M.E. INTEGRATED WATER RESOURCES MANAGEMENT

OBJECTIVES
1. To prepare the students for a successful career as water professionals.
2. To develop the ability among students to synthesis data and technical concepts for application in Integrated Water Resources Management.
3. To provide students an opportunity to work as a part of an interdisciplinary team.
4. To provide students with a sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for their career.
5. To promote student awareness for the life-long learning and to introduce them professional ethics and codes of professional practice in water resources management.

OUTCOME
1. An ability to choose and use Research methodologies, Integrated Water Resources Management and gender relations and roles, legal aspects as it applies to the field of Water Resources Management.
2. An ability to design and construct hardware and software water resource system components or processes to meet desired needs within realistic constraints such as environmental, socio-economical, water governance, political, ethical, health and safety, and sustainability.
3. An understanding of professional, institutional arrangements, legal and ethical issues, and responsibilities as it pertain to water resource management.
4. An ability to use the techniques, skills, and modern modeling software tools necessary for water resource planning and management.
5. The broad education necessary to understand the impact of water and water related issues in a global, economic, environmental, and societal context.
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OBJECTIVES:
- To make the students understand the various process of the hydrological cycle and its practical applications.
- To make the students get the basic concepts of groundwater and its movement, which will help them to make an assessment of this resource.

UNIT I  HYDROLOGICAL CYCLE AND PRECIPITATION  9
Hydrological cycle, Hydrological budget – Hydro meteorological observation - Precipitation, Types and Forms - Measurement - Processing of precipitation data

UNIT II  HYDROLOGICAL PROCESSES OF ABSTRACTION  9
Water losses – Initial abstraction – interception and Depression storage - Evaporation, Evapotranspiration and infiltration – Field Measurement – Estimation by empirical formulae

UNIT III  RUNOFF PROCESS  9
Runoff – components of runoff – Factors affecting Runoff - Hydrograph, hydrograph separation, Unit hydrograph, Instantaneous unit hydrograph, Synthetic unit hydrograph, rainfall-runoff models – SCS method – Yield Estimation

UNIT IV  GROUNDWATER  9
Origin of groundwater, Rock properties affecting groundwater, Types of aquifer, Darcy’s law, coefficient of permeability, groundwater flow rates, permeability formulae, laboratory and field measurement of permeability, Groundwater movement

UNIT V  WELL HYDRAULICS  9
General flow equation, Steady and unsteady flow, well flow near aquifer boundaries, partially penetrating wells, characteristics of well losses, specific capacity – Safe yield - Ground Water Assessment.

OUTCOME:
- The students obtain the complete knowledge on hydrologic cycle and hydro meteorological measurements
- The students know the various methods of field measurements and estimation of precipitation, abstraction and runoff process which they apply to carryout the assessment of water balance and runoff potential
- The students apply their knowledge on ground water, well hydraulics to estimate the safe yield and ground water potential

REFERENCES

OBJECTIVES:
- To enable the understanding which seeks to improve gender relations and roles how they affect and are affected by water.
- To improve the understanding and awareness of gender concepts through an easy reference to existing materials and tools.
UNIT I INTRODUCTION
Basic Concepts of Sociology - Definition - Gender – Social Perspectives - Historical Framework - Gender and Early Sociological Thought – Social Stratification and Roles - Power and authority - Equity and Equality - Gender Empowerment

UNIT II GENDER IN DEVELOPMENT SECTORS
Gender Issues in Agriculture and Irrigation - Gender and Allied and Other Agricultural Activities - Gender in Coastal Region: Salt Production - Gender and Health

UNIT III GENDER AND INTEGRATED WATER RESOURCES MANAGEMENT
Gender Approach to Water Management - Drinking and Domestic Water - Sanitation and Hygiene – Gender and Food Security - Indicators for Development - Gender Policies in Water Management - Country Experiences

UNIT IV GENDER COMPETENCY ISSUES

UNIT V GENDER IN GLOBAL SCENARIO

TOTAL: 45 PERIODS

OUTCOMES:
- By taking this course the students can have better insight into the interpersonal relationship in society; analyze the contemporary status of gender in all walks of their life.
- The course offers better anchorage of ideas, knowledge and practice in the respective field.

REFERENCES

IM8154 INTEGRATED WATER RESOURCES MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:
- Students will be introduced to the role of disciplines of ecology and socio-economics play in management of water resources.
- They will be exposed to global food security and public-private participation issues and legal and regulatory settings, in the context of IWRM

UNIT I CONTEXT FOR IWRM
Water as a global issue: key challenges and needs – Definition of 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 – Non-market 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.

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.

TOTAL: 45 PERIODS

OUTCOMES:
- There will be a paradigm shift in attitude of the students towards interdisciplinary research.
- The students will gain knowledge about economic aspects of water.
- They will gain a broad understanding of the complexities of dealing with water resources problems.

