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Master of Technology (Water Resources Engineering)

SEMESTER I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCE 2101	BS	SYSTEM MATHEMATICS & MATHEMATICAL MODELLING	60	20	20	-	-	3	1	-	4

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:

Student will be able to understand

1. What a mathematical model is and explain the series of steps involved in a mathematical modeling process.
2. Acquire basic mathematical modeling skills that will enable them carry out simple modeling tasks in transportation engineering.

Course Outcomes:

1. To understand different aspects of system analysis.
2. To understand the formulation of linear programming.
3. To acquire knowledge about network analysis and various methods.
4. To understand the fundamentals of simulation.

Syllabus:

UNIT I

Concept of a System & System Analysis, Mathematical Modeling. Introduction to Mathematical Programming Techniques viz – Non Linear Programming, Geometric Programming, Quadratic Programming, Linear Programming, Dynamic Programming, Game Theory etc.. Transportation problems, their formulations & solutions.

UNIT II

Linear Programming, formulation, Graphical solution, Simplex method, BIG-M & Two Phase methods, Duality in LP, Revised Simplex.

UNIT III

Network Analysis, CPM-PERT technique, Project Optimality Analysis, Updating, Dynamic Programming, Stage Coach Problem & its D.P. solution

UNIT IV

Measures of Central Tendency, Central Limit Theorem, Statistical Frequency distributions, Additional and Multiplication laws of Probability, Baye's Theorem, Mathematical Expectation, Binomial, Poisson, Normal 't', 'F' & Square Distributions, Tolerance limits, Confidence limits, Tests of Significance, Analysis of Variance.

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UNIT V

Linear & Non-linear Regression Analysis, Testing of Hypothesis, Acceptance Sampling, Fundamentals of Simulation, Introduction to Sensitivity Analysis, its limitations

Text Books:

1. Operation Research by Phillips & Ravindran
2. Operation Research by TAHA

Reference Books:

1. Probability, Statistics & Decision in Civil Engineering by Benjamin & Cornell Optimization by S.S. Rao

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCE 3102	DCS	DESIGN OF DIVERSION STRUCTURES	60	20	20	30	20	3	1	2	5

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 Objective

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

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Explain the different Diversion structures and their utilization according to the work.
2. Understand and employ the recommendations made in IS Code.
3. Design different Diversion structures like Weir, Barrage etc.
4. Identify the different theories which are required according to the field conditions.
5. Design the canals, Head Regulator and Cross Regulators.

Syllabus:

UNIT I

Introduction: Diversion scheme and their components, water distribution networks, components of network, Introduction to various structures provided in a distribution network.
Canals: Design of canals, Kennedy's and Lacey's theory of channel design, design of stable channels considering concepts of sediment transport, Design of Lined channels.

UNIT II

Structures on Pervious Formations: Introduction, Bligh's Creep theory, Lane's weighted creep theory, Potential flow. Theory and properties of flow net, Plotting of Flow Net , Khosla's theory of independent variables, Method of electrical analogy, Seepage force and safety against piping, Inverted Filter, Design considerations, design for surface and sub-surface flow, scour considerations, structural designing.
Hydraulic jump phenomenon, critical flow, normal and sequent depths, critical depth, forms of hydraulic jump, plotting of pre jump and post jump profiles, energy dissipation in jump formation.

UNIT III

Canal Head Works: Weirs and Barrages, Distinction, Types of Weirs, Layout of Diversion Headwork, Design of Vertical Drop Weir, Slopping Glacis Weir, Design of Head Regulator as Intake at the Headwork site, Design of Wing Walls.

UNIT IV

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Canal Regulation Structures: Necessity of functions and regulation structures like Head and Cross regulators, Canal Falls, C.D. Works, Outlets etc. Types of Falls, C.D. Works and outlets, Design of Head Regulator and Cross Regulator, Design of Sarda Type Fall. Canal Escape.

UNIT V

Cross Drainage Works: Introduction to transitions, contracting transitions, Expanding transitions, Mitra's and Chaturvedi's Approach for Design of transition, Hind's Transitions. Design of Aqueduct, Syphon Aqueduct, Super Passage, Canal Syphon, Sediment Excluder, Design of Sediment Ejector, Outlet works.

