DEPARTMENT OF CIVIL ENGINEERING

COURSE STRUCTURE AND SYLLABUS
(1ST – 4TH SEMESTER)

FOR

M. TECH PROGRAMME

SPECIALISATION

IN

WATER RESOURCES ENGINEERING

(EFFECTIVE FROM YEAR 2016-17)
### First (Autumn) Semester:

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### Fourth (Project) Semester:

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**Grand Total = 96**
Electives in Group – A
1. Neuro-Fuzzy Applications in Civil Engineering
2. River Engineering
3. Groundwater Hydraulics
4. Land & Water Management
5. Environmental Evaluation of Water Resources Development Projects
6. Hydrometry, Water Acts and Water Services

Electives in Group – B
1. GIS Applications in Water Resources Engineering
2. Computational Hydrodynamics
3. Groundwater Quality, Pollution and Control
4. Sediment Transport
5. Water Power Engineering
6. Urban Drainage and Sewerage System
ADVANCED FLUID MECHANICS

Instruction (Hours / Week) Lectures 4-0-0

Course Objectives:

1. To acquire knowledge of fluid mechanics and apply the Mass, Momentum and Energy Conservation Principles for Fluid Flow
2. To learn the concept of boundary layer and apply to the real life hydraulic structures
3. To understand the N-S equations and to apply it to both laminar and turbulent boundary layers
4. To learn the process of Design of an Experiment, Dimensional Analysis and Dispersion of Pollutants in a Fluid Medium

COURSE CONTENT

Module I


Module II

Module III

Module IV
Design and Testing of Models: Design of an Experiment, Dimensional Analysis, Complete Set of Dimensionless Parameters, Dimensional Analysis, Scale effect, Distorted Models, Practical Significance of Key Modeling Parameters, Design of Models and Model Tests.
Diffusion: Equations of Fluid Dynamics for a Mixture of Fluids, Dispersion of Pollutants in a Fluid Medium, Coefficient of Mass Transfer.

References:

Course Outcomes
CO1: ability to apply the Mass, Momentum and Energy Conservation Principles for Fluid Flow
CO2: ability to apply the knowledge acquired regarding the boundary layer and apply to the real life hydraulic structures
CO3: ability to know the concept of boundary layer theory and apply to the real life hydraulic structures
CO4: ability to Design an Experiment, perform Dimensional Analysis and apply the knowledge of Dispersion of Pollutants in a Fluid Medium in real life.
ENGINEERING HYDROLOGY AND HYDROLOGIC SYSTEMS  
(CE/WRE/ )

Instructions (Hours / Week) Lectures 4-0-0

Course Objectives

1. To understand the concept of hydrologic cycle and to quantify evaporation and infiltration processes
2. To understand the concept of unit hydrograph and to review various rational and conceptual rainfall-runoff models
3. To be able to analyse hydrologic time series
4. To be able to perform real time flood forecasting

COURSE CONTENT

Module I

Module II

Module III
Hydrologic Time Series Analysis: Independent and Autocorrelated Data, Structure of a Hydrologic Time Series, Trend, Jump and Seasonality, Stationarity and Ergodicity, Autocovariance and Auto Correlation Function, Correlogram Analysis, Spectral Analysis,

**Module IV**
Hydrologic Flood Routing: Reservoir Routing, Channel Routing, Estimation of Parameters of Flood Routing Models, Flood estimation and flood frequency studies, Real Time Flood Forecasting.

**References:**


**Course Outcomes**

CO1: ability to know the concept of hydrologic cycle and to quantify evaporation and infiltration processes

CO2: ability to know the concept of unit hydrograph and to review various rational and conceptual rainfall-runoff models

CO3: ability to analyse hydrologic time series

CO4: ability to perform real time flood forecasting
COMPUTATIONAL AND STATISTICAL METHODS
(CE/WRE/ )

Instructions (Hours/Week) Lectures 4-0-0

Course Objectives

1. To get knowledge of ordinary and partial differential equations and finite difference methods
2. To understand concept of finite element method and its application
3. To be able to apply basic concept of probability and about probability distribution functions in Water resources engineering problems
4. To be able to apply simple and multiple linear regression analysis and correlation analysis in Water resources engineering problems