REFERENCES

IM8155  WATER AND ECOSYSTEMS

OBJECTIVE:
- To introduce the principles of natural ecosystems, the social dimensions and approaches to water, the benefits to the society and the need for conservation of aquatic ecosystems.
UNIT I  ECOLOGICAL PRINCIPLES
Levels of organization - Concept of Ecosystems – Ecosystem structure and function – Ecosystem development - Freshwater ecosystems – Agro ecosystems.

UNIT II  AQUATIC ECOSYSTEMS

UNIT III  ECOSYSTEM SERVICES

UNIT IV  ACCESS AND EQUITY

UNIT V  ECOSYSTEM MANAGEMENT
Ecosystem assessments – Environmental flows – Future freshwater challenges - Eco tourism -- Social and political issues of water use - Sustainable Ecosystems - Environmental governance.

OUTCOME:
- Students will understand development pressures on distribution, ecological relations and the emerging social and economical dimensions of water resources today.

REFERENCES
2. Caroline M Figueres, Cecilia Tortajada and Johan Rockstrom (ed), Rethinking Water Management, EarthScan, VA, USA, 2005.

MA8161  STATISTICAL METHODS FOR ENGINEERS

OBJECTIVES:
- To study and understand the concepts of Statistical methods and its applications in Engineering.
- To study the effect of estimation theory, testing of hypothesis, correlation and regression, randomized design, and multivariate analysis.

UNIT I  ESTIMATION THEORY

UNIT II  TESTING OF HYPOTHESIS
Tests based on Normal, t, X² and F distributions for testing of means, variance and proportions – Analysis of r x c tables – Goodness of fit.
UNIT III  CORRELATION AND REGRESSION  9+3
Multiple and Partial Correlation – Method of Least Squares – Plane of Regression – Properties of
Residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple
correlation with total and partial correlations – Regression and Partial correlations in terms of lower
order co-efficient.

UNIT IV  DESIGN OF EXPERIMENTS  9+3
Analysis of variance – One-way and two-way classifications – Completely randomized design –
Randomized block design – Latin square design.

UNIT V  MULTIVARIATE ANALYSIS  9+3
Random vectors and Matrices – Mean vectors and Covariance matrices – Multivariate Normal
density and its properties – Principal components: Population principal components – Principal
components from standardized variables.

OUTCOME:
• On completion of this course the students will be able to solve various problems in the field of
  engineering employing probability and statistical methods.

REFERENCES:
  Thomson and Duxbury, Singapore, 2002
  McGraw-Hill, 2000

IW8161  WATER QUALITY LABORATORY  L T P C
OBJECTIVE:
• To expose students in field and laboratory methods in water quality.

LIST OF EXPERIMENTS
1. Demo of water quality kit
2. Field estimations
3. Water sample collection and transport
4. Introduction to analytical laboratory
5. Hydrochemical methods
6. Selection of suitable methods
7. Measurement of turbidity, solids, pH and EC
8. Measurement of major ions
9. Measurement of minor ions / nutrients
10. Demo of BOD and COD estimations
11. Calculation of SAR, Hardness, Alkalinity
12. Evaluation of water quality for irrigation purposes

OUTCOME:
• Students will able to estimate water quality using current methods and make evaluation of it
  for beneficial uses.

TOTAL: 30 PERIODS
OBJECTIVE:
- To teach the principles and applications of remote sensing, GPS and GIS in the context of water resources. At the end of the course, the student will appreciate the importance of remote sensing and GIS in solving the spatial problems in water resources.

UNIT I REMOTE SENSING
Physics of remote sensing, electromagnetic radiation (EMR), Interaction of EMR with atmosphere, earth surface, soil, water and vegetation; Remote sensing platforms – Monitoring atmosphere, land and water resources - LANDSAT, SPOT, ERS, IKONOS and others, Indian Space Programme.

UNIT II DIGITAL IMAGE PROCESSING

UNIT III GEOGRAPHIC INFORMATION SYSTEM

UNIT IV SPATIAL ANALYSIS

UNIT V WATER RESOURCES APPLICATIONS

TOTAL : 45 PERIODS

OUTCOMES:
- Introduce the technology and principles of Satellite Imaging
- Theoretical explanations on Image processing and information extraction from Satellite Data Products
- Functional elucidation of GIS integrating Satellite Data Products into the GIS platform for Decision making
- Potential of remote sensing and GIS is solving problems in water resources through case studies.

REFERENCES:
5. Centre for Water Resources, Post-Project Evaluation of Irrigation Commands

HW8254 SYSTEMS ANALYSIS IN WATER RESOURCES L T P C
3 0 0 3

OBJECTIVE:
- Students will be introduced to application of systems concept to water resources planning and management. Optimization technique for modeling water resources systems and advanced optimization techniques to cover the socio-technical aspects will be taught.

UNIT I SYSTEM CONCEPTS 7
Definition, classification, and characteristics of systems - Scope and steps in systems engineering - Need for systems approach to water resources and irrigation.