Text Books:

1. Theory & Design of Irrigation Structures Vol. II by Varshney Gupta & Gupta
2. Irrigation & Water Power Engg. By Punmia Lal.
3. Irrigation & Hydraulic Structure by S.K. Garg

Reference Books:

1. Design of Minor Irrigation & Canal structures by S. Sathyanarayana Murthy, New Age Publications
2. Engineering for Dams (Volumes I, II & III) by Creager, Justin & Hinds

List of Practical's:

1. Detailed Design and drawing of various diversion structures per the syllabus.

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			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	Th	T	P	CREDITS
MTCE 3103	DCS	MATERIAL SCIENCE AND FLUID MECHANICS	60	20	20	30	20	3	1	2	5

***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:

To gain the discrete knowledge of concrete and its technology, subject involves theoretical and practical approaches which help in exploring the different kinds of concrete & its properties, so that students can understand the nature and their significance in the field of water resources engineering.

Course Outcomes:

1. To identify the functional role of ingredients of concrete and apply this knowledge to mix design philosophy
2. To acquire and apply fundamental knowledge in the fresh and hardened properties of concrete
3. To evaluate the effect of the environment on service life performance, properties and failure modes of structural concrete and demonstrate techniques of measuring the Non Destructive Testing of concrete structure
4. To develop an awareness of the utilisation of waste materials as novel innovative materials for use in concrete

Syllabus:

UNIT I

Concrete: Cement, Manufacture, composition, hydrated cement paste, heat of hydration, test for physical properties, different types of cements, properties of aggregates.
Workability, factors affecting workability, Testing.

UNIT II

Strength of Concrete: Nature of strength, Factors affecting, Autogeneous heating, Maturity of concrete, Fatigue strength, Impact strength.
Elasticity, Shrinkage and Creep of concrete.

UNIT III

Testing Of Hardened Concrete: Destructive and non-destructive testing of concrete, Tests on composition of Hardened concrete, Accelerated testing of concrete.

UNIT IV

Mix Design: Basic consideration, factors in choice of mix proportion, Methods of mix design

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(I.S. Method, A.C.I. Method etc.).

UNIT V

Equations of motion in general orthogonal coordinate system; Dimensional analysis, Laminar Flow; Boundary layer theory – Laminar boundary layer, turbulent boundary layer; stability analysis of the boundary layer,Flow in Open Channel: Channel geometry and elements of channel section, velocity distribution, energy in open channel flow, specific energy, types of flow, Chezy's and Manning's formulae, Economical sections, Hydraulic Jump in open channel.

Text Books:

1. Concrete Technology by Neville
2. Concrete Technology by Shetty
3. Fluid Mechanics by R.K. Bansal
4. Fluid Mechanics by Modi and Seth

Reference Books:

1. Concrete Technology by Neville
2. F M White Fluid Mechanics by mcrghahills

List of Practical's:

1.To determine fineness of cement by dry sieving
2.To determine the normal consistency of a given sample of cement.
3. To determine the initial and final setting time of a given sample of cement.
4.To determine bulking of aggregate.
5.To determine specific gravity of a given sample of fine aggregate.
6.To determination of particle size distribution of coarse aggregates by sieving or screening
7. To study the determination of Coarse Aggregate
8. To determine the impact value coarse aggregates.
9.To determine the relative consistency of freshly mixed concrete by the use of Slump Test.
10. To determine the relative consistency of freshly mixed concrete by the use of Test
11. The determination of consisten a Vee-Bee consistometer
12. The test method covers determination of compressive strength of cubic concrete specimens
13. This clause deals with the procedure for determining the flexural strength of moulded concrete flexure test specimens.
14. To assess the likely concrete by using rebound hammer
15. To determine Uniform flow conditions in Open Channel.
16. Analysis of specific energy and momentum principle in Hydraulic jump.

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			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	Th	T	P	CREDITS
MTCE 3104	DCS	GROUND WATER HYDROLOGY	60	20	20	-	-	3	1	-	4

***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:

To learn basic fundamentals of groundwater flow and the hydraulics of different kinds of wells along with Conjunctive use of ground water with other fresh water sources.

Course Outcomes:

1. To understand the basic concepts, principles and application of the analysis and preliminary investigation of ground water resources.
2. Apply groundwater flow equations to confined and unconfined aquifers.
3. Ability to conduct groundwater well construction and design under various circumstances.
4. Able to decide on conjunctive water use, including ability to identify competing water demands, allot ground water usage according to yield of existing aquifer.

Syllabus:

UNIT I

Introduction to Ground Water Resources, Ground Water Investigations: Ground water Flow and Aquifer properties: Porosity, Specific Yield and its determination, Coefficient of storage, Permeability and Transmissibility, characteristics of aquifers, ground water exploration, presentation of hydrogeological data.

