Savitribai Phule Pune University
Faculty of Engineering
Board of Studies (Civil Engineering)

Syllabus for

M.E –Civil (Hydraulic Engineering)

Structure for ME Civil Engineering (Hydraulic Engineering) with effect from academic year 2017 – 2018

ME Civil (Hydraulic Engineering) 2017 course

SEMESTER -I									
SR. NO.	**SUBJECT CODE**	**SUBJECT**	**TEACHING SCHEME**	**EXAMINATION SCHEME**					**CREDITS**
			Lect./P	**Paper**		**TW**	**Oral/ Presentation**	**Total**	
				In Semester Assessment	**End Semester Assessment**				
1	501041	FM	4	50	50	-	-	100	4
2	501042	I & D	4	50	50	-	-	100	4
3	501043	PMWR	4	50	50	-	-	100	4
4	501044	DE	4	50	50	-	-	100	4
5	501045	Elective-I	5	50	50	-	-	100	5
6	501046	Lab Practice-I	4			50	50	100	4
		Total	25	250	250	50	50	600	25

FM: Fluid Mechanics

I & D: Irrigation & Drainage

PMWR: Planning and management of water resources

DE: Dam Engineering

Elective I: **501045A**-Design of Hydraulic Structures, **501045B**-Energy & Environment, **501045C**- Remote Sensing-GIS

SEMESTER -II									
SR. NO.	**SUBJECT CODE**	**SUBJECT**	**TEACHING SCHEME**	**EXAMINATION SCHEME**					**CREDITS**
			Lect./P	**Paper**		**TW**	**Oral/ Presentation**	**Total**	
				In Semester Assessment	**End Semester Assessment**				
1	501047	OCH	4	50	50	-	-	100	4
2	501048	STRM	4	50	50	-	-	100	4
3	501049	Hydrology	4	50	50	-	-	100	4
4	501050	Elective-II	5	50	50	-	-	100	5
5	501051	Lab Practice-II	4	-	-	50	50	100	4
6	501052	Seminar-I	4	-	-	50	50	100	4
		Total	25	200	200	100	100	600	25

OCH: Open Channel Hydraulics

STRM: Sediment Transport & River Mechanics

Elective II:**501050A -** Coastal Engineering, **501050B** - Water Management, **5015050C** - Computational Methods

SEMESTER -III									
SR. NO.	**SUBJECT CODE**	**SUBJECT**	**TEACHING SCHEME**	**EXAMINATION SCHEME**					**CREDITS**
			Lect./P	**Paper**		**TW**	**Oral/ Presentation**	**Total**	
				In Semester Assessment	**End Semester Assessment**				
1	601051	OT	4	50	50	-	-	100	4
2	601052	RM	4	50	50	-	-	100	4
3	601053	Elective - III	5	50	50	-	-	100	5
4	601054	Seminar-II	4	-	-	50	50	100	4
5	601055	Project Stage-I	08	-	-	50	50	100	8
		Total	25	150	150	100	100	500	25

OT: Optimization Techniques

RM: Research Methodology

Elective III: **601053A -** Hydropower, **601053B** - Closed Conduit Flow, **601053C** - Groundwater Modelling

SEMESTER -IV								
SR. NO.	**SUBJECT CODE**	**SUBJECT**	**TEACHING SCHEME**	**EXAMINATION SCHEME**				**CREDITS**
			Lect./P	**Paper**	**TW**	**Oral/ Presentation**	**Total**	
4	601056	Seminar-III	5	-	50	50	100	5
5	601057	Project work Stage-II	20	-	150	50	200	20

		Total	25	-	200	100	300	25

EXAMINATION SCHEME

A) Compulsory Subjects: Credits 4

Total marks: 100

To be done at Institute Level		**University Exam**	
In semester assessment Units 1-4		**End-semester assessment**	
Class tests	30 Marks	Units 1-4	18Marks
Assignments /Mini Project	20 Marks	Unit 5	16 Marks
		Unit 6	19 Marks
Total	50 Marks	Total	50 Marks

B) Elective Subjects: Credits 5

Total marks: 100

Module 1 (Credits-4)			
In semester assessment Units 1-4		**End-semester assessment**	
Class tests	15 Marks	Units 1& 2	12Marks
Assignments	10 Marks	Unit 3& 4	14Marks
		Unit 5	12 Marks
		Unit 6	12 Marks
Total	25 Marks	Total	50 Marks

Module 2 (Credit 1)	
In semester assessment	Units 1 - 2
Class Tests/	**25 Marks**

Assignments	

M.E FIRST YEAR - SEMESTER I

501041 - Fluid Mechanics

Teaching Scheme

Credits: 4

Lectures: 4 Hrs/week

Examination Scheme

In Sem Assessment: 50 Marks

End Sem Assessment:50 Marks

Total Marks:100

Unit 1: Kinematics I **(8 Hrs.)**

Revision of concepts in basic Fluid Mechanics such as classification of flows, Equation of continuity for three dimensional flow in Cartesian co-ordinates, equation of continuity for one-dimensional flow along a streamline, types of motion, rotational and irrotational motion velocity potential, stream function and flow net

Unit 2: Kinematics II **(8 Hrs.)**

Continuity Equation in polar and cylindrical coordinates, solving Laplace equation by graphical method, conformal mapping. Standard two dimensional flow pattern, source, sink, doublet and their combination

Unit 3: Laminar Flow **(8 Hrs.)**

Euler's equation of motion along a streamline and its integration, Bernoulli's equation. Derivation of Navier Stokes' equations, solution of NS equations for flow between parallel plates a) both plates stationary b) one plate moving , derivation of Hagen Poiseuille's equation using NS equations

Unit 4: Boundary Layer Theory **(8 Hrs.)**

Development of boundary layer on a flat plate nominal, displacement, momentum, energy thicknesses, laminar, transitional and turbulent boundary layer, laminar sub layer, Local and mean drag coefficients, Boundary layer equations, Karman's momentum integral equation, Karman Pohelhausen's solution, boundary layer separation

Unit 5: Turbulent Flow **(8Hrs.)**

Reynolds' equation of motion, typical solution, Energy and Momentum equation, Statistical theory of turbulence, Isotropic and homogeneous turbulence, probability density function

Unit 6: Fundamentals of Compressible Flow **(8 Hrs.)**

Compressible fluid flow-fundamental equation, continuity equation, energy equation, velocity of

propagation, Pressure, density and temperature in terms of Mach number, Normal shock in one dimensional compressible flow

Text books:

Hydraulics and Fluid Mechanics - P. N. Modi and S. N. Seth Standard book house

Fluid Mechanics and Hydraulic Machines – Sukumar Pati, Tata McGraw-Hill

Introduction to fluid Mehanics and fluid machines – S.K.Som, Gautam Biswas, Suman Chakraborty - McGraw-Hill – 2013 ed.