COURSE CONTENT

Module I

Module II


Module III

Probability Distributions – Discrete and Continuous Probability Distribution Functions – Binomial, Poisson, Normal, Lognormal, Exponential, Gamma Distributions, Extreme Value Distributions – Transformations to Normal Distributions, Selecting A Probability Distribution,

Module IV
Regression Analysis – Simple Linear Regression, Evaluation of Regression – Confidence Intervals and Tests of Hypotheses – Multiple Linear Regression – Correlation and Regression Analysis

References:


Course Outcomes

CO1: Ability to know about ordinary and partial differential equations and finite difference methods

CO2: Ability to know about basic concept of finite element method and its application

CO3: Ability to know about basic concept of probability and about probability distribution functions

CO4: Ability to know about simple and multiple linear regression analysis and correlation analysis

NEURO FUZZY APPLICATIONS IN CIVIL ENGINEERING

(CE / WRE/ )

Instructions (Hours/Week) Lectures 4-0-0

Course Objectives

1. To learn the basic concept of neural network models and fuzzy logic based models
2. To develop different types of neural network models
3. To apply fuzzy reasoning and fuzzy inference to solve Civil Engineering problems
4. To apply knowledge of neuro-fuzzy computing in hydrologic modelling

**COURSE CONTENT**

**Module I**
Introduction: Basic concepts of Neural Networks and Fuzzy Logic, Differences between conventional computing and Neuro-Fuzzy computing, Characteristics of Neuro-Fuzzy computing
Fuzzy Set Theory: Basic definitions and terminology and membership functions – Formulation and parameters, basic operations of fuzzy sets – complement, intersection vision, T-norm and T-conorm

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

**Module III**
Neuro - Fuzzy Modelling: Neuro-Fuzzy inference systems, Neuro-Fuzzy control

**Module IV**

**References:**

Course Outcomes

CO1: Ability to know basic concept of neural network models and fuzzy logic based models
CO2: Ability to develop different types of neural network models
CO3: Ability to apply fuzzy reasoning and fuzzy inference to solve Civil Engineering problems
CO4: Ability to apply neuro-fuzzy computing in hydrologic modelling

RIVER ENGINEERING

(CE/WRE/       )

Instructions (Hours/Week) Lectures 4-0-0

Course Objectives

1. To get knowledge of fluvial geomorphology
2. To understand concept of analysis of river flow hydraulics
3. To be able to analyse hydraulic geometry and to design stable alluvial channels
4. To be able to do fluvial design for river bank protection

COURSE CONTENT

Module-I

Fluvial Geomorphology: Fluvial system, variables for alluvial rivers, regime concept, river classifications, thresholds of river morphology, hydraulic geometry, meander platform, geomorphic analysis of river channel responses.

Module-II
Foundation of Fluvial Process: Hydraulics of flow in river channel, physical properties of sediments, scour criteria and scour-related problems, alluvial bed forms and flow resistance, sediment movements in Rivers, flow in curved channels

Module-III

Regime Rivers and Responses: Analytical basis for hydraulic geometry, design of stable alluvial channel, analytical river morphology, plan geometry and processes of river meanders

Module-IV

Modelling of river channel changes: Mathematical model for erodioble channels, gradual breach morphology tidal responses of river and delta system, fluvial design of river bank protection

References:


Course Outcomes

CO1: Ability to know about fluvial geomorphology
CO2: Ability to analyse river flow hydraulics
CO3: Ability to analyse hydraulic geometry and to design stable alluvial channels
CO4: Ability to have fluvial design for river bank protection

GROUNDWATER HYDRAULICS

(CE/WRE/ )

Instructions (Hours/Week) Lectures 4-0-0

Course Objectives

1. To get concept of various surface and subsurface geophysical methods for groundwater explorations
2. To know about well hydraulics
3. To know about design principles of well
4. To understand concept for groundwater management and modelling
COURSE CONTENT

Module I

Module II

Module III
Water Well Design and Well Drilling: Well Screen, Development and Completion of Well, Rotary Drilling and Rotary Percussion Drilling, maintenance of Wells.