UNIT II LINEAR PROGRAMMING 9
Introduction to operations research - Linear programming, problem formulation, graphical solution, solution by simplex method - Sensitivity analysis, application to design and operation of reservoir, single and multipurpose development plans - Case studies.

UNIT III DYNAMIC PROGRAMMING 9
Bellman's optimality criteria, problem formulation and solutions - Application to design and operation of reservoirs, Single and multipurpose reservoir development plans - Case studies.

UNIT IV SIMULATION 9
Basic principles and concepts - Random variant and random process - Monte Carlo techniques - Model development - Inputs and outputs - Single and multipurpose reservoir simulation models - Case studies.

UNIT V ADVANCED OPTIMIZATION TECHNIQUES 11
Integer and parametric linear programming - Goal programming models with applications Discrete differential dynamic programming and incremental dynamic programming - Linear decision rule models with application - Stochastic dynamic programming models.

TOTAL: 45 PERIODS

OUTCOME:
- At the completion of the course the students will be able to understand the system behaviors and know how to apply the various simulation and optimization techniques to resolves the various socio-technical aspects of water resources systems.

REFERENCES:
OBJECTIVES:
- Understanding the climate system, being aware of the impact of climate change on society,
- Understanding of adaptation in relation to water and climate change.
- At the end of the course, students must be in a position to describe the possible impacts, adaptations and remedies in relation to water resources and climate change.

UNIT I THE CLIMATE SYSTEM
Definitions- Climate, Climate system, climate change – Drivers of Climate change – Characteristics of climate system components - Green house effect – Carbon cycle – Wind systems - Trade Winds and the Hadley Cell – Ozone hole in the stratosphere - El Nino, La Nina – ENSO, Teleconnections

UNIT II IMPACTS OF CLIMATE CHANGE – OBSERVED AND PROJECTED
Global Scenario – Indian Scenario – Observed changes and projected changes of IPCC - Impacts on water resources – NATCOM Report –Impacts on sectoral vulnerabilities – SRES – Different scenarios

UNIT III TOOLS FOR VULNERABILITY ASSESSMENT
Need for vulnerability assessment – Steps for assessment – Approaches for assessment – Models – Quantitative models, Economic model, Impact matrix approach - Box models - Zero-dimensional models - Radioactive-convective models - Higher-dimension models - EMICs (Earth-system models of intermediate complexity) - GCMs (global climate models or general circulation models) – Sectoral models

UNIT IV ADAPTATION AND MITIGATION
Water-related adaptation to climate change in the fields of Ecosystems and biodiversity, - Agriculture and food security, land use and forestry, Human health, water supply and sanitation, infrastructure and Economy (insurance, tourism, industry and transportation) - Adaptation, vulnerability and sustainable development Sector-specific mitigation - Carbon dioxide capture and storage (CCS), Bio-energy crops, Biomass electricity, Hydropower, Geothermal energy, Energy use in buildings, Land-use change and management, Cropland management, Afforestation and Reforestation - Potential water resource conflicts between adaptation and mitigation - Implications for policy and sustainable development.

UNIT V CASE STUDIES
Water resources assessment case studies – Ganga Damodar Project, Himalayan glacier studies, Ganga valley project - Adaptation strategies in Assessment of water resources- Hydrological design practices and dam safety- Operation policies for water resources projects - Flood management strategies - Drought management strategies - Temporal & spatial assessment of water for Irrigation -Land use & cropping pattern - Coastal zone management strategies.

TOTAL: 45 PERIODS

OUTCOME:
- To orient towards the global climate change and its impact on water resources.
- To understand the climate change phenomenon and its related issues on water, irrigation and its social implications.

REFERENCES:
2. UNFCC Technologies for Adaptation to climate change, 2006.
OBJECTIVE:

- To teach interdisciplinary field research skills and enable the students to conduct field research within IWRM outlook.

UNIT I  RESEARCH  10

UNIT II  PARTICIPATORY AND FIELD RESEARCH  7+3
Types of Participation - Participatory meaning - Importance of Peoples Knowledge - Emergence of Participatory Research - Participatory Research Approaches in Science and Technology- Participatory Research and Development- Field Practice

UNIT III  TECHNIQUES IN FIELD RESEARCH  9+4
Primary data collection- Qualitative and Quantitative - Survey – Observation - Semi Structured Interview - Questionnaire Schedule and Field Trials – Analysis and Evaluation - Field Practice

UNIT IV  METHODS OF FIELD RESEARCH  10+4
Research Methods: Rapid Rural Appraisal (RRA), Participatory Rural Appraisal (PRA), Participatory Learning and Action (PLA) – Diagramming and Mapping - Field Observation and Field Trials – Analysis and Evaluating Participatory Research and Development: Some Key Elements - Field Practice

UNIT V  PARTICIPATORY TOOLS  9+4
Situation Query Problem and Response (SPQR) – Statistical Analysis- Exercises in the use of concepts and methods – Methodology - Field Practice

THEORY  45
TUTORIAL  15
TOTAL  60

OUTCOMES:

- The students would be put to observe the environment, capture the local knowledge and incorporate it to the main stream research.
- This subject matter could help students to enhance their knowledge both theoretical and practical with a comprehensive outlook for research.