UNIT II

Well Hydraulics: Darcy's Law, volume, elasticity of aquifers, Differential Equations governing ground water flow, Hydrogeological boundaries, Flow from and to streams, Numerical Analysis of water levels, Drawdown, Non leaky anisotropic artisan aquifer, water table aquifer, Leaky aquifer, Boundary conditions, salt water encroachment.

UNIT III

Water Well Design and Construction: Grain size distribution curves, Artificial and Natural pack, Production wells, Screens and Castings, Production well specifications, Production well construction, Collector wells, Open wells, Computation of Discharge from wells.

UNIT IV

Ground Water Recharge and Runoff: Recharge by vertical leakage, Artificial Recharge, ground water models, ground water runoff. QUALITY OF GROUND WATER: Chemical analysis, Dissolved constituents and gases, Absorption and sulphate reduction, Physical and

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Bacterial analysis.

UNIT V

Hydrology Systems Analysis: Ground water modelling, Analytical approach, Model aquifers and Mathematical modelling, Analog models.

Development and Management of Aquifers: Ground water development problems, Ground water use, ground water rights, ground water legislation, land subsidence due to ground water withdrawal.

Text Books:

1. Ground Water by Raghunath
2. Ground Water Hydrology by Todd

Reference Books:

1. Ground Water by Walton
2. Analysis of pumping test data by ILRI publications

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			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	Th	T	P	CREDITS
MTCE 3105	DCS	RIVER ENGINEERING	60	20	20	-	-	3	1	-	4

***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:

To learn the river dynamics and its morphology, engineering and management issues and solutions.

Course Outcomes:

1. The student knows the terminology used in river engineering and understand the various physical processes in river.
2. To understand the maintenance, mechanism and operation of river.
3. Learn the mathematical analysis of river in various situations, its calibration and validation.
4. Learn the planning, management and analysis of river flood by using remote sensing and GIS.

Syllabus:

UNIT I

Sediment Transport Processes: Incipient motion of sediment particles; Regimes of flow; Resistance to flow and velocity distribution in alluvial streams; transport of bed, suspended and total load

UNIT II

River Morphology: Plan form variations and river channel pattern; Meandering and braided stream characteristics; River equilibrium, river dynamics and adjustments to stream power

River Training Techniques: Principles of stabilisation and rectification of rivers, river bank stability analysis, spur / groyne, stream bank armouring, guide banks, submerged vanes, porcupine and jack jetty systems, gabions; Bandalling, surface and bottom panels

UNIT III

Inland Navigation Channel Development: Fairway dimensions and maintenance, canalization, navigation locks and terminals

UNIT IV

River Models: Mathematical modelling - types, mathematical formulation, numerical procedures, calibration and validation; Scale modelling – types, principles of similitude and dimensional analysis, model verification, limitations

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UNIT V

Flood Management and Remote Sensing Applications: Flood control planning, flood plain zoning and other non – structural measures, use of satellite imageries and topo sheets for DEM generation for flood plain zone mapping

Text Books:

1. Blazejewski, R., Pilarczyk, K.W,.,River Training Techniques: Fundamentals, Techniques and Applications, A. A. Balkema, Rotterdam. 1995
2. Cunge, J. A.,Practical Aspects of Computational River Hydraulics, Pitman Advance Pub. Program. 1980
3. Garde, R. J. and Rangaraju, K. G., Mechanics of Sediment Transportation and Alluvial Stream Problems, New Age International (P) Ltd. Revised Reprint 3rd Edition. 2006

Reference Books:

1. Julien, Pierre, Y., River Mechanics", Cambridge University Press. 2002
2. Peterson, Margaret, S., River Engineering"; Prentice Hall. 1986 7. Shen, H. W., "Modeling of Rivers, John Wiley and Sons.

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			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	Th	T	P	CREDITS
MTCE 3106	DCS	HYDROLOGICAL ANALYSIS	60	20	20	-	-	3	1	-	4

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:
Students understand the essential components and function of the hydrologic cycle including precipitation, evaporation/evapotranspiration, overland flow and surface storage, groundwater flow and storage, and channel flow, storm water runoff and water quality.

Course Outcomes:

1. Students know basic terms used in hydrology and physics of water flow and mass.
2. To develop unit hydrographs based on stream flow data, and conduct basic unit hydrograph analysis.
3. Students understand basic concepts of hydrologic simulation modeling to evaluate potential impacts of management decisions.
4. Students will be able to assess drought situations, flood scenarios and normal flows in streams and catchments using the skills developed by this course.