Module IV

References:
Course Outcomes

CO1: Ability to know about various surface and subsurface geophysical methods for groundwater explorations

CO2: Ability to know about well hydraulics

CO3: Ability to know about design principles of well

CO4: Ability to know about groundwater management and modelling

LAND & WATER MANAGEMENT
(CE/WRE)

Instructions (Hours/Week) Lectures 4-0-0

Course Objectives

1. To get knowledge of planning of irrigation projects
2. To understand concept of different methods for estimation of evapotranspiration and about irrigation scheduling
3. To know about watershed management
4. To know about irrigation management

COURSE CONTENT

Module I
Irrigation Development in India – Planning of Irrigation Projects, Command Area Development Programmes

Module II

Module III

Module IV

Reference:


Course Outcomes

CO1: Ability to know about planning of irrigation projects

CO2: Ability to know about different methods for estimation of evapotranspiration and about irrigation scheduling

CO3: Ability to know about watershed management

CO4: Ability to know about irrigation management

ENVIRONMENTAL EVALUATION OF WATER RESOURCES DEVELOPMENT

(CE/WRE/     )
Instructions (Hours/Week) Lectures 4-0-0

Course Objectives

1. To know about different methods of environmental impact assessment and water quality impact assessment
2. To know about environmental issues in water resources development

COURSE CONTENT

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

Module II

Module III
Environmental Indicators – Indicators of r climate- Indicators for tereestrial subsystems – Indectors for aquatic subsystems – Selection of indicators – Socio-economic indicators- Basic information – Indicators for economy – Social indicators – Indicators for health and nutrition – Cultural indicators – Loss of economic options – Selection of indicators

Module IV


References:


Course Outcomes

CO1: Ability to know about the methods of Environmental Impact Assessment and Ecological diversity, its importance and conservation

CO2: Ability to know about Environmental issues in water resource development and Water Quality Impact Assessment

HYDROMETRY, WATER ACTS AND WATER SERVICES

(CE/ WRE / )

Course Objectives

1. To have knowledge of real time data acquisition and transmission system
2. To understand concept of procedure for water allocation and pricing

COURSE CONTENT

MODULE – I

Real time Data Acquisition and transmission system. Data Bank and Instant Hydro-meteorological Data Query System for River Basins, Use of Acoustic Doppler Current Profiler ( 
ADCP), Accoustic Doppler velocimeter, Flow Tracker for discharge measurement, Digital flow measuring devices for pipe flow.

**MODULE – II**

Land acquisition, RR, Right to fair compensation and transparency in land acquisition, Rehabilitation and resettlement act. Critical Issues in Land Acquisition in LA and RR.

**MODULE – III**


**MODULE – IV**

Procedure for Water Allocation to Industrial / Commercial and other establishments (in different states). Pricing and recovery procedure for Industrial / Commercial and other establishments. Odisha Irrigation acts and rules. Lift Irrigation, Broad conceptual planning of a Mega Lift Scheme, Distribution network planning and design.

**Reference Books:**


**Course Outcomes**

CO1: Ability to know about the Real time Data Acquisition and transmission system

CO2: Ability to know about the Critical Issues in Land Acquisition in LA and RR.

CO3: Ability to know about the Procedure for Water Allocation and Pricing; and recovery procedure.

**HYDRAULIC AND HYDROLOGIC ENGINEERING LABORATORY**

(CE/WRE/ )

**Instructions (Hours/Week) Lectures 0-0-4**

**Course Objectives**
1. To plot velocity distribution and visualise boundary shear in rough and smooth channels
2. To develop correlation between rainfall and runoff phenomenon

**List of Experiments**

1. Measurement of velocity profile in straight and meandering open channel;
2. Experiments on velocity distribution and Boundary shear in rough and smooth channels,
3. Discharge measurement by weir;
4. Measurement of Shear stress from velocity distribution obtained from Acoustics Doppler Veloci-meter (ADV).
5. Measurement of rainfall, evaporation, infiltration, laboratory and field tests.
6. Characteristics of Hydraulic Jump in horizontal and Sloping Channels
7. Determination of Manning’s N for Composite Sections
8. Velocity Distribution in Open Channels
9. Performance Characteristics of Centrifugal pumps
10. Measurement of Soil Water Tension and Determination of Soil moisture Potential
11. Rainfall – Runoff Studies
12. Determination of Infiltration Characteristics

**Course Outcomes**

CO1: Ability to know about velocity distribution and Boundary shear in rough and smooth channels

CO2: Ability to know about Rainfall – Runoff correlations and its role in flood prediction

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**OPEN CHANNEL HYDRAULICS**

(CE/WRE/ )

**Instruction (Hours/Week) Lectures 4-0-0**

**Course Objectives:**

- To develop an understanding of continuity, momentum and energy equations to uniform and non-uniform open channel flows
- To learn to apply conservation laws to gradually varied and rapidly varied unsteady flows
To analyse hydraulics of mobile bed channel

COURSE CONTENT

Module I

Module II

Module III

Module IV
Introduction to Bridge Hydraulics: Water ways, Afflux, Scour: Local scour, abutment scour, Indian practice of design for scour.

