& III
Unit Test 2 Units IV, V& VI

11 : SELF STUDY PAPER I: GROUND WATER HYDROLOGY

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits 4

Course Prerequisites
Basic Engineering Hydrology.

Course Objectives
1 Explain role of ground water in hydrological cycle.
2 Describe ground water hydraulics and its applications.
3 Describe applications of ground water hydraulics for estimation of yield.
4 Explain numerical models in ground water hydraulics.
5 explain role of various organizations in ground water .

Unit – I **(**08 Hours)
Hydrological cycle, role of ground water in hydrological cycle, aquifers, classification and characteristics.

Unit – II **(**08 Hours)
Ground water hydraulics- Darcy's law and application, flow nets-application.

Unit – III
(08 Hours)
Ground water hydraulics- mass conservation, aquifer flow equation, heterogeneity, anisotropy, unsaturated flow, recharge, stream-aquifer interaction, well hydraulics.

Unit – IV (08 Hours)
Application of ground water hydraulics for estimation of yield- case study.

Unit – V
(08 Hours)
Model (Numerical) in ground water hydraulics

Unit – VI **(**08 Hours)
Working organization: Global and Indian data collection, water quality and control.

Text Books/References

Groundwater Hydrology, David Keith Todd and Larry W. Mays

Syllabus for Unit Test

Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

11: SELF STUDY PAPER I: INSTRUMENTAION IN HYDRAULICS

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits 4

Course Objectives

1 Explain role of instrumentation in hydraulics.
2 Describe qualification and characteristics of various instruments.
3 Describe the instruments for measurement of velocity and discharge.
4 Explain the methodologies adopted for observations.
5 Describe instruments for measurement of pressure and strain.

6 Describe modern and precision instruments used for measrrements.

Unit – I (08 Hours)

Definition of instruments, purpose of instrumentation, system of application of instrumentation, different classifications of instruments, main hydraulic and other civil engineering parameters involved.

Unit – II (08 Hours)

Qualifications and characteristic of instruments, calibration and errors – definitions, utility and dependability, transducers - their purpose, characteristics and usage, decision on the requirements for selection of instruments, need of system analysis before the selection of instruments.

Unit – III (08 Hours)

Specific instruments : measurement of velocity and discharge,requirements for field and laboratory, methods of measurement and different structures used, supporting structurerequirements, designs parameters.

Unit – IV (08 Hours)

Methodologies adopted for observations, requirements for good instruments andInstrumentation, application of above requirements to instrument systems.

Unit – V (08 Hours)

Specific instruments : measurement of pressure and strain, requirements for fieldand laboratory methods of measurement and different structures used, supporting structure requirements, designs parameters.

Unit – IV(08 Hours)

Modern electronic and high precision instruments. hot film anemometer, 3D observations for velocities, eddies, etc.

Text Books/References

Handbook for Flow measurement and documentation – South Florida Management District, USA

Calibration of Pressure Measurements – University of Porto Rico

Calibration of Pressure Measurements – USBR No 1040-1989

Discharge measurement structures – USBR; Agricultural research Service

Experimental Uncertainty and Measurement errors – An update - World Water and Environment Conference May 2005

Syllabus for Unit Test

Unit Test 1 Units I, II& III

Unit Test 2 Units IV, V& IV

11 : SELF STUDY PAPER I : DISASTER MANGEMENT

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits 4

Course Objectives

1 Describe factors causing disasters and damages.
2 Explain extreme value conditions in various disasters
3 Describe disasters due to failures of structures.
4 Describe the measures to avoid disasters and measures to minimize damages.
5 Explain pre disaster warning systems.
6 Explain various rescue operations .

Unit – I **(**08 Hours)

Factors causing disaster & damage to properties & human lives- Natural man

made,cause & short term / long term effects & needs to take measures.

Unit – II **(**08 Hours)
Extreme value conditions- Waves, flooding, storm surge, earthquake & Tsunami etc.