REFERENCES
OBJECTIVE:
- The hands on experiments in the image processing, GIS platforms and GPS will make the students appreciate their importance in hydrology and water resource.

LIST OF EXPERIMENTS
- Georeferencing of toposheet and creating vector layers(MapInfo/ArcGIS)
- Creation of attribute tables and layout preparation (MapInfo/ArcGIS)
- Creation of Digital Elevation Model using Vertical Mapper.
- GPS Survey and its data transformation into GIS environment.
- Transformation of Google files to GIS environment.
- Creation of Voronoi / Theissan diagram for points using MapInfo/ArcGIS.
- Use of D8 pointer algorithm for deriving flow direction, flow accumulation and watershed delineation.
- Interpolation of point data to create Spatial Maps.
- Overlay Analysis using ArcGIS.

OUTCOMES:
- Expertise in digital image processing
- Good exposure to the Global positioning system in real time data processing
- Potential of Geographical Information System
- Data integration between Satellite data, GPS and GIS in Decision Making

TOTAL: 60 PERIODS

OBJECTIVES:
- To learn the basics of water law, in a context of historical development and evolving recognition of issues related to human and ecological needs of water.
- To understand how the policies, laws and judicial approaches tackle the recent water issues.
- To help formulate recommendations/responses that could resolve/avoid disputes.
- To emphasize water as a finite common property resource that must be used in public interest.

UNIT I  HISTORICAL BACKGROUND AND CURRENT CHALLENGES

UNIT II  WATER LEGISLATION IN INDIA AND TAMIL NADU
UNIT III  WATER GOVERNANCE: POLICIES AND LEGAL FRAMEWORKS


UNIT IV  WATER CONFLICTS IN INDIA


UNIT V  TRANSBOUNDARY WATER ISSUES


TOTAL: 45 PERIODS

OUTCOMES:

- Knowledge in legal perspective of Water Resources Management would be strengthened.
- Critical analysis of water conflicts is made possible, which could reveal the gaps that need to be filled up.

REFERENCES

OBJECTIVES:

- To provide the technical, economical and sociological understanding of a watershed.
- To provide a comprehensive discourse on the engineering practices of watershed management for realizing the higher benefits of watershed management.

UNIT I WATERSHED CONCEPTS

UNIT II SOIL CONSERVATION MEASURES

UNIT III WATER HARVESTING AND CONSERVATION

UNIT IV WATERSHED MANAGEMENT

UNIT V GIS FOR WATERSHED MANAGEMENT
Applications of Remote Sensing and Geographical Information System - Role of Decision Support System – Conceptual Models and Case Studies

TOTAL: 45 PERIODS

OUTCOME:

- The students will be able to apply the knowledge of overall concepts of watershed which would help to comprehend and analyze for better management.

REFERENCES

OBJECTIVES:

- Students will be able to indicate and relate the factors influencing water supply, sanitation and health.
- Explain water related diseases and show their relationships with water resources management.
- Suggest integrated water management initiatives that could be implemented to achieve better sanitation and health in a region.

UNIT I  FUNDAMENTALS WASH
Meanings and Definition: Safe Water- Health, Nexus: Water- Sanitation - Health and Hygiene - Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH - Third World Scenario - Poor and Multidimensional Deprivation.

UNIT II  MANAGERIAL IMPLICATIONS AND IMPACT

UNIT III  MANAGEMENT AND DEVELOPMENT

UNIT IV  GOVERNANCE AND PARTICIPATORY IDEOLOGY
National Economy and Production - Investments on Water, (WASH) - Cost Benefit Analysis - Institutional Intervention-Public Private Partnership - Policy Directives - Social Insurance -Political Will vs Participatory Governance

UNIT V  INITIATIVES
Management vs Development -Accelerating Development- Development Indicators -Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH.

TOTAL: 45 PERIODS

OUTCOMES:

- This course would offer a better understanding of the perspectives; people and governance to upscale the downtrodden and to mainstream the unprivileged.
- With the knowledge of WASH, students can acquire knowledge of both national and international scenarios and explore avenues to streamline the equitable axis ownership of natural resource.

REFERENCES
OBJECTIVES:
- These courses introduce water quality concepts, its evaluation for irrigation purposes, besides relevant environmental problems and recycle and reuse concepts.
- At the end of the course, the students will understand the importance of water quality for irrigation and major uses of water and the role environmental issues.