References:


Course Outcomes:
CO1: Ability to apply continuity, momentum and energy equations to uniform and non-uniform open channel flows  
CO2: Ability to apply conservation laws to gradually varied and rapidly varied unsteady flows  
CO3: Ability to analyse hydraulics of mobile bed channel  
CO4: Ability to know about bridge hydraulics

**DESIGN OF HYDRAULIC STRUCTURES**  
*(CE/WRE/ )*

**Instructions (Hours / Week) Lectures 4 – 0 – 0**

**Course Objectives:**

- To develop an understanding of stability analysis of concrete gravity dams  
- To know the methods to perform stability analysis of earth and rock-fill dams and to know about measures for their slopes protection  
- To know about design principles of various types hydraulic structures e.g., spillways etc.  
- To know about working principles of different components of diversion head works and canal regulators

**COURSE CONTENT**

**Module I**  

**Module II**  
Spillway : Types, Design principles of Ogee spillway, side channel spillway, Chute spillway, Syphon Spillway, shaft Spillway, Gates & Valves. Energy dissipators and stilling basin design. Outlet works.

**Module III**  
Earth and rock fill Dams : subsurface explorations methods, cutoff trenches, sheet piling cutoffs, upstream blankets, horizontal drainage blankets and filters, toe drains and drainage trenches, pressure relief well. Seepage through embankments, Stability analysis of slopes of homogeneous and zoned embankment type under different reservoir conditions, Upstream and downstream slope protection measures.
Module IV

Diversion Headworks: Components, Weir, Design of impervious floor, Khosla’s theory
Canal Regulations works: Canal Fall, its type and design methods, Canal outlets

References:


Course Outcomes:

CO1: Ability to perform stability analysis of concrete gravity dams
CO2: Ability to perform stability analysis of earth and rock-fill dams and to know about measures for their slopes protection
CO3: Ability to know about design principles of various types hydraulic structures e.g., spillways etc.
CO4: Ability to know about working principles of different components of diversion head works and canal regulators

WATER RESOURCES SYSTEMS PLANNING & MANAGEMENT
(CE/WRE/ )

Instructions (Hours/Week) Lectures 4-0-0

Course Objectives:

- To develop an understanding of systems analysis and apply to problems in Water Resources Engineering
- To learn how to apply various methods of water resources economics to problems in Water Resources Engineering
- To know about surface and sub-surface water quality management
- To learn the legal aspects of water and environment systems
COURSE CONTENT

Module I

Module II

Module III

Module IV

References:


Course Outcomes:

CO1: Ability to know about general principles of systems analysis and apply to problems in Water Resources Engineering
CO2: Ability to apply various methods of water resources economics to various problems in Water Resources Engineering
CO3: Ability to know about surface and sub-surface water quality management
CO4: Ability to know about legal aspects of water and environment systems

GIS APPLICATIONS IN WATER RESOURCES ENGINEERING

(CR/WRE/ )

Instructions (Hours/Week) Lectures 4-0-0

Course Objectives:

- To develop an understanding of remote sensing and GIS applications in water resources and environmental systems
- To learn the rainfall-runoff modeling using remote sensing and GIS
- To know about watershed development and management using remote sensing and GIS
- To use remote sensing data and GIS maps for problems related to environmental issues

COURSE CONTENT

Module-I

Module-II
Flood and Drought Studies – Flood plain zoning – inundated areas – evaluation models –
Drought assessment and Monitoring.Command Area Studies – Cropping patterns, conditions of
crops, irrigation system performance – crop yield estimation.

**Module-III**
GIS, Hydrology and Resources Management – Watershed development, management options,

**Module-IV**
Reservoir Sedimentation – Erosion and Deposition – Catchment Area Treatment – Estimation of
Sediment Load – Use of Models

**References:**

   Introduction to the use of Geographic Information Systems for Practical Hydrology, ITC
   John Wiley and Sons, N York.

**Course Outcomes:**

CO1: Ability to know about scope of remote sensing and GIS in water resources and
environmental systems

CO2: Ability to perform rainfall-runoff modelling using remote sensing and GIS inputs

CO3: Ability to know about watershed development and management using remote sensing and
GIS inputs

CO4: Ability to use remote sensing data and GIS maps for problems related to environmental
issues
COMPUTATIONAL HYDRO-DYNAMICS
(CE/WRE/)  

Instructions (Hours/Week) Lectures 4-0-0

Course Objectives:
- To develop an understanding of ordinary and partial differential equations and finite difference methods
- To know application of various hydrodynamic techniques to steady and unsteady flows
- To know application of finite element method to steady and unsteady flows
- To learn to develop computer programs for the computational methods

COURSE CONTENT

Module-I
Ordinary and Partial differential equations, well-posed, ill-posed problem, Finite difference schemes, Stencil diagrams, basic aspect of discretization, truncation error, implicit and explicit types, accuracy, convergence, errors and stability analysis,

Module-II
Von Neumann method, CFL condition, some hydrodynamic techniques – Lax-Wendroff, MacCormack, Crank-Nicolson, staggered grid, ADI, ADE, pressure correction.

Module-III
SIMPLE and SOLA algorithm, method of characteristics, finite element method. Variational and weighted residual formulations, applications to steady and unsteady flows.

Module-IV
Pollutant dispersion, flood wave propagation, tidal model, applications with computer programming, etc.

References:
2. Computational Fluid Dynamics: T. J. Chung
4. Computational Methods in Surface/Subsurface Flow & Transport Problems:
Course Outcomes:
CO1: Ability to know about ordinary and partial differential equations and finite difference methods
CO2: Ability to know application of various hydrodynamic techniques to steady and unsteady flows
CO3: Ability to know application of finite element method to steady and unsteady flows
CO4: Ability to perform computer programming of these computational methods

SEDIMENT TRANSPORT
(CE/WRE/ )

Instructions (Hours/Week) Lectures 4-0-0

Course Objectives:

- To develop an understanding of properties of sediment and reservoir sedimentation
- To know the fundamentals of sediment transport and meandering of rivers

COURSE CONTENT

Module-I

Module-II
Sediment Sources & sediment yield: Gross erosion, sediment yield, delivery ratio, estimation of sheet erosion, Universal soil loss equation (USLE), different factors affecting erosion process
.Sediment delivery ratio from watershed, flow duration curve and sediment rating curve, reservoir sedimentation: empirical equations, trap efficiency, sediment control method.

Module-III

Module-IV
Introduction to Meandering of rivers and river engineering. Scour: local scour at a bridge & abutment, Indian Codal provision for design scour depth.

References:
1. Manuals and Reports on Engineering Practice No. 54, Sedimentation Engineering : Vito A. Vanoni
2. Sediment Transport (Theory and Practice): C.T. Yang
5. Sediment Transport (in 3 parts), ASCE: L. van Rijn
6. Hydraulics of Sediment Transport : W.H. Graf
7. Fundamentals of Fluvial Geomorphology: Ro Charlton

Course Outcomes:
CO1: Ability to know about properties of sediment and about reservoir sedimentation
CO2: Ability to know about fundamentals of sediment transport and about meandering of rivers

GROUNDWATER QUALITY, POLLUTION AND CONTROL
(CE/WRE/ )

Instructions (Hours/Week) Lectures 4-0-0

Course Objectives:
- To develop an understanding of monitoring the water quality and water quality
- To know about sources of pollution of groundwater
Module-I
Sources of salinity, measures of water quality, chemical analysis, concentration by weight, chemical equivalence, total dissolved solids, hardness, biological analysis, water samples.

Module-II
Water quality criteria, drinking water standards, industrial water criteria, irrigation water criteria, dissolved gases, changes in chemical composition, temperature, saline groundwater.

Module-III
Sources of Pollution of ground water and causes, liquid waste, municipal and industrial sources, tanks and pipe line leakages, mining activities, agriculture sources and causes, miscellaneous sources and causes, septic tank and cesspool.

Module-IV
Saline waste intrusion, attenuation of pollution, filtration, sorption, chemical processes, dilution, distribution of pollution, pollution potential and evaluation, ground water quality monitoring.

