

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 HARBOUR 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 (Blasius 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
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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 Chakrabarthy- 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 Losses.

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 Chakrabarthy- 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 stream 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

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Syllabus

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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.