Unit – III(08 Hours)
Failure of hydraulic structures - dams, fires in plants, (Thermal, Nuclear etc.), oil tanker leakage, sinking etc.

Unit – IV **(**08 Hours)
Measures to avoid disasters (manmade), measures for minimum damage natural Disasters.

Unit – V **(**08 Hours)
Warnings systems pre disaster- remote sensing, satellite, media, (Radio, Tv), communication systems.

Unit – VI(08 Hours)
Rescue operation, -Helicopter, Life saving systems, transportation, detection of areas of disaster, Global, National, Local management systems for all various activities.

Text Books/References

Harsh K. Gupta, Disaster Management, Universities Press(India), 2003.
Sundar I., Sezhiyan T., Disaster Management,, Sarup and Sons, 2007.
Thomas D. Schneid and Larry R. Collins, Disaster Management and Preparedness, 2002.
Awasthy Amit, Disaster Management : Warning response and Community Relocation, Global India Publications, 2009.
Pinkowski Jack, Disaster Management Handbook, CRC Press, 2008.
Sharma Vinod K., Disaster Management : First India Disaster Management Training Country Workshop, New Delhi, 1993.

Syllabus for Unit Test
Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

11 : SELF STUDY PAPER I : OPERATION AND MAINTENANCE OF HYDRAULIC STRUCTURES

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits 4

Course Objectives
1 Explain role of operation and maintenance in hydraulics structures.
2 Describe various causes of failure of dams and safety measures.
3 Describe guide lines for operation of dams.
4 Describe inspection guidelines for dams and spillways.

5 Describe monitoring and surveillance of gravity and embankment dams.
6 Describe maintenance works for dams and spillways.

Unit – I(08 Hours)Introduction : Hydraulic structures, types, major hydraulic structures requiring operation and maintenance, dams, types.

Unit – II(08 Hours)
Dam failures : historic dam failures, their causes, modes of failures of Embankmentdams, external erosion, internal erosion, structural failure, safety requirements/measures, Modes of failures of concrete dams, external erosion,internal erosion, structural failure, safety requirements/measures

Unit – III(08 Hours)
Guidelines for operations of dams, Operations of typical embankment dam and concrete dam

Unit – IV (08 Hours)
Inspection guidelines of dams, inspection of embankment dam : the crest, the upstream slope, the downstream slope, the abutments, the downstream toe etc. inspection of concrete dam , inspection, of appurtenant works, spillway, outletsetc.

Unit – V (08 Hours)
Monitoring and surveillance of embankment dams : Task and purpose of monitoring, Monitoring of porepressure, seepage, monitoring of displacements, measurements of stresses, seismic measurements , generalprinciples on the selection and positioning layout of measuring instruments, Monitoring and surveillance of concrete dams : On monitoring, surveillance and instrumentation of concrete dams in general, Monitoring by precise survey methods,
urveillance with embedded instruments

Unit VI(08 Hours)
Maintenance of embankment dam, maintenance of concrete dam, maintenance ofappurtenant works, spillway, outlets etc.

Text Books / References
Ljubomir Tanchev, *St. Cyril and Methodius University, Skopje, Macedonia (Emeritus),*Dams and Appurtenant Hydraulic Structures, Taylor & Francis, 2005.
British Columbia, Dam Safety Guidelines Inspection and Maintenance of Dams, 2011.
Texas commission on Environmental Quality, Guidelines for operation and Maintenance of dams in Texas

Syllabus for Unit Test

Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

11 : SELF STUDY PAPER I: APPLICATION OF REMOTE SENSING TO HYDRAULICS

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits 4

Course Objectives

1 Explain principles of electromagnetic remote sensing
2 Explain principles of infrared photography.
3 Explain principles of interpretation from photographs.
4 Explain alternate techniques of under ground survey.
5 Explain various techniques of remote sensing.
6 Explain fundamentals of digital image processing.