Reference books:

Fluid Mechanics - Streeter, Wylie and Bedfordn Tata McGraw Hill

Fluid Mechanics by White – Mc-Graw Hill

Fluid Mechanics-Fundamentals and Applications- Cengel and Cimbala, McGraw- Hill

Fluid Mechanics and Machinery – C.S.P Oza, R.Berndtsson, P.N.Chandramouli- Oxford University Press

501042 – Irrigation & Drainage

Teaching Scheme	**Examination Scheme**
Credits: 4	In Sem Assessment: 50 Marks
Lectures: 4 Hrs/week	End Sem Assessment:50 Marks
	Total Marks:100

Unit 1: Introduction **(8Hrs.)**

Definition, Necessity of irrigation, Benefits of Irrigation, ill effects of irrigation. Types of irrigation systems. Classification of Irrigation methods, Factors affecting the choice of irrigation methods, quality of irrigation water. Surface and Subsurface irrigation methods, sprinkler irrigation, Micro irrigation (theory only)

Unit 2: Soil Water-Crop Relationship **(8Hrs.)**

Soil classification, soil moisture and crop water Relationship, Determination of soil moisture, factors governing consumptive use of water, estimation of consumptive use and frequency of irrigation, irrigation efficiencies for economical use of water, assessment water charges, conjunctive use of surface and groundwater, multi-crop irrigation scheduling.

Unit 3: Lift Irrigation and Drip Irrigation (8Hrs.)

Lift Irrigation: General concepts, advantages, disadvantages, elements of lift Irrigation schemes, design considerations involved in intake well, jack well, rising main, distribution systems, concept of cost economics. Drip Irrigation: Definition and functions, types of drip Irrigation systems, components of Drip Irrigation systems. Design and installation of drip Irrigation systems, advantages and disadvantages of Drip Irrigation systems, operations and maintenance of Drip assembly.

Unit 4: Sprinkler Irrigation (8Hrs.)

Sprinkler Irrigation: Definition and introduction of Sprinkler Irrigation,, advantages and disadvantages of Sprinkler Irrigation, components of sprinkler Irrigation systems (Pumping set, desilting basin and debris screen , main and lateral pipe lines , sprinkler heads, perforated pipes, take off valves and flow control valves, fertilizer applicators), types of sprinklers, design of considerations sprinkler Irrigation systems(preparation of inventory of basic data, criteria for system layout, selection of sprinkler and its spacing, discharge capacity of the pump hydraulic design of sprinkler head, main and lateral pipe sizes)

Unit 5: Salt affected land and their reclamation (8Hrs.)

Salt accumulation in soil water, classification of salts affecting the soils and their characteristics, reclamation of saline and alkaline soils, leaching and salinity control. Water and wind erosion, design of various types of soil conservation measures.

Unit 6: Drainage of irrigated land (8Hrs.)

Need and purpose of drainage, water logging of agricultural lands and its reclamation, steady state and transient designs of surface and sub-surface drainage systems, drainage by wells, Soil Erosion and Conservation.

Text books:

Irrigation Engineering and hydraulic structures – S.R.Sahasrabudhe- Catson books, Delhi, 2014-3ed.

Irrigation Engineering - S. K. Garg.

Irrigation, Water Resources and water power engineering- Dr. P. N. Modi Publ Standard book house.

Reference books:

Irrigation, Michael, B.A.M., Vikas Publishing House Pvt. Ltd. New Delhi, 1990

Theory & design of irrigation structures Vol.I, II, III Varshney Gupta and Gupta Nemchand and brothers publication

501043 - Planning and Management of Water Resources

Teaching Scheme

Credits: 4

Lectures: 4 Hrs/week

Examination Scheme

In Sem Assessment: 50 Marks

End Sem Assessment:50 Marks

Total Marks:100

Unit 1: Introduction (8Hrs.)

Objectives: of water resource planning and management, its Necessity, Aspects of water resources planning, water resource development; needs and opportunities; social goals

Unit 2: Characteristics Of Water Resources (8Hrs.)

Spatial and temporal characteristics of water resources, constraints for its development like non-reversibility; planning region and horizons.

Unit 3: Management of Surface Water Resources (8Hrs.)

Characteristics and functions of reservoir; reservoir sedimentation; conservation storage; conflict among uses, Reservoir operation studies - effect on river regime; long term simulation; reliability; resiliency and vulnerability assessment

Unit 4: Management of Ground-Water Resources (8Hrs.)

Ground water evaluation; conjunctive use of surface and ground water, Ground water and well hydraulics, interference and specific yield of wells, construction and maintenance of artificial wells

Unit 5: Economic Planning (8Hrs.)

studies of single and multipurpose projects– multi objective planning models, financial analysis of water resources projects, allocation of cost of multipurpose projects; repayment of cost. Demand for drinking water; irrigation, hydropower; navigational; planning for flood control.

Unit 6: Benefit Cost Analysis (8Hrs.)

Discounting techniques; benefit cost parameters; estimation of benefits and costs; appraisal criteria; social benefit cost analysis. Basin planning; inter-basin transfer of water

Text books:

Bhave P.R., “Water Resources Systems”, Narosa Publications, New Delhi. .

Water Resources System Planning – by M.C.Chaturvedi.

Water Management System Application-A.K.Biswas

Reference books:

Economics of Water Resources Planning - by James, L .D., and Lee, R. R., Mc GrawHill.

Principles of Water Resources planning-by Goodman.

Water Resources Planning and Management by-O.J. Helwege.

Water resource Engineering- Linsley and Franzini, Mc Graw-Hill

501044 - Dam Engineering

Teaching Scheme

Credits: 4

Lectures: 4 Hrs/week

Examination Scheme

In Sem Assessment: 50 Marks

End Sem Assessment:50 Marks

Total Marks:100

Unit 1: Gravity Dams **(8Hrs.)**

Introduction, Different terms related to dams, External components of gravity dam, Internal components of gravity dam, Conditions favoring gravity dams, Forces acting on gravity dam , Combinations of loading for design, Seismic analysis of dam, Terms related to seismic analysis, Determination of Seismic forces, Stress analysis in gravity dam, Stress concentration, Middle third rule, ,Modes of failure of gravity dam, Elementary profile of gravity dam, Stress analysis for elementary profile.

Design methods of gravity dam, Gravity Method or 2 D Method, Finite element method, Slab analogy

method, Trial load twist method, Lattice analogy method, Model experimental studies or methods, Single step method, Multiple step method or Step by step method, Construction of gravity dams, Preparation of foundation, Construction of masonry, Colgrout masonry, Concreting in gravity dams, Roller Compacted Concrete (R.C.C.)

Temperature control in mass concreting, Crack formation in gravity dam, Construction joints Keys, Water seal

Unit 2: Arch Dams **(8Hrs.)**

Introduction, Concept of Arch Dam, Conditions favoring an arch dam, Layout of an arch dam, Classification of an arch dam, Constant angle arch dam, Constant radius arch dam, Variable radius arch dam, Arch gravity dam, Double curvature arch dam, Design of an arch dam, Basic assumptions in design of arch dam, Forces acting on an arch dam, Significant factors in design of arch dam, Soundness of abutment, Seismic stability of arch dams, Methods of arch dam design,Thin cylinder method

Unit 3: Buttress Dams & Rockfill Dams **(8Hrs.)**

Buttress dams: Advantages of Buttress dams,Limitations of Buttress dams., Types of buttress dams

Rockfill dams: Historic development of rockfill dam, Components of rockfill dam, Types of rockfill dams, Characteristics of material for rockfill dams, Significant design parameters for rockfill dam, Construction aspects of rockfill dam, Roller compacted concrete (R.C.C) dams, Concept and philosophy of R.C.C. dam, Design Considerations in R.C.C. dam, Advantages of R.C.C,Limitations of R.C.C.