UNIT I WATER QUALITY
Physical and chemical properties of water – Suspended and dissolved solids – EC and pH – major ions –. Water quality investigation – Sampling design - Samplers and automatic samplers - Data collection platforms – Field kits – Water quality data storage, analysis and inference – Software packages

UNIT II IRRIGATION WATER QUALITY
Water quality for irrigation – Salinity and permeability problem – Root zone salinity - Irrigation practices for poor quality water – Saline water irrigation – Future strategies

UNIT III WATER POLLUTION

UNIT IV RECYCLING AND REUSE OF WATER
Multiple uses of water – Reuse of water in agriculture – Low cost waste water treatment technologies - Economic and social dimensions - Packaged treatment units – Reverse osmosis and desalination in water reclamation.

UNIT V WATER QUALITY MANAGEMENT

TOTAL: 45 PERIODS

OUTCOMES:
- Students could relate water quality and its dependence on sources of water pollution.
- Students would understand and interpret water quality data for beneficial uses and in water quality models.

REFERENCES:

OBJECTIVES:
- To make the students be aware of the mass, moment and wave energy transformations, Wave kinematics and wave loads that are happening in nature and enable them in the prediction and analysis of sediment distribution along coastal areas, shore protection and hazard management.

OBJECTIVES:
- These courses introduce wave hydrodynamics concepts, its evaluation for coastal engineering purposes, besides relevant environmental problems and recycle and reuse concepts.
- At the end of the course, the students will understand the importance of wave hydrodynamics for shoreline protection and major uses of water and the role environmental issues.

UNIT VI WAVE HYDRODYNAMICS
Wave kinematics and wave loads that are happening in nature and enable them in the prediction and analysis of sediment distribution along coastal areas, shore protection and hazard management.
UNIT I  CONSERVATION OF MASS, MOMENT AND ENERGY  

UNIT II  CLASSIFICATION OF OCEAN WAVES  
Linear wave theory : Governing Equation, Boundary Conditions and solutions, Dispersion relation, Constancy of wave period.

UNIT III  WAVE KINEMATICS  

UNIT IV  WAVE TRANSFORMATIONS  

UNIT V  WAVE LOADS  

TOTAL: 45 PERIODS

OUTCOME:
- Students become aware of wave energy transformations, wave kinematics and enable them in the prediction / analysis of sediment distribution along coastal areas, shore protection and hazard management.

REFERENCES:

CM8251  COASTAL ENGINEERING  
L T P C  3 0 0 3

OBJECTIVE:
- The main purpose of coastal engineering is to protect harbors and improve navigation. The students to the diverse topics as wave mechanics, wave climate, shoreline protection methods and laboratory investigations using model studies.
UNIT I  INTRODUCTION TO COASTAL ENGINEERING  9
Indian Scenario – Classification of Harbours. Introduction - wind and waves – Sea and Swell - Introduction to small amplitude wave theory – use of wave tables- Mechanics of water waves – Linear (Airy) wave theory, Introduction to Tsunami

UNIT II  WAVE PROPERTIES AND ANALYSIS  9
Behaviour of waves in shallow waters, Introduction to non-linear waves and their properties – Waves in shallow waters – Wave Refraction, Diffraction and Shoaling –Hindcast wave generation models, wave shoaling; wave refraction; wave breaking; wave diffraction random and 3D waves- Short term wave analysis – wave spectra and its utilities - Long term wave analysis- Statistics analysis of grouped wave data.

UNIT III  COASTAL SEDIMENT TRANSPORT  9
Dynamic beach profile; cross-shore transport; along shore transport (Littoral transport), sediment movement

UNIT IV  COASTAL DEFENSE  9
Field measurement; models, groins, sea walls, offshore breakwaters, artificial nourishment - planning of coast protection works - Design of shore defense structures –Case studies.

UNIT V  MODELING IN COASTAL ENGINEERING  9
Physical modeling in Coastal Engineering – Limitations and advantages – Role of physical modeling in coastal engineering – Numerical modeling – Modeling aspects – limitations – Case studies using public domain models, Tsunami mitigation measures

TOTAL: 45 PERIODS

OUTCOME:
• Students will understand coastal engineering aspects of harbors methods to improve navigation, shoreline protection and other laboratory investigations using model studies and to use the skills and techniques in ICM.

REFERENCES:
6. Kamphuis, J.W., Introduction to Coastal Engineering and Management

HW8071  FLOOD MODELLING AND DROUGHT ASSESSMENT  L T P C
3 0 0 3

OBJECTIVE:
• This subject aims at making the students to understand the hydrologic extremes of floods and droughts, estimation of severity and extent of damages and the mitigation measures to combat them.

UNIT I  FLOOD ESTIMATION  9
UNIT II  FLOOD MODELLING AND MANAGEMENT 9
Hydrologic and Hydraulic Routing – Reservoir and Channel Routing - Flood Inundation Modelling –
HEC HMS and HEC RAS software - Flood control methods – Structural and non structural
measures - Flood Plain Zoning – Flood forecasting – Flood Mitigation - Remote Sensing and GIS
for Flood modelling and management.