Unit – I (08 Hours)

Principles of electromagnetic remote sensing, electromagnetic spectrum. aerial photography, satellite imagery.

Unit – II (08 Hours)

Infra red photography, temperature difference in water, aeromagnetic surveys at Low Altitude.

Unit – III (08 Hours)

Photographic techniques by aircrafts, satellites their principles & interpretation, aerial magnetic surveys a) subsurface rock structure b) flow of ground water.

Unit – IV (08 Hours)

Electrical conductance of rock, velocity of sound through different rocks , Electrical resistivity surveys.

Unit – V (08 Hours)

Preparation of maps on political land use, physiographic land gradient, methodology, geology of soil, hydrology and water shed , ground water potential, hydrogeology, agronomy, forestry, Civil engineering, A R. S. system classification a) Passive b) Active (A) Remote Sensing Characteristics i) Spatial resolution ii) Spectral resolution iii) Radiometric resolution iv) (B) Temporal resolution ,1D Extraction of information, fundamentals of Photogrammetric, Thermal infrared sensor (C) Side looking airborne radar (SLAR) (D) Land remote sensing satellite systems- satellites of different nations their sensors, No. of bands.

Unit – VI (08 Hours)

Fundamental concepts in computer aided image classification, data preprocessing : radiometric correction, geometric correction, large classifications : soft x hard classifiers, Contextual x Neural networks Classifiers, integration of Remote Sensing & GIS – Separate but equal, Seamless integration, Total integration.

Text Books/References

Chor Pang Lo, Albert K. W. Yeung, Concepts & Techniques of geographic information system, Prentice Hall, 2002

Paul Longly, Geographic Information Systems and Science, John Wiley & Sons,

2005.

Syllabus for Unit Test

Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

11 : SELF STUDY PAPER I : ENVIRONMENTAL IMPACT ASSESSMENT FOR WATER RESOURCES PROJECT

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits 4

Course Prerequisites

Environmental Engineering

Course Objectives

1 Explain environmental aspects of Water Resources Development.
2 Explain effect of dam construction on downstream river regime.
3 Explain environmental Impact Assessment methodology.
4 Explain environmental monitoring of water resources development projects.
5 Explain socio economic issues related to water resources project.
6 Explain environmental legislation in India with respect to water resources projects.

Unit – I (08 Hours)
Environmental Aspects of Water Resources Development, Rehabilitation of people affected by the project, submergence of the forest area, water logging and salinity in command areas, adverse effects on wild life ,water borne diseases,siltation of manmade reservoirs.

Unit – II **(**08 Hours)
Effect of dam construction on downstream river regime.Sediment transport, National

water policy and recommendations for environmental monitoring of water resources projects.

Unit – III **(**08 Hours)
Environmental Impact Assessment methodology.Description of site and its Developmentdescription of present and projected conditions, assessment of probable impacts, compliance with regulations , review of alternatives.

Unit – IV **(**08 Hours)
Environmentally sound water resources management, Various Case studies, catchment area treatment, compensatory afforest ration, command area treatment , status of environmental monitoring of water resources development projects.

Unit – V **(**08 Hours)
Socio economic issues related to water resources project.Deforestation ,submergence of land, change in land use pattern, submergence of existing roads, construction of new approach roads, construction of new town ships and other infrastructure.

Unit – VI **(**08 Hours)
Environmental legislation in India with respect to water resources projects.Water-prevention and control of pollution act, wild life protection act, forest conservation act, environmental protection act.

Text Books/References

Government of India National water policy
Central water commission Guide lines for sustainable water resources development and management, 1992.
Central board of Irrigation and Power- Seminar on Environmental Management of Water Resources and Power Projects, 1995

Syllabus for Unit Test

Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

11:SELF STUDY PAPER I– FLOODS AND FLOOD MANAGEMENT

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits -4

Course Prerequisites
Hydrology

Course Objectives
1 Describe various methods of flood estimation
2 Explain various methods of flood routing through channels.
3 Explain identification of floods and flood zones.
4 Explain various measures for flood control.
5 Explain dam break problem, PMF .

