ANDHRA UNIVERSITY

DEPARTMENT OF CIVIL ENGINEERING

PROGRAM : M.TECH(HYDRAULICS, COASTAL AND HABOUR ENGINEERING)

REGULATION AND SYLLABUS

EFFECTIVE FROM 2019-2020 BATCH

Department of Civil Engineering
M.Tech. (HYDRAULICS, COASTAL AND HABOUR ENGINEERING)
Scheme of Instruction and Examination
(with effect from 2019-20 Admitted Batch)

I – SEMESTER

Code No.	Course Title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam (hrs)	Ext.	Sess.		
HCH1.1	Advanced Fluid Mechanics	4	--	4	3	70	30	100	3
HCH1.2	Wave Hydrodynamics	4	--	4	3	70	30	100	3
HCH1.3	Hydrology and Water Resources Engineering	4	--	4	3	70	30	100	3
Program Elective –I HCH1.4	(a) Flood Modeling and Drought Assessment (b) Watershed Management (c) Remote Sensing and GIS Applications	4	--	4	3	70	30	100	3
Program Elective –II HCH1.5	(a) Climate Change and Water Resources Engineering (b) Structural Dynamics (c) Basic Coastal Engineering	4	--	4	3	70	30	100	3
HCH1.6	Computer Programming of Numerical Methods	-	3	3	Viva	50	50	100	1.5
HCH1.7	GIS lab	-	3	3	Viva	50	50	100	1.5
Total		**20**	**6**	**26**		**450**	**250**	**700**	**18**

II – SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam. (hrs)	Ext.	Sess.		
HCH2.1	Free Surface Flow	4	--	4	3	70	30	100	3
HCH2.2	Marine and Offshore Structures	4	--	4	3	70	30	100	3
HCH2.3	Siting and Planning of Port and Harbour Installations	4	--	4	3	70	30	100	3
Program Elective –III HCH2.4	(a) Estuarine Hydrodynamics and Salinity Transport (b) Groundwater Hydraulics (c) Design of Offshore Structures	4	--	4	3	70	30	100	3
Program Elective –IV HCH2.5	(a) Seismic Design of Port Structures (b) Finite Element Method of Analysis (c) Water Resources Systems Analysis	4	--	4	3	70	30	100	3
HCH2.6	Hydraulics and Coastal Engineering Lab.	--	3	3	Viva	50	50	100	1.5
HCH2.7	Sediment Transport and Dredging	--	3	3	Viva	50	50	100	1.5
HCH2.8	Seminar	--	3	3	Viva	50	50	100	2
Total		**20**	**9**	**29**		**500**	**300**	**800**	**20**

III SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec	Tut	Total	Exam (hrs)	Ext	Sess		
Program Elective –V HCH3.1	(a) Environmental Hydraulics (b) Urban Storm Water Drainage	4	--	4	3	70	30	100	3
Program Elective –VI HCH3.2	(a) Hydraulic Structures (b) Irrigation Water Systems and Analysis	4	--	4	3	70	30	100	3
HCH3.3	Dissertation (Preliminary)	--	--	--	Viva	--	100	100	8
Total		**8**	--	**8**		**140**	**160**	**300**	**14**

IV SEMESTER

Code No.	Course title	Scheme of Examination			Total	Credits
		Exam. (hrs)	Ext.	Sess.		
HCH4.1	Dissertation (Final)	Viva	100	--	100	16
Total						**16**

Department of Civil Engineering

SCHEME OF INSTRUCTION & SYLLABUS
FOR

M.Tech. (HYDRAULICS, COASTAL AND HARBOUR ENGINEERING)

(with effect from 2019-20 Admitted Batch)

Department of Civil Engineering

A.U. College of Engineering (A)

Visakhapatnam

M.Tech(HCH)

PROGRAMME EDUCATIONAL OBJECTIVES:

The graduating students of the Hydraulics, Coastal and Harbour Engineering Specialisation will be able to

PEO1. Acquire skills to plan, model, analyse, design and manage coastal engineering and port development projects.

PEO2. Analyse complex field situations and provide engineering solutions to coastal and harbor engineering issues.

PEO3. Analyse and solve the problems relevant to hydraulics, hydrodynamics and water resources engineering application.

PEO4. Practice as professional port and coastal engineers, coastal modelers and achieve proficiency in solving site specific coastal engineering problems and arriving timely decisions in a cost effective way.

PEO5. Achieve rigorous and realistic scientific attitude, strong self-learning ability and sense of innovation.

PROGRAM OUTCOMES:

At the end of the program student will be able to

PO1. Comprehend coastal engineering aspects with strong focus on wave behavior.

PO2. Analyse and design various structural components of coastal and harbour infrastructure using state of the art knowledge.

PO3. Apply critical thinking to model and simulate hydraulic/hydrologic processes/hydrodynamics, as well as to analyze and interpret the results.

PO4. Assess surface and groundwater resources, and plan sustainable water resources projects for meeting socio-economic needs.

PO5. Use knowledge and research methods of physical modeling, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

PO6. Engage in critical thinking and pursue learning for professional advancement.

Department of Civil Engineering

M.Tech. (HYDRAULICS, COASTAL AND HABOUR ENGINEERING)

Syllabus (with effect from 2019-20 Admitted Batch)

I – SEMESTER

HCH 1.1 ADVANCED FLUID MECHANICS

Course Objectives:

1) To acquire knowledge of potential flow theory and classical analysis for ideal flow around 2-D bodies
2) To derive and apply Navier-Stokes equation for viscous flows and obtain exact solution for simple boundary configurations
3) To derive Boundary layer equation, flow separation, vortex shedding, sources of drag force and to understand flow past a flat plate
4) To understand turbulent flows and Phenomenological theory and turbulent Boundary Layer along a Flat Plate
5) To understand the concepts of phenomenon of turbulence and turbulent flow

Two dimensional Irrotational Flow- Standard Pattern of Two Dimensional Flows – Uniform flow- Source- Sink- Vortex and Doublet – Spiral Vortex – Flow Past a Half Body – Flow Past a Cylinder with and without Circulation – Flow Past a Rankine Body. Laminar Flow- Introduction – Transformation – Relationship among Stresses – Relationship between Stresses and Deformations- Navier Stokes equations.

Learning Outcomes:

Students will be able to

- *Understand the method of developing expressions for pressure and velocity for flow past selected two dimensional bodies*
- *Generate flow patterns for flow past Rankine half body, Rankine full body and cylinder to compute velocity, pressure and forces on the cylinder.*
- *Derive Navier-Stokes equation and obtain exact solution for flow through pipes, annulus, rotating cylinder, slider bearing and other problems with simple boundary configuration.*

Simple Examples of Exact Solution – Poiseuille Flow – Couette Flow – Combination of Poiseuille and Couette Flow – Establishment of Simple Flows – Non linear Exact Solutions – Flow between Convergent and Divergent Plates – Flow against a Normal Wall – Approximate Solutions – Flow past a sphere – Laminar stability Parameter – Analysis of laminar stability – Experimental investigation on laminar stability. Laminar Boundary Layer- Introduction to the boundary layer – Thickness – Displacement momentum and energy thickness.

Learning Outcomes:

- *Students will be able to compute velocity and energy loss for selected Coutte and Poisseuille flows*

Boundary layer equations – Boundary layer along a Flat Plate with Zero Pressure Gradient (Blassius Solution) – Boundary layer Integral Momentum Equation – Transition of Turbulence. Turbulent Flow- Definitions – Wall Turbulence and Free Turbulence – Isotropic and homogeneous Turbulence – Turbulence intensity and scale and their measures – micro scale and integral scale – Correlations – Lagrangian and Eulerian description of the flow field.

Learning Outcomes:

Students will be able to

- *Understand Boundary layer concepts and derive Blasius equation and Karman-Prandtl integral momentum equation*
- *Compute boundary layer thickness, boundary shear stress and drag force on a flat plate with zero angle of incidence*

Reynolds Equations – Energy and Momentum Equations and Illustration of their Application by the example of Hydraulic Jump – Phenomenological theories – Turbulent Boundary Layer Along a 5 Flat Plat – Momentum Equation – Turbulent flow in pipes – Pipe Resistance Factor – Boundary Layer Separation – Wake Behind Cylinder – Simple Example of Free Turbulence Shear Flows.

Learning Outcomes:

Students will be able to

- *Know the classification of turbulence and derive Reynolds equations*
- *Understand the Prandtl mixing length hypothesis and its importance in obtaining solutions for velocity distribution for flow through pipes*
- *Understand boundary separation and formation of wakes behind bluff bodies*
- *Compute pipe resistance factor and other parameters for flow through pipes*

Course Outcomes:

On completion of this course, the student will be able to

1) Acquire advanced knowledge of potential flow theory, as well as a fundamental understanding of mechanics of incompressible flow
2) Understand the fundamental conservation laws of fluid mechanics in laminar and turbulent conditions
3) Understand the derivation of boundary layer equations for flow past a flat plate and compute local and averaged coefficient of drag.
4) Understand turbulent flow and mixing length theory and similarity hypothesis and estimate pipe resistance factor and other parameters for flow through pipes

Text Books / Reference Books

1. Applied Hydrodynamics by Valentine- H.R.- Butterworth's Scientific Publications.

2. Engineering Fluid Mechanics Vols. I and II by Narasimhan- S.- Orient Longman. .

3. Boundary layer theory by H. Schlichting.

4. Elementary Mechanics of Fluid by Hunter Rouse.

5. Hydraulic Machines by P. Kumar- BSP Books PVT Ltd

HCH 1.2 WAVE HYDRODYNAMICS

Course Objectives

1. To familiarize the students about the ocean and coastal engineering
2. To impart the knowledge about the governing equations, generation and propagation of surface gravity waves.
3. To import the skills of analysing the wave transformations and breaking processes.
4. To develop the skills to estimate wave forces.
5. To familiarize the students about the beach dynamics.

The Basics for the application of Potential Theory to Water Wave Problems – General Governing Equations – Bernoulli's Generalized Equation and General Boundary Conditions. Approximating the Governing Equations Based on Physical Reasoning – Solutions of Linear Equation for Progressive and Standing Waves – Pressure Velocity Fields – Surface Profile and Dispersion Relationship – Principle of Super Position – Wave Energy-Energy Flux And Energy Principle – Group Velocity. Various Perturbation Schemes for Solving Water Wave Problems – Stokes' Wave – Derivation of Second Order Governing Equations and Outline of Their Solution – Mass Transport and the Momentum Principle (Radiation Stresses) – Limitations of The Stokes' Solution – Cnoidal Waves And Solitary Waves – Wave Breaking Criteria.

Learning Outcomes

This is the Basic Course for the Coastal and Harbour Engineering course where student will learn Fundamentals of wave mechanics.

The Students will be able to

- *Understand the classification surface gravity waves in the ocean.*
- *Understands the application of potential theory to water wave mechanics which will helps in representing the physical phenomenon in mathematical expressions leading to analytical solutions*
- *Understands the boundary conditions and their applications in arriving at unique solutions.*

Wave Refraction – Graphical Techniques – Wave Diffraction around Breakwater and Through Breakwater Gaps. Wind Generated Wave – Some Statistical Aspects- Rayleigh Distribution Wave Heights- The Wave Spectrum and Mathematical Spectrum Models – PM- JANSWOP Etc. – Wave Forecasting Using SMB's Significant Wave Height Method and PNJ Wave Spectrum Method.

Learning Outcomes

This is the Basic Course for the Coastal and Harbour Engineering course where student will learn Fundamentals of wave mechanics.

The Students will be able to

- *Analyse the wave transformations and breaking processes.*
- *Evaluate the coefficients like shoaling, refraction, diffraction coefficients.*
- *Understands the different theories of wave prediction.*

Wave Forces on Piles – Basic Assumptions – Values of the Inertia and Drag Coefficients and their Dependence on the Wave Theory Used. Beach and Shoreline Development – Deltas- Head Lands and Estuaries – Water Movement in Near Shore area Sources and Characteristics of Materials – Littoral Transport – Contribution by Streams – Contribution by Erosion or Coastal Formation – Modes of Littoral Transport – Depths at which Material Moves – Determination of Direction and Direction Variability – Rates of Littoral Transport – Losses of Littoral Material.

Learning Outcomes

This is the Basic Course for the Coastal and Harbour Engineering course where student will learn Fundamentals of wave mechanics.

The Students will be able to

- *Evaluates the wave forces on slender cylindrical members from different wave theories.*
- *Evaluates the wave forces on group of piles.*
- *Understands interaction of waves and beach and their processes.*
- *Understands the sediment characteristics and its movement along the coastline.*

Course Outcomes

Students will be able to

1. Understand the different types of waves and its kinematics
2. Learns different types of wave theories and prediction models
3. Understands wave transformations and wave breaking
4. Analyze the wave forces on marine structures
5. Understands beach formation, sediment transport and its characteristics

Text Books/Reference Books

1. Shore Protection Manual (CEM)- U.S. Army Coastal Engineering Research Centre.
2. Estuary and Coastline Hydrodynamics by Ippen- A.T.- Iowa State University Press.
3. Coastal Engineering Vols. I & II by Silvester- R.- Elsevier Scientific Publishing Co.
4. Oceanographical Engineering by Wiegel- R.R.- Prentice Hall Inc.
5. Wind Waves and Maritime Structures by Minikin- R.R.-Charles Griffin & Co.
6. Coastal Hydraulics by Muir Wood- A.M. and C.A. Fleming- John Wiley and Sons.
7. Coastal Processes with Engineering Applications by Robert- A. D.- Cambridge University Press.
8. Coastal Hydrodynamics by Mani.- J.S.-PHI Learning Pvt. Ltd

HCH1.3 HYDROLOGY AND WATER RESOURCES ENGINEERING

Course objectives:

1. To build knowledge in hydrology and hydraulics and understanding of water resources systems.
2. To develop skills in the ground water flow, types of aquifer and yield from the well.
3. To provide the knowledge of design of reservoir operation, sedimentation and flood routing techniques.
4. To develop the skills in modelling of flood flows and flood routing.

To study the effect, causes and remedial measures of water logging and canal systems

Part A: Hydrology

Runoff-Runoff Process – Unit Hydrograph – Derivation and Analysis – S-Hydrograph – Synthetic Unit Hydrograph-Instantaneous Unit Hydrograph – Methods of Determining IUH – Conceptual Models of IUH – Formulation of Models – Concept of Linear Reservoir- Models of Nash and Dooge and Kulandaiswamy- Nonlinearity of Runoff-Distribution – Overland Flow Steam Flow – Flow Duration and Mass Curves and Time Series Analysis.

Floods: Importance of Flood Studies – Definition- Causes of Floods- Seasonal Distribution of Floods- Design Flood- Factors Affecting Flood Flow; Magnitude and Frequency of Floods – Empirical- Probability and Unit Hydrograph Methods; Flood Control Measures: Flood Control Reservoirs – Types- Location- Size – Levees and Flood Walls – Stage Reduction and Reduction in Peak Discharge Flood Routing Through Reservoirs.

Part B : Water Resources Engineering

Introduction to Water Resources- Hydrological Cycle – Characteristics – Surface and Ground Water Resources – Quality Conservation and Flood Control; Water Resources Planning – Purpose of Water Resources Development- Classification of Water Resources Development Projects- Functional Requirements of Multipurpose Projects- Process of Project Formulation- Project Evaluation- Strategies for the Future- Planning Strategies- Management Strategies.

Climate Change on Water Resources - Climate and Weather- the Vital Importance of Monsoon Rains- Clouds- Storms and Precipitation- Influences and Feedbacks of Hydrological Changes on Climate- Observed Climate Change Impacts- Future Changes in Water Availability and Demand Due to Climate Change- Climate Related Drivers of Freshwater Systems in the Future- Impacts of Climate Change on Water Stress in the Future-

Freshwater Areas and Sectors Highly Vulnerable to Climate Change- Potential Water Resource Conflicts Between Adaptation and Mitigation.

Site Investigations and Design Aspects of Water Resources - Surface Water Resources –Minor Tanks- Reservoirs- Diversion Head Works; Ground Water Resources – Tube Wells- Open Wells.
Rainwater Harvesting- Rainwater Harvesting- Artificial Recharge of Ground Water.

Learning outcomes:

The students will get the knowledge of

- *Analysis of rainfall data, concept of hydrology, hydrograph and water resources of india.*
- *Ground water flow dynamics, hydraulic properties of different types of aquifers and significance of rain water harvesting.*
- *Basic types of water resources, crops-seasons, crop water requirements and suitable irrigation methods.*
- *The types of reservoir, hydraulic structures including their aspects along with flood routing techniques.*

Canal systems including design aspects of lined canals along with regime theories.
Application of Remote Sensing (RS) and Geographical Information System (GIS) in Water Resource - A Brief History of RS- Sensor Systems Used in RS- RS Satellites- Landsat- and IRS. Remote Sensing Applications in Civil Engineering Projects GIS Over View- GIS Components- Raster Data Models and Vector Data Model- Application of RS and GIS in Water Resources Engineering.

Course outcomes:

On completion of the course, the students will be able to:

1. Demonstrate the concepts of hydrograph, S-hydrograph, unit hydrograph and IUH.
2. Analysis of ground water flow hydraulics along with rain water harvesting methods.
3. Demonstrate the basic types of irrigation, irrigation standards and crop water assessment.
4. Identify various types of reservoirs and their design aspects along with flood routing techniques.
5. Design aspects of canal systems and water logging remedies.