UNIT III  DROUGHT AND IMPACTS 9
Definition – Definitions based on rainfall, stream flow, vegetation and comprehensive aspects -
Characterisation of Drought/water shortage/aridity/desertification - Types of Drought – NCA
classification – Impacts of Drought – Environmental, Social and Economical aspects

UNIT IV  DROUGHT ASSESSMENT 9
Drought Severity Assessment – Meteorological Hydrological and Agricultural methods – Drought
Indices – GIS based Drought Information system – Drought Vulnerability Assessment and
Mapping Using GIS.

UNIT V  DROUGHT MONITORING AND MANAGEMENT 9
DPAP Programme - Drought Monitoring – Application of Remote sensing – Drought Mitigation –
Proactive and Reactive Approach – Supply and Demand Oriented Measures – Long term and
Short term Measures – Water Scarcity Management in Urban, Industrial and Agricultural sectors
TOTAL: 45 PERIODS

OUTCOMES:

• Students know the different methods of design flood estimation and perform channel reservoir
  routing. They carryout flood inundation modeling and suggest suitable flood control measures.
• Student acquires the knowledge about different types of drought and their impacts. They
  asses the severity, duration and frequency of drought using drought using drought indices.
• Students exposed to various approaches, measures and case studies of drought indices.

REFERENCES:
   University, USA, 1977.
4. Rangapathy V., Karmegam M., and Sakthivadivel R., Monograph in Flood Routing
   Methods as Applied to Indian Rivers, Anna University Publications

HW8073 RIVER ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

• To understand theoretical concepts of water and sediment movements in rivers
• To inculcate the benefits of fluvial system to the society

UNIT I  RIVER FUNCTIONS 8
Primary function of a river – River uses and measures – Water and Sediment loads of river –
Rivers in India, Himalaya and Peninsular.

UNIT II  RIVER HYDRAULICS 10
Physical Properties and Equations – Steady flow in rivers – uniform and non uniform – Turbulence
and velocity profiles – resistance coefficients – Boundary conditions and back waters – Transitions
waves – kinematic and diffusion analogy – velocity of propagation of flood waves – Flood wave –
Maximum
UNIT III  RIVER MECHANICS  9

UNIT IV  RIVER SURVEYS AND MODEL  9

UNIT V  RIVER MANAGEMENT  9
River training works and river regulation works – Flood plain management – waves and tides in Estuaries - Interlinking of rivers – River Stabilization

TOTAL: 45 PERIODS

OUTCOMES:
• The students will be able to appreciate the complex behavior of rivers.
• They will gain the skills to take up research activities in river engineering.

REFERENCES:

HW8074  URBAN WATER RESOURCES MANAGEMENT  L T P C
3 0 0 3

OBJECTIVES:
• To introduce the concepts of urbanization and its impact on the natural water cycle
• The student is exposed to the use the urban storm water models for better storm water management.
• Students also exposed for the preparation of urban storm water master plan and different types of operation and maintenance.

UNIT I  URBAN HYDROLOGIC CYCLE  9

UNIT II  URBAN WATER RESOURCES MANAGEMENT MODELS  9
Types of models – Physically based – conceptual or unit hydrograph based – Urban surface runoff models – Management models for flow rate and volume control rate – Quality models.

UNIT III  URBAN STORM WATER MANAGEMENT  9

UNIT IV  MASTER PLANS  9
Planning and organizational aspects – Inter dependency of planning and implementation of goals and measures – Socio – economics financial aspects – Potential costs and benefit measures – Measures of urban drainage and flood control benefits – Effective urban water user organizations.
UNIT V  OPERATION AND MAINTENANCE  9
General approaches to operations and maintenance – Complexity of operations and need for diagnostic analysis – Operation and maintenance in urban water system – Maintenance Management System – Inventories and conditions assessment – Social awareness and involvement.

OUTCOME:
• At the completion of the course the student should be able to apply appropriate management techniques for planning, operating and maintaining the different components of urban and drainage system.

REFERENCES:

HW8075  WATER SUPPLY AND BURIED PIPELINES  L T P C
3 0 0 3

OBJECTIVE:
• To educate the students in detailed design concepts related to water transmission mains, water distribution system and buried pipes with emphasis on computer application

UNIT I  WATER SUPPLY SYSTEMS  9

UNIT II  HYDRAULIC PRINCIPLES AND NETWORK PARAMETERS  10

UNIT III  STORM WATER DISTRIBUTION AND BURIED PIPES  9

UNIT IV  RELIABILITY ASSESSMENT AND DESIGN  8
Uncertainty and reliability – affecting events- assessment – reliability parameters- configurations. Design methodology - strengthening and expansion

UNIT V  FLUID TRANSIENTS  9
Basic equations of unsteady flows through closed conduits. Method of characteristics. Transients caused by centrifugal pumps and hydroelectric power plants.