References:

Course Outcomes:
CO1: Ability to monitor the water quality and water quality
CO2: Ability to know about sources of pollution of groundwater

WATER POWER ENGINEERING
(CE/WRE/ )

Instructions (Hours/Week) Lectures 4-0-0

Course Objectives:
- To develop an understanding of design concept of different components and their arrangement for hydel plants of both run off river plants and pumped storage plants.
- To understand design concept of different components of water conveyance system for power plants.
- To be able to design various components of different types of turbines.
- To gain the knowhow of planning of a power house.
COURSE CONTENT

Module-I
Instruction: Sources of Energy, Status of hydro power in the World. Transmission Voltages and Hydro-power, estimation of water power potential, General load curve, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm power, secondary power, prediction of load.

Module-II
Classification of Hydel Plants: Run off river plants, general arrangement of run off river plants, valley dam plants, diversion canal plants, high head diversion plants storage and pondage, Pumped storage plants: Types of Pumped storage plants, relative merits of two unit and three unit arrangement. Three unit arrangement, reversible pump turbines, problems of operation, power house, efficiency of P-S plants.

Module-III
Water Conveyance: Classification of penstocks, design criteria for penstocks, economical diameter of penstock, anchor blocks, conduit valves, types of valves, bends and manifolds, illustrative, water hammer, resonance in penstocks, channel surges, surge tanks. Intakes: Types of intakes, losses of intakes, air entrainment at intakes, inlet aeration, canals fore bay, tunnels.

Module-IV

References:
1. Water Power Engineering by M.M. Dandekar and K.N. Sharma, Vani Educational Books
Course Outcomes:
CO1: Ability to design different components and their arrangement for hydel plants of both run off river plants and pumped storage plants.
CO2: Ability to design different components of water conveyance system for power plants
CO3: Ability to design various components of different types of turbines
CO4: Ability to perform planning of a power house

URBAN DRAINAGE AND SEWERAGE SYSTEM
(CE/WRE/       )

Instructions (Hours/Week) Lectures 4-0-0

Course Objectives:

- To develop an understanding of the urban hydrological cycle
- To know about different elements of drainage system
- To design different elements of drainage system
- To learn the operation and management of urban drainage system and to develop storm water management models

COURSE CONTENT

Module I
Approaches to Urban Drainage, Urban Wastes and Urban Runoff Options for Waste Disposal, Separate and Combined Systems open Channels and closed Conduits, Wastewater and Stormwater Reuse, Data Requirements, Master Drainage Plans.

Module II
Elements of Drainage System Conveyance Elements, Appurtenances, Overflow Structures, Runoff Control, Pumping Stations.

**Module III**
Quantity of Stormwater, Stormwater Analysis, Rainfall Excess and Abstractions, Calculation of Runoff Volume and Peak Flow Hydrologic and Hydrodynamic methods.
Hydraulic Design of Conveyance Elements, Sizing of sewers and drainage Channels, Design of Appurtenances, Layout of Road Drainage, Layout of Pumping Stations.
Control Runoff and Pollution, On-site Storage and Use of Stormwater, infiltration, Detention and Retention Facilities for Stromwater Treatment, Erosion Control Measures.

**Module IV**
Stormwater Management Models.

**References:**

**Course Outcomes:**
CO1: Ability to know about urban hydrological cycle
CO2: Ability to know about different elements of drainage system
CO3: Ability to design different elements of drainage system
CO4: Ability to know about operation and management of urban drainage system and to develop storm water management models
Course Objectives:
- To develop an understanding of Watershed Modelling and Analysis and Design of Hydraulic Structures
- To know gain the knowledge of Diagnostic study of Irrigation Systems and Design and Analysis of water Distribution Network

List of Experiments
1. Estimation of Crop Water Requirements and design of an Irrigation System
2. Irrigation Scheduling
3. Watershed Modelling:
   a. Unit Hydrograph Models
   b. Synthetic Unit Hydrograph Models
4. Determination of Design Flood
6. Design and Analysis of water Distribution Network
7. Digital Simulation of Regional Aquifers
8. Parameter Estimation Through Regression
9. Design and Operation of a Reservoir
10. Design of Sewer Network
11. Diagnostic Analysis of Irrigation Systems
12. Stream Flow Analysis and Simulation
13. Design of Urban Storm water System

Course Outcomes:

CO1: Ability to know about Watershed Modelling and Analysis and Design of Hydraulic Structures

CO2: Ability to know about Diagnostic study of Irrigation Systems and Design and Analysis of water Distribution Network