Reference Books

1. *Hydrology by Wisler- C.O. and E.F. Brater- John Wiley and Sons..*

2. *Geo-Hydrology by De Wiest- R.J.M.- John Wiley and Sons.*
3. *Hydrology for Engineers by Linsley- R.K.- M.A. Kohler and J.L.H. Paulus McGraw-Hill.*
4. *Water Resources Engineering by Linsely- R.K.- J.B. Franzini- D.L. Freyberg and G. Tchobanoglous- McGraw- Hill Publishing Co.; 4th edition.*
5. *Irrigation Engineering and Hydraulic Structures by Garg S.K. Khanna Publishers.*
6. *Principles of Geographical Information Systems for land resource assessment by Burrough- P.A.- Clarendon press- Oxford.*
7. *Remote Sensing in Civil Engineering by Kennie- J.M. and M.C. Matthews McGraw-Hill.*
8. *Remote Sensing: Principles and Interpretation by Sabins F.F.-Waveland Pr Inc- 3rd Edition.*
9. *Impacts of climate change and climate variability on hydrological regimes by Jan C. van Dam- Cambridge University Press.*
10. *IPCC fourth assessment report- The AR4 synthesis report*
11. *IPCC fourth assessment report- Working Group I report- The physical Science Basis.*
12. *IPCC fourth assessment report- Working Group II report- Impacts- Adaptation and vulnerability.*
13. *IPCC fourth assessment report- Working Group III report- Mitigation of Climate Change.*

HCH1.4(a) FLOOD MODELLING AND DROUGHT ASSESSMENT

Course Objectives:

1. To teach the basics of flood studies and introduce various methods of flood estimates.
2. To impart knowledge on flood modeling and management by taking routing methods and use of software.
3. To teach RS and GIS methods for flood modeling and management and apply for flood mitigation.
4. To expose the students to the drought studies for understanding types of drought and drought assessment.
5. To teach the RS approach for drought monitoring and plan for mitigation using various approach.

Flood Estimation **:** Hydrologic extremes – Flood – Types of Flood – Effects of Flood – Design Flood - SPF/MPF - Estimation of design flood – Physical Indicators - Envelope curves - Empirical methods – Rational method - Statistical methods – Frequency analysis – Unit hydrograph method.

Flood Modeling And Management **:** Hydrologic and Hydraulic Routing – Reservoir and Channel Routing - Flood Inundation Modeling – HEC HMS and HEC RAS software's - Flood control methods – Structural and non structural measures - Flood Plain Zoning – Flood forecasting – Flood Mitigation - Remote Sensing and GIS for Flood modeling and management.

Learning Outcomes:

The students will be able to

- *Able to estimate design flood.*
- *Able to conduct reservoir routing and channel routing .*
- *Use software for flood inundation modeling.*
- *Plan for structural and non-structural control methods*

Drought And Impacts : Definition – Definitions based on rainfall- stream flow- vegetation and comprehensive aspects - Characterization of Drought/water shortage/aridity/desertification - Types of Drought – NCA classification – Impacts of Drought – Environmental- Social and Economical aspects

Drought Assessment: Drought Severity Assessment – Meteorological Hydrological and Agricultural methods – Drought Indices – GIS based Drought Information system – Drought Vulnerability Assessment and Mapping Using GIS.

Learning Outcomes:

The students will be able to

- *Gains awareness of flood frequency methods.*
- *Gains knowledge on RS and GIS methods for flood modeling and management.*
- *Understand the aspects of drought and severity.*
- *Use drought indices for assessment of its severity.*

Drought Monitoring And Management: 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

Learning Outcomes:

The students will be able to

- *Evaluate drought vulnerability and develop mapping using GIS.*
- *Gains knowledge of DPAP programme.*
- *Understand the long term and short term measures for drought mitigation.*

Course Outcomes:

1. Choose appropriate method to estimate design flood discharge.
2. Understand hydrologic and hydraulic routing and apply for flood modeling.
3. Gains knowledge in use of HEC HMS and HEC RAS for developing inundation models.
4. Plan for flood control using structural and non-structural mechanisms.

5. Understand drought types and perform drought assessment using various indices and drought vulnerability mapping using GIS.
6. Understand the various approaches for drought monitoring and management.

Reference Books

1. *Applied Hydrology by Chow V.T.- Maidment D.R.- Mays L.W.- McGraw Hill Publications- New York- 1995.*
2. *Elementary Hydrology by Vijay P.Singh.- Prentice Hall of India- New Delhi- 1994.*
3. *Drought Research Needs by Yevjevich V.- Water Resources Publications- Colorado State University- USA- 1977.*
4. *Flood Routing Methods as Applied to Indian Rivers by Rangapathy V.- Karmegam M.- and Sakthivadivel R.- Monograph in- Anna University Publications*

HCH1.4(b) WATERSHED MANAGEMENT

Common Syllabus for HCH1.4(b) and EEM1.4(b)

Course Objectives

- To expose to various aspects of water resources development and management on watershed basis.
- To impart skills of analyzing the complex issues in water management and specific knowledge on soil erosion issues of watershed management.
- To introduce various methods of national drainage management and river training works.
- To impart knowledge on causes for wastelands and its effect on surface and sub-surface drainage management.
- To expose the graduates for learning various flood hazard conditions and getting flood damage mitigation measures.
- To teach about the various water harvesting techniques and also watershed modeling.

Watershed Management Concept - Introduction- Concept of Watershed Management- History of Watershed Management and its Relevance to India- Watershed Characteristics; Climatic Characteristics- Physiographic Characteristics- Causes of Watershed Deterioration- Effect of Watershed on the Community- Water Resources Region of India

Learning Outcomes:

The students will be able to

- *Understand the concept of watershed management and causes of watershed deterioration.*
- *Understand the need of watershed management.*

Principles of Watershed Management- Integrated Watershed Management Approach (IWMA)- Objectives of IWMA- Envisaged Results- Success Criteria- Selection of Watershed Village- Equity Issues for Watershed Policies- Factors Causing The Inequality- Benchmark Survey- Remote Sensing Survey in Watershed Management- Land Capability Classification.

Learning Outcomes:

The students will be able to

- *Understand the concept of watershed management and causes of watershed deterioration.*
- *Understand the need of watershed management.*
- *Know the principles of watershed management and apply for IWMA.*
- *Have exposure to RS applications in watershed management.*

Soil Erosion: Introduction- Soil Erosion- Factors Affecting Soil Erosion- Different Types and Causes of Erosion- Geologic Erosion- Accelerated Erosion- Estimation of Loss of Soil from Erosion- Soil Loss Models- Sediment Models- Bed Load Models- Control of Soil Erosion
Management of Natural Drainages- Introduction- Check Dam- Structures for Gully Stabilization and Storage of Water- Rivers or Stream Bank Management Measures in Watershed- River Training Works- Methods of River Training Works.

Learning Outcomes:

The students will be able to

- *Able to know the types of soil erosion and apply knowledge to plan for its mitigation.*
- *Gains knowledge of various techniques for management of natural drainages.*
- *Know the need of river training works and its methods.*

Wasteland and Land Drainage Management- Introduction- Causes of Wasteland – Water Logging- Salinity- Soil Erosion- Overgrazing- Mining Operation- Industrial Effluent- Brickfields- Inadequate Surface and Subsurface Drainages- Remedial Measures in Wasteland Management- Land Drainage Management- Surface or Overland Drains- Subsurface or Underground Drains- Discharge and Spacing of tile Drain.

Learning Outcomes:

The students will be able to

- *Understand the various causes of waste land.*
- *Learn and practice remedial measures in waste land management.*

- *Plan for surface and subsurface drainage towards checking waterlogging.*

Flood Damage Mitigation Management- Introduction- Mitigation Measures- Structural Mitigation Measures- Non-Structural Mitigation Measures- Flood Plain Zoning- Flood Forecasting.

Water Harvesting- Introduction- Techniques of Water Harvesting- Indigenous Water Harvesting Methods in India- Engineering Methods of Water Harvesting.

Watershed Modeling- Introduction- Data of Watershed for Modeling- Application of Watershed Models- Model Calibration and Validation.

Learning Outcomes:

The students will be able to

- *Apply the structural and non-structural mitigation measures for flood damage.*
- *Ability to plan for water harvesting.*
- *Gains exposure to complete watershed modeling methods*

Courses outcomes:

on completion of the course, the student will be able to

- Plan for sustainable development by proper use of all available resources of a watershed for optimum production with minimum hazards to natural resources.
- Understand soil erosion process and develop soil erosion models towards its mitigation planning.
- Capability to determine the various solutions to flood hazard damages and implement damage mitigation measures.
- Ability to develop techniques or methods for water harvesting.
- Applying knowledge on determining effective watershed modeling.

Text Book

1. *Watershed management by Madan mohan das- Mimi das Saikia- PHI learning pvt. Ltd.*

Reference Books

1) *Watershed Management by Murty- J.V.S.-- New Age Intl.- New Delhi 1998.*
2) *Decision Support System for Integrated Watershed Management by Allam- G.I.Y.-- Colorado State University- 1994.*
3) *Watershed Planning and Management by Vir Singh- R.-- Yash Publishing House- Bikaner-*

4) *Watershed Management- American Soc. of Civil Engineers- New York- 1975.*

HCH1.4(c) REMOTE SENSING AND GIS APPLICATIONS

Common Syllabus for HCH1.4(c), SMFE1.4(c) and EEM1.4(c)

Course Objectives:

1. To introduce the basic concept and principles of Remote Sensing
2. To illustrate solar energy interactions with atmosphere and with earth surface features
3. To Know about different types of satellite and sensors.
4. To Learn image analysis and apply for interpretation of satellite images
5. To understand data types, data inputs and data analysis in GIS and Learning about map projection and coordinate system.
6. To develop knowledge on RS and GIS applications in civil engineering.

Introduction - Definition- Principle of Remote Sensing- History of Development of Remote Sensing- Stages in Remote Sensing- Electromagnetic Radiation and the Electromagnetic Spectrum- Interactions With the Atmosphere- Atmospheric Scattering- Atmospheric Absorption- Atmospheric Windows- Refraction- Interaction of EMR with the Earth's Surface- Reflection- Transmission- Spectral Signature.

Learning Outcomes:

- *Understand the principle of remote sensing and its basic components.*
- *Understand the electromagnetic radiation and its interactions with atmosphere and earth surface features.*
- *Know about spectral properties of various natural and cultural features.*

Platforms & Sensors- Remote Sensing Systems- Remote Sensing From Space- Remote Sensing Sensors- Resolution- Imaging Sensors- Optical Infrared (OIR) Imagers- Optical Sensors- Thermal Sensors- Microwave Sensors- Active Microwave Sensors- Data Preprocessing- Remote Sensing in India.

Introduction to Image Interpretation- Basic Principles of Image Interpretation- Elements of Image Interpretation- Techniques of Image Interpretation- Interpretation Keys- Introduction to Digital Image Processing- Digital Image- Image Rectification and Registration- Geometric Correction- Image Enhancement Techniques (Only Concepts)- Image Classification - Unsupervised Classification and Supervised Classification- Digital Photogrammetry - Stereo Images from Satellites - Data Merging .

Learning Outcomes:

- *Know about types of satellite images and their characteristics.*
- *Understand types of remote sensing such as active and passive remote sensing. and develop ability to choose appropriate sensor products for various remote sensing applications.*

Geographic Information Systems (GIS)- Definitions and Related Technology- GIS Operations- GIS Elements- GIS Concepts and Practice- Map Projection and Coordinate System.

Vector Data Model- Introduction- Vector Data Representation- Geometric Objects- Topology.

Vector Data Analysis- Introduction- Buffering- Applications of Buffering- Map Overlay- Feature Type and Map Overlay- Map Overlay Methods- Slivers- Error Propagation in Map - Overlay- Distance Measurement- Map Manipulation.Raster Data Analysis- Introduction- Analysis Environment- Local Operations- Local Operations With a Single Grid- Local Operations With Multiple Grids- Neighborhood Operations- Zonal Operations.

Learning Outcomes:

- *Understand spatial and non-spatial data features in GIS and learning about vector and raster data representation in GIS.*
- *Understanding data input, editing and creating base map and thematic layers using GIS.*
- *Understand the map projections and coordinates systems and able to create thematic layers.*
- *Develop ability to perform image analysis and image interpretation.*

Terrain Mapping and Analysis- Introduction- Data for Terrain Mapping and Analysis- Surface Models- DEM- TIN.

GIS Models and Modeling- Introduction- GIS Modeling- Binary Models- Index Models

Remote Sensing & GIS Application in Civil Engineering – Some Case Studies from Literature.

Learning Outcomes:

- *Know GIS analysis and Digital Elevetion Model.*
- *Understand the integration of Remote Sensing and GIS.*
- *Develop awareness about various applications of remote sensing and GIS in civil engineering through spatial analysis.*

Course Outcomes:

After completing this course the student will have acquired the ability on the following.

1. Understand the principle of remote sensing, develop ability to comprehend the energy interactions with atmosphere and earth surface features, spectral properties of various natural and cultural features.
2. Understand types of satellite images and their characteristics and develop ability to choose appropriate sensor products for various remote sensing applications.
3. Ability to perform image analysis and image interpretation.
4. Understand spatial and non-spatial data features in GIS and know vector and raster data representation in GIS.

5. Understand the map projections and coordinates systems and able to create thematic layers.
6. Understand the integration of Remote Sensing and GIS and apply the knowledge to work in various application fields through spatial analysis.

Text Books

1. *Fundamentals of Remote Sensing 2nd Ed by George Joseph- University Press- New Delhi.*
2. *Introduction to Geographic Information Systems by Kang Tsung Chang- Tata Mc.G.H. Publications- New Delhi.*

HCH1.5(a) CLIMATE CHANGE AND WATRE RESOURCES ENGINEERING

Course Objectives:

1. To impart knowledge about various climate systems, characteristics and their components.
2. Able to understand the effects of ozone hole and various types of wind systems.
3. To make them aware about global and Indian scenario of climate change.
4. To familiarize the students about different projects related to water resources assessment.
5. To study the concept of geothermal energy and energy use in buildings.
6. To study coastal zone management strategy with the help of case studies.

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.

Global Scenario – Indian Scenario – Observed Changes and Projected Changes of IPCC - Impacts on Water Resources – NATCOM Report –Impacts on Sectoral Vulnerabilities – SRES – Different Scenarios

Learning outcomes:

- *Gains knowledge about climate system and characteristics of climate system change.*
- *Understand the effect of ozone hole and other reasons for climate change.*
- *Analyze the variation in global and Indian scenario and projected changes which impact on water resources.*

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.

Learning outcomes:

- *Understand the vulnerability assessments, its steps and approaches and models related to it.*

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.

Learning outcomes:

- *Gains knowledge about climate change in the fields of ecosystems and biodiversity.*

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.

Learning outcomes:

- *Know the concepts of hydropower energy and energy use in buildings.*
- *Analyze the water resources assessment which involve various projects by taking up case studies.*
- *Design and practice hydrological condition and dam safety criteria in water resources project.*
- *Gains knowledge about flood management strategies and drought management strategy in detail.*
- *Understand the application involved in coastal zone management strategies.*

Course outcomes:

At the end of the course students will be able to

1. Analyze the effects involved in climate change and understand the reasons for climate change.
2. Understand the impact of climate change on water resources and its vulnerability.
3. Gains knowledge about various models involved in analysis of problems related to climate change.
4. Enhance the knowledge about the design of hydrological structuresand their safety.
5. Understand the importance of water resources projects by involving them in case studies.

Reference Books

1. *Climate change and water- IPCC Report Technical Paper VI- 2008.*
2. *UNFCC Technologies for Adaptation to climate change- 2006.*
3. *Climate Change and India: Vulnerability assessment and adaptation by P R Shukla- Subobh K Sarma- NH Ravindranath- Amit Garg and Sumana Bhattacharya-- University Press (India) Pvt Ltd- Hyderabad.*
4. *Preliminary consolidated Report on Effect of climate change on Water Resources- GOI- CWC- MOWR- 2008.*

HCH1.5(b) STRUCTURAL DYNAMICS

Common Syllabus for ST1.5(b) and HCH1.5(b)

One Degree Systems: Undamped systems, Various forcing functions damped systems, Response to pulsating force, Support motion.

Lumped Mass Multidegree System: Direct determination of natural frequencies, Characteristic shapes, Stodola-Vianelle method, Modified Rayleigh-Ritz method, Lagrange's equation, Model analysis of multi degree systems, Multistorey rigid frames subjected to lateral loads, Damping in multi degree systems.

Structures with distributed mass and load, Single span beams, Normal modes of vibration, Forced vibrations of beams, Beams with variable cross-section and mass.

Approximate design methods, Idealized system, Transformation factors, Dynamic reactions response calculations, Design example (RC beam, Steel beam and RC slab), Approximate design of multi degree systems.

Matrix Approach: Coordinates and lumped masses, Consistent mass matrix, Undamped force vibration of a system with one degree freedom, Response of single degree freedom undamped system, Viscous damped vibration of a single degree freedom system, Undamped vibration of multi degree freedom system, Orthogonality of natural nodes, Normal coordinates.

Text Books

- *Structural Dynamics by John M. Biggs. McGraw-Hill*

- *Dynamics of Structures, Theory and Applications to Earthquake Engineering by Anil K. Chopra, Prentice Hall of India.*

Reference Books

- *Structural Analysis by A. Ghali & A.M. Neville, CRC Press.*

HCH1.5(c) BASIC COASTAL ENGINEERING

The main objective of this course is introducing to students the coastal processes and their importance in public utility and CZM.

Course Objectives

1. To familiarize the students about the coastal engineering and coastal processes.
2. Making student to understand about the generation and propagation of surface gravity waves, tides, storm surges and Tsunamis.
3. To import the skills of analysing the wave transformations and breaking processes.
4. To familiarize the students about wave-soil interaction, sediment transport and the beach dynamics.
5. To develop the skill in analyzing the different types of coastal protection strutucres.