TOTAL: 45 PERIODS

OUTCOMES:
• The students will be able to get a basic knowledge of the design of pipe networks.
• They will be able to analyze pipe network problems using computer software like EPANET2.0
REFERENCES:
1. Bhave P. R, Optimal design of water distribution networks, Narosa publishing House, New Delhi, 2003
3. Manual on water supply and treatment, CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1999

HW8076 WATER POWER AND DAM ENGINEERING L T P C 3 0 0 3

OBJECTIVES:
- The student is exposed to the design aspects of hydro-power plants, various components of hydropower plants and their layout.
- Different types of dams design taking into account the suitability of the site and the different type loads that are likely to be encountered.

UNIT I HYDROELECTRIC POWER DEVELOPMENT 9

UNIT II DESIGN OF HYDROPOWER INSTALLATION 9

UNIT III TYPES OF POWER HOUSE 8

UNIT IV EMBANKMENT DAM ENGINEERING 9

UNIT V CONCRETE DAM ENGINEERING 10

TOTAL: 45 PERIODS

OUTCOME:
- The students will be able to get a basic knowledge of planning and designing hydropower plants.

REFERENCES:
OBJECTIVE:
- To develop skills of the students in software usage for simulation and water resources management. To enable the students to understand application of the latest information technology to water resources engineering

UNIT I  ADVANCED COMPUTING TECHNIQUES  10

UNIT II  ARTIFICIAL INTELLIGENCE  10

UNIT III  DIGITAL DATA MANAGEMENT  10
Data base structure - Data acquisition - Data warehouse - Data retrieval-Data format Attribute - RDBMS - Data analysis - Network data sharing - Statistical Analysis (SYSTAT) - Regression - factor analysis - histogram - scatter diagram - Goodness of fit.

UNIT IV  SIMULATION SOFTWARE IN WATER RESOURCES  8
Surface water models (HMS) - Storm Water Management Models (SWMM) –culvert hydraulic design(HY) – River Analysis system models (HEC-RAS)-Ground Water Flow models – Groundwater transport models.

UNIT V  SIMULATION MODELS IN IRRIGATION WATER MANAGEMENT  7
Soil water assessment simulation models (SWAT) - Basin simulation models (MITSIM, VASIM) - Real time operation models - Water Resources Information System, Management Information System. Decision support system for Irrigation management.

TOTAL: 45 PERIODS

OUTCOMES:
- Students can able to enhance the computational knowledge in the field of water resources systems.
- Students could themselves develop the simulation models and use the latest intelligent technology and algorithms.

REFERENCES:
OBJECTIVE:
- To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment in water resources development.

UNIT I  ENVIRONMENTAL ISSUES  7
Water resources development and environmental issues – Environment in water resources project planning – Environmental regulations and requirements – The EIA (Environmental Impact Assessment) notification.

UNIT II  EIA FUNDAMENTALS  8
Environmental Impact Assessment (EIA) – EIA in Project Cycle – Legal and Regulatory aspects in India according to Ministry of Environment and Forests – Types and limitations of EIA – Cross sectoral issues and terms of reference in EIA – Participation of Public and Non-Governmental Organizations in environmental decision making.

UNIT III  ENVIRONMENTAL IMPACTS  10

UNIT IV  METHODS OF EIA  10

UNIT V  ENVIRONMENTAL MANAGEMENT PLAN  10
In-stream ecological water requirements - Public participation in environmental decision making – Sustainable water resources development – Ecorestoration – Hydrology and global climate change – Human ecology – Ecosystem services – Environmental monitoring programs.

TOTAL: 45 PERIODS

OUTCOMES:
- The student will appreciate the importance of environment in water resources development and understand current methods of environmental assessment.
- Students will become aware of future challenges facing water resources management.

REFERENCES
OBJECTIVE:
- To expose the students to the need and importance of the rehabilitation and modernization of irrigation systems and to train them in the related concepts and methods.

UNIT I  IRRIGATION SYSTEMS  9
Historical evolution of irrigation systems in India; its importance to agricultural production. Irrigation system classification – Nature of system modernization and rehabilitation. Distinction between rehabilitation and modernization; Rehabilitation and modernization objectives – Theory and Practice.

UNIT II  SYSTEM MAINTENANCE  9

UNIT III  DIAGNOSTIC ANALYSIS OF IRRIGATION SYSTEMS  9

UNIT IV  REHABILITATION  9

UNIT V  CASE STUDIES  9

TOTAL: 45 PERIODS

OUTCOMES:
- The students will be familiar in understanding the different types of maintenance problems with respect to technical and social aspects, its occurrence and to overcome these problems by rehabilitation and modernisation methods.
- The students will get an overall exposure to different types of irrigation system maintenance issues and to solve them for improving their performance based on service oriented approach.

REFERENCES:
OBJECTIVES:

- To expose the students the various principles of irrigation methods
- To inculcate the different types of irrigation systems and their performance based on service oriented approach.