6 Describe various aspects of flood management.

Unit – I **(**08 Hours)

Introduction, Necessity, General information on flood damages at global level and in India. Various methods of flood estimation and models.

Unit – II **(**08 Hours)

Flood routing through channels , various method, with case studies.

Unit – III **(**08 Hours)

Flood Mitigation, Identification of floods and flood zones.

Unit – IV **(**08 Hours)

Flood control – Single & multipurpose reservoir , reservoir operation , rule curve, routing, zones of reservoir, structural and non structural measures.

Unit – V **(**08 Hours)

Special floods- Estimation , dam break, PMF, Application for damage evolution.

Unit – VI **(**08 Hours)

Aspects of flood management- identification of areas, extent & duration of flood, Environmental & Ecological aspects, economics of flood control project.

Text Books/References

"Flood & Flood control" Workshop proceedings at CWPRS Pune

"Flood forcasting & Warning" CWC guideline.

"Flood & Flood control" NIH Roorkey.

Syllabus for Unit Test

Unit Test 1	Units I, II& III
Unit Test 2	Units IV, V & IV

14 : SELF STUDY PAPER II : OFFSHORE STRUCTURES

TEACHING SCHEME

Lectures: 04 Hrs/Week

EXAMINATION SCHEME

Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks

Credits 4

Course Prerequisites

Coastal Engineering

Course Objectives

1 Describe types of offshore structures and their classification.
2 Explain the development of offshore structures in Indian continental shelf.
3 Explain basic design criteria for offshore structures.
4 Explain additional facilities/ functions related for oil transportations and storage
5 Explain safety measures for offshore structuresl.
6 Describe environmental and economical aspects of offshore structures.

Unit – I **(**08 Hours)

Types of ocean Structures,- Onshore / Offshore, Requirement of structures, its types/ classification- depth, function, design aspect.

Unit -II **(**08 Hours)

History of development of offshore structures, installation of platforms, development in Indian continental shelf in future, need for crude oil and availability

Unit -III **(**08 Hours)

Basic design criteria for drag/ lift forces, design principles for structural members , spacing, wave data and vibration analysis.

Unit -IV **(**08 Hours)

Additional facilities/ functions related for oil transportations, storage, transport, pumping from oil well to the refinery .

Unit -V **(**08 Hours)

Safety of offshore structures natural/ manmade ,accidental- case studies , factors affecting stability, design of pipe lines.

Unit -VI(08 Hours)

Environmental aspects- oil leakages, pollution, fire protection, extreme wave conditions-storm, Tsunami etc. Economic aspects in design, Installation, maintenance, and operations related to offshore structures

Text Books/References

Brunn Per, B. U. Naik, “Shore Protection Manual”, NIO Goa
Quinn A. D., “Port Planning”, McGraw Hill Book Co., New York
Richard Silvester, “ Coastal Engineering”’ Vol. I, II, University of western Australia.
Shore Protection Manual – 1984 and Coastal Protection Manual – 2002,
US Waterways Experiment Station, Corps of Engineer, Coastal Engineering research centre, Vicksburg , USA
Narasinhan and Kathiroli, “Harbor and Coastal Engineering”, Vol. I & II, Ocean and Coastal engineering Publication, NIOT, Chennai

Syllabus for Unit Test

Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

4 : SELF STUDY PAPER II: URBAN WATER MANAGEMENT

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits 4

Unit – I (08 Hours)

Drinking water qualities, potable limits, water softening processes, common impurities, alkalinity, acidity, Water purification, storage, treatment of waters, settling basins, slow sand filters, pressure and gravity filters

Unit – II (08 Hours)

Storage of water, service reservoirs, cisterns, elevated tanks, pressure equalizing Reservoirs, distribution of waters, demand of water for domestic and public purpose, wastage of water, prevention of leakages, different methods of distribution, design of distribution system, intermittent and constant system of supply

Unit – III (08 Hours)

Pipes of different metals,cement concrete pipes, Valves, meters taps

Unit – IV (08 Hours)

Pumping of water, suction and delivery pipes, water pumps, design of pumping stations

Unit – V (08 Hours)

Ground water and wells, water bearing strata, discharge from wells, tests of yields, depression head, cone of depression

Unit – IV(08 Hours)

Methods of boring, strainers, well lining

Text Books/References

Water supply and sanitary engineering by G. s Birdie and J. S. Birdie., Dhanpatrai Publications, 2006.