This is the Basic Course for the Coastal and Harbour Engineering course where student will learn Fundamentals of Coastal Processes.

Introduction- General Design Considerations for Coastal Engineering- Long Period Waves- Tides- Tsunamis- Storm Surge and Wind Set Up. Pressure Velocity Fields – Surface Profile and Dispersion Relationship – Wave Energy- Energy Flux And Energy Principle – Group Velocity.

Wave Mechanics- Celerity and Group Velocity-Wind Generated Waves.

Learning Outcomes

The Students will be able to

- *Understand the classification surface gravity waves in the ocean.*
- *Understands the application of potential theory to water wave mechanics which will helps in representing the physical phenomenon in mathematical expressions leading to analytical solutions*
- *Understands the boundary conditions and their applications in arriving at unique solutions*

Wave Transformation- Shoaling- Refraction- Diffraction and Reflection-Wave Breaking Criteria-Wave Forecasting for Deepwater Waves.

Coastal Sediments-Coastal Sediment Characteristics- Initiation of Sediment Motion Under Waves-Radiation Stress-Wave Set-Up and Wave Set- Down- Mechanics of Coastal Sediment Transport –

Limits for Littoral Drift – Suspended and Bed Load – Alongshore Sediment Transport Rate – Distribution of Alongshore Currents and Sediment Transport Rates in Surf Zone.

Learning Outcomes

The Students will be able to

- *Analyse the wave transformations and breaking processes.*
- *Evaluate the coefficients like shoaling, refraction, diffraction coefficients.*
- *Understands the different theories of wave prediction.*
- *Understands interaction of waves and beach and their processes.*

Onshore- Offshore Sediment Transport – Coastal Features – Beach Features – Beach Cycles – Beach Stability – Beach Profiles -Coastal Erosion- Planning And Methods of Coast Protection Works.

Design of Shore Defense Structures – Non-Breaking and Breaking Wave Forces on Coastal Structures –Wall Types Structures and Breakwaters- Classification- Design and Application in Coastal Protection and Harbor Planning- Case Studies on Coastal Erosion and Protection. Impacts of Coastal Structures on Shoreline Changes. Seawalls- Breakwaters- Groins- Jetties.

Learning Outcomes

The Students will be able to

- *Understand mechanics of coastal sediment transport.*
- *Evaluate the environmental forces applicable to coastal structures.*
- *Design of coastal protection structures like breakwaters, seawalls, groins etc., for shallow waters*

Course Outcomes

Students will be able to

- Understand the different types of coastal processes, beaches and landforms.
- Learns different types of wave theories and prediction models
- Understands wave transformations and wave breaking
- Analyze the coastal sediment characteristics, sediment transport and beach dynamics.
- Understands beach formation, sediment transport and its characteristics.
- To familiarize the basic governing equations for the design of coastal protections structures.

Text Books

- *Basic Coastal Engineering by Sorenson- R.M.-- A Wiley-Inter science Publication- New York- 1978*
- *Water wave mechanics for engineers and scientists by Dean and Darlymple.*

- *Coastal Hydrodynamics by J.S. Mani- PHI Learning*
- *Coastal Engineering by Horikawa- K.-- University of Tokyo press- 1978*
- *Introduction to coastal Engineering and Management by Kamphius- J.W.*
- *Advances on Ocean Engineering-Volume 16- World Scientific-2002.*

Reference Books

- *Coastal Engineering-Processes theory and design practice by Reeve-D.- Chadwick- A. and Fleming- C- Spon Press- Taylor & Francis Group- London & Paris-2004*
- *Coastal Stabilisation- Advances on Ocean Engineering-Volume 14 by Silvester- R. and Hsu- J.R.C. World Scientific- 1997.*
- *Coastal Engineering Manual- U. S. Army Corps of Engineers- Washington- DC 20314-1000- Vol. 1 to 3- July 2003.*

HCH1.6 COMPUTER PROGRAMMING OF NUMERICAL METHODS

Course objectives:

- Importance of computer programming of numerical methods.
- To build the student proficiencyin C language.
- To improve the skills on writing an algorithm and flow charts
- Improve knowledge on Sub-Programming, Subroutines Sub-Programme Statements, Declaration Statements, Logical Constants and Variables, Relational Operators, Programming of Some Hydraulics and Coastal Engineering Problems.

Introduction to Programming and Flow Charts- Digital and Analog Computers Functional Organization of a Digital Computer – Counting – Techniques Binary – Binary – Numbers Storage and Retrieval of Information – Programming Language – Applicability of Fortran – Flow Chart Concept – Few Examples.

Arithmetic Expressions and Statements- Arithmetic Expressions – Fortran Constants – Integer- Real and Complex Constants – Fortran Variables – Integer and Real Variables – Rules Regarding the Meaning of Variables and use of Operation of Symbols – Hierarchy of Arithmetic Operations – use of Parenthesis and Rules Regarding Parenthesis – Arithmetic Statements Built-in Functions.

Input Output and Format Statements- Input Output Devices – Rules Punching a Card – The Data Card – Read Statement Data Initialization Statement – Specification Statement Varieties – F E I and a Formats – Blank Field Specification – Carriage Control – Punching of Format Statements – Use of Coding Sheets.

Control Statements- Unconditional and Conditional Control Statements – Small Programmes. Subscripted Variables- Subscripted Variables – Rules Regarding Subscripted Variables – Dimension Statement – General Form – Do Statement – General Form – Continue Statement – Rules Regarding Do Statements and Nested Do Loops – Equivalence Statements – Small Programmes.
Sub-Programming- Subroutines Sub-Programme Statements – Rules Regarding Subroutine Sub-Programmes – Call Statements – Common Statement – Rules Regarding Common Statement – Examples with Small Programmes.

Learning outcomes:

The students will be familiar with

- *Algorithms and flow chart preparation concepts etc.*
- *Programming in c language and programming of numerical methods.*
- *The knowledge on Arithmetic Expressions, Input Output and Format Statements, Control Statements, Techniques Binary and Declaration Statements.*

Some Aspects of Fortran 90: Declaration Statements – Logical Constants and Variables – Relational Operators and Expressions – Logical Operators and Expressions – Logical Assignments – Statements – Logical IF Statement – Complex Variable and Expressions – Library Functions – Control Cards – Examples with Programmes.

Programming of Numerical Methods: Calculation of Mean- Variance and Correlation Coefficient – Linear Regression – Simple Linear Programming – Matrix Inversion by Partitioning Method Linear Interpolation – Taylor's Series – Real Roots by Iteration – Newton-Raphson Method – Von Mises Method – Chord Method – Bisection Method. Numerical Differentiation and Integration – Simpson's 1/3 Rule- Trapezoidal Rule – Milne's Predictor Corrector Method to Solve First and Second Order Differential Equations – Runge Kutta Method.

Programming of Some Hydraulics and Coastal Engineering Problems: Hydrograph Analysis- Stress Analysis of Gravity and Earth Dams- Wave Reflection Analysis (Two Probe and Three Probe Methods)- Computation of Wave Force on a Cylinder and a Wall- Best Hydraulic Section- GVF Surface Profile Computations- Bed and Suspended Sediment Load Computations.

Learning outcomes:

The students will be familiar with

- *The various numerical methods like Simple Linear Programming, Matrix Inversion by Partitioning Method Linear Interpolation, Taylor's Series, and Real Roots by Iteration, Newton-Raphson Method, Chord Method and Bisection Method.*
- *Programming of Some Hydraulics and Coastal Engineering Problems.*

Course outcomes:

Students will be able to

- Know the importance of computer programming of numerical methods.
- Write a programming in c language and programming of numerical methods.
- Know the concepts of flow charts, arithmetic expressions and control statement.
- Understand the various numerical methods like Simple Linear Programming, Matrix Inversion by Partitioning Method Linear Interpolation, Taylor's Series, and Real Roots by Iteration, Newton-Raphson Method, Chord Method and Bisection Method.
- Get the knowledge on Sub-Programming, Subroutines Sub-Programme Statements, Declaration Statements, Logical Constants and Variables, Relational Operators, Programming of Some Hydraulics and Coastal Engineering Problems.

Reference Boks

1. *Computer Programming in FORTRAN 90 & 95 by Rajaraman-V., PHI Learning Pvt. Ltd.*
2. *Numerical Methods and FORTRAN Programming: with applications in engineering and science by Daniel- D.M. and S.D. William- Wiley.*
3. *Numerical methods in Fortran by McCormick- J. M. and M. G. Salvadori Prentice Hall.*

HCH1.7 G.I.S. LABORATORY

Course Objectives:

1. To impart training on creating digital maps using GIS software.
2. To train on digital image processing of satellite images using software.
3. To impart knowledge of generating thematic maps through image integration.
4. To develop skills to create morph metric maps for watersheds.
5. To provide exposure to create digital elevation model and apply DEM for various hydrological methods.
6. To provide a practical experience on RS and GIS applications in water resources engineering through case studies.

Students are Supposed to Work on Various Problems Involving the Following Applications Using any GIS Package.

1. Creation of Vector Maps and Raster Maps Through Digitization and Rasterisation
2. Image Processing of Digital Images (Geometric Correction- Image Enhancement- Image Classification)
3. Preparation of Thematic Maps (Land Use/ Land Cover- Road Maps- Drainage Network Map Etc.) From Satellite Image of any Region.
4. Watershed Delineation from Drainage Map and Contour Map of any Region.
5. Development of Digital Elevation Model (DEM) using any Technique.
6. Any simple case study of RS & GIS Application in WRE.

Course Outcomes:

1. Create digital maps and rasterise vector maps.
2. Perform geo-coding, image enhancement and classification of satellite multi rationaldata.
3. Create GIS layers from satellite images through image interpretation.
4. Perform watershed studies.
5. Develop digital elevation models.
6. Have exposure on RS& GIS applications to water resources engineering.

Learning Outcomes:

- *Able to use GIS software to import digital data.*
- *Gains practice on creating vector data through digitalization.*
- *Able to identify digitalization errors and edit data.*
- *Know how to perform rasterisation of vector data.*
- *Gains knowledge of creating base maps.*
- *Know how to perform generalize corrections satellite data.*
- *Understand the different options of image enhancement.*
- *Know and apply different methods of image classification using DIP software.*
- *Gains knowledge of image interpretation and apply for creating for thematic maps.*
- *Create Digital Elevation Model through contour interpretation.*
- *Apply Digital Elevation Model for hydrological analysis.*
- *Apply RS&GIS for some studies in WATER RESOURCES Engineering.*

II – SEMESTER

HCH 2.1 FREE SURFACE FLOW

Course Objectives

1) To acquire knowledge of potential flow theory and classical analysis for ideal flow around 2-D bodies
2) To derive and apply Navier-Stokes equation for viscous flows and obtain exact solution for simple boundary configurations
3) To derive Boundary layer equation, flow separation, vortex shedding, sources of drag force and to understand flow past a flat plate
4) To understand turbulent flows and Phenomenological theory and turbulent Boundary Layer along a Flat Plate
5) To understand the concepts of phenomenon of turbulence and turbulent flow

Introduction: Classification of flows, velocity distribution, pressure distribution, Derivation of the general one-dimensional equations of continuity, energy and momentum used in open channel flow analysis.

Learning Outcomes

Students will be able to

- *Classify free surface flows and understand the distribution of velocity and pressure in an open channel*
- *Deriveone-dimensional equations of continuityand momentum for open channel flow*
- *Compute flow depths at canal transitions*
- *Recommend the proportions for hydraulically most efficient sections for different shaped channels*
- *Perform flow computations in compound channels*

Steady Uniform flow and non-uniform flows: Chezy's equation, Manning's formulae, uniform flow computations – Hydraulically efficient channel section, design of irrigation channels, specific energy, specific force, critical depth, calculation of critical depth, applications of specific energy, channel transitions and controls, hydraulic jumps, surges.

Gradually varied flow: Surface profile for gradually varied flow.

Unsteady flow in open channels:method of characteristics, surge formation. Kinematics of waves, flood routing and overhead flow.

Inland navigation: Introduction, Various Requirements of Navigable Waterways, Various Measures Adopted for Achieving Navigability, India's Navigable Waterways.

River Engineering: Classification of Rivers, Causes of Meandering, The Aggrading type of River, Degrading type of River, Cutoffs, river Training, Types of Training Works.

Learning Outcomes

Students will be able to

- *Carryout gradually varied flow analysis, compute and draw the profiles*
- *Carryout hydraulic jump computations in regular shaped channels and compute sequent depths, loss of energy, length and profile shape in rectangular channels*
- *Carryout unsteady gradually varied flow analysis and computations of flood routing*
- *Carryout the surge calculations and perform dam break analysis*
- *Recommend appropriate river training works and for given field and hydraulic conditions of the rivers*

Course Outcomes

On completion of this course, the student will be able to

1) Acquire advanced knowledge of potential flow theory, as well as a fundamental understanding of mechanics of incompressible flow
2) Understand the fundamental conservation laws of fluid mechanics in laminar and turbulent conditions
3) Understand the derivation of boundary layer equations for flow past a flat plate and compute local and averaged coefficient of drag.
4) Understand turbulent flow and mixing length theory and similarity hypothesis and estimate pipe resistance factor and other parameters for flow through pipes

References:

1. Flow in Open Channels, Subramanya, K., Tata McGraw-Hill Publishing Co. Ltd.
2. Flow through Open Channels by K.G. Ranga Raju, Tata McGraw-Hill Publishing
3. Open Channel Flow, Henderson, F.M.,Macmillan series in Civil Engineering.
4. Open Channel Hydraulics, Chow, V.T.,McGraw-Hill Ltd.
5. Engineering Hydraulics, Rouse, H., John Wiley & Sons Inc.
6. Open-Channel Flow by, Hanif Choudhury, M., Prentice Hall of India.
7. Irrigation and Hydraulic structures, Garg, S.K., Khanna Publishers.
8. Irrigation and Water Power Engineering, Punmia, B.C. and P.B.B. Lal, Laxmi Publications Pvt. Ltd

HCH 2.2: MARINE AND OFFSHORE STRUCTURES

Course Objectives

Pre-requisite: HCH 1.2 Wave Hydrodynamics

The main objective of this course is introducing to students the different types of marine and offshore structures and their applications.

1. To familiarize the students the different types of Marine structures
2. To import the knowledge about purpose and applications of different types of Marine and Offshore Structures.
3. To familiarize the basic governing equations for the design of Marine and offshore structures.
4. To develop the skills in design of breakwaters and jacket type platforms in shallow waters
5. To import the skills in conceptual design of subsea pipelines.
6. To import the skills in analysis of launching of jacket platforms.

Introduction, Coastal Protection works – Seawall – Groins – Structural aspects – Sand dunes – Vegetation – Beach nourishment.

Break waters – Types – Selection of site and type – Effects on the beach – Design principles of Rubble mound, vertical wall and composite Breakwaters – Stability of Rubble Structures.

Wharves and Jetties – Types – Materials of Construction – Design Principles – Deck for fenders – Types – Design.

Learning Outcomes

Students will be able to

- *Understand the various components of Marine and Offshore Structures and their merits and demerits.*
- *Preliminary design concepts of marine and offshore structures as per the BIS, DNV and API codes and guidelines.*
- *Evaluate the environmental forces applicable to marine and offshore structures.*
- *Evaluate the functional loads and buoyancy laods applicable to marine and offshore structures.*
- *Design of coastal protection structures like breakwaters, seawalls, groins etc., for shallow wate*

Dolphins – Mooring Accessories.

Submarine Pipelines – Route selection and Diameter / wall thickness calculations; Pipeline stability, free span calculations; Concrete coated pipelines and pipe-in-pipe insulated pipelines; Design using DNV 81 code.

Introduction: Offshore definition, Purpose of Offshore Structures, Classification and Examples, Various types of Offshore Structures – Jacket Platforms, Semi submersibles, Tension Leg Platforms, Gravity Platforms Guyed Towers, Articulated Towers.

Learning Outcomes

Students will be able to

- *Design of port structures like berthing structures, relieving platforms, wharves, jetties and mooring dolphins.*
- *Design of offshore structures like jacket platform etc., for shallow waters.*

Carryout design analysis for Launching of jacket platforms

Load Calculations:Environmental loads on offshore structures due to a)Wind b) Wave c) Current d) Ice e) Earth quake, Functional loads, Buoyant Forces. Installation forces, Soil structure interaction.Wave force calculation on a Jacket platform and Semi submersible.

Preliminary design aspects of offshore structures, Construction, Towing and installation procedure of Jacket platforms and Gravity platforms.

Learning Outcomes

Students will be able to

- *Calculate the diameter/wall thickness of subsea pipeline based different design criteria.*
- *Analyses different methods of subsea pipeline laying.*

Course Outcomes

Students will be able to

- Understand the conceptual design of different on-shore structures and Offshore Structures
- Compute the different types of loads for the analysis of on-shore and offshore structures.
- Learns the basic governing equations for the preliminary design concepts of on-shore and offshore structures.
- Design the breakwaters as per the CEM guidelines and BIS codes.
- Design the Jacket platforms and subsea pipelines based on DNV and API codes.

Text Books/Reference Books:

1. *Hydrodynamics of Offshore structures, Chakrabarthi, S.K., WIT Press / Computational Mechanics.*
2. *Mechanics of Wave Forces on Offshore structures, Turgut Sarpkaya & M. Issacson, Van Nostrand Reinhold Co.*
3. *Structural Engineering, Dawson, T.H.,Offshore Prentice Hall Inc Englewood Cliffs, N.J.*
4. *Dynamic Analysis of Offshore Structures, Brebia, C.A and S. Walker, New Butterworths, U.K.*
5. *API, Recommended Practice for Planning, Design*ning and Constructing Fixed Offshore Platforms, American Petroleum Institute Publication.