Unit 4: Earthen Dam **(8Hrs.)**

Earth Dam: Introduction; Components Factors influencing design; Design investigations, Design of components; Construction. Failure of earth dams , Conditions of analysis – Forces acting on earth dam, Factor of safety; Codal provisions; Earthquake effects,Stability of foundation

Seepage Analysis in earth dam : Types of flow; Laplace equation; Flow net in isotropic, anisotropic

and layered media; Entrance-exit conditions; Theoretical solutions; Determination of phreatic line. Determination of seepage discharge , steady seepage state, sudden draw down conditions;

Unit 5: Spillways & Gates **(8Hrs.)**

Introduction, Data collection for design of spillway, General principles of spillway, Different key levels and heads in spillway, Selection of site for spillway, Selection of size of spillway, Components of spillway, Classification of spillway, Classification based on operation, gates, features, Principles of hydraulic design of some important spillways , Energy dissipation below spillway, The need, Classification of energy dissipation devices, Energy dissipation in stilling basin, Stilling basin, Components of stilling basin, Types of stilling basins, Indian standard stilling basins, Energy dissipation through buckets, Correlation between jump height and tail water depth, Basics of hydraulic jump

Spillway gates, Classification of spillway crest gates, Classification based on function, Classification based on movement of gates, Classification based on special ,features, Requirements of spillway gates, Maintenance of gates, Inspection of gates

Unit 6: Dam Instrumentation **(8Hrs.)**

Instrumentation in dam, Objectives of Instrumentation , Instrumentation data system , Working principles of Instruments , Selection of Equipments Various types of Piezometers, Vibrating wire settlement cells ,settlement gauge, inclinometer; Jointmeter, Vibrating wire pressure cell, Distributed fibre optics temperature tool.

.

Text books:

Irrigation Engineering and hydraulic structures – S.R.Sahasrabudhe- Catson books, Delhi, 2014-3ed.

Irrigation Engineering - S. K. Garg.

Irrigation, Water Resources and water power engineering- Dr. P. N. Modi Publ Standard book house.

Reference books:

Irrigation, Michael, B.A.M., Vikas Publishing House Pvt. Ltd. New Delhi, 1990

Theory & design of irrigation structures Vol.I, II, III Varshney Gupta and Gupta Nemchand and brothers publication

Earth Dams – J.L. Sherard.

Dam Hydraulics--Vischer, Wiley India.

Concrete Dams – R.S. Varsheny

501045 A - Elective I: Design of Hydraulic structures

Module 1

Teaching Scheme	**Examination Scheme**
Credits: 4	In Sem Assessment: 50 Marks
Lectures: 4 Hrs/week	End Sem Assessment: 50 Marks
Laboratory Work: NA	**Total Marks:100**

Unit 1: Diversion Head works **(8Hrs.)**

Weir and Barrage, Gravity and non- gravity weirs, layout of a diversion head works and its components, The diversion weirs and its types, afflux and pond level, the under sluices or scouring sluices, the divide wall, fish ladder, head sluices, silt control devices.

Unit 2: Theories of seepage and design of weirs and Barrages **(8Hrs.)**

Failure of hydraulic structures founded on pervious foundations. Bligh's Creep theory for seepage flow, Lane's weighted Creep theory, Khosla's theory and concept of flow nets, Design of vertical drop weir on Bligh's theory, Design of modern weirs and barrages founded on permeable foundations on the basis of Khosla's theory.

Unit 3: Canal Falls **(8Hrs.)**

Definition and location of canal falls, Types of falls, Design of a trapezoidal notch fall, Design

of syphon well drop, design of simple vertical drop fall, design of Sarda type fall, design of a straight glacis fall, design of a baffle fall or Inglis fall.

Unit 4: Regulators Modules And Miscellaneous Canal Structures (8Hrs.)

Canal Regulation- Canal regulation works, canal regulators, alignment of the off taking channels, Distributary head regulator and cross regulator, design of cross regulator and head regulator, Canal escapes - types of canal escapes, Metering Flumes – Types of Metering Flumes, Canal Outlets or Modules – Requirements of good Module, types of Modules, Criteria for judging the performance of modules, certain other important definitions connected with modules, types of non-modular outlets, types of semi modules or Flexible outlets, types of rigid modules, Miscellaneous Canal Structures – Cattle crossings, bed bars.

Unit 5: Cross Drainage Works (8Hrs.)

Introduction, types of Cross Drainage Works, selection of suitable type of cross drainage work, various types of aqueducts and siphon aqueducts, design consideration for Cross Drainage Works, determination of maximum flood discharge, Fixing waterway requirements for aqueducts and siphon aqueducts. provision of joints and water bars in R.C.C ducts of aqueducts and super passages

Unit 6: Rivers, Their Behavior, control and training (8Hrs.)

Importance of rivers and necessity of controlling them, types of rivers and their characteristics, classification of the rivers on the basis of the topography of the river basin, Indian rivers and their classifications, Behavior of rivers, straight reaches, bends, meanders, Control and training of rivers, objective of river training, classification of river training, methods of river training, problems related to the river training.

Text books:

Irrigation Engineering and hydraulic structures – S.R.Sahasrabudhe- Catson books, Delhi, 2014-3ed.

Irrigation Engineering and Hydraulic Structures- Garg S.K- Khanna Publishers N.D. 13th ed, 1998.

Irrigation, Water Resources and water power engineering- Dr. P. N. Modi Publ Standard book house.

Reference books:

Theory & design of irrigation structures Vol.I, II, III Varshney- Gupta and Gupta Nemchand and br others publication

Hydraulic Structures, Vol. 1. & Vol. 2- Grishin M.M- Mir Publishers, Moscow, 1982.

Water Management – Jasapal Singh, M.S.Achrya, Arun Sharma – Himanshu Publication Press

Irrigation and Water Resources Engineering- Asawa G.L- New Age International (P) Ltd. Publishers, first ed, 2005

Module II

Teaching Scheme
Credits: 1
Lectures: 1 Hr/week

Examination Scheme
In Sem Assessment: 25 Marks
Total Marks:25

Unit 1: **(6Hrs.)**
Assignment on design of weir or barrage

Unit 2 **(6Hrs.)**
Assignment on design of any one type of CD works

501045 B - Elective I: Energy and Environment

Module I

Teaching Scheme
Credits: 4
Lectures: 4 Hrs/week
Laboratory Work: NA

Examination Scheme
In Sem Assessment: 50 Marks
End Sem Assessment: 50 Marks
Total Marks:100

Unit 1: Energy Crisis & Sources **(8Hrs.)**
Historical events , energy requirement of society in past and present situation, future possibilities of energy need and availability , conventional energy resources, Non-conventional energy sources like Hydro power, tidal energy, biomass energy, wind energy, Hydrogen as a source of energy, suitability in context of India

Unit 2: Environmental Impacts **(8Hrs.)**
Conventional and non-conventional energy sources and Environmental impact, Energy conversion technologies, their principles, equipment and suitability in context of India. Environmental impacts of these technologies

Unit 3: Solar & Biomass Energy **(8Hrs.)**

Solar Energy : Sun as source of energy, direct methods of solar energy collection, process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and application

Biomass Energy: Concept of biomass energy utilization, types of biomass energy, conversion processes, biogas production, biomass gasification process and technologies

Unit 4: Hydropower & Tidal Energy (8Hrs.)

