CENTRAL INSTITUTE OF TECHNOLOGY KOKRAJHAR

(Deemed to be University, MHRD, Govt. of India)

Civil Engineering Department

Course structure for M.Tech Programme in Water Resources and Hydraulic Engineering

Course structure

Semester I

Sl. No.	Course Code	Subject	Teaching Scheme (Hrs/week)			Credits
			L	T	P	C
1	MHS1**	Research Methodology and IPR	2	0	0	2
2	MCE102	Open Channel Flow	3	1	0	4
3	MCE103	Applied Hydrology	3	1	0	4
4	MCE104	Project Engineering and Management	2	0	0	0 (Audit)
5	MCE11**	Elective - I	3	1	0	4
6	MCE11**	Elective - II	3	1	0	4
7	MCE171	Water Resources Engineering Laboratory–I	0	0	4	2
Total			16	4	2	**20**

Elective - I Subjects		
Sl. No.	**Subject Code (MCE11**)**	**Subject**
1	MCE1101	Water resources systems analysis
2	MCE1102	Human resource Management for water resources projects
3	MCE1103	Industrial Water Pollution Control
4	MCE1104	Economic aspects of water resources development
5	MCE1105	Financing infrastructure projects

MCE11** : Any other subject offered from time to time with the approval of the competent authority.

Elective - II Subjects		
Sl. No.	**Subject Code (MCE11**)**	**Subject**
1	MCE1106	Hydropower engineering
2	MCE1107	Surface water quality modelling and control
3	MCE1108	Eco-hydraulics and hydrology
4	MCE1109	Environmental dynamics and control
5	MCE1110	Ground water hydrology

MCEW11**: Any other subject offered from time to time with the approval of the competent authority.

Course Syllabus for M. Tech Programme

Name of the Programme: **M. Tech in Water Resources and Hydraulic Engineering**

Name of the Department: **Civil Engineering Department**

Semester I

Compulsory courses

MHS1:** Research Methodology and IPR **2 Credits (2-0-0)**

MCE102: Open channel flow **4 Credits (3-1-0)**

Energy and momentum of flow; critical flow; channel control and transitions; discharge measurement methods; uniform flow and flow resistance; composite roughness and compound channels; gradually varied flow; classifications and computations of free surface profiles; spatially varied flow; supercritical flows and oblique flows; rapidly varied flow; hydraulic jump; continuity and dynamic equations of unsteady flow; wave propagation and surge; method of characteristics; dam-break problem; flow in channel bends; buoyant and submerged jets.

Course Outcomes: By the end of the course the student is expected to: (a) apply knowledge of mathematics, science, and engineering in the analysis of flow to be conveyed in channels and canals, (b) design a system, component, or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (c) identify, formulate, and solve engineering problems.

Reference / Text Book (s):

1. Flow in open channels by K. Subramanya (1982), Tata McGraw-Hill Education.
2. Open-Channel Flow by M. Hanif Chaudhry (1993), Springer.

MCE103: Applied Hydrology **4 Credits (3-1-0)**

Hydrologic Processes: System concept of watershed; components of hydrologic cycle; atmospheric circulation, water vapor, precipitation, evaporation, and evapotranspiration. *Hydrologic Analysis*: Response functions of a linear system, unit hydrograph, synthetic unit hydrograph and instantaneous unit hydrograph, flood routing and frequency analysis, droughts. *Hydrologic Statistics*: Analysis of hydrologic data, parameter estimation, commonly used distribution function in hydrology, concept of uncertainty and risk, Introduction to time series analysis and forecasting.

Hydrologic Design: Estimated Limiting Value, Hydrologic design scale and design level; Design storms – Design precipitation, IDF and DAD relationships, Design hyetograph, Estimated limiting storms and PMP; Flood plain analysis and flood control measures.

Course Outcomes: By the end of the course the student is expected to: a) apply various data processing techniques including statistical methods for analysis of hydrometeorological and climatological data; b) use various methods of estimation and analysis of rainfall data, b) use techniques to assess stream flow, c) analyse and predict extreme events, such as floods and droughts, c) use various modelling techniques for hydrological simulation and forecasting.

Reference / Text Book (s):
Applied Hydrology by Ven T Chow, David R. Maidment and Larry Mays (1988), McGraw-Hill Education.