HCH 2.3 SITING AND PLANNING OF PORT AND HARBOUR INSTALLATIONS

Course objectives:

- Importance, need and necessity of Navigation / water transport along with ports, Harbours and docks.
- To build the student proficiency in site selection planning of port, Harbours and docks.
- To develop the skills pertaining to survey and analysis of Hydrological, bathymetric wave data etc.
- To develop the knowledge on Harbour and port facilities including off-shore/on-shore structures like break water, groynes, dwarfwall and jetty structures etc.
- Improve knowledge on different types of ports, harbours, docks including navigational aids etc.

History of port growth – Factors affecting growth of port.

Classification of Harbours – Planning of a port – Ship characteristics as they relate to port planning – Need and economic justification of a port – Volume and type of commerce – Hinterland studies and growth.

Learning outcomes:

The students will be familiar with

- *Hinter land / Economic development due to the establishment of port and harbours.*
- *The skill for selection of site for port, harbour and docks based on the meteorological, hydrological, oceanographic data and engineering surveys.*
- *The knowledge on planning of off-shore/ on-shore structures like break water, groynes, dwarf wall and jetty etc.*
- *The knowledge of types of cargo, ship characteristics, channel maintenance and terminal basin etc.*
- *Signaling systems, R.S and GIS technologies.*

Meteorological, Hydrographic and oceanographic data required for port design – Determination of best location of a harbour to afford maximum protection, minimum maintenance and facilities for expansion.

Size and shape of harbour and turning basin – Type, location and height of Breakwaters – Location and width of entrance to harbour – Depth of harbour and navigational channel – Number, location and type of docks or berths or jetties.

Shore facilities for Marine terminals and fishing harbours.

Course outcomes:

Students will be able to

- Recognize the significance of water transport systems like port and harbour.
- Conduct different surveys / data collection and analysis for the construction of port and harbour.
- Select the site for planning of port, harbor and docks etc.
- Plan the off-shore and on-shore structures like break water, groynes, jetty and dwarf wall.

- Get the knowledge on types of cargo, ship characteristics, approach channel maintenance and signaling system etc.

References:

1. Dock and Harbour Engineering Vols. I, II & III, Cornick, H.F.,Charles Griffin & Co.
2. Design & Construction of ports and Marine structures, Quinn, A.D.F.,McGraw-Hill.
3. Port Engineering, Brunn, P., Gulf Publishing Co.

HCH 2.4 (a) ESTUARINE HYDRAULICS

COURSE OBJECTIVES

1) To understand the general characteristics of tidal estuaries
2) To impart knowledge of theoretical application to idealised tidal estuaries in rectangular channels
3) To understand the mechanism of arrested salinity wedge and its diffusion process, and analyse the experimental results for stratified estuarine systems
4) To understand dispersion in partially mixed estuaries and have an insight into experimental studies of salinity intrusion in estuaries
5) To impart knowledge of salinity intrusion in mixed flow condition in estuaries

Introduction to estuaries in general, Morphological and geological features. Salinity gradients, Tide propagation and associated currents.

Estuaries classifications, Estuarine residual circulation theories and application.

Learning Outcomes

The student will be able to

- *Carryout analysis for tidal estuaries in rectangular channels*
- *Carryout analysis for tidal estuaries with and without friction*
- *Understand established experimental results of WES flume studies for tidal hydrodynamics*
- *Comprehend the analysis of damped cooscillating tidal wave*
- *Compute hydrodynamic parameters for real estuaries based on results of WES flume studies*
- *Classify the estuaries based on salinity stratification*
- *Understand one-dimensional turbulent diffusion in constant density flow*
- *Understand one-dimensional turbulent diffusion in stratified flow*
- *Understand the effects of salinity and fresh-water flow on tidal conditions*
- *Carryout one-dimensional analysis of mixed estuaries*

Sediment processes (turbidity maximum and fluid mud).

Long-term morphodynamic evolution, Physical processes and management.

Case studies (from literature).

Course Outcomes

On completion of this course, the student will be able to

1) Understand the theoretical basis of the hydrodynamics of tidal estuaries in idealized conditions
2) Compute hydrodynamic parameters using field observations using the analysis validated through established experimental results
3) Classify the estuaries based on stratification condition and apply experimental observation to stratified estuaries
4) Understand the factors influencing distribution of salinity in tidal estuaries

Text books:

1. Estuary and coastline hydrodynamics / Arthur T. Ippen [editor]., New York : McGraw-Hill Book Co.

HCH 2.4 (b) GROUNDWATER HYDRAULICS

Course Objectives:

- Students will understand and be able to apply fundamental concepts of Hydrologic cycle on movement and occurrence of Ground Water.
- To provide students with exposure to the systematic methods for solving engineering problems in groundwater engineering.
- To learn the basic concepts of flow nets, boundary conditions, steady and unsteady flow in confined and unconfined aquifers.
- To build the necessary theoretical background for Ground water modeling using Electrical analogous models and Finite Element/difference models.
- To provide introductory information on the pollutant transport phenomenon in groundwater and remediation.

Introduction: Hydrologic cycle, Movement & occurrence of groundwater, properties of groundwater, general flow equations, Dupuit equation

Fundamentals of Groundwater Flow :Occurrence of Ground Water, Vertical Distribution of G.W., Darcy's Law, Permeability, Porosity, Anisotropic Aquifers, Differential equations of G.W. flow.

***Learning Outcomes**:*

The students will be able to

- *Gains knowledge on fundamental concepts of hydrological cycle and apply for understanding ground water occurrence and movement.*
- *Understand the distribution of ground water.*
- *Apply Darcy's law to ground water towards understanding the ground water hydraulics.*

Potential Flow: Flownets, Boundary conditions, Flow-net construction for confined & unconfined flow systems.

Mechanics of Well Flow: Steady & unsteady flow in confined & unconfined aquifers, Leaky aquifers, Partial penetration of wells, Multiple well systems, Boundary effects & method of images, Well Loses.

Learning Outcomes*:*

The students will be able to

- *Determine the aquifer parameters and yield using well hydraulics.*
- *Gains knowledge on concepts of potential flow and apply to construct flow-net for confined and unconfined aquifers.*
- *Ability to construct steady confined and unconfined aquifers at leaky aquifers.*
- *Know and compute well losses*

Groundwater Modelling: Sand Tank, Heleshaw, Electrical analogous models, Finite Element/Difference models.

Groundwater Development and Management: Design of wells, construction of wells, Well Development, Artificial recharge, Conjunctive use, Salinity of G.W.,

Learning Outcomes*:*

The students will be able to

- *Perform Ground water modeling.*
- *Able to design ground water wells for different field conditions.*
- *Understand construction of wells.*

Groundwater pollution.Sources & type of groundwater contamination, Contaminant transport mechanisms: Advection, Diffusion & dispersion, Mass transport equations, one & two-dimensional modeling

Sorption & other chemical reactions: factors affecting sorption, Sorption isotherms, Sorption effect on fate & transport of pollutants, Estimation of sorption

Biodegradation reactions & kinetics: biological transformations, microbial dynamics, kinetics of biodegradation

Nonaqueous-phase liquids: Types of NAPLs, general processes, NAPL transport computational methods

Groundwater remediation and design: Remedial alternatives, source control, hydraulic controls, bioremediation, soil vapor extraction systems, remediating NAPL sites, emerging technologies

Learning Outcomes*:*

The students will be able to

- *Plan for artificial ground water recharge, conjunctive use of water and understand saline water intrution.*
- *Understand sources and types of ground water pollution, contaminant transport mechanism and sorption*

Course Outcomes:

On the completion of this course,

- Student will able to know the Ground Water origin and affect of Hydrologic cycle on Ground water concentration.
- Able to calculate various fundamental parameters using Darcy's law, Dupuit's equation and estimation of ground water yields.
- Capability to use different effective models for Ground water modeling analysis.
- Able to develop new techniques or methods to reduce the contamination of ground water in various areas around the India.

Text books:

1. Rifai & Newell, Ground Water Contamination, Transport and Remediation by Bedient, , PTR Prentice Hall
2. D.K. Todd, groundwater hydrology, john wiley & sons
3. M.E. Harr, Groundwater and Seepage.

HCH 2.4(c) DESIGN OF OFFSHORE STRUCTURES

Introduction: Offshore definition, Purpose of Offshore Structures, Classification and Examples, Various types of Offshore Structures – Jacket Platforms, Semi submersibles, Tension Leg Platforms, Gravity Platforms Guyed Towers, Articulated Towers.Materials used in offshore structures; elements of hydrodynamics and wave theory-fluid structure interaction.

Load Calculations: I. Environmental loads on offshore structures due to (a) Wind, Wave, Current, Ice and Earth quake- II. Functional loads - III. Buoyant Forces - IV. Installation forces. Design Wave heights and Spectral Definition; Hydrodynamic Coefficients and Marine growth; Fatigue Load. Wave forces on vertical and inclined cylinders, Wave force calculation on Jacket platforms.

Analysis of Offshore structural member using matrix methods: plane truss, plane frame and space frame. Static method of analysis and dynamics of offshore structures. Use of approximate methods - Design of structural elements. Principles of Static and dynamic analyses of fixed platforms, Analysis of Jacket plat form under wave loading.

Dynamic Analysis: Introduction to dynamic analysis and calculation of responses of semisubmersible and TLP's under wave loading.

Preliminary design aspects of offshore structures: Construction, Towing and installation procedure of Jacket platforms and Gravity platforms.

Steel Tubular Member Design:Introduction to tubular joints - Possible modes of failure - Eccentric connections and offset connections Principles of ASD and LRFD; Allowable stresses and Partial Safety Factors; Tubular Members, Slenderness effects; Column Buckling, Design for Hydrostatic pressure; Design for combined axial and bending stresses (API RP 2A guidelines). Simple tubular joints design using allowable loads; stress concentration factors; Fatigue of tubular joints - Fatigue behavior; S-N curves and fatigue damage calculations.

Text Books/Reference Books:

1. Hydrodynamics of Offshore structures, Chakrabarthi, S.K., WIT Press / Computational Mechanics.
2. Mechanics of Wave Forces on Offshore structures, Turgut Sarpkaya & M. Issacson, Van Nostrand Reinhold Co.
3. Structural Engineering, Dawson, T.H.,Offshore Prentice Hall Inc Englewood Cliffs, N.J.
4. Dynamic Analysis of Offshore Structures, Brebia, C.A and S. Walker, New Butterworths, U.K.
5. API, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms, American Petroleum Institute Publication.

HCH 2.5 (a) SEISMIC DESIGN OF PORT STRUCTURES

Course Objectives:

1. To impart the knowledge on earthquake motion and its impart on port structures through the review of the literature on seismic damages occurred in the past for various ports in the world.
2. To introduce performance based design for seismic design of Port Structures.
3. To impartthe design criteria for various types of portstructures such as gravity quay walls, sheet piles, wharves and breakwaters etc.
4. To give exposure to types of seismic analysis towards port structures design.
5. To review the IS codes and international manuals for the seismic design of Port Structures.

Earthquake and Port Structures: Introduction, earthquake motion, liquefaction, tsunamis, port structures, some examples of seismic damages.

Learning Outcomes:

- *Able to evaluate design ground motions.*
- *Know the effects of liquefication, tsunamis on the port structures through case studies.*

Design Philosophy: Performance based designs, reference levels of earthquake motions, performance evaluation.

Damage criteria: gravity quay walls, sheet pile quay walls, pile supported wharves, cellular quay walls, quay walls with cranes, breakwaters.

Learning Outcomes:

- *Able to evaluate seismic performance requirements of port structures.*

- *Understand the damage criteria for pile supported port structures and break waters*
- *Able to understand and apply analysis to assess seismic performance of pile supported wharves.*
- *Able to understand and apply pseudo static analysis for caisson quay walls.*
- *Able to understand and apply effective stress analysis for anchored sheet pile wall design*

Seismic Analysis: Types of analyses, site response/ liquefaction analysis, analysis of port structures, input and output of analysis.

Existing codes and guidelines

Learning Outcomes:

- *Understand the importance of seismic specific design ground motions.*
- *Understand the seismic design guidelines given in various codes and manuals*

Course outcomes:

- Understand the basics and the impact on earthquake motion, liquefaction tunnels on the port structures and damages occurred in the past due to earthquake damages, liquefaction etc.
- Gains knowledge about design philosophy and performanceevaluation of the port structures.
- Understand damage criteria of various types of port structures such as gravity quay walls, sheet piles walls, piles supported wharves, breakwaters etc..
- Aware of types of seismic analysis, liquefaction analysis and apply this knowledge for the analysis of port structures.
- Understand the methods and guidelines of port structure design given in IS codes and international manuals and its limitations and apply to appropriate methods.

References:

1. Bowles, J.E. (1997). Foundation Analysis and Design; Fifth Edition 2012; McGraw-Hill Companies Inc N.Y. USA.
2. Ministry of Transport, Japan (ed) (1999). Design Standard for Port and Harbour Facilities and Commentaries, Japan Port and Harbour Association (in Japanese). ; English edition (2001) by the Overseas Coastal Area Development Institute of Japan.
3. PIANC (2011), Seismic Design Guidelines for Port Structures, Working Group No. 34 of the Maritime Navigation Commission, International Navigation Association, A.A. Balkema, Rotterdam, The Netherlands.

HCH 2.5 (c) WATER RESOURCE SYSTEMS ANALYSIS

Course objectives:

- To introduce the various typres of system approach to water resources planning and management.
- To study the concepts of various linear and dynamic programming tools and their application in water resources Engineering.
- To understand various simulation techniques and their application to water resources problems.
- To study the application of advanced optimization techniques for operation and management of water resources system analysis works

System concepts: Definition, classification, and characteristics of systems - Scope and steps in systems engineering - Need for systems approach to water resources and irrigation.

Linear programming: 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.

Learning Outcomes:

- *Gains knowledge about the classification and characteristics of water resources planning and management.*
- *Analyze linear programming and sensitivity analysis.*
- *Design single and multi-purpose development plans both linear and dynamic programming .*
- *Analyze the problem associated with operation of reservoir involved in linear programming with a case study.*

Dynamic programming: Bellman's optimality criteria, problem formulation and solutions - Application to design and operation of reservoirs, Single and multipurpose reservoir development plans - Case studies.

Simulation: 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.

Learning Outcomes:

- *Understand the need for system approach to water resources and irrigation analysis.*
- *Analyze the problem associated with operation of reservoir involved in dynamic programming by taking up case studies.*

Gains knowledge about simulation techniques and analyze it by taking up case studies.

Advanced optimization techniques: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.

Learning Outcomes:

- *Understand the applications of goal programming model and problems involved in it.*
- *Distinguish problems involved in discrete differential dynamic programming and incremental dynamic programming.*

Gains knowledge about stochastic dynamic programming models and applications of linear decision rule models

Course outcomes:

At the end of the course the student should will be able to:

- Understand the system approaches to water resources planning and management.
- Develop linear programming models and dynamic models and its application for water resources problems.
- Apply simulation techniques for optimal operation of single reservoir systemand develop objective function and constraints for water resources problems using optimization techniques.

References:

1. Daniel P. Loucks and Eelco van Beek, “Water Resources Systems Planning and Management- An Introduction to Methods, Models and Applications”, United Nations Educational, Scientific and Cultural Organization, 7, place de Fontenoy F-75352 Paris 07 SP, 2005.
2. Gupta P.K and Man Mohan, "Problems in Operations Research (Methods and solutions)". Sultan Chand and sons, New Delhi, 1995.
3. Hiller F.S and Liebermann G.J., "Operations Research” CBS Publications and distributions. New Delhi, 1992.
4. Chaturvedi. M.C., "Water Resources Systems Planning and Management". Tata McGraw Hill, New Delhi, 1997.
5. Mays L.W., and Tung YK, "Hydro systems Engineering and Management". McGraw Hill Inc., New York, 1992.
6. Wagner H.M., "Principles of Operations Research with Application to Management Decisions", Prentice Hall, India, New Delhi, 1993.

HCH2.6 HYDRAULICSANDCOASTALENGINEERINGLABORATORY

Course Objectives

Pre-requisite: HCH 1.2 Wave Hydrodynamics

The main objective of this course is introducing to students the measurements of surface wave characteristics, wave forces and flow velocities.

- To familiarize the students the two-dimensional wave flume and mechanics of generation of surface waves.
- To familiarize the students the different types of models and marine measuring instruments.
- To import the knowledge about handling the censors and their application.
- To develop the skills in measurements of wave parameters.

- To import the skills in free surface flow measurements channels.

1. Studyof Pressure Distributionand D/S Profiles over aSpillway.

2. StudyofMeasurementofVelocitiesusingaPitotTubeandCurrentMeterinOpen Channel.
3. Studyof a Venturiflume.

4. StudyofMeasurementofRegularAndRandomWaves-CalibrationofInstrumentsfor theMeasurement of Waves.
5. Studyof Measurement of WaveHeight- Wave Lengthand WavePeriod

6. StudyofMeasurementofWaveReflectionfromBeachandTransmissionThrough/Over the Structures.
7. Studyof Measurement of Wave Force on a Cylindrical Member.

8. Studyof Measurement ofDisplacement ofa Floating Bodyunder Waves.

Course Outcomes

Students will be able to

- Learns the basic governing equations for the preliminary design of model scale ratios and their ranges in carrying out their experiments.
- Understand the making of physical models for the experiments.
- Compute the various censors and their ranges of measurement.
- Operate different machinery and measuring the outputs from the censors.

