Course Structure

For Post Graduate Degree Programme

M. Tech. in Civil Engineering
With Specialization in
Water Resources Engineering

Dr. Babasaheb Ambedkar Technological University

Lonere 402 103, Dist. - Raigad, Maharashtra, INDIA

Program Objectives

Goal of the Civil engineering with a specialization in Water Resources Engineering (WRE) at Dr. Babasaheb Ambedkar technological University, Lonere (BATU) is to provide students with preparation to become worthy of professional careers in the field of Water Resources Engineering and to be motivated for lifelong learning. All prescribed courses have definite objectives and outcomes. Program objectives are expected qualities of engineers as under:

a) Preparation: To prepare students to excel in various educational programmers or to succeed in industry / technical profession through further education/training;

b) Core Competence: To provide students with a solid foundation in mathematical, scientific fundamentals required to solve Water Resources problems;

c) Breadth: To train students with a breadth of scientific knowledge to comprehend, analyze, design & create novel products and solutions for real life problems;

d) Professionalism: To inculcate in students professional/ethical attitude, effective team work skills, multidisciplinary approach and to relate engineering issues to a broader context;

e) Learning Environment: To provide students with academic environment of excellence, leadership, ethical guidelines and life-long learning needed for a long / productive career.

In addition to above DBATU Post graduates is expected to be

1. Taking pride in their profession and have commitment to highest standards of ethical practices and related technical disciplines;
2. Able to design Water Resources structural system that is safe, economical and efficient;
3. Capable of using modern tools efficiently in all aspects of professional practices;
4. Dealing successfully with real life Water Resources civil engineering problems and achieve practical solutions based on a sound science and engineering knowledge;
5. Shall be engage in continuous research, development and exchange of knowledge for professional development;
6. Be honest in their control and performing their duties and promote effective use of resources through open, honest and impartial services to the public;
7. Act in such a manner which will uphold the honor, integrity, or dignity of the engineering profession, and avoid knowingly engaging in business or professional practices of a fraudulent, dishonest or unethical nature;
8. Recognize that the lives, safety, health and welfare of the general public are dependent upon engineering, decision and practices;
9. Continue their professional development throughout their careers and provide opportunities for the professional development;

First Semester

Sr. No.	Subject Code	Name of Subject	Hours /Week			Credit	Examination Scheme				
							Theory		CA	PR/ OR	Total
			L	P	T		TH	MTE			
01	CVWRE101	Engineering Hydrology And Hydrological System	03	--	1	04	60	20	20	--	**100**
02	CVWRE102	Ground Water Hydrology	03	--	1	04	60	20	20	--	**100**
03	CVWRE103	Advanced Fluid Mechanics	03	--	1	04	60	20	20	--	**100**
04	CVWRE104	Communication Skills	02	--	--	02	--	--	25	25	**50**
05	CVWRE-L01	PG Lab-I	--	03	--	02	--	--	25	25	**50**
06	CVWRE-E1	Elective-I	03	--	--	03	60	20	20	--	**100**
07	CVWRE-E2	Elective-II	03	--	--	03	60	20	20	--	**100**
		Total for Semester I	**17**	**03**	**03**	**22**	**300**	**100**	**150**	**50**	**600**

Elective-I

CVWRE-E1-01: Water Application Systems

CVWRE-E1-02: Computational and Statistical Methods

Elective-II

CVWRE-E2-01: Water Supply Systems

CVWRE-E2-02: GIS in Water Resources Engineering

CVWRE-E2-03- Integrated River Basin Management

Second Semester

Sr. No.	Subject Code	Name of Subject	Hours /Week			Credit	Examination Scheme				
							Theory		CA	PR/ OR	Total
			L	P	T		TH	MTE			
01	CVWRE201	Water Resources and Hydraulic Structures	03	--	1	04	60	20	20	--	**100**
02	CVWRE202	Water Resources Systems Planning &Management	03	--	1	04	60	20	20	--	**100**
03	CVWRE-S01	Seminar-I	--	04	--	02	--	--	50	50	**100**
04	CVWRE-L02	PG Lab-II or Mini -Project	--	04	--	02	--	--	50	50	**100**
05	CVWRE-E3	Elective-III (Departmental)	03	--	--	03	60	20	20	--	**100**
06	CVWRE-E4	Elective-IV (Departmental)	03	--	--	03	60	20	20	--	**100**
07	CVWRE-E5	Elective-V (Open)	03	--	--	03	60	20	20	--	**100**
		Total for Semester II	**15**	**08**	**02**	**21**	**300**	**100**	**200**	**100**	**700**

Elective-III

CVWRE-E3-01: Land and Water Management

CVWRE-E3-02: Artificial Intelligence Techniques

Elective- IV

CVWRE-E4-01: Environmental Impact Assessment

CVWRE-E4-02: Channel and River Hydraulics

Elective-V (Open)

CVWRE-E5-01: Water Power Engineering

CVWRE-E5-02: Climate Change

Third Semester

Sr. No.	Subject Code	Name of the subject	Hours/ Week			Credit	Examination scheme				
							Theory		CA	PR / OR	Total
			L	P	T		TH	Test			
1	CVSWR301	Project Management and Intellectual Property Rights (Self Study)*	--	--	--	02	--	--	50	50	**100**
2	CVWREPS1	Project Stage -I	--	--	--	10	--	--	50	50	**100**
		Total for Semester III	**--**	**--**	**--**	**12**	**--**	**--**	**100**	**100**	**200**

Fourth Semester

Sr. No.	Subject Code	Name of the subject	Hours/Week			Credit	Examination scheme				
							Theory		CA	PR/ OR	Total
			L	P	T		TH	Test			
1	CVWREPS2	Project Stage-II	--	--	--	20	--	--	100	100	**200**
		Total for Semester IV	**--**	**--**	**--**	**20**	**--**	**--**	**100**	**100**	**200**
GRAND TOTAL											**1700**

* Student may select this course either from NPTEL/MOOC pool or any other approved reputed source. The submission of course completion certificate is mandatory.

Semester I

CVWRE101 Engineering Hydrology and Hydrologic Systems

Teaching Schemes: 3 Lect. + 1 Tut hrs. /week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To study the different component parts of hydrologic cycle.
- To study hydrographic analysis and unit hydrograph.
- To study the rain fall and run off analysis.
- To understand the hydrologic statics and flood design.
- To enable the student with knowledge of hydrologic flood routing, channel routing, reservoir routing.
- To gain understanding of the application of remote sensing and GIS in hydrology.

Course Contents

Module 1:

Introduction: Hydrologic cycle, Physical and systems Approach, Systems concept, Linear and nonlinear systems, Lumped and Distributed Systems, Deterministic and Stochastic Systems, Time Invariant Systems, Nature of Problems in Engineering Hydrology.

(07 Lectures)

Module 2:

Hydrograph Analysis: Infiltration, Effective Rainfall, Runoff, Runoff components, direct Runoff Hydrograph.
Unit Hydrograph Theory: Linear Time Invariant System, Response Functions of Linear Systems, Derivation of Non Parametric Unit Hydrograph from Single Storm and Multi Storm Events, S-Curve Hydrograph, Instantaneous Unit Hydrograph.

(08 Lectures)

Module 3:

Rain fall: Run off Analysis: Review of rational Methods, Conceptual Model, Clark and nash Models Derivation of Unit Hydrograph for ungauged catchments, Synthetic unit Hydrograph.

(06 Lectures)

Module 4:

Hydrologic Statistic: Probabilistic Treatment of Hydrologic Data, Frequency and Probability Functions, Statistical parameters, Frequency analysis, annual maximum and partial duration series models, Regional frequency analysis, Design flood.

(06 Lectures)

Module 5:

Hydrologic Flood Routing: Reservoir routing, channel routing, estimation of flood routing models, flood forecasting, analog models, real time flood forecasting.

(07 Lectures)

Module 6:

Applications of remote sensing and GIS in hydrology: Geomorphologic hydrological Land use and soil mapping using remote sensing, Evaluation of water resources potential using remote sensed data, Areal Assessment of floods Inundated Areas, Soil moisture areas and pollution of River Waters, Watershed Management Using Remote Sensing Techniques, Concepts of Geographical information Systems (GIS) and its Application in Hydrologic Studies.

(08 Lectures)

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of minimum Three Modules.

References:

- Chow, V.T. Maidment, D.R. and Mays, L.W., "Applied Hydrology". McGraw Hill Inc. N. York. 1988.
- Singh, V.P.,"Hydrologic Systems", Prentice Hall, N. York 1985.
- Singh, V.P, "Elementary Hydrology", Prentice Hall of India, N Delhi.1992
- Haan C.T,"Statistical Methods in Hydrology", East West Press, New Delhi.1995
- Viessman, W, Lewis, G.L. and Knapp, J.W, "Introduction to Hydrology", Harper and Row Publications Inc. Singapore.1989
- Ponce, W.F., "Engineering Hydrology, "Remote Sensing and Image Interpretation", John Wiley & Sons.1987
- Lillesand, T.M. and Kiefer, R.H. "Remote sensing and Image Interpretation", John Wiley & Sons.1993

Outcomes:

Upon completion of the course, the student will be able to:

- The students will be able to understand the component of hydrologic cycle.
- Plan and design the flood.
- Analyze and design hydrograph.
- Demonstrate the flood routing model.
- Solve problems for unit hydrograph.
- The students will be able to assess hydrologic data.
- The students will be able to construct and apply models of hydrologic processes
- Construct a rainfall hydrograph for a given storm duration and frequency
- The students will be able to understand the flood estimation and real time forecasting

CVWRE102 Ground Water Hydrology

Teaching Schemes: 3 Lect. + 1 Tut hrs. /week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Objectives

- To provide the students with a basic understanding of hydrogeology.
- To enable the student to study of well hydraulics, aquifer parameters, laws, Aquifer directions, equations
- To provide the student with a basic introduction of groundwater flow processes.
- To provide students the well design and well drilling.
- To enable students to select appropriate method of modeling.

Course Contents

Module 1: Hydrogeology

Porosity and permeability of Rocks, Groundwater in Igneous, Metamorphic Sedimentary rocks and non industrated sediments, hydro geological regions of India, surface and subsurface geophysical methods for groundwater explorations.

(08 Lectures)

Module 2: Well Hydraulics

Aquifers and aquifer parameters, Darcy's law, hydraulic conductivity and its characteristics, Dupuit's equation, groundwater flow direction, steady groundwater flow, groundwater flow equation,

(06 Lectures)

Module 3:

Estimation of aquifer parameters from pumping test data, graphical techniques and their limitations, groundwater well losses, interference among wells, potential flow, image well theory and its applications in groundwater flow.

(06 Lectures)

Module 4:

Water well design and well drilling: Well screen, development and completion of wells, rotary drilling and rotary percussion drilling, maintenance of wells . **(08 Lectures)**

Module 5:

Groundwater management: Conjunctive use, alternative basin yields, artificial recharge of groundwater, groundwater quality, case study.

(07 Lectures)

Module 6:

Groundwater modeling: Groundwater flow, mathematical analog and digital modeling Case studies, regional groundwater modeling. **(07 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover syllabus of any three Modules.

References:

- Todd, D.K, "Groundwater Hydrology", JohnWiley & Sons, Singapore 1995
- Raghunath, H.M., "Groundwater" Wiley Eastern Ltd., N. Delhi.1992
- Garg, S.P., "Groundwater and Tube Wells", Oxford and IBH Publishing Co. N. Delhi.1993
- Domenico , "Concepts and Models in Groundwater Hydrology", McGraw Hill I NC. New York.1972

Outcomes:

Upon completion of the course, the student will be able to:

- The students will be able to design of water wells and well drilling.
- The students will be able to assess surface and subsurface geophysical methods.
- The students will be able to construct and apply models of ground water flow.
- The students will be able to manage ground water quality and make the conjunctive use of surface and ground water
- The students will be able to calculate ground water flows and carry out case studies.

CVWRE103 Advanced Fluid Mechanics

Teaching Schemes: 3 Lect. + 1 Tut hrs/week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To provide insight in Reynolds transport theorem.
- Provide an insight in principle of fluid flow
- To understand characteristic of turbulent flow and flow through pipes varying flow with impact of jet.
- This course imparts the knowledge of fluid measuring devices viz. notches & weir and concept of spillway.
- Students will induce a skill to design and testing of models
- This course aims to provide an insight into understanding of dimensional analysis & model analysis

Course Contents

Module 1: Introduction

Survey of Fluid Mechanics, Structure of Fluid mechanics based on Rheological, Dilational, Temporal Variation, Fluid Type, Motion Characteristics and spital Dimensionality Considerations, Approaches in Solving Fluid Flow Problems, Fundamental Idealizations and Descriptions of Fluid motion, Quantitative definition of Fluid and flow, Reynolds Transport Theorem, Mass Momentum and energy conservation Principles for Fluid Flow.

(07 Lectures)

Module 2: Potential Flow

Response to Unit Impulse, Arbitrary Time Varying Force, Response to Step and Ramp Forces, Response to Pulse Excitations, Rectangular Pulse, Half Sine Wave Pulse, Triangular Pulse, Response to Ground Motion, Numerical Evaluation of Dynamic Responses, Time Stepping Methods, Interpolation Methods, Newmark's Beta Method. **(07 Lectures)**

Module 3: Differential analysis of fluid flow

Study of Local Behavior, Differential Approaches in Analysis Viscous Flows, Equation of Motion of Viscous flow, Navier – Stokes Equations, Exact and approximate solution of N-S equations, Hele – Shaw Flow, Creeping Flow past a sphere, Boundary layer concepts, Prandtl's Boundary Layer Equations, Laminar Boundary Layer Along a Flat Plate, Integral Momentum Equation, Blassius Solution. **(09 Lectures)**

Module 4: Turbulence in Fluid Flow

Origin of Turbulence, Statistical analysis of turbulence, Reynolds equations for turbulence, Theories of Turbulent shear Stresses, Velocity distribution in smooth and rough pipes, Resistance coefficients for pipes, Turbulent boundary layer and boundary layer separation . **(07 Lectures)**