Hydro power plant: Concept of hydro power, generation process / technology involved, working principle and application

Tidal energy : Concept of tidal energy, generation process / technology involved, working principle and application

Unit 5: Wind Energy (8Hrs.)

Wind Energy: concept of wind energy, generation process / technology involved, working principle and application

Hydrogen as a source of energy: concept of hydrogen as a source of energy, generation process / technology involved, working principle and application

Unit 6: Energy Storage & Recovery Systems (8Hrs.)

Energy Storage Systems: Types of energy storage, devices for sensible and latent heat storage, energy storage in dry batteries, nickel-cadmium batteries, secondary heat storage, chemical storage, environmental consequences of energy storage systems

Energy Recovery Systems: Approaches to waste Energy Utilization, Equipment, Utilization System, objective, principles of heat transfer, Gas to Gas heat transfer, Gas to Liquid heat transfer, Recovery of waste heat in coil coating, Non-conventional liquid fuels, Heat recovery by Cogeneration.

Reference books:

1. Bewik M.W.M. - Handbook of organic waste conversion.
2. Bokris J.O. - Energy, the solar hydrogen alternative.
3. Rai G.D - Non-conventional Energy Sources

Module II

Teaching Scheme	**Examination Scheme**
Credits: 1	In Sem Assessment: 25 Marks

Lectures: 1 Hr/week **Total Marks:25**

Unit 1: (6Hrs.)

A) Study of "Current scenario of energy requirement in India and available resources with its sustenance period"

B) Study of ; "different energy conversion technologies and government role"

C) Presentation on " utilization of Solar energy based on a Case study"

D) Presentation on " utilization of Biomass as a source of energy based on a Case study"

E) Comparative analysis between conventional and non-conventional energy sources and its utility over last 5 decades in any one country.

Unit 2 (6Hrs.)

A) Study of "Current scenario of hydropower or tidal energy in India and presentation on a case study"

B) Study of ; "wind enegy scenario in Idia and government initiative"

C) Presentation on " utilization of Hydogen as a source of energy based on any one Case study "

D) Presentation on " energy storage systems with environmental concern"

E) Presentation on " energy recovery systems with a case study"

501045 C - Elective I: Remote Sensing and GIS

Module I

Teaching Scheme

Credits: 4

Lectures: 4 Hrs/week

Laboratory Work: NA

Examination Scheme

In Sem Assessment: 50 Marks

End Sem Assessment: 50 Marks

Total Marks:100

Unit 1: Introduction to Remote Sensing and EMR (8Hrs.)

Introduction of Remote Sensing – Energy sources and Radiation principles, Energy equation, EMR and Spectrum, EMR interaction with Atmosphere scattering, Absorption, EMR interaction with earth surface features reflection, absorption, emission and transmission, Spectral response pattern , vegetation, soil, water bodies- Spectral reflectance. Aerial photography and photogrammetry, height determination contouring - photographic interpretations - stereoscopy –

parallax bar- Flight Planning- Photo Interpretation.

Unit 2: Data Acquisition and Satellites. (8Hrs.)

Data acquisition –Procedure, Reflectance and Digital numbers- Intensity- Reference data , Ground truth, Analog to digital conversion, Detector mechanism- Spectro- radiometer-Ideal remote sensing system – Characters of real and successful remote sensing system- Platforms and sensors- orbits types – Resolution. Remote sensing satellites: Land observation satellites, characters and applications, IRS series, LANDSAT series and INSAT series.

Unit 3: Types of remote sensing and image interpretation (8Hrs.)

Introduction- Active, Passive, Optical Remote sensing, sensors and characters. SLAR, SAR Scattrometers,- Altimeter, Characteristics , Image interpretation characters. Introduction to: Image Acquisition And Format, Image Distortion And Rectification, Image Enhancement, Image Classification Image Analysis.

Unit 4: Introduction to GIS (8Hrs.)

Definitions, Components of GIS, Representation of Geographic features in Vector and Raster Data models, Concept of arc, node, vertices and topology – maps and spatial information, Hardware & Software requirements for GIS.

Unit 5: Data & Processing (8Hrs.)

Types of geographic data, levels of measurements. Concepts of space and time, Spatial data models, encoding methods of data input – Keyboard, Manual Digitizing and Automatic Digitizing methods, Linking of Spatial and Attribute data to maps, Metadata Spatial data input: Digitization, error identification. Errors: Types, sources, correction. Editing and topology building.

Unit 6: Applications of RS GIS in water resources engineering (8Hrs.)

Simple-complex query with two or more tables using SQL. Queries using Union, Intersection, Join etc operations. Types of Models, Conceptual Models of WREE, GIS analysis and Interpretation, Over view of Open sources softwares such as ARC – GIS, Q – GIS.

Text books:

Remote sensing methods & applications – R. Michael Hord, Wily Interscience Publication.

Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York

Kresse, W. and Danko, D. (2002): Springer Handbook of Geographic Information,

Springer Drecht, London

Bao, J., Tsui, Y. (2005): Fundamentals of Global Positioning System Receivers, John Wiley Sons,

Inc., Hoboken .

Reference books:

Remote sensing & image interpretation – Lilleson J.T.M. & Krefer R.W. Wiely, New York.

Photogrammetry by – Sheford

Environmental Systems Research Institute, Inc. (1998): Understanding GIS: The ARC/INFO Method, ESRI Press, Redland

Ahmed, E. L., Rabbany (2002): Introduction to Global Positioning System, Artech House, Boston

Module II

Teaching Scheme	**Examination Scheme**
Credits: 1	In Sem Assessment: 25 Marks
Lectures: 1 Hr/week	**Total Marks:25**

Unit 1: **(6Hrs.)**

Assignment on image classification

Unit 2 **(6Hrs.)**

Assignment using Q-GIS

501046 - Lab Practice I

Teaching Scheme	**Examination Scheme**
Credits: 4	TW: 50
Laboratory Work: 4 Hrs/week	Oral Exam : 50Marks
	Total Marks: 100

The lab practice-I will be based on completion of assignments / practicals / reports of site visits, confined to the course in that semester.

The term work will consist of --

i) **Visit reports** of minimum two site visits, exploring the field aspects for various subjects

ii) **Report on** minimum 2 software applications on any subject of the semester.

iii) **Report of laboratory work consisting of following....**

1. Solution of Laplace equation by graphical / relaxation method.

2. Flow past a cylinder using wind tunnel
3. Flow past aerofoil using wind tunnel.
4. Growth of a boundary layer along a flat plate using wind tunnel/air flow bench
5. Determination of friction factor using experimental observations, Darcy-Weishbach equation and Moody's diagram for different pipes(materials)
6. Assignment based on cost benefit studies of single and multipurpose projects– multi objective Planning models, financial analysis of water resources projects.
7. Assignment on basin planning for water management
8. Study of one research paper from referred journal and it's report in the form of discussion

M.E FIRST YEAR - SEMESTER II

501047 - Open Channel Flow

Teaching Scheme	**Examination Scheme**
Credits: 4	In Sem Assessment: 50 Marks
Lectures: 4 Hrs/week	End Sem Assessment:50 Marks
	Total Marks:100

Unit 1: Uniform Flow **(8 Hrs.)**

Specific Energy, Specific Force, Critical depth, and its computations, critical flow, critical velocity .section factor , First Hydraulic exponent, Depth Energy relationship, Uniform flow, Flow through prismatic channels

Unit 2: Hydraulic Jump **(8 Hrs)**

Introduction to Jump, Momentum equation of jump, classification of jump, Characteristics of jump in a rectangular channel, Formations of jump in expanding channel, jump at an abrupt drop and rise, control of jump by baffle blocks, jump in sloping rectangular channels

Unit 3: Gradually Varied Steady Flow **(8 Hrs.)**

Gradually varied steady flow and rapidly varied steady flow in open channels, surface profiles in GVF-analysis, different method of computations, Chow's methods, standard step method, finite difference method.

Unit 4: Spatially Varied Flow **(8 Hrs.)**

Differential Equation of spatially varied flow with increasing and decreasing discharge, side weir,

bottom rack.

Unit 5: Unsteady Flow **(8 Hrs.)**

Gradually varied unsteady flow: Continuity equation, dynamic equation, Monoclinal rising waves, dynamic equation for uniformly progressive flow, wave profile of uniformly progressive flow, wave propagation. Rapidly varied unsteady flow: Uniformly progressive flow, positive surge, negative surge.

Unit 6: Flood Routing **(8 Hrs.)**

Hydraulic and Hydrologic flood routing, Reservoir and channel routing, Differential form of Momentum Equation, Muskinghum method, Finite difference scheme, Method of characteristics.

Text books

Flow in Open Channel – K. Subramanya, Tata Mc-Graw Hill.

Hydraulics and Fluid Mechanics by P. N. Modi and S. N. Seth Standard book house

Flow in Open Channel: K. G. RangaRaju - Tata McGraw Hill.

Reference books

Open Channel Hydraulics – VenTe Chow, Mc-Graw Hill.

Open Channel Flow - Henderson

Open Channel Hydraulics-French, Mc-Graw Hill.

Open Channel Flow – M. Hanif Chaudhry, Springer.

501048 - Sediment Transport and River Mechanics

Teaching Scheme	**Examination Scheme**
Credits: 4	In Sem Assessment: 50 Marks
Lectures: 4 Hrs/week	End Sem Assessment:50 Marks
	Total Marks:100

Unit 1: Introduction **(8 Hrs.)**

Definition of sediment, fluvial hydraulics, Origin and formation of sediments, Nature of sediment ; Problems, fundamental properties of individual sediment particles, Concept of fall velocity, Bulk properties of sediment

Unit 2: Incipient Condition of Motion **(8 Hrs)**

Approaches of establishment of incipient motion, Shields analysis and other methods. Regimes of flow – study of different bed forms like ripples, dunes, anti dunes with characteristics, significances,

resistance analysis

Unit 3: Sediment Transport (8 Hrs.)

Modes of sediment transport, Introduction to different bed load equations– empirical, dimensional and Semi-theoretical equations, study of Du Boys equation, Einstein equation, Meyer-Peter and Muller equation, Saltation mechanism, Concept of suspended load, total load, wash load.

Unit 4: Stable Channel Design (8 Hrs.)

Concept of stable channel, Design procedure such as regime method, Kennedy method, Laceys method, Introduction to other methods such as Bunch, Simmon-Albertson method, Tractive force approach.

Unit 5: Sediment Sampling & Measurement (8 Hrs.)

Bed load measurement, suspended load measurement, Plan form river bends, Channel characteristics, bifurcations, confluences, river gauging, continuity equation for sediment, stream bed changes during floods, Aggradation, Degradation, Silting of reservoir

Unit 6: River Training Works (8 Hrs.)

Objective of river training and bank protection; River training for- flood control, navigation and guiding the flow; sediment control, River bank protection, Introduction to alluvial river models; Introduction to sediment transport through pipes

Reference books

Yang. C.T. " Sediment Transport theory and Practice " McGraw –Hill , New-York, 1996

Graf, W.H. "Hydraulics of Sediment Transport", McGraw –Hill , New-York,1971

Raudkivi, A.J. " loose Boundary Hydraulics"2nd edition, Pergamon Press, 1976

F.M.Hendorson," Open Channel Flow "Mac Millan , New York , 1996

Grade, R.J. and Ranga Raju, K.G."Mechanics of Sediment Transport and Alluvial Stream Problems" New Age International(P)Ltd.Publications,New Delhi , 2006.

501049 - Hydrology

Teaching Scheme

Credits: 4

Lectures: 4 Hrs/week

Examination Scheme

In Sem Assessment: 50 Marks

End Sem Assessment:50 Marks

Total Marks:100

Unit 1: Introduction (8Hrs.)

Hydrologic Cycle, Precipitation, Evaporation, Infiltration, Interception and Depression, Depth area duration analysis, Unit hydrograph theory, IUH, Rainfall runoff models-SWM, Tanks, CLS models

Unit 2: Stochastic processes (8Hrs.)

Stochastic processes-classification, time series & it's components, various statistical distributions like binomial, normal, log-normal, Poisson, Beta B, gamma, Pearson type I, II and III & their uses in hydrology, Chi square test, plotting, position, frequency factors, extreme value theory, synthetic generation of yearly and monthly flows in hydrology.

Unit 3: Flood Analysis (8Hrs.)

Flood estimation by various methods, forecasting of floods, flood frequency analysis, Gumbel's, Pearson type I, II, and III distribution, Log-normal method, design flood for various hydraulic structures

Unit 4: Ground Water Hydraulics (8Hrs.)

Definition of Ground Water, aquifers, vertical distribution of subsurface water, Darcy's Law-it's range of validity, DupuitForchheimer assumption, application of Darcy's law to simple flow systems governing differential equation for confined and unconfined aquifers, fully & partially penetrating wells, interference of wells, pumping test with steady & unsteady flow, method of image.

Unit 5: Ground Water Development (8Hrs.)

Ground water Exploration, well types, well construction & design, screens, perforations & gravel packs, pumping equipment, quality of ground water, pollution of groundwater

Unit 6: Ground Water Conservation (8Hrs.)