Learning Outcomes

The Students will be able to

- *Understand the various components of physical modeling in marine and open channel flows.*
- *Plan and arrange the censors/probes required for their experiments.*
- *Plan the experimental programme.*
- *Finalize the type of censors and their appropriate locations to be installed over the models.*
- *Calibrate the censors.*
- *Analyse and plan the appropriate materials required for the experiments.*
- *Carryout preliminary design of scaled down models of marine structures as per the flume constraints.*
- *Evaluate the different outputs obtained from the experimentation and draw the calibration curves and related coefficients.*
- *Study the pressure distribution and Draw the D/S profiles on the spillway.*
- *Measure the forces on the marine structures.*

HCH 2.7 SEDIMENT TRANSPORT & DREDGING

Course objectives:

- To introduce the fundamentals and principles of mechanism of sediment transport, types of sediment load, analytical approaches for measurement of bed load, suspended load and total loads.
- Measurement of sediment load by means of samplers and its approach to sediment transport phenomenon.
- Imparting knowledge on dredging, objectives of dredging, types of dredgers and disposal of dredged materials.
- Case studies on reservoir siltation and river sedimentation.
- Case studies on dredging problems in ports and harbors.

1. Study of basics of sediment transport phenomenon.
2. Estimation of bed load &suspended load and Reservoir Siltation
3. Sediment samplers and sampling: Bed load sampling, suspended load sampling and computation of total load.

L*earning outcomes*:

The students will be able to

- *Gains fundamental knowledge on sediment transport mechanism and various theories involved.*
- *Understand the basics of regimes of flow and bed load transport theories.*
- *Gains knowledge in analytical approaches for the measurement of suspended and total load.*
- *Acquires knowledge on sediment samplers used for measurement of bed load and suspended load.*
- *Obtains knowledge regarding dredging, its importance and various types of dredgers used.*
- *Understand about disposal methods involved in dredging.*

4. Dredging and Disposal of dredged materials.
5. Case studies of Reservoir siltation.
6. Case studies of Dredging in ports and harbours.

***Learning outcomes*:**

The students will be able to

- *Analyze the problems associated with the reservoir siltation issues by taking up the case studies.*

- *Analyze the problems associated with the river sedimentation issues by taking up the case studies.*
- *Analyze the problems associated with the dredging issues involved in port and harbor by taking up the case studies.*
- *Enhance their presentation skills by preparing the report on the case studies gone through them.*

Course outcomes:

- On completion of the course the student will be able to work on measurement of various types of sediment loads on rivers and reservoirs by analytical and experimental approaches.
- The student can gain the knowledge on various types of dredgers and its disposal process.
- The student will be able to analyze the problems associated with the reservoir and river sedimentation issues by taking up the case studies.
- Gains knowledge on various types of dredging problems associated with ports and harbors by taking up the case studies.

References:

1. Mechanics of Sediment Transportation and Alluvial steam problems, Garde, R.J. and K.G. Ranga Raju, Second Edition, Wiley Eastern Limited.
2. Hydraulics of Sediment Transport, Graf, W.H., McGraw-Hill Book Co.
3. Loose Boundary Hydraulics, Raudkivi, A.J.,Pergamon press.
4. Practical Dredging, Cooper, H.R., Brown, Son & Ferguson, Glasgow.
5. Dock and Harbour Engineering Vols. I, II & III, Cornick, H.F., Charles Griffin & Co.
6. Dock and Harbour Engineering, Seetharaman, S. Umesh Publication.

HCH3.1(b) URBAN STORM WATER DRAINAGE

Course objectives:

1. To impart knowledge on urban drainage problems in different climatic conditions.
2. To understand various Urban drainage system planning concepts and master plan for drainage structures.
3. Able to understand various Empirical, Time-area and Unit Hydrograph approaches for urban-runoff computations.
4. To imbibe a spirit of inquiry among graduates in order to promote the importance of controlling storm water pollution and maintenance of urban storm water drainage systems.

5. To consider various fundamental aspects for learning the effective urban storm water drainage systems.

Introduction to Drainage Problems in Different Climates- Urbanization- its Effects and Consequences for Drainage-Interaction Between Urban and Peri-Urban Areas Process of Urbanization and Influence on Hydrologic Cycle.

Planning Concepts and System Planning- Objectives of Urban Drainage and Planning Criteria-

Drainage and System Layout. Planning Tools and Data Requirement- Drainage Master Plan-

Examples for Drainage Structures.

Learning outcomes:

- *Gains knowledge about the drainage problems in different climates and concept of urbanization, that influences hydrological cycle.*
- *Understand concepts of planning, its objectives and criteria for drainage system layout.*
- *Design master plan of drainage system using planning tools.*

Review of Hydrologic and Hydraulic Principles- Urban Hydrologic Cycle- Hydrologic Principles- Rainfall analysis in Urban Environment and Design Storm- Hydraulic Principles-

Hydrodynamic Principles.

Urban Runoff Computations - Empirical- Time-Area and Unit Hydrograph approaches

Design of Drainage System Elements: Hydraulic Fundamentals- Infiltration and on-Site Detention of Storm water- Design of Sewerage And Drainage Channels- Design of Appurtenances- Road Drainage- Design of Pumping Stations.

Control of Storm water Pollution- Pollution Build-Up and Wash off Process with Reference to

Urban Drainage Systems. Source Control in Commercial and Industrial Complexes- Storage Options - Dry and Wet Ponds- Biological Treatment of Wastewater- Chemical Treatment of Storm water.

Learning outcomes:

- *Obtain knowledge regarding principles of urban hydrologic cycle and rainfall analysis.*
- *Design of sewerage, drainage channels, and pumping station.*
- *Analyze storm water pollution control related to urban drainage system.*
- *Analyze the chemical and biological treatment of storm water and waste water.*

Operation and Maintenance of Urban Drainage Systems- Maintenance Requirement for Different

Structures- Maintenance Planning- Cleaning of Sewers and Drains- Inventory of Damages-

Repair Options.

Urban Drainage - Kinematic Wave Theory Approach. Introduction to Urban Watershed

Software's Hydrologic Cistern- Water Conservation and Ecological aspects Water Harvesting.

Learning outcomes:

- *Understand operation and maintenance of urban drainage system and its planning.*
- *Gains knowledge about the damages in sewers and its repair options.*
- *Understand the concept of watershed software's hydrologic cistern, water conservation and ecological aspect of water harvesting.*

Course outcomes:

On completion of the course, the student will be able to develop

1. Skills to understand the problems of urban storm water drainage systems in critical conditions.
2. Capability to design the effective urban storm water drainage system master plans.
3. Skill to overcome the damages occurred during the operation and maintenance of urban drainage system.
4. Capability to design various sewerage and pumping stations considering suitable criteria.
5. Skills related to analyse water and waste water properties that effects urban drainage system

Text-Books

1. Handbook of Applied Hydrology : A Compendium of Water resources by Chow- V.T.

2. Hydrology and hydraulic systems by Gupta- R.S.-- Prentice Hall- Englewood cliffs.

3. Urban Hydrology by Hall- M.J.

4. Hydrology by Viesmann& Knapp.

HCH 3.2 (A) HYDRAULIC STRUCTURES

Course objectives:

- To introduce the fundamentals and principles of site planning and selection of type of the dam.
- To acquire knowledge in actual practices involved in the design of all types of dams that are common in India.
- To give comprehensive understanding on complete planning & design of all types of dams and their stability analysis.
- To impart knowledge on various types of construction and structural problems, their remedial measures associates with gravity and earth dams.
- To impart knowledge on the fundamentals and design principles of spillways and other appurtenant works are also aimed in this course.

Dams: Types, Choice of type of dam, Forces acting on dams, Requirements of stability, Causes of failure.

Gravity dams: Non-overflow and overflow types, Modes of failure and criteria for structural stability of gravity dams, Design of gravity dam, Single step and multistep design, Cracks and joints in a gravity dam, Foundation treatment for gravity dams, Stress concentration around openings in dams,gravity dams subjected to earthquakes.

Learning outcomes:

The students will be able to

- *Understand the basic investigations required for the selection of site for a dam project and gains knowledge required for selection of type of dam.*
- *Design of low and high gravity dams using different design procedures.*
- *Can perform stability analysis on gravity dams including seismic forces.*
- *Gains knowledge regarding opening in dams, various construction issues associated with gravity dams along with their remedial measures.*

Spillways: Different types of spillways and their design principles, Energy dissipation below spillways, Use of hydraulic jump as energy dissipater and design of stilling basins, Types of spillway gates.

Arch dams: Types, loads on arch dams, Cylinder theory – Constant radius, Constant angle, Variable radius types, and Principles of elastic theory and Trial load method of analysis.

Buttress dams: Components, Advantages and Disadvantages, Types, Forces, Theory of buttress design, Buttress spacing and buttress construction details.

Learning outcomes:

The students will be able to

- *Understand the types of spillways and their design principles including spillway gates.*
- *Gains a knowledge on energy dissipating devices used below the spillway along with their design principles.*
- *Analyze and design arch and buttress dams, their classification and problems associated with their construction procedures*

Earth dams: Types of earth dams, Methods of construction, Causes of failure of earth dam, Design criteria for earth dams, Selecting a suitable section for an earth dam, Requirements of safety, Seepage, Construction of seepage line for different conditions, Seepage control methods, Stability analysis for different conditions, Factor of safety against foundation shear, Details of method of construction of earth dams, Maintenance and treatment of common troubles in earth dams.

Appurtenance works: Design principles of various types of crest gates, Stilling basins, and drainage galleries.What hammer analysis and design of surge tanks, Penstocks, Draft tubes and Scroll casing.

Learning outcomes:

The students will be able to

- *Gains knowledge on earth dams, various types, their construction methods and seepage analysis.*
- *Perform design and stability analysis of earth dams.*
- *Understand the design principles involved in various appurtenance works of hydraulic structures like surge tanks and penstocks.*

Course outcomes:

- On completion of the course the student will be able to select the important inputs for the selection of site and dam type suitable to any particular environmental conditions.
- Able to design the gravity dams, earth dams and can perform their stability analysis.
- Understand the design principles of spillways, stilling basins and various appurtenances.
- The student will be well conversant with various design practices for hydraulic structures that are being followed in the country.

References :

1. Theory and Design of Irrigation Structures Vol. I & II, 7th edition, Varshney, R.S., S.C. Gupta and Gupta, R.L.,Nem Chand & Brothers.
2. Irrigation: Practice and Design – Vols. II & III, Khushalani, K.B. and M Khushalani, Oxford of IBH Publishing Co
3. Irrigation and Hydraulic structures, Garg, S.K., Khanna Publishers.
4. Engineering for Dams – Vols. I, II & III, Creager, W.P, J.D. Justin and J. Hinds,John Wiley & Sons.
5. Hand Book of Applied Hydraulics, Davis, C.V. and K.E.Sorensen, Third Edition, McGraw-Hill Book Co

HCH3.2(b) IRRIGATION WATER SYSTEMS AND MANAGEMENT

Course Objectives

1. To impart knowledge on irrigation systems, including different methodologies of irrigation and relative merits and demerits.
2. To understand the importance of soil and water characteristics in agriculture.
3. To visualize the systematic approach for estimating the crop water requirements and effective irrigation system planning.
4. To expose the graduates to various design techniques for effective irrigation.
5. To learn the optimization techniques in water logging and their preventive measures.
6. The graduate able to learn Agriculture Hydrology, various modeling and mitigation measures of droughts.

Irrigation Systems – Major- Mini- Minor Potential Surface- Lift and GW Systems- Methods of Irrigation- Relative Merits and Demerits- Modeling

Soil Physics and Soil Chemistry; Terminology; Soil-Water and Hydraulic Conductivity. Soil

Chemical Properties- Impact of Soil and Water Chemical Concentrations on Yields –

Management of Soil Chemical Concentrations.

Learning outcomes:

- *The student will be able to gains knowledge about irrigation systems, their classification and methods of irrigation.*

Soil Physics and Soil Agriculture- Cropping Pattern- Irrigation- Sustainable Systems.

Planning Irrigation Systems – Crop Water Requirements- Irrigation Frequency- Yield – Methods

of Estimation of Crop Water Requirements – Methods Based on Temperature and Pan

Evaporation; Combined Method; Crop Coefficient Curves.

Surface System Design: Definitions –Furrow System Design – Level Basin System Design –

Graded Border System Design

Learning outcomes:

The student will be able to

- *Understand the concepts of soil physics and soil chemistry which involve planning irrigation systems.*
- *Analyze methods of estimation of crop water requirements which is based on temperature and pan evaporation.*
- *Design the surface system and able to differentiate the various systems involved in it*

Sprinkler System Design: Uniformity and Adequacy of Water Application-Evaporation And

Wind Drift- Components of System Design. Distribution System Design and Layout- Centre

Pivot System- Linear Move System- Big Gun and Boom Sprinkler Systems.

Trickle (Drip) Irrigation System Design: Concept of Trickle System- Emitters – Flow Through

Laterals – Filtration and Water Treatment Systems- Fertilizer Injection Systems.

Water Logging and Prevention and Efficiencies. Optimization Techniques in Planning as

Applied to Irrigation.

Agricultural Hydrology- Subsurface- Unsaturated Flow- Hysteresis- Soil Moisture and Deep

Percolation- Return Flows and Modeling Droughts and Mitigation of Droughts.

Learning outcomes:

The student will be able to

- *Design of sprinkler system and their components.*
- *Analyze the distribution system layout and gains knowledge about the various systems involved in sprinkler system.*
- *Understand filtration and water treatment systems along with fertilizer injection system.*
- *Gains knowledge about optimization techniques in planning as applied to irrigation.*
- *Understand the essence of agriculture hydrology and parameters involved in it.*

- *Understand the modeling and mitigation of drought*

Course outcomes:

On completion of the course, the student will be able to develop

1. To understand the benefits and necessity of irrigation and to suggest for suitable irrigation methods. Also to understand the consequences of over irrigation.
2. Basic understanding on impact of soil and water chemical concentration on yields and able to manage soil chemical concentrations.
3. Ability to design and implementation of new methodologies for effective irrigation practices.
4. Capability to determine the solutions to various related problems.

Text Books

1. Water Resources Systems Planning and Management by Chaturvedi- M.C. Tata McGraw Hill

2. Economics of Water Resources Planning by v James L.D and Lee R.R-- McGraw Hill

3. Irrigation Theory &Practise by Maiche

4. Irrigation System Design (An engineering approach) by Richard H. Cuenea- Prentice Hall

5. Water Resources Systems Planning and Analysis by Deniel P. Louchs- Jerry R. Stedinger and Danglass. A. Haith- Prentice Hall.

Reference Books

1. Irrigation – Principles and methods by Irstelsen and Hanesn.

2. Hydro Systems Engineering and Management by Mays L.W. and Tung Y.K.- McGraw Hill

3. Systems Analysis for Civil Engineer by Ossenburgen P.J.-John Wiley and Sons-Publication of NW- Roorkee

Department of Civil Engineering

SCHEME OF INSTRUCTION & SYLLABUS
FOR

M.Tech. (HYDRAULICS, COASTAL AND HARBOUR ENGINEERING)

(with effect from 2019-20 Admitted Batch)

Department of Civil Engineering

A.U. College of Engineering (A)

Visakhapatnam

Department of Civil Engineering
M.Tech. (HYDRAULICS, COASTAL AND HABOUR ENGINEERING)
Scheme of Instruction and Examination
(with effect from 2019-20 Admitted Batch)

I – SEMESTER

Code No.	Course Title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam (hrs)	Ext.	Sess.		
HCH1.1	Advanced Fluid Mechanics	4	--	4	3	70	30	100	3
HCH1.2	Wave Hydrodynamics	4	--	4	3	70	30	100	3
HCH1.3	Hydrology and Water Resources Engineering	4	--	4	3	70	30	100	3
Program Elective –I HCH1.4	(a) Flood Modeling and Drought Assessment (b) Watershed Management (c) Remote Sensing and GIS Applications	4	--	4	3	70	30	100	3
Program Elective –II HCH1.5	(a) Climate Change and Water Resources Engineering (b) Structural Dynamics (c) Basic Coastal Engineering	4	--	4	3	70	30	100	3
HCH1.6	Computer Programming of Numerical Methods	-	3	3	Viva	50	50	100	1.5
HCH1.7	GIS lab	-	3	3	Viva	50	50	100	1.5
Total		**20**	**6**	**26**		**450**	**250**	**700**	**18**

II – SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam. (hrs)	Ext.	Sess.		
HCH2.1	Free Surface Flow	4	--	4	3	70	30	100	3
HCH2.2	Marine and Offshore Structures	4	--	4	3	70	30	100	3
HCH2.3	Siting and Planning of Port and Harbour Installations	4	--	4	3	70	30	100	3
Program Elective –III HCH2.4	(a) Estuarine Hydrodynamics and Salinity Transport (b) Groundwater Hydraulics (c) Design of Offshore Structures	4	--	4	3	70	30	100	3
Program Elective –IV HCH2.5	(a) Seismic Design of Port Structures (b) Finite Element Method of Analysis (c) Water Resources Systems Analysis	4	--	4	3	70	30	100	3
HCH2.6	Hydraulics and Coastal Engineering Lab.	--	3	3	Viva	50	50	100	1.5
HCH2.7	Sediment Transport and Dredging	--	3	3	Viva	50	50	100	1.5
HCH2.8	Seminar	--	3	3	Viva	50	50	100	2
Total		**20**	**9**	**29**		**500**	**300**	**800**	**20**

III SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec	Tut	Total	Exam (hrs)	Ext	Sess		
Program Elective –V HCH3.1	(a) Environmental Hydraulics (b) Urban Storm Water Drainage	4	--	4	3	70	30	100	3
Program Elective –VI HCH3.2	(a) Hydraulic Structures (b) Irrigation Water Systems and Analysis	4	--	4	3	70	30	100	3
HCH3.3	Dissertation (Preliminary)	--	--	--	Viva	--	100	100	8
Total		**8**	--	**8**		**140**	**160**	**300**	**14**

IV SEMESTER

Code No.	Course title	Scheme of Examination			Total	Credits
		Exam. (hrs)	Ext.	Sess.		
HCH4.1	Dissertation (Final)	Viva	100	--	100	16
Total						**16**

Department of Civil Engineering
M.Tech. (HYDRAULICS, COASTAL AND HABOUR ENGINEERING)

Syllabus

(with effect from 2019-20 Admitted Batch)

I – SEMESTER

HCH 1.1 ADVANCED FLUID MECHANICS

Two dimensional Irrotational Flow- Standard Pattern of Two Dimensional Flows – Uniform flow- Source- Sink- Vortex and Doublet – Spiral Vortex – Flow Past a Half Body – Flow Past a Cylinder with and without Circulation – Flow Past a Rankine Body.