Syllabus:

UNIT I
Introduction: Description of Hydrologic Cycle, Precipitation: Characteristics of precipitation in India, Measurement of precipitation, rain gauge network, collection and presentation of rainfall data, Test for consistency and continuity of data, analysis of rainfall data, average precipitation over an area, intensity-duration frequency analysis and depth-area-duration analysis, development of design storms, Probable Maximum Precipitation.

UNIT II
Abstractions from Precipitations: Evaporation and Evaporation Process, measurement, estimation and control of evaporation, Empirical formulae, Water Budget, Mass Transfer Method and Energy Budget method. Evapotranspiration: measurement and estimation of evapotranspiration. Initial Loss: Interception and depression storage, Infiltration process, measurement of infiltration, infiltration capacity, infiltration models and infiltration indices.

UNIT III
Stream flow Measurement: Stream flow measurement, stage-discharge relationship and rating curve.
Runoff: Runoff characteristics, catchment characteristics affecting the runoff, yield from a catchment, flow duration curve and flow mass curve.

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UNIT IV

Hydrograph Theory: Components of hydrograph, base flow separation, direct runoff hydrograph, Unit hydrograph theory, derivation of unit hydrograph, S-hydrograph and instantaneous unit hydrograph, Derivation of unit hydrograph for ungauged catchments, synthetic unit hydrograph and its derivation.

UNIT V

Flood Estimation: Peak discharge estimation procedures, enveloping curve, rational method, and unit hydrograph methods, Design flood, return period, flood frequency analysis, probabilistic and statistical concepts, Gumbel's method, Log Pearson Type III method and log normal method.

Flood Routing: Concepts of flow routing, hydraulic and hydrologic routing, Reservoir routing, Channel routing, Muskingum method of channel routing and flood forecasting

Text Books:

1. Engg. Hydrology by Subramanya
2. Hydrology by K.N. Mutreja
3. Hydrology by Jayrami Reddy

Reference Books:

1. Hydrology: Principles, Analysis, Design, "H.M. Raghunath", New Age International Pvt Ltd; 3rd,1 January 2015.
2. Hydrology: An Advanced Introduction to Hydrological Process and Modelling,Elsevier

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MTCE 3107	DCS	ENVIRONMENTAL IMPACT ASSESSMENT OF WATER RESOURCES PROJECTS	60	20	20	-	-	3	1	-	4

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 aim of the course is to learn the National and international theory, the practical process, terminology and methods of performing an EIA of water resources projects.

Course Outcomes:

1. To understand the necessity and importance of environmental impact assessment of various water resource project.
2. Learn the list and comply with the environmental clearance procedures in India.
3. Understand environmental impact predictions, evaluation and mitigation.
4. Review, monitor and audit EIA reports for decision-making.

Syllabus:

UNIT I
Introduction: Human concern; Need for environmental impact assessment (EIA); Requirements and levels of EIA; Potential impacts of water resource development projects

UNIT II
EIA Procedure: Screening, baseline data, scoping, terms of reference (TOR) Environmental Clearance: Guidelines, acts and legislations, codes and country practices.

UNIT III
Environmental Flow: River as habitat, downstream direct and indirect uses, criteria and methods of assessment, Soil and Water Quality Management: Effect of project development on soil and water quality, water logging, soil salinity, and contamination, remedial measures

UNIT IV
Rehabilitation: Submergence effects, rehabilitation guidelines, planning, and procedures. **Monitoring**: Parameters to be monitored, frequency of monitoring, reporting procedures

UNIT V

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Simulation Exercises and Case Studies

Text Books:

1. Govt. of India, "Environmental Impact Assessment of Development Projects", Ministry of Environment and Forests. 1989
2. Canter, L. W., "Environmental Impact Assessment", McGraw Hill. 1996
3. Govt. of India, "EIA Notification 2006", Ministry of Environment and Forest. 2006
4. Bureau of Indian Standards, "Parameters for EIA of Water resources Project", IS 5442:2004. 2004

Reference Books:

1. Charles H. Eccleston, Environmental Impact Assessment: A Guide to Best Professional Practices,CRC Press; edition (29 March 2011)
2. N. S. Raman, A. R. Gajbhiye, S. R. Khandeshwar, Environmental Impact Assessment, I K International Publishing House Pvt. Ltd (1 January 2014)

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