Audit course

MCE104: Project Engineering and Management **0 Credit (2-0-0)**

Introduction: Foundations of Project Management, Project Life Cycle, The Project Environment, Project Selection, Project Proposal, Project Scope, Work Breakdown Structure. Network Scheduling, Critical Path Method, Program Evaluation & Review Technique, Planning and Scheduling of Activity Networks, Assumptions in PERT Modelling, Time-cost Trade-offs, Linear Programming and Network Flow Formulations, PERT/COST Accounting. Scheduling with limited resources, Resource Planning, Resource Allocation, Project Schedule Compression, Project Scheduling Software, Precedence Diagrams, Decision CPM, Generalized Activity Networks, GERT. Estimation of Project Costs, Earned Value Analysis, Monitoring Project Progress, Project Appraisal and Selection, Recent Trends in Project Management.

Course Outcomes: By the end of the course the student is expected to: a) recognise the constituent parts of a project life cycle and the relevant parties involved; b) demonstrate understanding of the importance project demand and client responsibility in project success;
c) be able to analyse basic project cost and time information and produce simple estimates and plans; d) develop competence in applying application software, such as Primavera or Microsoft Project, for efficient project management.

Reference / Text Book (s):
1. Projects: Planning, Analysis, Selection, Implementation & Review, Prasanna Chandra, 5th Ed., 2002.
2. Project Management: A systems approach to planning and controlling, Harold Kerzner, CBS Publisher, New Delhi, 2nd Ed., 2000.

Semester I

Elective-I courses

MCE1101: Water Resources Systems Analysis **4 Credits (3-1-0)**

The nature of water resources systems: Systems analysis - the jargon used. Methods of systems analysis. Linear programming models - concept of simplex tableau, its working principles - the two phases of simplex method - revised simplex method - duality, decomposition principle - post optimality analysis. Transportation problem. Non-linear programming of simple cases. Dynamic programming - multi stage decision process - computational procedure in Dynamic programming - basic concepts of probability -

Stochastic linear and Dynamic programming - application of systems analysis to water resources systems in particular.

Course Outcomes: By the end of the course the student is expected to: a) understand the fundamentals of economic theory as applied to water resources, b) be familiar with optimization and simulation modelling, c) be able to design and solve optimization models of water systems.

Reference / Text Book (s):

1. Water resources systems analysis by Mohammad Karamouz and Ven Te Chow (2003), CRC press.

MCE1102:

Human resources management for water resource projects **4 Credits (3-1-0)**

Introduction to Human Resource Management

The focus of the first unit is on identifying what the personnel and human resource function is all about. It explores the typical responsibilities of HR departments and how they are affected by the corporate culture, environmental forces, and government regulations. It also introduces the topics of strategic and employment planning.

Staffing

Once the organization has determined its strategic and human resource objectives and analyzes the jobs to be filled, it is ready to fill them. This unit reviews the two steps in the staffing process: recruitment and selection. Recruitment aims at identifying and attracting the largest possible number of qualified applicants to hire for each job.

Compensation & Benefits

This unit focuses on compensation and related issues. Among the topics to be covered are forms of and bases for compensation, job evaluation and compensation/evaluation systems.

Performance Management

This unit discusses and examines performance evaluation as a system including process and procedures used in developing reliable and valid standards, criteria, and evaluation mechanisms. A good performance management system is fair to the employee while also serving the goals and interests of the organization.

Human Resource Development

Employee training and development is another important HR function. More specifically, this unit focuses on deciding who is to be trained, in what and how they are to be trained, and how effective was the training for the employee and her/his organizational component. To be effective, training and development programs must be matched to types of employees with specific skill deficiencies and to new skills anticipated to be needed by the organization.

Global Human Resource Management & Future Issues

Declining productivity, substantial demographic shifts, changing employee attitudes and expectations, innovation technologies, and government regulations will continue to affect human resource management into the 21st century. This final unit deals with the most

significant trends in human resource management and how they can be addressed through innovative and effective organizational strategies.

Case studies involving water resources engineering projects.

Course Outcomes: By the end of the course the student is expected to: a) gain understanding of an office setup in respect of employees either in the private or in the government sector: b) develop, implement, and evaluate employee orientation, training, and development programs. c) facilitate and support effective employee and labour relations in both non-union and union environments, d) research and support the development and communication of the organization's total compensation plan; and e) succeed as a team leader or an office manager in any organization involving water resources development.

Reference / Text Book (s):

1. A Handbook of Human Resource Management Practice by Michael Armstrong (2017), Kogan Page Publishers.
2. Human Resource Management by Gary Dessler (1997), Prentice Hall.

MCE1103: Industrial Water Pollution Control **4 Credits (3-1-0)**

Introduction of pollutants: characteristics and classification of water pollutants.