Laminar Flow- Introduction – Transformation – Relationship among Stresses – Relationship between Stresses and Deformations- Navier Stokes equations – Simple Examples of Exact Solution – Poiseuille Flow – Couette Flow – Combination of Poiseuille and Couette Flow – Establishment of Simple Flows – Non linear Exact Solutions – Flow between Convergent and Divergent Plates – Flow against a Normal Wall – Approximate Solutions – Flow past a sphere – Laminar stability Parameter – Analysis of laminar stability – Experimental investigation on laminar stability.

Laminar Boundary Layer- Introduction to the boundary layer – Thickness – Displacement-momentum and energy thickness – Boundary layer equations – Boundary layer along a Flat Plate with Zero Pressure Gradient (Blassius Solution) – Boundary layer Integral Momentum Equation – Transition of Turbulence.

Turbulent Flow- Definitions – Wall Turbulence and Free Turbulence – Isotropic and homogeneous Turbulence – Turbulence intensity and scale and their measures – micro scale and integral scale – Correlations – Lagrangian and Eulerian description of the flow field – Reynolds Equations – Energy and Momentum Equations and Illustration of their Application by the example of Hydraulic Jump – Phenomenological theories – Turbulent Boundary Layer Along a

Flat Plat – Momentum Equation – Turbulent flow in pipes – Pipe Resistance Factor – Boundary Layer Separation – Wake Behind Cylinder – Simple Example of Free Turbulence Shear Flows.

Text Books / Reference Books

1. *Applied Hydrodynamics by Valentine- H.R.- Butterworth's Scientific Publications.*
2. *Engineering Fluid Mechanics Vols. I and II by Narasimhan- S.- Orient Longman. .*
3. *Boundary layer theory by H. Schlichting.*
4. *Elementary Mechanics of Fluid by Hunter Rouse.*
5. *Hydraulic Machines by P. Kumar- BSP Books PVT Ltd*

HCH 1.2 WAVE HYDRODYNAMICS

The Basics for the application of Potential Theory to Water Wave Problems – General Governing Equations – Bernoulli's Generalized Equation and General Boundary Conditions.

Approximating the Governing Equations Based on Physical Reasoning – Solutions of Linear Equation for Progressive and Standing Waves – Pressure Velocity Fields – Surface Profile and Dispersion Relationship – Principle of Super Position – Wave Energy- Energy Flux And Energy Principle – Group Velocity.

Various Perturbation Schemes for Solving Water Wave Problems – Stokes' Wave – Derivation of Second Order Governing Equations and Outline of Their Solution – Mass Transport and the Momentum Principle (Radiation Stresses) – Limitations of The Stokes' Solution – Cnoidal Waves And Solitary Waves – Wave Breaking Criteria.

Wave Refraction – Graphical Techniques – Wave Diffraction Around Breakwater and Through Breakwater Gaps. Wind Generated Wave – Some Statistical Aspects- Rayleigh Distribution Wave Heights- The Wave Spectrum and Mathematical Spectrum Models – PM- JANSWOP Etc. – Wave Forecasting Using SMB's Significant Wave Height Method and PNJ Wave Spectrum Method.

Wave Forces on Piles – Basic Assumptions – Values of the Inertia and Drag Coefficients and their Dependence on the Wave Theory Used.

Beach and Shoreline Development – Deltas- Head Lands and Estuaries – Water Movement in Near Shore area Sources and Characteristics of Materials – Littoral Transport – Contribution by Streams – Contribution by Erosion or Coastal Formation – Modes of Littoral Transport – Depths at which Material Moves – Determination of Direction and Direction Variability – Rates of Littoral Transport – Losses of Littoral Material.

Text Books/Reference Books

1. *Shore Protection Manual (CEM)- U.S. Army Coastal Engineering Research Centre.*
2. *Estuary and Coastline Hydrodynamics by Ippen- A.T.- Iowa State University Press.*
3. *Coastal Engineering Vols. I & II by Silvester- R.- Elsevier Scientific Publishing Co.*
4. *Oceanographical Engineering by Wiegel- R.R.- Prentice Hall Inc.*
5. *Wind Waves and Maritime Structures by Minikin- R.R.-Charles Griffin & Co.*
6. *Coastal Hydraulics by Muir Wood- A.M. and C.A. Fleming- John Wiley and Sons.*
7. *Coastal Processes with Engineering Applications by Robert- A. D.- Cambridge University Press.*
8. *Coastal Hydrodynamics by Mani.- J.S.-PHI Learning Pvt. Ltd*

HCH1.3 HYDROLOGY AND WATER RESOURCES ENGINEERING

Part A: Hydrology

Runoff-Runoff Process – Unit Hydrograph – Derivation and Analysis – S-Hydrograph – Synthetic Unit Hydrograph-Instantaneous Unit Hydrograph – Methods of Determining IUH – Conceptual Models of IUH – Formulation of Models – Concept of Linear Reservoir- Models of Nash and Dooge and Kulandaiswamy- Nonlinearity of Runoff-Distribution – Overland Flow Steam Flow – Flow Duration and Mass Curves and Time Series Analysis.

Floods: Importance of Flood Studies – Definition- Causes of Floods- Seasonal Distribution of Floods- Design Flood- Factors Affecting Flood Flow; Magnitude and Frequency of Floods – Empirical- Probability and Unit Hydrograph Methods; Flood Control Measures: Flood Control

Reservoirs – Types- Location- Size – Levees and Flood Walls – Stage Reduction and Reduction in Peak Discharge Flood Routing Through Reservoirs.

Part B : Water Resources Engineering

Introduction to Water Resources- Hydrological Cycle – Characteristics – Surface and Ground Water Resources – Quality Conservation and Flood Control; Water Resources Planning – Purpose of Water Resources Development- Classification of Water Resources Development Projects- Functional Requirements of Multipurpose Projects- Process of Project Formulation- Project Evaluation- Strategies for the Future- Planning Strategies- Management Strategies.

Climate Change on Water Resources - Climate and Weather- the Vital Importance of Monsoon Rains- Clouds- Storms and Precipitation- Influences and Feedbacks of Hydrological Changes on Climate- Observed Climate Change Impacts- Future Changes in Water Availability and Demand Due to Climate Change- Climate Related Drivers of Freshwater Systems in the Future- Impacts of Climate Change on Water Stress in the Future- Freshwater Areas and Sectors Highly Vulnerable to Climate Change- Potential Water Resource Conflicts Between Adaptation and Mitigation.

Site Investigations and Design Aspects of Water Resources - Surface Water Resources –Minor Tanks- Reservoirs- Diversion Head Works; Ground Water Resources – Tube Wells- Open Wells. Rainwater Harvesting- Rainwater Harvesting- Artificial Recharge of Ground Water.

Application of Remote Sensing (RS) and Geographical Information System (GIS) in Water Resource - A Brief History of RS- Sensor Systems Used in RS- RS Satellites- Landsat- and IRS. Remote Sensing Applications in Civil Engineering Projects GIS Over View- GIS Components- Raster Data Models and Vector Data Model- Application of RS and GIS in Water Resources Engineering.

Reference Books

1. *Hydrology by Wisler- C.O. and E.F. Brater- John Wiley and Sons..*
2. *Geo-Hydrology by De Wiest- R.J.M.- John Wiley and Sons.*
3. *Hydrology for Engineers by Linsley- R.K.- M.A. Kohler and J.L.H. Paulus McGraw-Hill.*

4. *Water Resources Engineering by Linsely- R.K.- J.B. Franzini- D.L. Freyberg and G. Tchobanoglous- McGraw- Hill Publishing Co.; 4th edition.*
5. *Irrigation Engineering and Hydraulic Structures by Garg S.K. Khanna Publishers.*
6. *Principles of Geographical Information Systems for land resource assessment by Burrough- P.A.- Clarendon press- Oxford.*
7. *Remote Sensing in Civil Engineering by Kennie- J.M. and M.C. Matthews McGraw-Hill.*
8. *Remote Sensing: Principles and Interpretation by Sabins F.F.-Waveland Pr Inc- 3rd Edition.*
9. *Impacts of climate change and climate variability on hydrological regimes by Jan C. van Dam- Cambridge University Press.*
10. *IPCC fourth assessment report- The AR4 synthesis report*
11. *IPCC fourth assessment report- Working Group I report- The physical Science Basis.*
12. *IPCC fourth assessment report- Working Group II report- Impacts- Adaptation and vulnerability.*
13. *IPCC fourth assessment report- Working Group III report- Mitigation of Climate Change.*

HCH1.4(a) FLOOD MODELLING AND DROUGHT ASSESSMENT

Flood Estimation **:** Hydrologic extremes – Flood – Types of Flood – Effects of Flood – Design Flood - SPF/MPF - Estimation of design flood – Physical Indicators - Envelope curves - Empirical methods – Rational method - Statistical methods – Frequency analysis – Unit hydrograph method.

Flood Modeling And Management **:** Hydrologic and Hydraulic Routing – Reservoir and Channel Routing - Flood Inundation Modeling – HEC HMS and HEC RAS software's - Flood control methods – Structural and non structural measures - Flood Plain Zoning – Flood forecasting – Flood Mitigation - Remote Sensing and GIS for Flood modeling and management.

Drought And Impacts : Definition – Definitions based on rainfall- stream flow- vegetation and comprehensive aspects - Characterization of Drought/water shortage/aridity/desertification - Types of Drought – NCA classification – Impacts of Drought – Environmental- Social and Economical aspects

Drought Assessment: Drought Severity Assessment – Meteorological Hydrological and Agricultural methods – Drought Indices – GIS based Drought Information system – Drought Vulnerability Assessment and Mapping Using GIS.

Drought Monitoring And Management: 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

Reference Books

1. *Applied Hydrology by Chow V.T.- Maidment D.R.- Mays L.W.- McGraw Hill Publications- New York- 1995.*
2. *Elementary Hydrology by Vijay P.Singh.- Prentice Hall of India- New Delhi- 1994.*
3. *Drought Research Needs by Yevjevich V.- Water Resources Publications- Colorado State University- USA- 1977.*
4. *Flood Routing Methods as Applied to Indian Rivers by Rangapathy V.- Karmegam M.- and Sakthivadivel R.- Monograph in- Anna University Publications*

HCH1.4(b) WATERSHED MANAGEMENT

Common Syllabus for HCH1.4(b) and EEM1.4(b)

Watershed Management Concept - Introduction- Concept of Watershed Management- History of Watershed Management and its Relevance to India- Watershed Characteristics; Climatic Characteristics- Physiographic Characteristics- Causes of Watershed Deterioration- Effect of Watershed on the Community- Water Resources Region of India

Principles of Watershed Management- Integrated Watershed Management Approach (IWMA)- Objectives of IWMA- Envisaged Results- Success Criteria- Selection of Watershed Village- Equity Issues for Watershed Policies- Factors Causing The Inequality- Benchmark Survey- Remote Sensing Survey in Watershed Management- Land Capability Classification.

Soil Erosion: Introduction- Soil Erosion- Factors Affecting Soil Erosion- Different Types and Causes of Erosion- Geologic Erosion- Accelerated Erosion- Estimation of Loss of Soil from Erosion- Soil Loss Models- Sediment Models- Bed Load Models- Control of Soil Erosion Management of Natural Drainages- Introduction- Check Dam- Structures for Gully Stabilization and Storage of Water- Rivers or Stream Bank Management Measures in Watershed- River Training Works- Methods of River Training Works.

Wasteland and Land Drainage Management- Introduction- Causes of Wasteland – Water Logging- Salinity- Soil Erosion- Overgrazing- Mining Operation- Industrial Effluent- Brickfields- Inadequate Surface and Subsurface Drainages- Remedial Measures in Wasteland Management- Land Drainage Management- Surface or Overland Drains- Subsurface or Underground Drains- Discharge and Spacing of tile Drain.

Flood Damage Mitigation Management- Introduction- Mitigation Measures- Structural Mitigation Measures- Non-Structural Mitigation Measures- Flood Plain Zoning- Flood Forecasting.

Water Harvesting- Introduction- Techniques of Water Harvesting- Indigenous Water Harvesting Methods in India- Engineering Methods of Water Harvesting.

Watershed Modeling- Introduction- Data of Watershed for Modeling- Application of Watershed Models- Model Calibration and Validation.

Text Book

1. *Watershed management by Madan mohan das- Mimi das Saikia- PHI learning pvt. Ltd.*

Reference Books

1) *Watershed Management by Murty- J.V.S.-- New Age Intl.- New Delhi 1998.*
2) *Decision Support System for Integrated Watershed Management by Allam- G.I.Y.-- Colorado State University- 1994.*
3) *Watershed Planning and Management by Vir Singh- R.-- Yash Publishing House- Bikaner-*
4) *Watershed Management- American Soc. of Civil Engineers- New York- 1975.*

HCH1.4(c) REMOTE SENSING AND GIS APPLICATIONS

Common Syllabus for HCH1.4(c), SMFE1.4(c) and EEM1.4(c)

Introduction - Definition- Principle of Remote Sensing- History of Development of Remote Sensing- Stages in Remote Sensing- Electromagnetic Radiation and the Electromagnetic Spectrum- Interactions With the Atmosphere- Atmospheric Scattering- Atmospheric Absorption- Atmospheric Windows- Refraction- Interaction of EMR with the Earth's Surface- Reflection- Transmission- Spectral Signature.

Platforms & Sensors- Remote Sensing Systems- Remote Sensing From Space- Remote Sensing Sensors- Resolution- Imaging Sensors- Optical Infrared (OIR) Imagers- Optical Sensors- Thermal Sensors- Microwave Sensors- Active Microwave Sensors- Data Preprocessing- Remote Sensing in India.

Introduction to Image Interpretation- Basic Principles of Image Interpretation- Elements of Image Interpretation- Techniques of Image Interpretation- Interpretation Keys- Introduction to Digital Image Processing- Digital Image- Image Rectification and Registration- Geometric Correction- Image Enhancement Techniques (Only Concepts)- Image Classification - Unsupervised Classification and Supervised Classification- Digital Photogrammetry - Stereo Images from Satellites - Data Merging .

Geographic Information Systems (GIS)- Definitions and Related Technology- GIS Operations- GIS Elements- GIS Concepts and Practice- Map Projection and Coordinate System.

Vector Data Model- Introduction- Vector Data Representation- Geometric Objects- Topology.

Vector Data Analysis- Introduction- Buffering- Applications of Buffering- Map Overlay- Feature Type and Map Overlay- Map Overlay Methods- Slivers- Error Propagation in Map - Overlay- Distance Measurement- Map Manipulation.Raster Data Analysis- Introduction- Analysis Environment- Local Operations- Local Operations With a Single Grid- Local Operations With Multiple Grids- Neighborhood Operations- Zonal Operations.

Terrain Mapping and Analysis- Introduction- Data for Terrain Mapping and Analysis- Surface Models-DEM- TIN.

GIS Models and Modeling- Introduction- GIS Modeling- Binary Models- Index Models

Remote Sensing & GIS Application in Civil Engineering – Some Case Studies from Literature.

Text Books

1. *Fundamentals of Remote Sensing 2nd Ed by George Joseph- University Press- New Delhi.*
2. *Introduction to Geographic Information Systems by Kang Tsung Chang- Tata Mc.G.H. Publications- New Delhi.*
3. *Remote Sensing and Image Interpretation by Lillesand- T.M. and Kieffer- Joh Wiley and Sons- New York- 1987.*

Reference Books

1. *Remote Sensing of the Environment – An Earth Resource Prespective by John R. Jensen- Pearson Education- New Delhi.*
2. *Geographic Information Systems: A Management Perspective by Aronoff- S. Ottawa: Wdl Publications- 1989.*
3. *Geographic Information Systems For Geoscientists: Modeling with GIS by Bonham Carter- G-F.- New York: Pergamon Press- 1994.*
4. *Principles of Geographical Information Systems by Burrough- P.A And R.A. Mcdonnell.. Oxford: Oxford University Press- 1998.*
5. *Concepts and Technologies of Geographic Information Systems by Lo- C.P.- and Albert K.W. Young- Prentice Hall of India (Pvt) Ltd- New Delhi.*
6. *Introductory Digital Image Processing by John R Jensen- Prentice Hall- New Jersey.*
7. *Application of Remote Sensing to Hydrology Including Groundwater by Farsworth- R.K.- Bawetl- E.C. & Dhanju- M.S.-- IHP- UNESCO- 1984.*

HCH1.5(a) CLIMATE CHANGE AND WATRE RESOURCES ENGINEERING

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.

Global Scenario – Indian Scenario – Observed Changes and Projected Changes of IPCC - Impacts on Water Resources – NATCOM Report –Impacts on Sectoral Vulnerabilities – SRES – Different Scenarios

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.