UNIT I  IRRIGATION DEVELOPMENT IN INDIA
Importance of Irrigation in Agriculture - Historical evolution of irrigation in India – Irrigation development during pre-colonisation – Colonisation and post-colonization – Different types of Irrigation prevalent in India: Warabandi, Shejpali and South Indian systems - Focus of Irrigation in India – Command area development approach and farmers’ participation.

UNIT II  IRRIGATION SYSTEMS AND PERFORMANCE INDICATORS

UNIT III  MAIN SYSTEM MANAGEMENT
Main system components – Reservoir allocation rule, Operating rule and optimization methods to improve main system performance - irrigation scheduling – Constraints.

UNIT IV  COMMAND AREA DEVELOPMENT AND PARTICIPATORY IRRIGATION MANAGEMENT
Command area development principles – Participatory Irrigation Management and Irrigation management transfer – Case studies – Constraints.

UNIT V  IRRIGATION POLICY AND INSTITUTIONS

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to understand an irrigation system, its components,its performance, and management of irrigation complexities to tackle different issues.
- The students will acquire knowledge about the need for participatory approach and irrigation management transfer along with irrigation policy and institutional aspects.

REFERENCES:


OBJECTIVES:

- Students will be exposed to ground water, hydraulics of ground water related to drainage, drainage concepts, planning, design and management of drainage related work.
- They will learn about the latest developments in ground water applications to drainage on the basis of a clear understanding of the principles of drainage engineering.
UNIT I  GROUND WATER COMPONENT AND MOVEMENT  8
Occurrence of Ground water – Utilization – Ground water component in hydrologic cycle –
Geological formations – Types of aquifers and their characteristics – Ground water movement –
Darcy’s Law – Flow through layered soils – Stream Lines and Equipotential Lines – Boundary
Conditions.

UNIT II  GROUND WATER HYDRAULICS  10
Steady and unsteady flow of ground water– Ground water recharge – Dupuit-Forchheimer
assumptions - Subsurface flow into drains – Steady and unsteady state drainage equations –
Seepage from river into aquifers – Seepage from open channels.

UNIT III  DRAINAGE PRINCIPLES AND CRITERIA  9
Factors to be considered in land drainage – Combined irrigation and drainage systems - Water
balance – Equations for water balance – Drainage surveys – Agricultural drainage criteria – Effect
of field drainage systems on agriculture.

UNIT IV  SALINITY CONTROL  9
Salinity in relation to irrigation and drainage – Soil Salinity and Sodicity- Salt balance of the root
zone – Salinisation due to capillary rise - Leaching process – Long term salinity level – Sodium
Hazard of Irrigation Water – Reclamation of salt affected soils – Bio drainage – Environmental
aspects of drainage.

UNIT V  DESIGN AND MANAGEMENT OF DRAINAGE SYSTEMS  9
Drainage materials – Surface drainage systems, their components and applications in sloping
areas – Subsurface drainage systems – Mole drainage - Tube well irrigation - Drainage application
and design – Management and maintenance of drainage systems.

TOTAL: 45 PERIODS

OUTCOMES:
• This course impacts knowledge about the need for irrigation drainage system and its design.
• In addition it enabled to manage the salinity problems and leaching process.

REFERENCES:
Reclamation and Improvement, Netherlands. 1979.
of Land Reclamation and Improvement, Netherlands. 1994.

IW8351  IRRIGATION ECONOMICS  LT PC
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OBJECTIVES:
• To provide an overall exposure on the use of economic concepts in irrigation development.
• To impart knowledge on economic planning so as to enable viable allocation of resources in
the irrigation sector.

UNIT I  SCOPE OF ECONOMICS  8
Scope of irrigation economics – Role of irrigation in economic development – Performance of
agriculture in Indian economy: pre independent, post independent and post liberalisation scenario.

UNIT II  CONSUMPTION ECONOMICS  9
Concept of demand and supply – Tools of economic analysis – Price determination – Demand and
UNIT III PRODUCTION ECONOMICS
Production economics – Conventional approach – Non-conventional approach – Cobb Douglas, Spillman and other types of production functions – Data analysis for production function estimation - Cost, revenue, production and profit maximization approach.

UNIT IV FARM ECONOMICS
Concept of farm management – Farm records and budgeting – Whole farm and partial budgeting – Risk and uncertainty in farming – Case studies.

UNIT V FINANCIAL ANALYSIS
Role of financial analysis – Central and State financing – Economic instruments: water charges, cess, taxes, subsidies and compensation - Irrigation water pricing - Concept and methods of irrigation water pricing - Discounting factors and techniques – Applications of discounting techniques for irrigation project viability.

TOTAL: 45 PERIODS

OUTCOMES:
• The students will understand the economic concepts useful for overall irrigation development based on the current trends of production, consumption and farm economics.
• The students will acquaint themselves in the allocation of resources and financial analysis in the irrigation sector.

REFERENCES: