Shri Vaishnav Vidyapeeth Vishwavidyalaya

Master of Technology (Water Resources Engineering)

SEMESTER II

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE 3201	DCS	DESIGN OF STORAGE STRUCTURES	2	1	2	4	60	20	20	30	20

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
*__Teacher Assessment__ shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives: The students (A) will be able to design different Storage Structures (B) according to condition and nature of work (C) efficiently & economically (D)

Course Outcomes:

1. Explain different Storage structures and their utilization according to the work
2. Design different Storage structures like Gravity Dam, Earth Dam, etc.
3. Identify different theories which are required according to the field conditions
4. Design Spillways and Energy Dissipaters

Syllabus:

UNIT I

Introduction: Storage scheme and their components, types of structures.

Reservoir Planning and Investigation: Review of reservoir planning and investigation aspects; Reservoir sedimentation, measurement of sediment yield, trap efficiency, distribution of sediment, life of reservoir, sedimentation control

Dam: General, selection of type of dam, site selection, economic size, geological investigations; Engineering properties of foundations, foundation treatment; River diversion aspects construction of dam.

UNIT II

Earth Dam: Introduction, foundation for earth dams, causes of failure, design criteria, prevention of embankment corrosion; Seepage through dams, pheratic line; Stability of slopes, seepage control through foundations, drainage in earth dams and selection of type of earth dam; Foundation treatment and maintenance of earthen dams.

Rock Fill Dam: Definition and types; Foundation requirements and treatment; Membrane cut-off; Embankment design.

UNIT III

Gravity Dam: General, profile shape; Forces acting on gravity dam and their estimation; Earthquake forces and their effects, I.S. load combination, design concepts and criteria; Gravity method of stability analysis; Stress analysis, internal stresses; Openings in gravity dams and stress concentration around opening; Design of galleries and shafts, joints and keys in gravity dams; Design aspects of high dams.

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Shri Vaishnav Vidyapeeth Vishwavidyalaya

Master of Technology (Water Resources Engineering)

SEMESTER II

UNIT IV

Spillways: Need, functioning, capacity determination; Design of ogee spillways; Introduction to design of siphon, chute, side channel and shaft spillways; Considerations of side walls.

Gates and Valves: Types of control gates, control valve, spillway gates and their functioning, introduction to design of radial gates, introduction to design aspects of arch dam.

UNIT V

Energy Dissipating Devices: Necessity, location and types of energy dissipaters; Hydraulic jump type and bucket type dissipaters; Design of I.S. stilling basins, type I to IV; Design of solid and slotted roller buckets, Design of trajectory bucket type of dissipaters.

Text Books:

1. Concrete dams by R.S. Varshnay, Oxford & IBH Publishing Co.
2. Earth & Rock fill dams by Bharat Singh & H.D. Sharma, Sarita Prakashan Meerut.
3. Irrigation Engineering by Raghunath, Wiley India Pvt. Limited,2011

Reference Books:

1. Hand book of dam design by Golze, Van Nostrand Reinhold Co.

List of Practical's:

1. Detailed drawing of various structural systems as per the syllabus.

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Shri Vaishnav Vidyapeeth Vishwavidyalaya

Master of Technology (Water Resources Engineering)

SEMESTER II

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE3202	DCS	WATER RESOURCES SYSTEM ENGINEERING	2	1	2	4	60	20	20	30	20

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objective The students (A) will be able to design the different Water Resources System(B) according to condition and nature of work (C) efficiently & economically (D)

Course Outcomes:

1. Explain the concept and components of a water resources system.
2. Understand water resources engineering problems
3. Learn various mathematical programming techniques
4. Design and optimization of reservoir components
5. Analyze reservoir operation problems and flood control problem

Syllabus:

UNIT I

Introduction: Introduction to water resources planning; Concept of a system, terminology and definitions; Need of system analysis of water resources problems, system approach, characteristics of system analysis applications.

Water Resources Engineering Problems -Development, design, operation problems; Statistical analysis and stochastic processes; Evaluation of time streams of benefits and coasts, interest and discount rate, determination of net economic benefit, discounting technique, cost estimation procedures

UNIT II

Mathematical Programming Techniques: Review of various mathematical programming techniques viz. method of Lagrangian multipliers, linear programming, dynamic programming, integer programming, goal programming, simulation and search methods;
Introduction to the Monte Carlo method; Generation of synthetic stream flow data; Case studies

UNIT III

Reservoir Sizing: Reservoir capacity determination- mass diagram analysis, sequent peak analysis, optimization analysis; Reservoir simulation models

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Shri Vaishnav Vidyapeeth Vishwavidyalaya

Master of Technology (Water Resources Engineering)

SEMESTER II

UNIT IV

Reservoir Modelling: Reservoir operation problem; Deterministic and stochastic D.P. modelling of reservoir storage yield; Flood control problem and model synthesis; Case studies

UNIT V

Irrigation System Modelling: Model for optimal cropping pattern; Irrigation planning and operation modelling; Annual costs, annual net income and net benefits; case studies.

Text Books:

1. Planning &Analysis of Water Resources System; by Loucks, Stedinger&Haith, Prentice Hall; Englewood Cliffs, N.J., edition 1981
2. Stochastic Water Resources Technology; by N.T. Kottegoda, Palgrave Macmillan, London, edition 1980
3. Water Resources System; S Vedula and P PMujumdar; Tata McGraw-Hill Education, edition,2005

List of Practical's:

Problem solving using mathematical programming techniques

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Master of Technology (Water Resources Engineering)

SEMESTER II

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE 3203	DCS	STOCHASTIC HYDROLOGY	2	1	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
*__Teacher Assessment__ shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives: The students (A) will be able to analyses and solve problems stochastic hydrology (B) according to condition and nature of work (C) efficiently & economically (D)

Course Outcomes:

1. Explain the concept and terminologies of stochastic hydrology
2. Design and analysis of concepts of probability and probability distribution.
3. Estimation of parameters for probability distribution
4. Testing of hypothesis and analysis of various confidence intervals
5. Analysis of hydrologic time series and spectral analysis
6. Analysis of autoregressive modeling, and their limitations.

Syllabus:

UNIT I

Introduction: Definition and terminologies; Stochastic and time series models; Characteristics of annual periodic; Multi-variate and intermittent hydrologic time series.

Statistics: Samples and population; Properties of random variables; Moments and expectations for univariate distribution random variables, tendency, peakedness, moments of expectations for jointly distributed random variables.

UNIT II

Probability Distribution: Discrete probability distributions viz. binomial, Poisson, exponential distributions; Basic concepts of probability and probability distribution; Continuous probability distribution viz. normal, lognormal, extreme value type 1 and III; Pearson, log Pearson type III and Gamma distributions.

Parameter Estimation: General methods of parameter estimation; Method of moments; Maximum likelihood; Probable weighted moment method.

UNIT III

Confidence Intervals and Hypothesis Testing: Confidences interval; Mean and variance of normal distribution, one side confidence intervals; Hypothesis testing for different cases; Chi-square goodness of fit test, The Kolmogorov-Smirnov test, D-index test.

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Master of Technology (Water Resources Engineering)

SEMESTER II

UNIT IV

Time Series Modelling: Analysis of hydrologic time series; Cross correlation, serial correlation, variance and covariance, Spectral analysis; First order Markov process; Multi site Markov model.

UNIT V

Autoregressive Modelling: First and second order models for annual and for periodic time series; Description of ARMA modelling of annual and periodic time series, limitations, auto regressive integrated moving average modelling of time series; Multiplicative ARIMA modelling of periodic time series, Pre-treatment of historical data model selection and application.

Text Books:

1. Stochastic hydrology by P. Jaya Rami Reddy, Laxmi Publications; Second edition (2016)
2. Statistical methods in hydrology by C.T. Haan, Wiley & Sons, Incorporated, John

Reference Books:

1. Frequency & risk analysis by G.W. Kile
2. Frequency analysis, NIH publication

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Master of Technology (Water Resources Engineering)

SEMESTER II

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE3204	**DCS**	**IRRIGATION WATER MANAGEMENT**	2	1	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:
The students (A) will be able to identify the different techniques of irrigation water management and apply the best techniques of allocation (B) according to condition and nature of work (C) efficiently & economically (D)

Course Outcomes:

1. Scientific estimation of irrigation water requirement
2. Understand various on- farm development works and maintenance of these
3. Learn suitable methods of irrigation scheduling and methods to improve irrigation efficiency
4. Identify suitable methods of irrigation water application and drainage
5. Learn water quality considerations and advantages of conjunctive use of surface and ground water

Syllabus:

UNIT I
Introduction: Development and utilization of irrigation potential; Classification of irrigation schemes
Irrigation Requirement: Evapo-transpiration; Crop planning and Crop water requirement; Net and gross irrigation requirement; Field capacity and its determination

UNIT II
On Farm Development: Introduction to OFD works: land consolidation, water courses, field channels, field drains, land grading and field layout; Method of water measurement: current meters, weirs, Parshall flume, orifices and meter gates: Maintenance of water courses and drainage channels;

UNIT III
Irrigation Scheduling: Methods of water delivery: on demand, continuous supply, rotational delivery; Design of rotational water delivery and its advantages; Night irrigation; Improvement in irrigation efficiencies;

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Master of Technology (Water Resources Engineering)

SEMESTER II

UNIT IV

Water Application Method: Evaluation of basic variables and efficiencies in irrigation methods; Border irrigation; Check basin irrigation; Furrow irrigation; Sprinkler irrigation; Drip irrigation; Sub-Surface method.

Drainage: Introduction; Surface, sub-surface and vertical drainage;

UNIT V

Quality of Irrigation Water: Quality parameters for irrigation water; Irrigation with poor quality water;

Conjunctive use of ground and surface water: Various type of conjunctive use; Advantages; Conjunctive use planning

Text Books:

1. Irrigation Theory and Practice. by A.M. Michael, Second t edition Reprint 2010,Vikas Publishing House, NOIDA(UP)
2. Crop water requirements FAO publication No. 24

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Master of Technology (Water Resources Engineering)

SEMESTER II

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE 3205(1)	**DCS**	**REGIONAL WATER RESOURCES PLANNING AND ECONOMIC**	2	1	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives: The students (A) will be able to understand integrated water resource management (B) based on the economical condition and nature of basin (C) with consideration of supply and demand (D)

Course Outcomes:

1. Global key challenges in development of integrated water resources management.
2. Principle of planning for water resource projects
3. Concept of basin economy – Economic view of water issues in project development
4. Demand and supply of water in integrated water resources management.
5. Understand legal and regulatory framework.

Syllabus:

UNIT I

Context for IWRM: Water as a global issue: key challenges and needs; Definition of integrated water resources management (IWRM) within the broader context of development; Complexity of the IWRM process; Examining the key elements of IWRM process.

UNIT II

Water Economics: Economic view of water issues: Economic characteristics of water good and services; Nonmarket monetary valuation methods; Water economic instruments; Policy options for water conservation and sustainable use; Case studies; Pricing: distinction between values and charges; Private sector involvement in water resources management; PPP objectives, PPP options, PPP processes, PPP experiences through case studies; Links between PPP and IWRM.

UNIT III

Water Supply and Health within the IWRM Consideration: Links between water and human health: options to include water management interventions for health; Health protection and promotion in the context of IWRM; Health impact assessment of water resources development.

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Master of Technology (Water Resources Engineering)

SEMESTER II

UNIT IV

Agriculture in the Concept of IWRM: Water for food production: 'blue' versus 'green' water debate; Virtual water trade for achieving global water security; Irrigation efficiencies, irrigation methods and current water pricing.

UNIT V

Water Legal and Regulatory Settings: Basic notion of law and governance; Principles of international and national law in the area of water management; Understanding UN law on non-navigable uses of international water courses; Development of IWRM in line with legal and regulatory framework.

Text Books:

1. Czech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
2. Planning & analysis of water resources system by Loucks, Stedinger & Haith
3. Water Resources system by Vedula & Majumdar

Reference Books:

1. Water Resources Management Plan: Hagerman Fossil Beds National Monument by Idaho.
2. Designing Water Disaster Management Policies: Theory and Empirics by Chennat Gopala krishnan

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Shri Vaishnav Vidyapeeth Vishwavidyalaya

Master of Technology (Water Resources Engineering)

SEMESTER II

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE 3205(2)	DCS	ADVANCED HYDROLOGICAL MODELING	2	1	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives: Student will learn modeling strategies (A)what are the methods of regional parameterization, (B) what are the issues to be studied in using hydrological model in climate change study (C) and coupling the hydrological model with climate model(D)

Course Outcomes:

1. Understand the objective modeling in ground water.
2. Review numerical methods for stream & aquifer.
3. Learn the advanced concept of channel routing.
4. Get idea of choosing structural models and its applications

Syllabus:

UNIT I

Modelling Strategies: Objectives, choice of model, conclusions and prospects

Soil Water Modelling: Simple water balance models; Complex models; Remote sensing application on soil moisture model and forestry.

UNIT II

Ground Water Modeling: Review of numerical methods; Finite difference formulation of leaky aquifers; Aquifer interaction; Finite element application to ground water modelling.

UNIT III

Lumped Catchment Models: The catchment; Lumped models; Development of conceptual model; Institute of Hydrology model; Model selection criteria; Model fitting techniques; Application of conceptual model to hydrological forecasting.

UNIT IV

Variable Source Area Models: Concept; Studies of watershed process; Model VSAS 1 and VSAS 2 model.

Distributed Models: Nature of distributed models; Choice of model structure; Application of model

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Master of Technology (Water Resources Engineering)

SEMESTER II

UNIT V

Advanced Concepts in Channel Routing: Empirical models; Linearized models; Hydrological models viz. storage routing; Muskingham routing; Muskingham cunge; Lag and Route; Simplified hydraulic models; Finite element models; Dynamic wave model; Routing in channel networks.

Text Books:

1. Mathematical models in hydrology by Clarke, FAO publication No. 19
2. Hydrological modeling of Watersheds by C.T. Haan
3. Hydrological modeling by McCuen
4. Hydrological modeling by V.P. Singh (Vol. I & II)

Reference Books:

1. Simulation modelling and analysis (SIE) by Averill Law
2. System Modelling and Simulation by V P Singh

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Shri Vaishnav Vidyapeeth Vishwavidyalaya

Master of Technology (Water Resources Engineering)

SEMESTER II

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE 3205(3)	**DCS**	**FINITE ELEMENT APPLICATIONS IN WATER RESOURCES**	2	1	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:
To provide the fundamental concepts of the theory of the finite element method

Course Outcomes:

1. To obtain an understanding of the fundamental theory of the FEA method
2. To develop the ability to generate the governing FE equations for systems governed by partial differential equations
3. To understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements
4. To understand the application and use of the FE method for heat transfer problems.

Syllabus:

UNIT I
Introduction: Finite difference method (FDM); Finite element method (FEM); Advantages of FEM over FDM and matrix algebra.

UNIT II
Basics of FEM: Steps; Formulation of element equations; Shape functions for triangular elements; Load and strain displacements; Stress strain relations; Variational principles.

UNIT III
Weighted Residual Methods: Collocation; sub-domain; Galerkin's and least square; Applications of FEM; Dams and seepage problems; Software applications: case studies, data preparation, processing and result reporting for field problems.

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Shape Functions: Linear Elements; Element Equations; Iso-Parametric Elements; Hermite Polynomial; Jacobian Matrix; Numerical Integration; Two Dimensional; Lagrangian; Triangular and trapezoidal elements

UNIT V

Solution Techniques: Axis metric problems; Element Equations, Stiffness Matrix, Boundary Conditions; Direct and Iterative methods, band solver and frontal solution techniques.

Text Books:

1. Desai, C. S., and Abel, J.E., "Introduction to Finite Element Method", Van Nostrand Reinhold Company. 1972.
2. Hinton , E. and Owen, D.R. J., "Finite Element Programming", Academic Press. 1977
3. Norrie, D.H.; De Vries, G., "Introduction to Finite Element Analysis", Academic Press. 1978
4. Tirupathi, R. Chandrupatla and Belegundu, Ashok D. "Introduction to Finite Elements in Engineering", Pearson Education. 2002
5. Zienkiewicz, O.C., "The Finite Element Method", McGraw Hill.

Reference Books:

1. Buchanan, Finite element Analysis (schaum Outline S), TMH
2. Krishnamurthy, Finite element analysis, TMH)

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