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.

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.

Reference Books

1. *Climate change and water- IPCC Report Technical Paper VI- 2008.*
2. *UNFCC Technologies for Adaptation to climate change- 2006.*
3. *Climate Change and India: Vulnerability assessment and adaptation by P R Shukla- Subobh K Sarma- NH Ravindranath- Amit Garg and Sumana Bhattacharya-- University Press (India) Pvt Ltd- Hyderabad.*

4. *Preliminary consolidated Report on Effect of climate change on Water Resources- GOI-CWC- MOWR- 2008*.

HCH1.5(b) STRUCTURAL DYNAMICS

Common Syllabus for ST1.5(b) and HCH1.5(b)

One Degree Systems: Undamped systems, Various forcing functions damped systems, Response to pulsating force, Support motion.

Lumped Mass Multidegree System: Direct determination of natural frequencies, Characteristic shapes, Stodola-Vianelle method, Modified Rayleigh-Ritz method, Lagrange's equation, Model analysis of multi degree systems, Multistorey rigid frames subjected to lateral loads, Damping in multi degree systems.

Structures with distributed mass and load, Single span beams, Normal modes of vibration, Forced vibrations of beams, Beams with variable cross-section and mass.

Approximate design methods, Idealized system, Transformation factors, Dynamic reactions response calculations, Design example (RC beam, Steel beam and RC slab), Approximate design of multi degree systems.

Matrix Approach: Coordinates and lumped masses, Consistent mass matrix, Undamped force vibration of a system with one degree freedom, Response of single degree freedom undamped system, Viscous damped vibration of a single degree freedom system, Undamped vibration of multi degree freedom system, Orthogonality of natural nodes, Normal coordinates.

Text Books

1. *Structural Dynamics by John M. Biggs. McGraw-Hill*
2. *Dynamics of Structures, Theory and Applications to Earthquake Engineering by Anil K. Chopra, Prentice Hall of India.*

Reference Books

1. *Structural Analysis by A. Ghali & A.M. Neville, CRC Press.*

HCH1.5(c) BASIC COASTAL ENGINEERING

Introduction- General Design Considerations for Coastal Engineering- Long Period Waves- Tides- Tsunamis- Storm Surge and Wind Set Up. Pressure Velocity Fields – Surface Profile and Dispersion Relationship – Wave Energy- Energy Flux And Energy Principle – Group Velocity. Wave Mechanics- Celerity and Group Velocity-Wind Generated Waves.

Wave Transformation- Shoaling- Refraction- Diffraction and Reflection-Wave Breaking Criteria- Wave Forecasting for Deepwater Waves.

Coastal Sediments-Coastal Sediment Characteristics- Initiation of Sediment Motion Under Waves- Radiation Stress-Wave Set-Up and Wave Set- Down- Mechanics of Coastal Sediment Transport – Limits for Littoral Drift – Suspended and Bed Load – Alongshore Sediment Transport Rate – Distribution of Alongshore Currents and Sediment Transport Rates in Surf Zone.

Onshore- Offshore Sediment Transport – Coastal Features – Beach Features – Beach Cycles – Beach Stability – Beach Profiles -Coastal Erosion- Planning And Methods of Coast Protection Works.

Design of Shore Defense Structures – Non-Breaking and Breaking Wave Forces on Coastal Structures –Wall Types Structures and Breakwaters- Classification- Design and Application in Coastal Protection and Harbor Planning- Case Studies on Coastal Erosion and Protection. Impacts of Coastal Structures on Shoreline Changes. Seawalls- Breakwaters- Groins- Jetties.

Text Books

1. *Basic Coastal Engineering by Sorenson- R.M.-- A Wiley-Inter science Publication- New York- 1978*
2. *Water wave mechanics for engineers and scientists by Dean and Darlymple.*
3. *Coastal Hydrodynamics by J.S. Mani- PHI Learning*

4. *Coastal Engineering by Horikawa- K.-- University of Tokyo press- 1978*
5. *Introduction to coastal Engineering and Management by Kamphius- J.W.*
6. *Advances on Ocean Engineering-Volume 16- World Scientific-2002.*

Reference Books

1. *Coastal Engineering-Processes theory and design practice by Reeve-D.- Chadwick- A. and Fleming- C- Spon Press- Taylor & Francis Group- London & Paris-2004*
2. *Coastal Stabilisation- Advances on Ocean Engineering-Volume 14 by Silvester- R. and Hsu- J.R.C. World Scientific- 1997.*
3. *Coastal Engineering Manual- U. S. Army Corps of Engineers- Washington- DC 20314-1000- Vol. 1 to 3- July 2003.*

HCH1.6 COMPUTER PROGRAMMING OF NUMERICAL METHODS

Introduction to Programming and Flow Charts- Digital and Analog Computers Functional Organization of a Digital Computer – Counting – Techniques Binary – Binary – Numbers Storage and Retrieval of Information – Programming Language – Applicability of Fortran – Flow Chart Concept – Few Examples.

Arithmetic Expressions and Statements- Arithmetic Expressions – Fortran Constants – Integer- Real and Complex Constants – Fortran Variables – Integer and Real Variables – Rules Regarding the Meaning of Variables and use of Operation of Symbols – Hierarchy of Arithmetic Operations – use of Parenthesis and Rules Regarding Parenthesis – Arithmetic Statements Built-in Functions.

Input Output and Format Statements- Input Output Devices – Rules Punching a Card – The Data Card – Read Statement Data Initialization Statement – Specification Statement Varieties – F E I and a Formats – Blank Field Specification – Carriage Control – Punching of Format Statements – Use of Coding Sheets.

Control Statements- Unconditional and Conditional Control Statements – Small Programmes. Subscripted Variables- Subscripted Variables – Rules Regarding Subscripted Variables – Dimension Statement – General Form – Do Statement – General Form – Continue Statement – Rules Regarding Do Statements and Nested Do Loops – Equivalence Statements – Small Programmes.

Sub-Programming- Subroutines Sub-Programme Statements – Rules Regarding Subroutine Sub-Programmes – Call Statements – Common Statement – Rules Regarding Common Statement – Examples with Small Programmes.

Some Aspects of Fortran 90: Declaration Statements – Logical Constants and Variables – Relational Operators and Expressions – Logical Operators and Expressions – Logical Assignments – Statements – Logical IF Statement – Complex Variable and Expressions – Library Functions – Control Cards – Examples with Programmes.

Programming of Numerical Methods: Calculation of Mean- Variance and Correlation Coefficient – Linear Regression – Simple Linear Programming – Matrix Inversion by Partitioning Method Linear Interpolation – Taylor's Series – Real Roots by Iteration – Newton-Raphson Method – Von Mises Method – Chord Method – Bisection Method. Numerical Differentiation and Integration – Simpson's 1/3 Rule- Trapezoidal Rule – Milne's Predictor Corrector Method to Solve First and Second Order Differential Equations – Runge Kutta Method.

Programming of Some Hydraulics and Coastal Engineering Problems: Hydrograph Analysis- Stress Analysis of Gravity and Earth Dams- Wave Reflection Analysis (Two Probe and Three Probe Methods)- Computation of Wave Force on a Cylinder and a Wall- Best Hydraulic Section- GVF Surface Profile Computations- Bed and Suspended Sediment Load Computations.

Reference Boks

1. *Computer Programming in FORTRAN 90 & 95 by Rajaraman-V., PHI Learning Pvt. Ltd.*
2. *Numerical Methods and FORTRAN Programming: with applications in engineering and science by Daniel- D.M. and S.D. William- Wiley.*
3. *Numerical methods in Fortran by McCormick- J. M. and M. G. Salvadori Prentice Hall.*

HCH1.7 G.I.S. LABORATORY

Students are Supposed to Work on Various Problems Involving the Following Applications Using any GIS Package.

1. Creation of Vector Maps and Raster Maps Through Digitization and Rasterisation
2. Image Processing of Digital Images (Geometric Correction- Image Enhancement- Image Classification)
3. Preparation of Thematic Maps (Land Use/ Land Cover- Road Maps- Drainage Network Map Etc.) From Satellite Image of any Region.
4. Watershed Delineation from Drainage Map and Contour Map of any Region.
5. Development of Digital Elevation Model (DEM) using any Technique.
6. Any simple case study of RS & GIS Application in WRE.

Department of Civil Engineering
M.Tech. (HYDRAULICS, COASTAL AND HABOUR ENGINEERING)

Syllabus

(with effect from 2019-20 Admitted Batch)

II – SEMESTER

HCH2.1 FREE SURFACE FLOW

Introduction- Classification of Flows- Velocity Distribution- Pressure Distribution- Derivation of the General One-Dimensional Equations of Continuity- Energy and Momentum used in Open Channel Flow Analysis.

Steady Uniform Flow and Non-Uniform Flows - Chezy's Equation- Manning's Formulae- Uniform Flow Computations – Hydraulically Efficient Channel Section- Design of Irrigation Channels- Specific Energy- Specific Force- Critical Depth- Calculation of Critical Depth- Applications of Specific Energy- Channel Transitions and Controls- Hydraulic Jumps- Surges.

Gradually Varied Flow: Surface Profile for Gradually Varied Flow.Unsteady Flow in Open Channels**:** Method of Characteristics- Surge Formation. Kinematics of Waves- Flood Routing and Overhead Flow.

Inland Navigation- Introduction- Various Requirements of Navigable Waterways- Various Measures adopted for achieving Navigability- India's Navigable Waterways.

River Engineering- Classification of Rivers- Causes of Meandering- the Aggrading type of River- Degrading type of River- Cutoffs- River Training- Types of Training Works.

Reference Books

1. *Flow in Open Channels by Subramanya- K.- Tata McGraw-Hill Publishing Co. Ltd.*
2. *Flow through Open Channels by K.G. Ranga Raju- Tata McGraw-Hill Publishing*
3. *Open Channel Flow by Henderson- F.M.- Macmillan series in Civil Engineering.*
4. *Open Channel Hydraulics by Chow- V.T.- McGraw-Hill Ltd.*
5. *Engineering Hydraulics by Rouse- H.- John Wiley & Sons Inc.*

6. *Open-Channel Flow by Hanif Choudhury- M.- Prentice Hall of India.*
7. *Irrigation and Hydraulic structures by Garg- S.K.- Khanna Publishers.*
8. *Irrigation and Water Power Engineering by Punmia- B.C. and P.B.B. Lal- Laxmi Publications Pvt. Ltd.*

HCH2.2 MARINE AND OFFSHORE STRUCTURES

Introduction- Coastal Protection Works – Seawall – Groins – Structural Aspects – Sand Dunes – Vegetation – Beach Nourishment.

Break Waters – Types – Selection of Site and Type – Effects on the Beach – Design Principles of Rubble Mound- Vertical Wall and Composite Breakwaters – Stability of Rubble Structures.

Wharves and Jetties – Types – Materials of Construction – Design Principles – Deck for Fenders Types – Design- Dolphins – Mooring Accessories.

Submarine Pipelines – Route Selection and Diameter / Wall Thickness Calculations; Pipeline Stability- Free Span Calculations; Concrete Coated Pipelines and Pipe-In-Pipe Insulated Pipelines; Design using DNV 81 Code.

Introduction- Offshore Definition- Purpose of Offshore Structures- Classification and Examples- Various Types of Offshore Structures – Jacket Platforms- Semi Submersibles- Tension Leg Platforms- Gravity Platforms Guyed Towers- Articulated Towers.Load Calculations: Environmental Loads on Offshore Structures due to A)Wind B) Wave C) Current D) Ice E) Earth Quake- Functional Loads- Buoyant Forces.

Installation Forces- Soil Structure Interaction. Wave Force Calculation on A Jacket Platform And Semi Submersible. Preliminary Design Aspects of Offshore Structures- Construction- Towing and Installation Procedure of Jacket Platforms and Gravity Platforms.

Text Books/Reference Books

1. *Hydrodynamics of Offshore structures by Chakrabarthi- S.K.- WIT Press / Computational Mechanics.*

2. *Mechanics of Wave Forces on Offshore structures by Turgut Sarpkaya & M. Issacson- Van Nostrand Reinhold Co.*
3. *Structural Engineering by Dawson- T.H.-Offshore Prentice Hall Inc Englewood Cliffs- N.J.*
4. *Dynamic Analysis of Offshore Structures by Brebia- C.A and S. Walker- New Butterworths- U.K.*
5. *Recommended Practice for Planning- Designing and Constructing Fixed Offshore Platforms- API- American Petroleum Institute Publication.*

HCH2.3 SITING AND PLANNING OF PORT AND HARBOUR INSTALLATIONS

History of Port Growth – Factors affecting Growth of Port.

Classification of Harbours – Planning of A Port – Ship Characteristics as they Relate to Port Planning – Need and Economic Justification of a Port – Volume and Type of Commerce – Hinterland Studies and Growth.

Meteorological- Hydrographic and Oceanographic Data Required for Port Design – Determination of Best Location of a Harbour to Afford Maximum Protection- Minimum Maintenance and Facilities for Expansion.

Size and Shape of Harbour and Turning Basin – Type- Location and Height of Breakwaters – Location and Width of Entrance to Harbour – Depth of Harbour and Navigational Channel – Number- Location and Type of Docks or Berths or Jetties.

Shore Facilities for Marine Terminals and Fishing Harbours.

Reference Books

1. *Dock and Harbour Engineering Vols. I- II & III by Cornick- H.F.- Charles Griffin & Co.*
2. *Design & Construction of ports and Marine structures by Quinn- A.D.F.- McGraw-Hill.*
3. *Port Engineering by Brunn- P.- Gulf Publishing Co.*

HCH2.4(a) ESTUARINE HYDRODYNAMICS AND SALINITY TRANSPORT

Common Syllabus for HCH2.4(a) and WRE2.4(a)

Tidal Dynamics in Estuaries- Estuaries of Rectangular Section: General Review of Engineering Problems in Tidal Estuaries- General Characteristics of Estuaries- Mathematic Description of Tides Without Friction- Mathematic Description of Tides With Friction- Experimental Results on Cooscillating Tides.

Real Estuaries- Introduction- Methods of Analysis- Numerical Integration Methods- and Harmonic Method- Damped Cooscillating Tide.

The Mechanism of An Arrested Saline Wedge- Introduction- Form Characteristics of Arrested saline Wedges- The Pattern of Velocities- Mixing in Arrested Saline Wedge- Hydrodynamics of Layers- Estimation of the Length of Arrested Saline Wedges in Wide Channels.

Diffusion Processes in Stratified Flow- Introduction- Convective-Diffusion Equation for Turbulent Flow- One-Dimensional Turbulent Diffusion in Constant-Density Flow- One-Dimensional Turbulent Diffusion in Stratified Flow.

Salinity Intrusion in Estuaries- Basics Factors Governing Salinity Distribution in Estuaries- Effects of Salinity and Fresh-Water Flow on Tidal Conditions- Internal Flow Processes- One-Dimensional Analysis of Mixed Estuaries- Experimental Results for WES Tidal Flume.

Reference Book

1. *Estuary and Coastline Hydrodynamics by A.T. Ippen (Author)- Publisher: McGraw-Hill Inc.*

HCH2.4(b) GROUNDWATER HYDRAULICS

Introduction- Hydrologic Cycle- Movement & Occurrence of Groundwater- Properties of Groundwater- General Flow Equations- Dupuit Equation.

Fundamentals of Groundwater Flow- Occurrence of Ground Water- Vertical Distribution of G.W. Flow- Darcy's Law- Permeability- Porosity- Anisotropic Aquifers- Differential Equations of G.W. Flow.

Potential Flow- Flow nets- Boundary Conditions- Flow-Net Construction for Confined& Unconfined Flow Systems.

Mechanics of Well Flow- Steady & Unsteady Flow in Confined & Unconfined Aquifers- Leaky Aquifers- Partial Penetration of Wells- Multiple Well Systems- Boundary Effects & Method of Images- Well Loses.

Groundwater Modeling- Sand Tank-Heleshaw- Electrical Analogous Models- Finite Element/Difference Models.

Groundwater Development and Management- Design of Wells- Construction of Wells- Well Development- Artificial Recharge- Conjunctive Use- Salinity of G.W.

Groundwater Pollution. Sources & Type of Groundwater Contamination- Contaminant Transport Mechanisms: Advection- Diffusion & Dispersion- Mass Transport Equations- One & Two-Dimensional Modeling.

Sorption & Other Chemical Reactions: Factors affecting Sorption- Sorption Isotherms- Sorption Effect on Fate & Transport of Pollutants- Estimation of Sorption.

Biodegradation Reactions & Kinetics- Biological Transformations- Microbial Dynamics- Kinetics of Biodegradation

Nonaqueous-Phase Liquids- Types of NAPL- General Processes- NAPL Transport Computational Methods.

Groundwater Remediation and Design- Remedial Alternatives- Source Control- Hydraulic Controls- Bioremediation- Soil Vapor Extraction Systems- Remediating NAPL Sites- Emerging Technologies

Text Books

1. *Ground Water Contamination Transport and Remediation by Bedient- Rifai & Newell - PTR Prentice Hall*
2. *Groundwater hydrology- D.K. Todd- john wiley & sons*
3. *Groundwater and Seepage by M.E. Harr.*

HCH2.4(c) DESIGN OF OFFSHORE STRUCTURES

Introduction- Offshore Definition- Purpose of Offshore Structures- Classification and Examples- Various Types of Offshore Structures – Jacket Platforms- Semi Submersibles- Tension Leg Platforms- Gravity Platforms Guyed Towers- Articulated Towers. Materials used in Offshore Structures; Elements of Hydrodynamics and Wave Theory-Fluid Structure Interaction.