Ground water budget, seepage from surface water artificial recharge, Porous media models, Analog models, Electric analog models, Digital computer models

Text books

Engineering Hydrology-K. Subramanya, Tata Mc-Graw Hill.

Hydrology- H.M. Raghunath, Wily Eastern, New Delhi.

A text book of Hydrology- Jaya Rami Reddy, University Science Press

Reference books

Applied Hydrology-LinsleyKolhar&Paulhas (Mc-Graw Hill)

Water Resource & Hydrology-S.K. Garg.

Stochastic Hydrology-Jaya Rami Reddy, Laxmi Pub., New Delhi.

Applied Hydrology-V.T. Chow, McGraw-Hill Book Company.

501050 A - Elective II: Coastal Engineering

Module I

Teaching Scheme	**Examination Scheme**
Credits: 4	In Sem Assessment: 50 Marks
Lectures: 4 Hrs/week	End Sem Assessment: 50 Marks
Laboratory Work: NA	**Total Marks:100**

Unit 1: Introduction **(8Hrs.)**

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 2: Tides & Coastal Processes **(8Hrs.)**

Global tidal cycle, tidal anályis. 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 3: Coastal Structures **(8Hrs.)**

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 , Introduction to 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 4: Ports & Harbours **(8Hrs.)**

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 5: Dredging & Disposal **(8Hrs.)**

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

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, Coastal

regulation zone.

Unit 6: Case Study **(8Hrs.)**

Application & case studies for Coastal Engineering Projects.

Including Site & Lab (CWPRS) visit, desk studies for port development

Text books

Basic Coastal Engineering-R.M.Sorensen,2006.

Coastal Hydrodynamics-J.S.Mani ,I IT Madras

Reference books

Shore Protection Manual-U.S.Waterways Experiment Station Corps of Engineer,

Coastal Protection Manual 2002.

Narasinhan and S. Kathiroli, " Harbour and Coastal Engineering", Vol I&II, Ocean

and Coastal Engineering Publication, NIOT, Chennai

Module II

Teaching Scheme

Credits: 1

Lectures: 1 Hr/week

Examination Scheme

In Sem Assessment: 25 Marks

Total Marks:25

Unit 1: **(6Hrs.)**

Assignment on analysis of wave data.

Unit 2 **(6Hrs.)**

Assignment on data design of any coastal structure

501050 B - Elective II: Water Management

Module I

Teaching Scheme

Credits: 4

Lectures: 4 Hrs/week

Laboratory Work: NA

Examination Scheme

In Sem Assessment: 50 Marks

End Sem Assessment: 50 Marks

Total Marks:100

Unit 1: Introduction **(8Hrs.)**

Global and national water problems, law and legislation, Indian Government Policies and Programs, Quantity estimation of water –urban and rural sectors' requirement

Unit 2: Water Laws (8Hrs.)

Constitutional provisions, National Water Policy, riparian rights / ground water owner ship, prior appropriation, permit systems, acquisition and use of rights, scope for privatization.

Unit 3: Economics of Water (8Hrs.)

Water as economic good, intrinsic value, principles of water pricing & water allocation, capital cost, opportunity cost, internal rate of return, benefit cost analysis, principles of planning and financing of water resources project

Unit 4: Watershed Management (8Hrs.)

Objectives of Planning Watershed Projects, Guidelines for Project Preparation, Approach in Govt. programs, people's participation, conservation farming, Watershed management planning, identification of problems, objectives and priorities, socioeconomic survey

Unit 5: Flood Management (8Hrs.)

Causes of floods, structural and non-structural measures, mitigation plan, flood damage assessment, use of geoinformatics,

Unit 6: Drought Management (8Hrs.)

Types of droughts, severity index, drought forecasting, damage assessment, mitigation plan, use of geoinformatics.

Reference books

Water Resources Systems Engg, D. P. Loucks, Prentice Hall

Chaturvedi, M.C. " Water Resources Systems Planning and Management" Tata McGraw Hill

James L.D and Lee R.R " Economics of Water Resources Planning", McGraw Hill

Water resources hand book; Larry W. Mays, McGraw International Edition

Module II

Teaching Scheme	**Examination Scheme**
Credits: 1	In Sem Assessment: 25 Marks
Lectures: 1 Hr/week	**Total Marks:25**

Unit 1: **(6Hrs.)**

Assignment on Flood Management

Unit 2 **(6Hrs.)**

Assignment on "Jalyukt Shivar" as a method of drought management

501050 C - Elective II: Computational Methods

Module I

Teaching Scheme

Credits: 4

Lectures: 4 Hrs/week

Laboratory Work: NA

Examination Scheme

In Sem Assessment: 50 Marks

End Sem Assessment: 50 Marks

Total Marks:100

Unit 1:Numerical Methods in Linear Algebra **(8Hrs.)**

Gauss elimination, LU-factorization, Gauss- Jordan methods, Jacobi iteration, matrix inversion, Gauss-SeidelMethod, Eigen values by iteration, Tridiagonalization and QR-factorization.

Unit 2: Numerical Integration **(8Hrs.)**

Simpson's $1/3^{rd}$rule, Simpson's $3/8^{th}$ rule, Trapezoidal rule, Gauss integration formula, Romberg integration, Quadrature formulae.

Unit 3: Numerical Differentiation **(8Hrs.)**

Eulers's method, Predictor-corrector method, Runge-Kutta method, Adams-Bashforth method, Methods for elliptic Partial differential equations, Method for parabolic equations, Method for hyperbolic equations, Laplace and Poisson's equation-solution, method of characteristics for solution of initial boundary value problems-it's use.

Unit 4: Statistics **(8Hrs.)**

Moments, Skewness and Kurtosis, Regression and correlation , rank correlation, multiple and partial correlation, analysis of variance-one way and two way classifications, experimental design, Latin square design, Time series analysis.

Unit 5: Probability **(8Hrs.)**

Probability, conditional probability, various theoretical distributions like binomial, normal, log-normal, Poisson, gamma distribution, Pearson type I, II & II distribution test of significance, Gumbel distribution, testing of hypotheses – Large sample tests for mean and proportion, Chi-square test

Unit 6: Complex Variables **(8Hrs.)**

Cauchy- Riemann equations, Schwarz Christoffel transformation, Conformal mapping, Jukowski transformation, Complex integration, Taylors expansion, Application to boundary value problem.

Reference books

Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Venkatraman, M.K., Numerical Methods in Science and Engineering, National Publisher Company.

Numerical Methods by Krishna Raju

Shanthakumar M.S., Numerical Methods & Analysis

Gupta, S.C. and Kapur, V.K., "Fundamentals of Mathematical Statistics ", Sultan Chand & Sons, New Delhi, 1999.

Computational Fluid Dynamics – Anderson.

Computational Fluid Mechanics – Victor L. Street er, Mc-Graw Hill.