Water supply engineering by B. C. Punmia, Laxmi publications, 2009.

Syllabus for Unit Test

Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

14 : SELF STUDY PAPER II : RIVER ENGINEERING

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits 4

Course Prerequisites
Sediment Transport and river Engineering.

Course objectives

1) Explain classification of rivers based on different criteria.
2) Describe rivers equilibrium.
3) Explain river dynamics.
4) Describe river flow control structures.
5) Explain river training works and their hydraulic design.
6) Describe river navigation and required structures.

Unit – I **(**08 Hours)
Classification of Rivers: Based on different approach/criteria, River plan forms and their Characteristics, Development/variation of plan forms in meandering and migration, braiding, its characteristics and causes for their development.

Unit – II **(**08 Hours)
Rivers in equilibrium: Channel stability, regime relations and applications, Natural constraints and their effects on the river regime, Hydraulic structures and their effects in the river regime.

Unit – III (08 Hours)
Rivers in dynamics: Bed level changes, aggradation and degradation confluences and braiding, their causes and effects on river regime.

Unit – IV (08 Hours)
River flow control structures: weirs, barrages, intakes, bridges and diversion structures, design and operational concepts, river improvement methods.

Unit – V (08 Hours)
Rivers training works: Rivers training structures for weirs, barrages, intakes, bridges, diversion structures, hydraulic design and operational concepts, river improvement.

Unit – VI (08 Hours)
Rivers navigation: Advantages and disadvantages, hydraulic structures for river navigation, river dredging, necessity and effects.

Text Books/References

River mechanics, Pierre Y, Julian (2002), Cambridge University Press

Brown S. A. 1985a, “Design of spur – type, Stream stabilization structure, final report,” Federal highway administration.
Knighton, D., 1998, Fluvial forms and processes, Arnold, Baltimore.

Syllabus for Unit Test

Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

14 : SELF STUDY PAPER II : PLANNING OF PORTS

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits 4

Course Prerequisites – Coastal Engineering.

Course Objectives

1) Explain status of port development in India and world.
2) Describe modern port facilities.
3) Describe special purpose births in ports
4) Explain port cost analysis and economics’
5) Describe transportation in ports.
6) Explain limiting factors for planning of ports-facilities.

Unit – I(08 Hours)
Port development requirement, world port development- Major, Minor Fisheries, Indian port service, General planning of port requirement, Roll of modeling in planning of port,present status of Indian port & future demands of next four decades

Unit -II (08 Hours)
Modern port facilities, roll of road / rail link with planning of ports, Automation in port development

Unit- III(08 Hours)
Analysis of case studies- evaluation , comments suggestions
Special purpose berths in ports- Container, oil, Car transport .

Unit -IV(08 Hours)
Port cost analysis and economics’, maintenance of port structures, Modern trends- Roll of management techniques , skill in operation for safety purpose ,concept of GDP/GNP.