Liquid Waste Management: Industrial Waste Water (in terms of Quality & Quantities), Environmental aspect of Dyes & Pigment, Drug Industry, Glass & Ceramics, Rubber, Polymer, Leather and tannery, Nuclear Power Plant, Energy Industries etc. Special Waste Water (Toxic & Nuclear Power plant). Effluent Treatment processes and plants.

Course Outcomes: By the end of the course the student is expected to: a) recognise the complex nature of environmental pollutants released by different industries, b) assess the impacts of industrial pollutants, c) identify and design processes for controlling water pollution caused by industrial effluents, d) provide decision support for environmental protection from industrial pollutants.

Reference / Text Book (s):

1. Industrial Water Pollution Control by W. Eckenfelder Jr., McGraw-Hill, 1966.
2. Environmental Engineering and Water Resources, McGraw-Hill, 1999.

MCE1104: Economic Aspects of Water Resources Development **4 Credits (3-1-0)**

Economics of water and development, Basic economic concepts, Financial analysis of a project, Pricing concepts, Benefit-cost-sensitivity analysis, Capital budgeting and cost allocation, Economics of natural resources management, Hydro economic model, Hydro-economic risk assessment, Economics of river restoration, Economics of trans-boundary water resources management.

Course Outcomes: By the end of the course the student is expected to: a) analyse policy and planning frameworks for water resources management; b) identify and critically review

the conflicting interests to be considered in making water resource management decisions; c) design approaches to reconcile competing interests in water; d) analyse and make provision for sustainability limits; e) evaluate requirements for the resource consenting process and apply in practice.

Reference / Text Book (s):

1. Economics of Water Resource Planning by L. Douglas James and Robert R. Lee. McGraw-Hill Book Company, 1971.

MCE1105: Financing Infrastructure Projects **4 Credits (3-1-0)**

Investment decisions in infrastructural projects: benefit cost analysis, measurement problems, examples from past projects, indirect estimation methods of benefits. Cost of capital: private and public money, different schools of thought on social capital- cases. Multiple projects and constraints: linear and integer programming models, goal programming formulation. Financing infrastructure projects: venture capital, sources of capital–private and public participation, modes of cooperation such as BOOT and BOT national and international sources, international agencies, borrowing terms and conditionalities. Public policy issues, leasing and mortgaging, evaluation issues, infrastructural mutual funds, valuation aspects. Risk coverage, risk evaluation and containment of public projects. Real options, value of option for delay, abandonment and vacant land – judgmental assessment of options. post review and administrative issues in project management, international (cross country) projects, implementation issues.

Course Outcomes: By the end of the course the student is expected to: a) demonstrate a systematic understanding of how to use project finance methods to fund and value water resources and other large-scale projects; b) assess how to mitigate specific risks and provide incentives in infrastructure projects, including optimal restructuring of projects in distress; c) demonstrate a critical ability to analyse and structure project risks.

Reference / Text Book (s):

1. Financing Infrastructure Projects by Cyrus Njiru and Tony Merna. Thomastelford, 2002.

Semester I

Elective-II courses

MCE1106: Hydropower Engineering **4 Credits (3-1-0)**

Hydropower development schemes and their various configurations; Planning for firm Capacities, Peak Load and Base Load configurations; role of Hydropower development in a mixed power systems; Governing of Hydropower systems; Study of hydraulic transients in Penstocks. Surge analysis and dynamics of Surge tanks; design of hydropower installation components - intake structures; water conductor systems tunnels; surge-tanks; penstocks; valves and anchor-blocks; types of powerhouse - underground and semi-underground; turbines and their foundations; introduction to structural and geotechnical aspects of powerhouse design - CAD applications; similitude and models; Mini and Micro hydro power developments.

Course Outcomes: By the end of the course the student is expected to: a) discover principles of operation and design of storage, run-of-the-river and pumped storage types of hydropower projects, b) learn about specific types of turbines and installation of the necessary accessories for a specific location; b) develop competence in preparing Due-diligence Report, Pre-feasibility study report, Feasibility Report, Detail Project Report, etc.; c) undertake detailed design and engineering of hydropower projects, d) develop understanding of electric power systems and competence to assess hydropower potential of projects, determine optimal installed capacity, recommend suitable number, type and size of generating units, and e) estimate quantum of annual energy generation, load factor, firm power, secondary power, etc.