Module II

Teaching Scheme
Credits: 1
Lectures: 1 Hr/week

Examination Scheme
In Sem Assessment: 25 Marks
Total Marks:25

Unit 1: **(6Hrs.)**
Assignment on Statistics & Probability
Unit 2 **(6Hrs.)**
Assignment on Numerical Methods

501051 - Lab Practice II

Teaching Scheme
Credits: 4
Laboratory Work: 4 hrs/week

Examination Scheme
TW: 50 Marks
Oral Exam : 50 Marks
Total Marks:100

The lab practice-II will be based on completion of assignments / practicals / reports of site visits, confined to the courses in that semester.

The term work will consist of --

i) Visit reports of minimum two site visits, exploring the field aspects for various subjects

ii) The laboratory work report of following experiments

1. Characteristics of Hydraulic Jump in horizontal and sloping channel
2. Experimental Study of any open channel transition
3. Velocity distribution in open channel flow using pitot tube or current meter
4. Assignment on open channel flow simulation software such as HEC RAS/MIKE-21
5. Numerical simulation of 1-D open channel flow using MATLAB
6. Assignment on flood forecasting
7. Assignment on ground water hydrology
8. Study of one research paper from referred journal and it's report in the form of discussion

501052 - Seminar I

Teaching Scheme
Credits: 4
Laboratory Work: 4 Hrs/week

Examination Scheme
TW: 50 Marks
Presentation : 50 Marks
Total Marks:100

Seminar I: Shall be on state of the art topic of student's own choice approved by an authority. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work by the concerned Guide and head of the department/institute.

M.E SECOND YEAR - SEMESTER III

601051 - Optimization Techniques

Teaching Scheme

Credits: 4

Lectures: 4 Hrs/week

Examination Scheme

In Sem Assessment: 50 Marks

End Sem Assessment:50 Marks

Total marks : 100

Unit 1: Linear Programming I **(8Hrs.)**

Introduction to Optimization techniques, Linear programming basic concepts, graphical method, Simplex method, Big M Method, Two phase method

Unit 2: Linear Programming II **(8Hrs.)**

Duality, sensitivity analysis, Transportation Model, Assignment Model

Unit 3:- Non Linear Programming **(8Hrs.)**

Unconstrained one Dimensional search methods: Dichotomous search method, Fibonacci, Golden section, Multivariable unconstrained techniques: Steepest ascent and Descent methods, Newton's methods, Constrained technique: Lagrangian Multiplier technique

Unit 4: Dynamic Programming **(8Hrs.)**

Principle of optimality, recursive equations

Unit 5: Stochastic Methods **(8Hrs.)**

Queuing theory, simulation technique, sequencing model.

Unit 6: Games Theory **(8Hrs.)**

Theory of games, 2 person zero sum game with and without saddle point, mixed strategies (2 x n games or m x 2 games), 2 x 3 game with no dominance, graphical method

Text books

Operations Research – Premkumar Gupta &D.S.Hira ., S.Chand

Problems in Opeartions Research - Premkumar Gupta & D.S.Hira, S.Chand

Reference books

Engineering Optimazation Theory & Practice – S.S. Rao.,Wiely.

Operation Research – TahaHamdey A.

Principles of Operation Research – Wagner, PrenticeHall.

601 052: Research Methodology

Teaching Scheme	Examination Scheme
Lectures: 4 hours/week	**In semester Exam. : 50 marks**
Credits: 4	**End Semester Exam. : 50 marks**
	Duration of End term. Exam: 3 hrs

Unit 1: Introduction to Research

Meaning of research, types of research, process of research, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, formulation of research hypotheses**.** Search for causation. Developing a Research Proposal Format of research proposal, Individual research proposal, Institutional research proposal, Significance, objectives, methodology, Funding for the proposal, Different funding agencies. Framework for the planning

Unit 2: Literature survey

Definition of literature and literature survey, need of literature survey, sources of literature, elements and objectives of literature survey, styles of literature survey, and strategies of literature survey.

Unit 3: Data collection, Measuring, Sampling and Scaling

Classification of data, benefits and drawbacks of data, evaluation of data, qualitative methods of data collection, methods of qualitative research, Sampling, sample size, sampling strategy, attitude measurement and scaling, types of measurements, criteria of good measurements, classification of scales.

Unit 4: Preliminary data analysis

Testing of hypothesis- concepts and testing, analysis of variance techniques, introduction to non-parametric tests. Validity and reliability, Approaches to qualitative and quantitative data analysis.

Unit 5: Advanced data analysis techniques

Correlation and regression analysis, Introduction to factor analysis, discriminant analysis, cluster analysis, multidimensional scaling, Descriptive statistics, Inferential statistics, Multi-dimensional measurement and factor analysis

Unit 6: Report writing

Need of effective documentation, importance of report writing, types of reports, report structure, report formulation, Plagiarism. Research briefing, presentation styles, impact of presentation, elements of effective presentation, writing of research paper, presenting and publishing paper, patent procedure.

References

1**.** Research Methodology: concepts and cases, Deepak Chawla and Neena Sondhi, Vikas Publishing House Pvt. Ltd.

2. Research Methods for Business, Sekaran Uma and Rogure Boudie, Wiley, India.

3. Research Methodology: Methods and Trends, by Dr. C. R. Kothari, New Age

International Publishers.

4. Research Methods in Education, Louis Cohen, Manion, Morrison, Routledge (Taylor &Francis Group)/ Cambridge University Press India Pvt. Ltd.

5. Research Methodology: An Introduction, Wayne Goddard and Stuart Melville.

6. Research Methodology: A Step by Step Guide for Beginners, by Ranjit Kumar

7. Research in Education, John Best and James Kahn, Prentice Hall of India Pvt. Ltd.

601053 A - Elective III: Hydropower

Module I

Teaching Scheme	**Examination Scheme**
Credits: 4	In Sem Assessment: 50 Marks
Lectures: 4 Hrs/week	End Sem Assessment: 50 Marks
Laboratory Work: NA	**Total Marks:100**

Unit 1:Introduction **(8Hrs.)**

Power resources, Need & advantages, Estimation of Hydropower potential. Calculations for estimation of electrical load on turbines. Load factor, peak demand and utilization factor load duration curve Prediction of load.

Unit 2: Classification of Hydropower Plants **(8Hrs.)**

General Management of running of river plants. Storage, pondage, diversion, canal plants, valley dam plants. Pumped storage plants, advantages & disadvantages, types. Tidal power plants.

Unit 3: Powerhouse **(8Hrs.)**

Components, Structural details of powerhouse

Unit 4: Penstocks **(8Hrs.)**

Classification, design criteria, water hammer phenomenon, surge tanks, design procedures & details classification, canal surges.

Unit 5: Turbines **(8Hrs.)**

Selection, classification, Arrangements in powerhouse. Draft tubes, cavitation, governing of turbines. Design principles of impulse & reaction turbines.

Unit 6: Micro Hydro Power Generation **(8Hrs.)**

Design of micro hydel power plants

Reference books

Water Power Engineering – M.M. Dandekar and K. N.Sharma, Vikas Publishing House, 2010.

Water Power Engineering – R. K. Sharma and T. K. Sharma, S. Chand & Co. Ltd., 2003.

Hydro-Power Structures – R. S. Varshney, Nem Chand Publishers, 1977.