Unit -V (08 Hours)
Concept of mother port, outer to outer port, offshore port etc. SBM linked transport, efficacy of port-Transport ,cost per tonne, VLCC

Unit -VI(08 Hours)

Limiting factors for planning of ports-facilities, pollution, draft requirement, maintenance of port, measures for various aspects, development, National policy

Text Books/References

Quinn A. D., "Port Planning", McGraw Hill Book Co., New York.
Shore Protection Manual – 1984 and Coastal Protection Manual – 2002, US Waterways Experiment Station, Corps of Engineer, Coastal Engineering research centre, Vicksburg , USA
Narasinhan and Kathiroli, "Harbor and Coastal Engineering", Vol. I & II, Ocean and Coastal engineering Publication, NIOT, Chennai

Syllabus for Unit Test
Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

14 : SELF STUDY PAPER II : SOIL CONSERVATION AND WATERSHED MANAGEMENT

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits 4

Unit – I(08 Hours)
Watershed concept-Size , shape, physiographic , climate, drainage, land use, vegetation,geology and soils, hydrology , hydrogeology.

Unit – II **(**08 Hours)
Water Erosion- Mechanics of water erosion, types of erosion, estimation of water erosion losses, measurement of water erosion.

Unit – III **(**08 Hours)
Water erosion control- land classification for soil conservation, mechanical methods of water erosion control , biological methods of water erosion control.

Unit – IV **(**08 Hours)
Soil conservation in special problem areas – hilly areas, control of gullies, ravine reclamation, waterlogged and wetlands**.**

Unit – V **(**08 Hours)
Land use management practices in semiarid and arid zones –problems of soil and water Management in semi arid and arid zones of India, control measures.

Unit – VI **(**08 Hours)
Watershed Management- Planning for watershed management, measures for watershed management , land use planning, water harvesting and recycling ,socio economic aspects, recent trends in watershed management.

Text Books/References

Watershed Management-JVS Murthy, New Age International Publishers, 2009
Soil Erosion and conservation, R.P. Tripathy , H.P.Sing, New Age International Publishers, 2008

Syllabus for Unit Test

Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

14 : SELF STUDY PAPER II : RESERVOIR SEDIMENTATION

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks

Credits 4

Course Prerequisites
Sediment transport and river Engineering

Course Objectives

1) Explain scope and significance of reservoir sedimentation
2) Describe the process of silting of reservoirs.
3) Describe various methods of predicting sedimentation.
4) Describe various methods of measurement of sedimentation.
5) Describe various methods to control reservoir sedimentation.
6) Describe various methods to estimate life of reservoir.

Unit – I **(**08 Hours)

Introduction : Scope and significance of reservoir sedimentation, properties ofsediments. Basic concepts of sedimentation, bed load, suspended load sediment inflow, sediment out flow, trap efficiency, retention time.

Unit – II **(**08 Hours)

Reservoir sedimentation processSettling of sediments, Density currents, pattern of reservoir sedimentation . Aggredation above dams, Degradation below dams, sources of sediments.

Unit – III **(**08 Hours)

Reservoir sedimentation Prediction , Factors affecting sedimentation, various

methods of predicting sedimentation Empirical studies, Mathematical modeling.

Unit – IV **(**08 Hours)

Measurement of reservoir sedimentation , need for measurement , measurement of sediments in Rivers, streams etc. Measurements of suspended load, reservoir survey for sediments methods of measurements of sediments , sediments transport ,capacity survey,remote sensing techniques.

Unit – V **(**08 Hours)

Sedimentation of reservoirs in India case studies, control of reservoir sedimentation, soil conservation measures, vegetation land treatment measures to check inflow of sediments in to reservoirs. Removal of sediments from reservoir.

Unit – VI **(**08 Hours)

Estimate life of reservoir , different concepts and procedures practiced in USA, Japan, India.

Text Books/References

Reservoir sedimentation and control Central water Commission 1991,New Delhi.

Sedimentation of reservoirs-National Institute of Hydrology Dept. RN – 26-1985-86.

Life of reservoir – Technical report No.19. CBIP – New Delhi

Syllabus for Unit Test

Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

14 : SELF STUDY PAPER II: TIDES AND TIDAL HYDRAULICS

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits 4

Unit I

Definition of tide, Generation of tides, reasons for formation , Role of celestial bodies, Global tidal Phenomenon, Amphedormic point, Co-tidal lines, tidal constituents, coriolis force, Harmonic analysis, Hign water, low water, intertidal zones.