Module 5: Design and Testing of Models

Design of an experiment, Dimensional Analysis, Complete set of Dimensional Analysis, Practical Significance of Key Modeling Parameters, Design of Model and model tests. **(06 Lectures)**

Module 6: Computational Fluid dynamics

Introduction and fundamentals, equation of motions, solution procedure, grid generation, and boundary conditions, laminar, turbulent and open channel flow, CFD calculations. **(06 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Valentine, H.R. "Applied Hydrodynamics", International Text Butterworth 1970
- White, F.M. "Viscous Fluid Flow", McGraw Hill Pub. Co. N. York, 1980
- Yalin, M.S. "Theory of Hydraulic Models", McMillian Co. 1971
- Mohanthy A.K., Fluid Mechanics", Prentice Hall of India, New Delhi.1993

Outcomes:

Upon completion of the course, the student will be able to:

•This course will help them to develop ability to design and conduct experiments, Interpret and analyze data with experimental results in hydraulic engineering.
• At the end of the course, graduates will develop the ability to design and conduct experiments with analysis of data to produce experimental results.
• Students will develop an ability to carry out calibration of venture meter and notches.
•They will develop ability to improve the existing pressure measuring devices.
•The students will be able analyze fluid flows and will be able to design pipe networks

CVWRE104 Communication Skill

Teaching Schemes: 2 Lect. hrs/week; Evaluation **Scheme:** Class Assessment 25; Oral examination 25

Course Contents

Module 1: Language for Technical Purpose and Presentation Tools

Technical vocabulary, Sentence structures, Microsoft office, Graphical presentations **(03 Lectures)**

Module 2: Formal Written Communication

Drafting Letters, e-Mails, Memos, Notices, Circulars, Schedules. **(03 Lectures)**

Module 3: Project Research Proposals and Reports

Research Proposal: Essentials, Abstract, Aims, Background & significance, Design & methods, Writing a sample proposal.

Project Report: Types of reports, Planning a report, Collection & organization of information, Structure & style, Proofreading etc. Writing a sample report. **(06 Lectures)**

Module 4: Leadership Skill and Team Building, Working.

Leadership Skills**:** Leadership quality and styles, Emotional intelligence, Diplomacy and Tact and effective communication, Case studies.

Need of team, Effective teams, Group development, Roles in group, Case studies. **(06 Lectures)**

Module 5: Business Meetings

Understanding role of meetings, planning meetings, developing meeting agendas, scheduling meetings, conducting meetings effectively, Taking notes and publishing minutes and concluding meetings, action plans, Demo meetings. **(06 Lectures)**

Module 6: Presentation Skills

Preparation, Understanding audience, Use of presentation tools, Presentation, nonverbal techniques, handling questions, Demo presentations.

(04 Lectures)

References:

- S. Hariharan, et.al. Soft Skills; MJP Publishers, 2010.
- John Seely, Oxford Guide to Effective Writing and Speaking; Oxford University Press, 2009.
- Thomas N. Huckin and Leslie A. Olsen, Technical Writing and Professional Communication
- for Nonnative Speakers of English; Tata McGraw Hills, International Edition, 1991.
- Jeff Butterfield,Soft Skills for Everyone,cengage Learning India Private Limited,2010.
- L. Ann Masters & Harold R. Wallace, Personal Development for Life & Work,10e,Cengage
- Learning India Private Limited,2011.

Outcomes:

PG Lab-I

CVWRE-L01PG Lab-1

Teaching Schemes: 3 Pract. Hrs. /week; **Evaluation Scheme:** Oral 25; Class Assessment 25

Laboratory Work:

The term work will consist of –
Any five following experiments are required to perform in the laboratory.
1. Flow around immersed lamina using Hele Shaw model.
2. Verification of Bernoulli's equation.
3. Study of Hydraulic Jump.
4. Determination of discharge coefficient of standing wave flume.
5. Study of water hammer phenomenon.
6. Water quality Analysis for various parameters.
7. Study of tilting flume for water discharge measurement.

Elective I

CVWRE-E1/01 Water Application Systems

Teaching Schemes: 3 Lect. hrs. /week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

• To study the conveyance, types of lining, economics of lining.
• To understand the cross-drainage work and regulating structures.
•. To study various regulators.
• To analyze lift irrigation and drip irrigation.
• To demonstrate the features and the use of most widely used commercial and freely available irrigation systems, types, methods

Course Contents

Module 1:

Conveyance through Open channel, Lined and unlined channels, types of linings and economics of lined channels.

(04 Lectures)

Module 2:

Cross-drainage works and regulating structures. Types of C.D. works such as aqueducts, super-passage, canal siphons and culverts. There layout and hydraulic design concept.

(08 Lectures)

Module 3:

Main head regulators, cross regulators and distributary head regulators. Their layouts and hydraulic design considerations. Conveyance through closed conduit system, elements, controlling devices, general concepts of hydraulic design. Water Application Techniques

(08 Lectures)

Module 4:

Lift irrigation- General concepts, elements of lift irrigation schemes. Design consideration involved in intake well, jackwell, rising main and distribution system. Concept of cost economics.

(08 Lectures)

Module 5:

Drip Irrigation: General concept, advantages and disadvantages. Components of system types of sprinklers, design concepts of drip irrigation.

(07 Lectures)

Module 6:

Sprinkler irrigation: General concept, advantages and disadvantages. Components of the system types of sprinklers, design concepts of sprinkler irrigation system.

(07 Lectures)

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References

- Israelsen Henson- "Irrigation Principles and Practices", John Wiley.
- Finkel, H.J-"Hand Book of irrigation Technology" CRC Press Inc., Florida
- Cuenca, R. H.- "Irrigation system design" Prentice Hall.
- Khushani-"Irrigation system design-Vol. III Oxford and IBH.

Outcomes:

Upon completion of the course the students will be able to:

- Demonstrate the methods of water application.
- Analyze the cross drainage work.
- The students will be able to assess hydraulic design considerations in regulators.
- The students will be able to understand Water Application Techniques.
- The students will be able to understand and design of lift irrigation system.
- The students will be able to design of drip and sprinkler water application techniques.

Elective I

CVWRE-E1/02 Computational and Statistical Methods

Teaching Schemes: 3 Lect. hrs. /week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course objectives:

1. To study the numerical solutions of ordinary differential equation.
2. To understand the numerical techniques applied in FEM
3. To study classification of data and concepts of probability.
4. To analyze fuzzy and neuron models.

Course Contents

Module 1:

Numerical Solution of Ordinary Differential Equations : Solution by Taylor's Series, Euler's Method, Runge Kutta Methods, Solution of Algebraic and Transcendental equations, Newton Rapson, Bisection method.

(04 Lectures)

Module 2:

Finite Elements method : Basic Concepts, Solution of Discrete Problems, Steady State and Time Dependent Continuous Problems, Application of Finite method through illustrative examples.

(06 Lectures)

Module 3:

Classification and Presentation of data, Basic Concepts of Probability, Probability Axioms, Analysis and Treatment of Data, Population and Samples, Measures of Central Tendency Measures of Dispersions, Measures of Symmetry.

(06 Lectures)

Module 4:

Probability Distributions: Discrete and Continuous Probability Distribution Functions – Binomial, Poisson, Normal, Lognormal, Transformations to Normal Distributions, Extreme Value Distributions, Parameter Estimation – Methods of Moments, Method of Maximum Likelihood, Probability Weighted Moments and Least Square Methods.

(08 Lectures)

Module 5:

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

(08 Lectures)

Module 6:

Fuzzy logic, Neural Networks and Genetic Algorithms : Introduction, Concepts, Basic Fuzzy Mathematical Operations, Mathematical Model of Neuron, Learning Algorithms, Architecture, Introduction to genetic algorithm, Operators, Applications.

(08 Lectures)

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Gupta S.P. "Statistical Methods ", S. Chand & Sons1999
- Hann C.T., "Statistical Methods in Hydrology", East West Press, New 1995 Delhi.
- Sastry, S.S., "Introductory Methods of Numerical Analysis ", Prentice Hall of India (P) Ltd., New Delhi.1995
- Rao V & H. Rao, "C++, Neural Networks and Fuzzy Logic, BPB Publications, New Delhi.1995
- Goldberg, D.E. (200), "Genetic Algorithms in Search, Optimization & Machine Learning", Addison Wesley Longman (Singapore) Pte. Ltd., Indian Branch, Delhi.

Outcomes:

Upon completion of the course the students will be able to:

1. Demonstrate the classification and presentation of data.
2. Compute the problems by FEM.
3. Analyze by fuzzy methods
4. Estimation of parameters.
3. Analyze mathematical models by neuron.

Elective II

CVWRE-E2/01 Water Supply Systems

Teaching Schemes: 3 Lect. hrs. /week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Objectives

•To acquaint the students with drinking water quality standards and criteria
•Study of conventional water treatment processes.
•To prepare the students to carry out study of test and odor, softener.
• To acquaint the students with various design of transportation systems.

Course Contents

Module 1: Introduction

Water Requirements , Sources of water, water Supply , water Supply Considerations Water Quality , Drinking Water Standards, Secondary Standards – Toxics, Water Pollutants, Quality Criteria for surface Water ,purpose of Water Treatment –Selection of Water processes.

(08 Lectures)

Module 2: Conventional Treatment processes

sedimentation , type of sedimentation , Zone Setting ,Filtration ,Gravity Granular ,- Media Filtration ,Head Losses , Back Washing and Media Filtration , Head Losses, Back Washing and Media Fluidization,- Pressure Filters –slow sand Filters, Coagulation and flocculation Coagulants, Coagulant aids, Rapid Mixing Devices, Disinfection Methods Fluoridation, De fluoridation **(09 Lectures)**

Module 3: Water Softening

Lime Soda Process, Variations-Ion Exchange Softening and Nitrate Removal **(06 Lectures)**

Module 4: Iron and Manganese Removal

Iron Corrosion, Water Stabilization –Cathodic Protection **(06 Lectures)**

Module 5: Test and Odour

Method of control, Aeration, Adsorption and Control of Algae Growth.

(06 Lectures)

Module 6: Reduction of Dissolved Salt

Distillation, Reverse Osmosis, Electrolysis Transportation and Distribution of Water: Aqueducts, Hydraulic Consideration, Design Of Transportation System, Distribution Reservoirs and Service Storage.

(07 Lectures)

Guidelines for Assignments:

- Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- .ViessmanJr.,mark J Hammer Water Supply and Pollution Control. McGraw International Edition 1990
- .Peavy ,H.S.Row ,D.R. and Techbanaglous, G(1995) Environmental Engineering McGraw International Edition
- Fair, Geyer, oakum Water Supply Engineering John Wiley 1990
- Turbuit T H Y "Principles of Water Quality Control", Pergamon Press.1998

Outcomes:

Upon completion of the course the students will be able to:

• Analyze water quality.
•. Selection of proper water treatment units and plan their operations on the basis of raw water
• Apply knowledge of advanced water treatment processes for individual water purification units.
• Design and supervise of water treatment units

Elective II

CVWRE-E2/02 GIS In Water Resources Engineering

Teaching Schemes: 3 Lect. hrs. /week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:
• To gain understanding of the physics of remote sensing and an introduction to the major remote sensing systems that are in operation today.
• To provide introductory understanding and working knowledge of Geographic Information Systems (GIS)
• To gain applied experience in using GIS through a number of case study exercises.
• An understanding of current research, technology and policy developments in the GIS/RS area and their potential applications to environmental and sustainability issues.

Course Contents

Module 1:

Introduction Scope of Remote Sensing and GIS in Water Resource and Environmental Systems – Geomorphological, Hydrological and Land use Mapping. Evaluation of Water Resources Potential Rainfall Runoff modeling using remote sensing inputs.

(08 Lectures)

Module 2:

Flood and Draught Studies, Flood plain zoning – inundated areas – evaluation models – Draught assignment and monitoring.

(07 Lectures)

Module 3:

Command Area Studies – Cropping patterns, conditions of crops, irrigation system performance – crop yield estimation.

(07 Lectures)

Module 4:

GIS, Hydrology and Resources Management – Watershed development, measurement options, inventory.
Remote Sensing in Show Cover Studies – Snowmelt Runoff.

(08 Lectures)

Module 5:

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

(06 Lectures)

Module 6:

Environmental Applications – Urban Storm water Studies – Soil waste management – wetlands nonpoint sources pollution.

(06 Lectures)

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- . Lillesand T.M. and Kiefer R.W., Remote Sensing and Image Interpretation" JohnWiley and Sons, N York 1993
- . Swain P.H., and S.M. Davis, "Remote Sensing – The Quantitative Approach", McGraw Hill Publishing Company, N. York.'1987
- . Lyon, J.G. and McLarthy, J., "Wetland and Environmental Application of GIS", Lewis Publisher, Washington.1995

Outcomes:

Upon completion of the course the students will be able to:

• GIS and remote sensing techniques.
•Different softwares related to GIS and remote sensing
•Rainfall runoff modelling
•Flood and drought studies

Elective II

CVWRE-E2/03 Integrated River Basin Management

Teaching Schemes: 3 Lect. hrs. /week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To understand naturally functioning river basin system.
- To study conservation, management and development of water.
- To learn integrated water resources planning management including water supply and demand management.
- To study decision support for river basin management

Course Contents

Module 1: Introduction

Global and national scenario in general. Naturally functioning river basin river system. Concept of integration in the river basin setting. Conservation, management and development of water. Economic and social benefits, restoring freshwater ecosystem.

(06 Lectures)

Module 2: Interlinking of major rivers in India

Water Resources Development in India: National water policy of India, Water resources potential of India, Inter basin transfer of water: Concept of inter basin transfer of water, Proposed inter basin transfer of water from surplus regions of India to deficit regions of India, National perspective plan of India-Himalayan rivers component and peninsular rivers component.

(08 Lectures)

Module 3: River basin planning and management:

water quantity and quality and its protection; Land use; socio-economic condition; Integrated water resource planning management including water supply and demand management; urban and rural water development; decision support for river basin management; International river basin management including conflict and resolution and sustainable development. Maintenance of echo system, conventional approaches. **(08 Lectures)**

Module 4: Climate change and water resources sustainability

Reasons, details of climate change, and sustainable development introduction to cost-benefit analysis economic evaluation of environmental goods environmental and social cost-benefit analysis.

(07 Lectures)

Module 5: Long term vision

Stake holders and initiates, integration of policies, decision and cost across, sectoral interest includes industry, agricultural, urban development, navigation, fisheries, fisheries management and conservations, strategic decision making at river basin scheme

(07Lectures)

Module 6:

Legal Aspects of water & Environment Systems: Principles of Law Applied to Water Rights and water allocation, water laws. Environmental protection law. Environmental constraints on Water Resources Development.

(06 Lectures)

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Kemper, Karin; Blomquist, William; Dinar, "Integrated River Basin Management through Decentralization" Ariel (Eds.) 2007,
- Saha S.K.,"River basin management theory and practice" Chichester:John Wiley,1981.
- Falconer R. A. "River basin management" Cardiff University, United Kingdom and W. R. BLAIN, Wessex Institute of Technology, United Kingdom.

Outcomes:

Upon completion of the course the students will be able to:

• River basin planning and management.
•Details of climate change concept

Semester II

CVWRE201 Water Resources and Hydraulic Structures

Teaching Schemes: 3 Lect. + 1 Tut hrs. /week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives

• To study the different aspects of design of hydraulic structures
•To design different types of dams
•To provide knowledge on various hydraulic structures such as energy dissipaters, head regulators and, Cross regulators, canal falls and structures involved in cross drainage works
•To understand the analysis of seepage and hydraulic jump
• To study the different aspects of spillways and spillway gates.

Course Contents

Module 1

Water Resources Development in India: National water policy of India, Water resources potential of India, Inter basin transfer of water: Concept of inter basin transfer of water, Proposed inter basin transfer of water from surplus regions of India to deficit regions of India, National perspective plan of India-Himalayan rivers component and peninsular rivers component.

(08 Lectures)

Module 2

Masonry and concrete dams: Evaluation of theory of design, Earth quake forces on dam and water mass, up-lift force. Strengthening and raising of dams, High dams.
Arch dams – Development of arch dams, equations of cylindrical shells, general concepts about trial load method and elastic shell method.
Counter fort and hollow dams: Genesis of the style, pros and cons. General stability of the dam.
Rock fills dams: General Design principles, methods of constructions and compaction **(10 Lectures)**

Module 3:

Instrumentation in dams **(04 Lectures)**

Module 4: Earth dams

Calculation and control of seepage through dam and foundation. Drainage of earth dams, design of filters, design of earth dams.

(06 Lectures)

Module 5 Spillways

Determination of capacity, Types, ogee, side channel, chute, shaft, siphon, etc. general layout and elements, Basic Principles of hydraulic design. Energy dissipation arrangements.
Spillway Gates – Types such as Tainter, drum, vertical lift, automatic gates. General discussion about layout, elements and basic principles of design. Design of weirs **(08 Lectures)**

Module 6: Outlets through dams:

Pressure and non-pressure outlets, types, layouts, general arrangement and components, nature of flow in outlets, head losses, hydraulic considerations involved in the design of high head outlets. **(06 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the course shall be performed by the candidate.

Guidelines for Class-Test: Class test shall cover syllabus of minimum three module

References:

• . Creager, Justin, Hinds – "Engineering for dams Vol. I, II, III.
• Sharma, H.D. "Concrete Dams"
• Garg, S.K. "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, 1988

Course Outcomes:

On completion of the course, student will be able to
• Plan and design the reservoirs depending upon the water resources potential.
• Analyze and design Gravity dams and Earth dams.
• Demonstrate the design principles of Arch dams.

• Solve seepage problems for Weirs on Permeable Foundations
• Demonstrate the knowledge of water power engineering and river training works.

CVWRE202: WATER RESOURCES SYSTEMS PLANNING & MANAGEMENT

Teaching Schemes: 3 Lect. + 1 Tut hrs. /week; **Evaluation Scheme**: Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Objectives

• To provide the students with a basic understanding of water resources engineering,
• To enable the student to the economic analysis of water resources systems.
• To provide the student with a methods of system analysis.
• To provide students the Water quality management practices.
•To enable students to select appropriate legal aspects of water and environment systems.

Course Contents

Module 1

Introduction: General Principles of Systems Analysis to Problems in Water Resources Engineering, Objectives of water resources systems Socio – Economic Characteristics

(06 Lectures)

Module 2: Economics of planning

Global scenario of water resources planning, price theory, Resource allocation, project optimality conditions,, cost benefit studies, role of benefit cost ratio parameters in project selection. Economic feasibility tests. Decision making under uncertainty and risk. Cost benefit studies of single and multipurpose projects. Economic planning. Capacity expansion. Principles of Engineering Economy, Capital, Interest and Interest rate, Time Value of Money, Depreciation, Benefit Cost Evaluation, Discounting Techniques, Socio – Economic Analysis

(08 Lectures)

Module 3:

Methods of Systems Analysis: Linear Programming Models, Simplex Method, Sensitivity Analysis, Dual Programming, Dynamic Programming Models, classical optimization techniques, Non-Linear Programming, Gradient Techniques., Genetic algorithm, Stochastic Programming, Simulation, Search techniques, Multi objective optimization **(08 Lectures)**

Module 4:

Water Quantity Management: Surface water storage requirements, storage capacity and yield, reservoir design, water allocations for water supply, irrigation, hydropower and flood control reservoir operations, planning of an Irrigation system, irrigation scheduling, groundwater management, conjunctive use of surface and subsurface water resources, Design of water conveyance and distribution systems.

(08 Lectures)

Module 5:

Water Quality Management: Water Quality Objectives and Standards, Water Quality Control Models, Flow Augmentation, Wastewater Transport Systems, River Water Quality Models.

(06 Lectures)

Module 6:

Legal Aspects of water & Environment Systems: Principles of Law Applied to Water Rights and water allocation, water laws. Environmental protection law. Environmental constraints on Water Resources Development.

(06 Lectures)

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the course shall be performed by the candidate.

Guidelines for Class-Test: Class test shall cover syllabus of minimum three module

References:

•Loucks, D.P., Stedinger, J.R. and Haith, D.A. “Water Resources Systems Planning and Analysis”, Prentice Hall Inc. N. York 1982
• Chaturvedi, M.C. , “Water Resources Systems Planning and Management”, Tata McGraw Hill Pub. Co., N. Delhi, 1987
• Hall W.A. and Dracup, J.A. , “Economics of Water Resources Planning “, McGraw Hill publication N Delhi.1975
• James, L.D. and Lee “Economics of water resources planning”, McGraw Hill Inc. N York.1975
• Kuiper, E. “Water Resources Development, Planning, Engineering and economics”, Buttersworth, London.1973
• Biswas A.K.“Systems Approach to water management” McGraw Hill Inc, N York.1975
• Taha, H.A., “Operation research”, Prentice Hall of India, N. Delhi.1995

Course Outcomes:

• The students will be able to assess general principles of systems analysis to problems in Water Resources Engineering.
• The students will be able to analyze economic of water resources engineering.
•The students will be able to analyze methods of systems analysis
•The students will be able to understand the. Water Quantity Management
•The students will be able to describe legal aspects of water & environment systems.

CVWRE-S01 Seminar I

Teaching Schemes: 4 Pract. Hrs. /week; Evaluation **Scheme:** Class Assessment 50; Oral Examination 50

Laboratory Scheme:

Seminar I shall be presented on one of the advanced topics chosen in consultation with the supervisor. Students must study latest literature. The concepts must be clearly understood and presented by the student. All modern methods of presentation should be used by the student. Minimum 03 presentations are expected within period of semester by the student. A hard copy of the report should be submitted before delivering the seminar. A copy of the report in soft form must be submitted to the Supervisor along with other details, if any.

PG Lab-2

CVWRE-L02: PG-Lab -2

Teaching Scheme: Practical: 04 Hours / Week Class Assessment :50 Practical Exam: 50 Marks

The term work will consist of –
Any five following experiments are required to perform in the laboratory.
1. Determination of rainfall-runoff co-relation for any rainfall, runoff data
2. Determination of mass curve and hyetograph from obtained data.
3. Measurement of permeability.
4. Determination of rate of evaporation.
5. Design of rainwater harvesting system.
6. Study of velocity meter.
7. Study of vortex flow.
8. Study of water budgeting & water audit

CVWRE-L02 Mini Project

Teaching Schemes: 4 Pract. Hrs. /week; Evaluation **Scheme:** Class Assessment 50; Oral Examination 50

Laboratory Scheme:

Mini project shall be based on one of the topic chosen in consultation with the supervisor. Mini project may be interdisciplinary nature. Areas of recent techno-management development shall be explored. Research innovations may be considered as

prospective areas. Mini project may be related with main project to explore possibilities of continuation further and to study the pre-requisites.

Elective III

CVWRE-E3/01 Land and Water Management

Teaching Schemes: 3 Lect. hrs. /week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Objectives

•To provide the students with a irrigation development in India.
• To enable the student to analysis of the physical and chemical properties of soil..
•To provide the student with a basic introduction of soil plant relationship..
• To provide students the basic introduction of Watershed management practices.
• To enable students to select appropriate irrigation management. Systems.

Course Contents

Module 1

Irrigation Development in India, Planning of Irrigation projects, command area development Programme,

(06 Lectures)

Module 2

Physical and chemical properties of soil, soil profile, soil aeration, classification of Irrigable Soils, Soil survey, soil management

(06 Lectures)

Module 3

Soil-Plant-Water relationships, Capillary and non-capillary pores, water relation of Soils, infiltration, Hydraulic conductivity, water movement through soils, Soil water potential, soil moisture constants, plant water relations, rooting characteristics

(08 Lectures)

Module 4

Watershed management: Objectives, water conservation and harvesting, soil erosion-principles and causes, estimation of soil loss, universal soil loss equation control and conservation, Land capability classification.

(06 Lectures)

Module 5

Watershed development ridge to valley concept, water harvesting technique for life Saving irrigations, land treatment, drainage line treatment, role of geology, design of Structure, estimation of water harvested, impact on environment, hydrology of micro watershed, case study.

(08 Lectures)

Module 6

Irrigation Management: Land grading and Field Layout, Cropping patterns, Fertilizers, On-farm developments, Diagnostic analysis of irrigation system, water Application methods, Rotational water distribution, Micro Irrigation, Water Logging and Salt Problems, Reclamation and Management of Salt affected Soils, Drainage, Participatory Irrigation Management.

(08 Lectures)

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Murthy, V.V.N. “Land and Water Management Engineering”, Kalyani Publishers, Ludhiana.1999
- Scwabe G.O., Fagmeir, D.D. and Eliot W.J. “Soil and Water Management Systems”, Jhn Wiley and Sons, N York.1995
- Michael, B.A.M. “Irrigation”, Vikas Publishing House Pvt. Ltd. N Delhi1990
- Asawa, G •.L. “Irrigation Engineering”, New Age International Pub. Co. N Delhi.1995

- Suresh, R.L. "Soil and water conservation engineering", standard publishing Co. Delhi.1999
- Watershed hydrology by V.S.R. Murthy

Course Outcomes:
• The students will be able to assess Irrigation Development in India
• The students will be able to analyze Physical and chemical properties of soil,
• The students will be able to develop Soil-Plant-Water relationships.
•The students will be able to understand the Watershed management
• The students will be able to analyze case studies

Elective III

CVWRE-E3/02 Artificial Intelligence Techniques

Teaching Schemes: 3 Lect. hrs. /week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Objectives
• To provide the students with a basic understanding of neural networks.
• To enable the student to study Fuzzy set theory
• To provide the student with a basic introduction of Fuzzy Reasoning and Fuzzy Interference
• To provide students the basic introduction of. Fundamental concepts of Artificial Neural Networks
• To enable students to study of Neuro-Fuzzy Modeling.

Course Contents

Module 1

Introduction: Basic concepts of Neural Networks and Fuzzy logic, differences between conventional computing and Neuro-Fuzzy computing, characteristics of Neuro-Fuzzy computing.

(08 Lectures)

Module 2

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

(06 Lectures)

Module 3

Fuzzy Reasoning and Fuzzy Interference: Fuzzy rules, Fuzzy resoning, Fuzzy Inference systems, Fuzzy modeling, Applications of Fuzzy reasoning and modeling in Civil Engineering problems.

(08 Lectures)

Module 4
Fundamental concepts of Artificial Neural Networks: Model of a neuron, activation functions, neural processing, Network architectures, learning methods.

(06 Lectures)

Module 5

Neural Network Models : Feed forward Neural Network, Back propagation algorithm, Applications of Feed forward networks, Recurrent networks, Hopfield networks, Habbian learning, self-organizing networks, unsupervised learning, competitive learning.

(08 Lectures)

Module 6

Neuro-Fuzzy Modeling: Neuro-Fuzzy computing, Hydrologic modeling Time series Analysis and Modeling, Water Management.

(06 Lectures)

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Jang, JSR, C.T. Sun and E. Mizutan , " Neuro-Fuzzy and Soft Computing", Prentice Hall, N.J.1997
- Simon Haykin, , "Neural Networks, A Comprehensive Foundation", McMillan College Publishing Company.1993
- Kosko, B. , "Neural Networks and Fuzzy Systems", Prentice Hall of India Pvt. Ltd., New Delhi.1997
- Klir, George J., T.A. Forger, "Fuzzy Sets, Uncertainty and Information", Prentice Hall of India, Pvt. Ltd., New Delhi.1995

5 Rao V. and H. Rao, "C++ Neural Networks and Fuzzy Logic, BPB Publications, New Delhi. 1995

Course Outcomes:

- The students will be able to assess. Basic concepts of Neural Networks
- The students will be able to apply Fuzzy reasoning and modeling in Civil Engineering problems.
- The students will be able to understand Neural Network Models
- The students will be able to develop Fuzzy Set Theory
- Acquire knowledge on the Fundamental concepts of Artificial Neural Networks.

Elective IV

CVWRE-E4/01 Environmental Impact Assessment

Teaching Schemes: 3 Lect. hrs. /week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Objectives

- To provide the students with a basic understanding of Principles of Environmental engineering
- To enable the student to predict: Environment and its interaction with human activities
- To provide the student with a basic introduction of. Environmental issues in water resource development
- To provide students the basic understanding of Water Quality Impact Assessment
- To enable students to the Methodologies for Carrying Environmental Impact Assessment

Course Contents

Module 1

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

(08 Lectures)

Module 2

Principles of Environmental engineering, Ecological diversity, its importance And conservation, Ecosystem evaluation, landscape-main ecological elements, Diversity, matrices, patches, corridors, Interrelations of ecological elements in a Cultural landscape, Reclamation and environmental engineering, water resources and ecology, saving endangered species, International and regional convention on environmental protection.

(08 Lectures)

Module 3

Environmental issues in water resource development – Land Use – Soil erosion And their sort and long term effect – Eco system studies – Flora –Fauna –Aquatic and terrestrial ecosystem balance – Disturbance and long term impacts – changes in quantity and quality of flow – sedimentation – Environmental impact Assessment of water resources development structures – Case Studies.

(08 Lectures)

Module 4

Water Quality Impact Assessment: Attributes to be Considered, Water Quality Impact Assessment of Water Resources Projects, Data Requirement of water quality impact Assessment for Dams, Impacts of Dams on Environment, Case Studies.

(06 Lectures)

Module 5

Methodologies for Carrying Environmental Impact Assessment: Overview of Methodologies Adhoc Checklist, Matrix, Network, Overlays, Benefit Cost Analysis, Choosing a Methodology, Review Criteria.

(06 Lectures)

Module 6

Guidelines and legal aspects for environmental protection, role of Ministry of environment and forests, Role of pollution control board, Environmental protection acts, measures of effectiveness of pollution control activity.

(06 Lectures)

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Jain, R.K., Urban, L.V., Stacy, G.S., "Environmental Impact Analysis", Van No strand Reinhold Co., New York.1991
- Rau, J.G. and Wooten, D.C. , "Environmental Impact Assessment " ,McGraw Hill Publication Co., New York.1995
- Canter, L.W., "Environmental Impact Assessment", McGraw Hill Pub. Co., New York.1997
- Environmental impact of water Resource Projects by S.A. Abbasi , Discovery Publishing house, New Delhi.

Outcomes:

Upon completion of the course the students will be able to:

- The students will be able to develop Environmental issues in water resource development
- The students will be able to analyze
- The students will be able to understand the. Principles of Environmental engineering
- The students will be able to develop Methodologies for Carrying Environmental Impact Assessment

Elective IV

CVWRE-E4/02 Channel and River Hydraulics

Teaching Schemes: 3 Lect. hrs. /week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Objectives:

- To learn principles of flow in open channels, conservation laws and various types of flow
- To learn analytical and numerical techniques for flow analysis
- To study the fundamental principles governing open channel hydraulics for the design of engineering systems.
- To develop the skills needed for systematic decomposition and solution of real world problems

Course Contents

Module 1

Basic concepts of free surface flows: flow regimes, velocity and pressure distribution, kinetic energy and momentum principles, engery-depth relationships, specific energy, critical depth, computation of the critical depth, section factors, hydraulic exponents, specific force diagram.

(08 Lectures)

Module 2

Flow resistance: the resistance equation, uniform and non uniform flow computation and application, longitudinal profiles.

(06 Lectures)

Module 3

Steady gradually varied flow: dynamic equation, characteristics of flow profiles, and methods of computation, practical problems, gradually varied flow analysis and computation.

(07 Lectures)

Module 4

Steady Rapidly varied flow: Hydraulic jump analysis and location, jump in sloping channels and oblique jump.

(06 Lectures)

Module 5

Unsteady rapidly varied flow: Monoclinal Rising wave, Dam Break Problem, Moving hudraulic jump, positive and negative surges, Hydraulic Flood Routing.

(07 Lectures)

Module 6

Fluvial hydraulics: Basic characteristics of river beds and sediments, initiation of motion, Regimes of flow, Resistance to flow in alluvial streams, Theories of Bed load, suspended load and total load. Design of stable channels: Regime and Tractive force methods. **(08 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References

- Subramanya K. "Flow in Open Channels", Tata McGraw Hill Publishing Co.1998
- . Henderson. "Open channel flow", McMillan Pub. London.1955
- Chow V.T. "Open Channel Hydraulics", McGraw Hill Inc. New York.1979
- Garde R, J. and RangaRaju K.G. "Mechanics of Sediment Transportation1980 and Alluvial Stream Problems" Wiley Eastern Limited, New Age International Limited, New Delhi, Pune.
- French R.H. "Open Channel Hydraulics," McGraw Hill Publishing Co. New York.1995

Outcomes:

Upon completion of the course the students will be able to:

- Demonstrate basic principles of the open channel flow.
- Analyze the various types of flows viz. uniform flow, gradually varied flows rapidly varied flow etc.
- Apply the knowledge of open channel hydraulics to for river engineering.
- To perform model analysis studies.

Elective V

CVWRE-E5/01 Water Power Engineering

Teaching Schemes: 3 Lect. hrs. /week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Objectives:

- To estimate the available hydropower potential
- To understand types of hydro-power stations
- To study the components and functions of hydro-power system
- To learn the types of hydro-power system
- To study the different types of loads on power plants

Course Contents

Module 1

Introduction: Sources of energy, types of power, choice of type of generation. Components of a waterpower project, types of hydro power schemes and their general layouts. Concept of power transmission. Estimation of Hydropower available – Basic water

power equation, estimation of discharge and hear available. Preliminary choice of the type of system.

(08 Lectures)

Module 2

Nature of demand: Load curves, load duration curves, load factor, plant capacity factor, plant use factor, firm and secondary power. **(06 Lectures)**

Module 3

Intakes: Types, elements of an intake, hydraulic design of various elements. Conveyance System : Power channel, pressure conduits, tunnels. General concepts of design and the economics. Tail Race: Functions, types (Channel and tunnel). Draft tubes, function and principle types.

(08 Lectures)

Module 4

Surge tank: Function, location, types such as simple, restricted orifice, differential, air cushion chamber type. Basic design criteria. Fore bay.

(06 Lectures)

Module 5

Power station: Types, elements of a power station. General criterion for the design of main dimensional of the powerhouse. Economic comparison of underground power stations with the surface power stations. Turbines: Classification, characteristics of different types, choice of type. Turbine setting and cavitations. Tidal power stations: Concepts general layout, classification, types.

(08 Lectures)

Module 6

Pumped storage plants: Concepts, general layout, types and economics. Other types of power plant :a) Depression power plant. (b) Micro Power Station – Need for the development and the problems faced.