Module II

Teaching Scheme
Credits: 1
Lectures: 1 Hr/week

Examination Scheme
In Sem Assessment: 25 Marks
Total Marks:25

Unit 1: **(6Hrs.)**

Assignment on design of any type of turbine

Unit 2 **(6Hrs.)**

Assignment on micro hydel power plant (Site visit necessary)

601053 B - Elective III: Closed Conduit Flow
Module I

Teaching Scheme **Examination Scheme**

Credits: 4
Lectures: 4 Hrs/week
Laboratory Work: NA

In Sem Assessment: 50 Marks
End Sem Assessment: 50 Marks
Total Marks:100

Unit 1: Introduction **(8Hrs.)**

Energy equation, friction losses, minor losses, types of pipe flow & Reynolds number, series piping, parallel piping

Unit 2: Steady Flow in simple pipelines **(8Hrs.)**

Pump characteristics, pipeline analysis water Hammer: Fundamental equations, elastics waves in conduits, boundary effects, numerical and graphical methods.

Unit 3: Surge Tanks **(8Hrs.)**

Differential equation for surge tank, method of solution, simple, and differential surge tanks with expanded chambers

Unit 4: Pipe network analysis (Steady state & transient) **(8Hrs.)**

Tree type networks, closed loop systems, general pipe system, computer analysis, use of PIPE2000(KYPIPE) and related programs, transient flow in pipe systems, introduction to SURGE program

Unit 5: Lift Irrigation Scheme **(8Hrs.)**

Study of various components of any major lift irrigation scheme

Unit 6: Industrial Piping **(8Hrs.)**

Study and design of industrial pipe network

Reference books

Engineering Fluid Mechanics – K.L. Kumar, Eurasia Publication.

Principles of Fluid Mechanics – M.K. Natrajan, Oxford & IBH Publication

Module II

Teaching Scheme

Credits: 1
Lectures: 1 Hr/week

Examination Scheme

In Sem Assessment: 25 Marks
Total Marks:25

Unit 1: **(6Hrs.)**

Assignment on design of water conductor system.

Unit 2 **(6Hrs.)**

Assignment on water distribution network for a small village

601053 C - Elective III: Groundwater Modelling

Module I

Teaching Scheme	**Examination Scheme**
Credits: 4	In Sem Assessment: 50 Marks
Lectures: 4 Hrs/week	End Sem Assessment: 50 Marks
Laboratory Work: NA	**Total Marks:100**

Unit 1: Groundwater Occurrence and Movement **(8Hrs.)**

General Introduction, Darcy's law, application of Darcy's law to confined and unconfined aquifers, wells - fully & partially penetrating wells, multiple wells, interference of wells, pumping test with steady and unsteady flow

Unit 2: Surface and sub-surface investigation of ground water **(8Hrs.)**

Geological/geophysical exploration/remote sensing/electric resistivity/seismic refraction based methods for surface investigation of ground water, test drilling and ground water level measurement Sub-surface ground water investigation through geophysical/resistivity/ spontaneous potential/radiation/temperature/caliper/fluid conductivity/fluid velocity/miscellaneous logging.

Unit 3: Planning of Groundwater Development **(8Hrs.)**

Water balance, assessment of recharge, utilizable recharge, Groundwater estimation norms in India, Constraints on groundwater development. Planning of ground water development in canal command areas-conjunctive use models, planning of ground water development in coastal aquifers

Unit 4: Numerical Modelling of Groundwater flow **(8Hrs.)**

Ground water modeling through porous media/analog/electric analog/digital computer models;

Review of differential equations, finite difference solution, direct problem, inverse problem; groundwater modeling using finite element method Artificial ground water recharge: Concept, methods of artificial ground water recharge, waste water recharge for reuse, water spreading

Unit 5: Management of Groundwater (8Hrs.)

Ground water basin management concept, hydrologic equilibrium equation, ground water basin investigations, data collection & field work, dynamic equilibrium in natural aquifers, management potential & safe yield of aquifer, stream-aquifer interaction.

Unit 6: Saline Water intrusion in coastal aquifers (8Hrs.)

Ghyben-Herzberg relation between fresh & saline waters, shape & structure of fresh & saline water interface Upcoming of saline water, fresh-saline water relations on oceanic islands, sea water intrusion in Karst terrains, saline water intrusion control

Reference books

Remson, I., Hornberger, G.M., and Molz. F.J., Numerical methods in sub-surface hydrology, Wiley Inter Science.

Rushton, K.R. and Redshaw, S.C., Numerical analysis by analog & digital methods, John Wiley.

Todd, D.K., Groundwater Hydrology, John Wiley, 1980.

Groundwater Modeling by Anderson.

Numerical ground water modeling by A K Rastogi, Penram International Publishing (India) Pvt Ltd. 2007

Module II

Teaching Scheme	**Examination Scheme**
Credits: 1	In Sem Assessment: 25 Marks
Lectures: 1 Hr/week	**Total Marks:25**

Unit 1: (6Hrs.)

Assignment on case study of any method of groundwater exploration.

Unit 2 (6Hrs.)

Assignment on case study of recuperation test

601054 - Seminar II

Teaching Scheme	**Examination Scheme**
Credits: 4	TW: 50 Marks
Laboratory Work: 4 Hrs/week	Presentation : 50 Marks
	Total Marks:100

The student is required to deliver a seminar in first semester of second year on the topic relevant to latest trends in the field of Hydraulics, preferably on the physical model demonstrating any principles/laws/theorems in Hydraulic engineering, approved by authority. The student shall submit the seminar report in standard format, duly certified for satisfactory completion of the work by the concerned guide and head of the Department/ Institute.

601055 - Project Stage I

Teaching Scheme	**Examination Scheme**
Credits: 8	TW: 50 Marks
Laboratory Work: 8 Hrs/week	Presentation: 50 Marks
	Total Marks:100

Project Stage-I is the integral part of the dissertation project. The project should be based on the knowledge acquired by the students during the coursework and should contribute to the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems in an area where the students like to acquire specialized skills. The student shall complete the part of the project that will consist of problem statement, literature review: project overview, scheme of implementation (Mathematical Model/block diagram/PERT chart, etc) and Layout & Design of setup. As a part of project stage I, the student shall deliver a presentation on advancement in Technology pertaining to selected topic. The student shall submit the report of project work completed partly in standard format approved by the University.

M.E SECOND YEAR - SEMESTER IV

601056 - Seminar III

Teaching Scheme	**Examination Scheme**
Credits: 5	TW: 50 Marks
Laboratory Work: 5 Hrs/week	Presentation : 50 Marks
	Total Marks: 100

Seminar III: Shall preferably be an extension of seminar II. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

601057 - Project Stage II

Teaching Scheme	**Examination Scheme**
Credits: 20	TW: 150 Marks
Laboratory Work: 20Hrs/week	Oral Exam : 50 Marks
	Total Marks:200

Project Work Stage-II: In Project Work stage –II, the student shall complete the remaining part of the project which will consist of the fabrication of set up required for the project, work station, conducting experiments and taking results, analysis and validation of results and conclusions.

The student shall prepare the duly certified final report of the project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.