Reference / Text Book (s):

1. Water power development by Mosonyi, Emil (1991), Akademia Budapest.
2. Hydro Power – The Design, Use and Function of Hydromechanical, Hydraulic, and Electrical Equipment by Prof. Dr.-Ing. J. Raabe. VDI-Verlag GmbH, 1985.
3. Guidelines for preparation of Detailed Project Reports of Irrigation and Multipurpose Projects. Working Group Report. Government of India, Ministry of Irrigation, 1980.
4. Micro Hydroelectric Power Stations by L. Monition, M. LE NIR and J. Roux, Translated by J. McMullan. John Wiley & Sons, 1981.
5. Micro-Hydro Design Manual – A Guide to Small-Scale Water Power schemes by A. Harvey with a. Brown, P. Hettiarachi and A. Inversin. ITDG Publishing, 2002.
6. Relevant publications and Guidelines of Central Electricity Authority, Central Water Commission and Central Board of Irrigation and Power, Government of India.
7. Guide on How to Develop a Small Hydropower Plant, Part 1 and 2. by European Small Hydropower Association (ESHA), 2004.

MCE1107: Surface water quality modelling and control **4 Credits (3-1-0)**

River hydrology and derivation of Stream Equation, Derivation of Estaury equation, Distribution of water quality in rivers and estuaries. Physical and Chemical characteristics of Lakes, Finite Difference steady state river, estaury and Lake models., Dissolved Oxygen models in rivers, estuaries and Lakes, Fate of Indicator Bacteria and pathogens in water bodies. Basic Mechanism of Eutrophication, Lake Phytoplankton models, eutrophication in rivers and estuaries. Elements of Toxic substance analysis.

Course Outcomes: By the end of the course the student is expected to: a) understand the idea, methodology and basic tools of water quality modelling; b) understand the different modelling approaches, their scope and limitations; c) understand the fate and transport of pollutants in different water bodies.

Reference / Text Book (s):

1. Principles of Surface Water Quality Modelling and Control by Robert V. Thomann, John A. Mueller (1987), Harper & Row.

MCE1108: Eco-hydraulics and hydrology **4 Credits (3-1-0)**

Classification of Hydro environmental systems, governing equations for open surface flow domains, pollutant transport equations in hydro-environmental flow systems, computational

methods and solution techniques. Study of ecological descriptors, numerical ecology, multi-objective definitions of environmental flows, Hydrologic indices for e-flows and river health assessment. Riverine habitat characterization and habitat simulation models. Anthropogenic triggers for changes in riverine habitat.

Course Outcomes: By the end of the course the student is expected to: a) get advanced knowledge of impacts of encroachments on river systems; b) have knowledge on the most recent methods for impact analysis and mitigation using Eco hydrological and Eco hydraulic tools; c) know the most common modelling tools that is applied within the field and how they are applied.

Reference / Text Book (s):

1. 'Eco hydraulics: An Integrated Approach' By Ian Maddock, Atle Harby, Paul Kemp, Paul J. Woo (2013), Willey.
2. 'Environmental hydrology & hydraulics' By S.N. Ghosh and V.R. Desai; Science Publishers (2006), Enfield, NH, USA.

MCE1109: Environmental dynamics and Control **4 Credits (3-1-0)**

Environmental property and processes, Environmental simulation models, Elements of environmental impact analysis, Impact assessment methodologies, Framework of environmental assessment, Environmental impact of water resources projects, Assessment of hydrological hazards, Environmental management, Case studies.

Course Outcomes: By the end of the course the student is expected to: a) recognise the complex structure of environmental systems and apply qualitative modelling techniques to describe and analyse the influence and feedback structures within these systems; b) Comprehend fundamental dynamic systems theory concepts (phase-line and phase-space representations, null clines, equilibria and stability analysis) and apply them to analyse 1- and 2-D dynamic systems.

Reference / Text Book (s):

1. Adaptive Management: From Theory to Practice by James Oglethorpe. IUCN-The World Conservation Union, 2002.
2. Modelling Environmental Dynamics: Advances in Geomatic Solutions edited by Martin Paegelow, María Teresa Camacho Olmedo. Springer, 2008.

MCE1110: Ground water hydrology **4 Credits (3-1-0)**

Occurrence and movement of groundwater including subsurface investigations of groundwater. Flow through saturated and unsaturated media. Well Hydraulics and aquifer parameters. Pumping wells and their design, construction, monitoring and rehabilitation of wells. Recharge of groundwater by various means. Salt water intrusion and coastal aquifer hydraulics. Analog and numerical models and application of Finite Difference method to groundwater, case studies.

Course Outcomes: By the end of the course the student is expected to: a) learn basics of flow through porous media, groundwater flow and well hydraulics; b) understand contaminant transport, salt water intrusion phenomena in groundwater hydraulics; c) gain knowledge about remediation and restoration techniques for better aquifer management.

Reference / Text Book (s):

1. Ground Water Hydrology by David Keith Todd (1959), Wiley.