(06 Lectures)

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References

- Mosonyi, E. – "Water Power Development" Vol. I & II
- Brown,G. Etal – "Hydro –electric engineering practice" Vol. I, II and III
- Dandekar M.M. – "Water Power Engineering Vikas Pub. House Pvt. Ltd :

Outcomes:

Upon completion of the course the students will be able to:

- Estimate the available hydropower in a project
- Select suitable types of hydro-power system for particular site conditions
- Design penstock and anchor blocks
- Analyze the different types of loads on power plants
- Design the components of Tidal power plant

Elective V

CVWRE-E5/02 Climate Change

Teaching Schemes: 3 Lect. hrs. /week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Objectives:

- To learn Atmosphere and cyclones in Indian cities.
- To learn Global climatology.
- To study the Indian climatology.
- To study the Indian rainfall in different seasons
- To understand the impacts of human activities on climate changes and change in rainfall intensities
- To study about Global and Indian Climatology and development of monsoons.

Course Contents

Module 1

Introduction Atmosphere and its constituents, Synoptic observations- surface and upper air, Tropical meteorology: Easterly Waves, ET-ITCZ, Inversion. Monsoon – Onset, Activity, Withdrawal, Breaks, Depressions, Easterly Jet Stream. Post Monsoon - Cyclones in the Indian Seas, N. E. Monsoon

(08 Lectures)

Module 2

Global Climatology - Global distribution of pressure and temperature at mean sea level in winter and summer, distribution of annual rainfall and its variability, distribution of moisture and clouds, Vertical distribution of temperature. General circulation of atmosphere, Development of monsoons, Major categories of world climates

(08 Lectures)

Module 3

Indian Climatology - Different seasons, Distribution of Means Sea level pressure/temperature in different seasons, Wind circulation and temperature distribution over India in lower, middle and upper troposphere in different seasons.

(06 Lectures)

Module 4

Indian rainfall in different seasons, Indian summer monsoon, onset, withdrawal, rainfall distribution, inter annual variability of monsoon. Main synoptic pressure systems causing weather over India in different seasons.

(06 Lectures)

Module 5

Climate Change & Variability - Overview of the climatic history of the earth. Long term changes (Climate of Past century, past millennium, past glacial period), Methods of determining past climate. Possible causes of climate change- External (Milankovitch variation and Solar activity) and Internal (natural and anthropogenic). General idea of internal dynamical processes of the atmosphere, oceanic processes, Cryospheric processes, land processes

(08 Lectures)

Module 6

Man's impact on climate, Greenhouse gases and global warming, basic radiation processes, Climate feedback mechanism, Climate predictability, future climate, potential consequences, International efforts to minimize climate change and their effects. Indian scenario

(06 Lectures)

References

- Atmosphere, Weather and Climate R.J. Barry and R.G. Chorley (Methuen Publication · South West Monsoon" by Y.P. Rao (IMD Publication)
- An Introduction to Meteorology by S. Pettersen
- Elements of meteorology by Miller, Thompson and Paterson.
- General Meteorology by H.R. Byer
- Monsoon by P.K. Das.

Outcomes:

Upon completion of the course the students will be able to:

- Understand the basics of global and Indian Climatology.
- Understood impact of human activities on climate change.

Semester- III

Project Management and Intellectual Property Rights

Teaching Schemes: Self Study; **Evaluation Scheme:** Class Assessment 50; Oral Examination 50

Course Content

Project Management

Module 1: Introduction to Project Management

Brief history of project management, Role of a Project Manager, benefits of project management, Project vs. operation, Project lifecycle: Initiating, Planning, Executing, Controlling, and Closing processes. Project Integration Management - Project plan development, Project plan execution, and Overall change control. **(06 Lectures)**

Module 2: Beginning a Project

Project Selection, Defining criteria, Project selection methods, Sacred Cow, Comparative Benefit Model (CBM), Quality functional deployment (QFD), Scope Definition, Project Charter development **(06 Lectures)**

Module 3: Risk Management

Project Risk Management Processes, Types of Risk, Risk Defined, Risk Factors, Risk Factors Risk identification, Qualitative risk analysis, Quantitative risk analysis, Risk planning, Risk control. **(06 Lectures)**

Module 4: Professional Responsibility (Ethics)

Ensuring Integrity and Professionalism, Project Management Knowledge Base, Enhancing Individual Competence, Balancing Stakeholder Interests, Interactions with Team Members and Stakeholders, Templates, Tools and Techniques. **(06 Lectures)**

Intellectual Property Rights

Module 5: Introduction to Intellectual Property Rights

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

International Scenario

International cooperation on Intellectual Property, Procedure for grants of patents, Patenting under PCT. **(06 Lectures)**

Module 6: Patent Rights

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Recent Developments in IPR

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies. **(06 Lectures)**

References

- PMBOK® Guide 5th Edition, ISBN 978-1935589679
- Managing Across Cultures: The 7 Keys to Doing Business with a Global Mindset 1st Edition, ISBN 978-0071605854
- The PMP Exam: How to Pass on Your First Try 5th Edition, ISBN 978-0982760857

- The PMP Exam: Quick Reference Guide 5th Edition, ISBN 978-0982760895
- T. Hegazy, Computer-based construction project management, Prentice Hall, New Jersey, 2002.
- S. M. Levy, Project management in construction, 5 th ed., McGraw Hill, New York, 2007.
- PMI, A guide to the project management body of knowledge, 3 rd ed., Project Management Institute, Pennsylvania, 1996.
- Prabuddha Ganguly, "Intellectual Property Rights",Tata Mc-Graw Hill.
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley "Intellectual Property in New Technological Age".

CVWREPS1 Project Stage I

Evaluation Scheme: Class Assessment 50; Oral Examination 50

Dissertation Stage I and Synopsis Approval Presentation:

It is a course requirement under the guidance of faculty Supervisor. PG student from second year is required to do innovative and research oriented applied work related to various theory and laboratory courses. Dissertation work may cover analytical formulation, experimentation or survey based project or combination of these. Student are encouraged to undertake an interdisciplinary type project.

- **Synopsis:**

It is expected from the student to carry out exhaustive literature survey with consultation of his/her Supervisor for not less than 15 reputed national, international journal and conference papers. Student should present the Synopsis Submission Presentation (SSP) with literature survey report to justify about the research gap, innovativeness, applicability, relevance and significance of the work. Student shall undertake project work after approval of synopsis.

- **Dissertation Stage I presentation:**

It is expected that student shall present preliminary results from his/her work during the semester with report as per prescribed format. If student is not showing satisfactory performance, then he/she will be given grace period of 2 weeks. After 2 weeks student will be again evaluated with grade penalty. Minimum 02 ISE presentations should be delivered by the student during semester.

Semester- IV

CVWREPS2 Project Stage II

Evaluation Scheme: Class Assessment 100; Oral Examination 100

Based on the guidelines and progress of stage II works, all the desired work should be completed and final dissertation report will be prepared and presented during examination. It is desirable that student presents/publishes the research paper in peer reviewed conference/research journals. If student is not showing satisfactory performance, then he/she will be given grace period of 4 weeks. After 4 weeks student will be again evaluated with grade penalty.