Load Calculations- I.Environmental Loads on Offshore Structures Due to (A) Wind- Wave- Current- Ice and Earth Quake- II. Functional Loads - III. Buoyant Forces - IV. Installation Forces. Design Wave Heights and Spectral Definition; Hydrodynamic Coefficients and Marine Growth; Fatigue Load. Wave Forces on Vertical and Inclined Cylinders- Wave Force Calculation on Jacket Platforms.

Analysis of Offshore Structural Member Using Matrix Methods- Plane Truss- Plane Frame and Space Frame. Static Method of Analysis and Dynamics of Offshore Structures. Use of Approximate Methods - Design of Structural Elements. Principles of Static and Dynamic Analyses of Fixed Platforms- Analysis of Jacket Plat form under Wave Loading.

Dynamic Analysis-Introduction to Dynamic Analysis and Calculation of Responses of Semisubmersible and TLP's Under Wave Loading.

Preliminary Design Aspects of Offshore Structures- Construction- Towing and Installation Procedure of Jacket Platforms and Gravity Platforms.

Steel Tubular Member Design- Introduction to Tubular Joints - Possible Modes of Failure - Eccentric Connections and Offset Connections Principles of ASD and LRFD- Allowable Stresses and Partial Safety Factors; Tubular Members- Slenderness Effects; Column Buckling- Design for Hydrostatic Pressure; Design for Combined Axial and Bending Stresses (API RP 2A Guidelines)- Simple Tubular Joints Design using Allowable Loads; Stress Concentration Factors- Fatigue of Tubular Joints - Fatigue Behavior- S-N Curves and Fatigue Damage Calculations.

Text Books/Reference Books

1. *Hydrodynamics of Offshore structures by Chakrabarthi- S.K.- WIT Press / Computational Mechanics.*
2. *Mechanics of Wave Forces on Offshore structures by Turgut Sarpkaya & M. Issacson- Van Nostrand Reinhold Co.*
3. *Structural Engineering by Dawson- T.H.-Offshore Prentice Hall Inc Englewood Cliffs- N.J.*

HCH2.5(a) SEISMIC DESIGN OF PORT STRUCTURES

Earthquake and Port Structures- Introduction- Earthquake Motion- Liquefaction- Tsunamis- Port Structures- Some Examples of Seismic Damages.

Design Philosophy- Performance Based Designs- Reference Levels of Earthquake Motions- Performance Evaluation.

Damage Criteria- Gravity Quay Walls- Sheet Pile Quay Walls- Pile Supported Wharves- Cellular Quay Walls- Quay Walls with Cranes- Breakwaters.

Seismic Analysis - Types of Analyses- Site Response/ Liquefaction Analysis- Analysis of Port Structures- Input and Output of Analysis. Existing Codes and Guidelines.

Reference Books

1. *Foundation Analysis and Design by Bowles- J.E. (1997); Fifth Edition 2012; McGraw-Hill Companies Inc N.Y. USA.*
2. *Design Standard for Port and Harbour Facilities and Commentaries- Japan Port and Harbour Association (in Japanese). ; English edition (2001) by the Overseas Coastal Area Development Institute of Japan.*
3. *Seismic Design Guidelines for Port Structures- Working Group No. 34 of the Maritime Navigation Commission- International Navigation Association- A.A. Balkema- Rotterdam- The Netherlands- PIANC (2011).*

HCH2.5(b) FINITE ELEMENT METHOD OF ANALYSIS

Common Syllabus for ST2.2, SMFE2.5(b), WRE2.5(b), HCH2.5(b) and TE2.5(b)

Introduction: A brief history of F.E.M. Need of the method, Review of basic principles of solid mechanics- Equations of equilibrium, Boundary conditions, Compatibility, Strain displacement relations, Constitutive relationship in matrix form, plane stress & plane strain and axisymmetric bodies of revolution with axi-symmetric loading, Energy principles - Raleigh - Ritz method of functional approximation.

Theory relating to the formulation of the finite element method, Coordinate system (local and global), generalized coordinates, Concept of the element, Various element shapes, Discretisation of a structure, Mesh refinement Vs. Higher order element, Interconnections at nodes of displacement models, inter element compatibility, -shape functions.

Basic component – One dimensional FEM single bar element, Beam element : Derivation of stiffness matrix, Assembly of stiffness, Matrix boundary conditions, shape functions for 1 D elements, Initial strain and temperature effects, and trusses under axial forces.

Two dimensional FEM**:** Different types of elements for plane stress and plane strain analysis – Displacement models Generation of element stiffness and nodal load matrices –static condensation.

Isoparametric representation and its formulation for 2d analysis. Formulation of 4-noded and 8-noded isoparametric quadrilateral elements – Lagrangian elements-serendipity elements.

Text Books

1. *Finite Element Analysis by C.S.Krishnamoorthy, (2002), Tata McGraw Hill Publishing Co. Ltd.*
2. *Introduction to Finite Element Method by Desai,C.S.and Abel, J.F.,Van Nostrand, 1972.*

Reference Books

1. *Introduction to Finite Element Method by Tirupathi chandra Patla and Belugundu*
2. *The Finite Element Method in Engineering Science by Zienkiewicz, P., McGraw Hill, 1971.*

HCH2.5(c) WATER RESOURCES SYSTEMS ANALYSIS

System Concepts- Definition- Classification and Characteristics of Systems - Scope and Steps in Systems Engineering - Need for Systems Approach to Water Resources and Irrigation.

Linear Programming- 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.

Dynamic Programming- Bellman's Optimality Criteria- Problem Formulation and Solutions - Application to Design and Operation of Reservoirs- Single and Multipurpose Reservoir Development Plans - Case Studies.

Simulation- 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.

Advanced Optimization Techniques: 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.

Reference Books

1. *Water Resources Systems Planning and Management- An Introduction to Methods- Models and Applications by Daniel P. Loucks and Eelco van Beek- United Nations Educational- Scientific and Cultural Organization- 7- place de Fontenoy F-75352 Paris 07 SP- 2005.*
2. *Problems in Operations Research (Methods and solutions) by Gupta P.K and Man Mohan- Sultan Chand and sons- New Delhi- 1995.*
3. *Operations Research by Hiller F.S and Liebermann G.J.-CBS Publications and distributions. New Delhi- 1992.*
4. *Water Resources Systems Planning and Management by Chaturvedi. M.C.- Tata McGraw Hill- New Delhi- 1997.*
5. *Hydro systems Engineering and Management by Mays L.W.- and Tung YK- McGraw Hill Inc.- New York- 1992.*
6. *Principles of Operations Research with Application to Management Decisions by Wagner H.M.- Prentice Hall- India- New Delhi- 1993.*

HCH2.6 HYDRAULICS AND COASTAL ENGINEERING LABORATORY

1. Study of Pressure Distribution and D/S Profiles over a Spillway.
2. Study of Measurement of Velocities using a Pitot Tube and Current Meter in Open Channel.
3. Study of a Venturiflume.
4. Study of Measurement of Regular And Random Waves - Calibration of Instruments for the Measurement of Waves.
5. Study of Measurement of Wave Height- Wave Length and Wave Period.

6. Study of Measurement of Wave Reflection from Beach and Transmission Through/Over the Structures.
7. Study of Measurement of Wave Force on a Cylindrical Member.
8. Study of Measurement of Displacement of a Floating Body under Waves.

HCH2.7 SEDIMENT TRANSPORT & DREDGING

1. Study of Basics of Sediment Transport Phenomenon.
2. Estimation of Bed Load & Suspended Load and Reservoir Siltation
3. Sediment Samplers and Sampling: Bed Load Sampling- Suspended Load Sampling and Computation of Total Load.
4. Dredging and Disposal of Dredged Materials.
5. Case Studies of Reservoir Siltation.
6. Case Studies of Dredging in Ports and Harbours.

Text Books

1. *Mechanics of Sediment Transportation and Alluvial steam problems by Garde- R.J. and K.G. Ranga Raju- Second Edition- Wiley Eastern Limited.*
2. *Hydraulics of Sediment Transport by Graf- W.H.- McGraw-Hill Book Co.*

Reference Books

1. *Loose Boundary Hydraulics by Raudkivi- A.J.-Pergamon press.*
2. *Practical Dredging by Cooper- H.R.- Brown- Son & Ferguson- Glasgow.*
3. *Dock and Harbour Engineering Vols. I- II & III by Cornick- H.F.- Charles Griffin & Co.*
4. *Dock and Harbour Engineering by Seetharaman- S. Umesh Publication.*

HCH2.8 SEMINAR

Each student has to select a topic and collect about 10 papers with at least 5 journal papers and prepare a report and give a seminar at the end of the semester

Department of Civil Engineering
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Syllabus

(with effect from 2019-20 Admitted Batch)

III – SEMESTER

HCH3.1(a) ENVIRONMENTAL HYDRAULICS

Common Syllabus for EEM3.1(a) and HCH3.1(a)

Hydrology: Statistical analysis of Hydrological Data -, Intensity–Duration frequency Curves. Hydraulics of groundwater flow: Non–equilibrium flow, Yield estimations, Interferences Infiltration galleries, ground water recharge.

Transportation and distribution of water: Storage capacity, Pumping of Water, Design and selection of economical diameter of pumping main. Distribution of Water - Pressure and capacity requirements of distribution system, Analysis of networks, Appurtenances in a distribution layout, detection and prevention of leakage mains.

Hydraulics of Sewers: Design of sewers in full and partial flow conditions, Flow at Sewer transitions, Sewage pumping. Open channel flow–design of open channel flow sections.

Transport phenomenon – diffusion – dispersion – advection – adsorption - conservative and non-conservative pollutants. Governing Equations for flow and transport in surface and subsurface waters-chemical and biological process models-simplified models for lakes, streams, and estuaries.

Modelling of the transport phenomenon: complexity - coupled and uncoupled models – linear and nonlinear models - Solution techniques – calibration. Numerical models: FDM, FEM and Finite volume techniques - explicit vs. implicit methods - numerical errors. Different types of Stream quality modeling and Groundwater transport modeling.

References

1. *Water and waste water Engineering by Fair Gayer and Okun*
2. *Engineering Hydrology by K. Subramanya, Tata McGraw-Hill Education*
3. *Hydrodynamics of transport for water quality modeling by Martin, L.J. and McCucheon, S.C, Lewis Publishers.*
4. *Groundwater by Freeze, R.A. and Cherry. J.A. Prentice Hall,*
5. *Groundwater Hydrology by Todd, Wiley Publications*

HCH3.1(b) URBAN STORM WATER DRAINAGE

Introduction to Drainage Problems in Different Climates- Urbanization- its Effects and Consequences for Drainage-Interaction Between Urban and Peri-Urban Areas Process of Urbanization and Influence on Hydrologic Cycle.

Planning Concepts and System Planning- Objectives of Urban Drainage and Planning Criteria- Drainage and System Layout. Planning Tools and Data Requirement- Drainage Master Plan- Examples for Drainage Structures.

Review of Hydrologic and Hydraulic Principles- Urban Hydrologic Cycle- Hydrologic Principles- Rainfall analysis in Urban Environment and Design Storm- Hydraulic Principles- Hydrodynamic Principles.

Urban Runoff Computations - Empirical- Time-Area and Unit Hydrograph approaches

Design of Drainage System Elements: Hydraulic Fundamentals- Infiltration and on-Site Detention of Storm water- Design of Sewerage And Drainage Channels- Design of Appurtenances- Road Drainage- Design of Pumping Stations.

Control of Storm water Pollution- Pollution Build-Up and Wash off Process with Reference to Urban Drainage Systems. Source Control in Commercial and Industrial Complexes- Storage Options - Dry and Wet Ponds- Biological Treatment of Wastewater- Chemical Treatment of Storm water.

Operation and Maintenance of Urban Drainage Systems- Maintenance Requirement for Different Structures- Maintenance Planning- Cleaning of Sewers and Drains- Inventory of Damages- Repair Options.

Urban Drainage - Kinematic Wave Theory Approach. Introduction to Urban Watershed Software's Hydrologic Cistern- Water Conservation and Ecological aspects Water Harvesting.

Text-Books

1. *Handbook of Applied Hydrology : A Compendium of Water resources by Chow- V.T.*
2. *Hydrology and hydraulic systems by Gupta- R.S.-- Prentice Hall- Englewood cliffs.*
3. *Urban Hydrology by Hall- M.J.*
4. *Hydrology by Viesmann & Knapp*

HCH3.2(a) HYDRAULIC STRUCTURES

Common Syllabus for HCH3.2(a) and WRE3.2(a)

Dams- Types- Choice of Type of Dam- Forces Acting on Dams- Requirements of Stability- Causes of Failure.

Gravity Dams- Non-Overflow and Overflow Types- Modes of Failure and Criteria For Structural Stability of Gravity Dams- Design of Gravity Dam- Single Step and Multistep Design- Cracks and Joints in a Gravity Dam- Foundation Treatment for Gravity Dams- Stress Concentration around Openings in Dams- Gravity Dams Subjected to Earthquakes.

Spillways-Different Types of Spillways and Their Design Principles- Energy Dissipation Below Spillways- use of Hydraulic Jump as Energy Dissipater and Design of Stilling Basins- Types of Spillway Gates.

Arch Dams- Types- Loads on Arch Dams- Cylinder Theory – Constant Radius- Constant Angle- Variable Radius types- and Principles of Elastic Theory and Trial Load method of analysis.

Buttress Dams- Components- Advantages and Disadvantages- Types- Forces- Theory of Buttress Design- Buttress Spacing and Buttress Construction Details.

Earth Dams- Types of Earth Dams- Methods of Construction- Causes of Failure of Earth Dam- Design Criteria For Earth Dams- Selecting a Suitable Section for an Earth Dam- Requirements of Safety- Seepage- Construction of Seepage Line for Different Conditions- Seepage Control Methods- Stability Analysis for Different Conditions- Factor of Safety against Foundation Shear- Details of Method of Construction of Earth Dams- Maintenance and Treatment of Common Troubles in Earth Dams.

Appurtenance Works- Design Principles of Various types of Crest Gates- Stilling Basins- and Drainage Galleries. What Hammer Analysis and Design of Surge Tanks- Penstocks- Draft Tubes and Scroll Casing.

Reference Books

1. *Theory and Design of Irrigation Structures Vol. I & II by Varshney- R.S.- S.C. Gupta and Gupta- R.L.-Nem Chand & Brothers.*
2. *Irrigation: Practice and Design – Vols. II & III by Khushalani- K.B. and M Khushalani- Oxford of IBH Publishing Co*
3. *Irrigation and Hydraulic structures by Garg- S.K.- Khanna Publishers.*
4. *Engineering for Dams – Vols. I- II & III by Creager- W.P- J.D. Justin and J. Hinds-John Wiley & Sons.*
5. *Hand Book of Applied Hydraulics by Davis- C.V. and K.E.Sorensen- Third Edition- McGraw-Hill Book Co*

HCH3.2(b) IRRIGATION WATER SYSTEMS AND MANAGEMENT

Irrigation Systems – Major- Mini- Minor Potential Surface- Lift and GW Systems- Methods of Irrigation- Relative Merits and Demerits- Modeling

Soil Physics and Soil Chemistry; Terminology; Soil-Water and Hydraulic Conductivity. Soil Chemical Properties- Impact of Soil and Water Chemical Concentrations on Yields – Management of Soil Chemical Concentrations.

Soil Physics and Soil Agriculture- Cropping Pattern- Irrigation- Sustainable Systems

Planning Irrigation Systems – Crop Water Requirements- Irrigation Frequency- Yield – Methods of Estimation of Crop Water Requirements – Methods Based on Temperature and Pan Evaporation; Combined Method; Crop Coefficient Curves.

Surface System Design: Definitions –Furrow System Design – Level Basin System Design – Graded Border System Design

Sprinkler System Design: Uniformity and Adequacy of Water Application-Evaporation And Wind Drift- Components of System Design. Distribution System Design and Layout- Centre Pivot System- Linear Move System- Big Gun and Boom Sprinkler Systems.

Trickle (Drip) Irrigation System Design: Concept of Trickle System- Emitters – Flow Through Laterals – Filtration and Water Treatment Systems- Fertilizer Injection Systems.

Water Logging and Prevention and Efficiencies. Optimization Techniques in Planning as Applied to Irrigation.

Agricultural Hydrology- Subsurface- Unsaturated Flow- Hysteresis- Soil Moisture and Deep Percolation- Return Flows and Modeling Droughts and Mitigation of Droughts.

Text Books

1. *Water Resources Systems Planning and Management by Chaturvedi- M.C. Tata McGraw Hill*
2. *Economics of Water Resources Planning by v James L.D and Lee R.R-- McGraw Hill*
3. *Irrigation Theory & Practise by Maiche*
4. *Irrigation System Design (An engineering approach) by Richard H. Cuenea- Prentice Hall*
5. *Water Resources Systems Planning and Analysis by Deniel P. Louchs- Jerry R. Stedinger and Danglass. A. Haith- Prentice Hall.*

Reference Books

1. *Irrigation – Principles and methods by Irstelsen and Hanesn.*
2. *Hydro Systems Engineering and Management by Mays L.W. and Tung Y.K.- McGraw Hill*
3. *Systems Analysis for Civil Engineer by Ossenburgen P.J.-John Wiley and Sons-Publication of NW- Roorkee*

HCH3.3 DISSERTATION (Preliminary)

The student shall submit a brief report on the selected topic of his/her thesis work and attend for a formal viva-voce examination before a committee comprising the Chairman, BOS, Head of the Department and the Guide.

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IV – SEMESTER

HCH4.1 DISSERTATION (Final)

The student shall submit his/her thesis work and attend for a formal viva-voce examination before a Committee comprising the Chairman, BOS, Head of the Department, the Guide and the External Examiner.