Unit II

Sidereal day ,Solar day, Lunar day, Declination of moon, Sidereal year, Lunar month, Apibelion, Peribelion , Apogee, Perigee, Force diagram for tide generation, if of lunar and earth axis

Unit III

Theories of tides, Tidal predictions, tidal inequality, types of tides, tidal duration, Amplitude, tidal variaties, spring tides, neap tides, Effects of tide, tidal scenario in India and world, Diurnal tides, mixed tides, semi-dia tides, shift of tides.

Unit IV

Different similitude's, similarities, Hydraulic models, tidal in Distortions in model, Reasons for distortions, Fixed bed and movable bed tidal models, Layout of tidal model, different instruments for tidal model studies, Automatic tide generator in model, inferances from tidal model studies.

Unit V

Definition of tidal inlet, different features, stability of tidal inlet, Hydraulic processes near tidal inlet, tidal prism, formulae for assessment of stability of tidal inlets, different types of tidal inlets, meaowees for stabilization of inlet effect of littoral drift, jarretts clarification, kenlegen's k, importance of tides in port and harbor operations.

Unit VI

Global tide ranges, range variation along Indian coast, different forms of unconventional/renewable energy their cheeris sources, tidal power, economies of tidal power, potential locations of tidal power plants around world and in India, single basin/double basin-single cycle/double cycle model of power generation, case study of existing/operating tidal power plants.

Text Books/References

Coastal Engineering Manual (CEM) USA corps of engineering
Ven Te Chow-Open Channel Hydraulics.
Jarrette M.A. : Stability of coastal inlets.
CWPRS Brochures on model Studies.
Indian institute of Ocean Technology : Coastal Manual Dr.Kathiroli, at Chennai.

Syllabus for Unit Test

Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV

14 : SELF STUDY PAPER II : DAM BREAK ANALYSIS

TEACHING SCHEME
Lectures: 04 Hrs/Week

EXAMINATION SCHEME
Theory : 60 Marks
Duration : 03 Hours
Internal Assessment : 40 Marks
Credits 4

Unit – I **(**08 Hours)
Introduction: Review of dams in India, Necessity of Dam Break Analysis

Unit – II **(**08 Hours)
Design criteria of Dams: Earth, Gravity, Arc Dams with likelihood of Exceedence

Unit – III **(**08 Hours)
Types of Failures : Type of dam, Structural, Purpose, Parameters of Failure

Unit – IV **(**08 Hours)

Aspects in Dam Break Analysis : Economic, Managerial, Social, Environmental

Unit – V **(**08 Hours)

Hydraulics of Dam Break Analysis : St. Venant's equations - forms, methods of SolutionSimulation Models – DAMBRK, FLDWAV, MIKE 11, HECRAS

Unit – VI **(**08 Hours)

Case Study, Review of Literature, Data Collection and Compilation.

Text Books/References

F M Henderson "Open Channel Flow", Macmillan Publishing Co, NY
Ven Te Chow " Open Channel Hydraulics", McGraw Hill Book Co. NY
Rouse H "Engineering Hydraulics", John Wiley & Sons, Inc.
Streeter V L and Wylie E B "Hydraulic Transients", McGraw Hill Book Co. NY
"HEC-RAS 4.1 : River Analysis System", US Army Corps Of Engineers, Hydrologic Engineering Centre, 'Hydraulic Reference Manual', CPD – 69, January 2010
"HEC-RAS 4.1 : River Analysis System", US Army Corps Of Engineers, Hydrologic Engineering Centre, 'User's Manual', CPD – 68, January 2010
"HEC-RAS 4.1 : River Analysis System", US Army Corps Of Engineers, Hydrologic Engineering Centre, 'Applications Guide', CPD – 70, January 2010

Syllabus for Unit Test

Unit Test 1 Units I, II& III
Unit Test 2 Units IV, V& IV