CIVIL ENGINEERING
M.E. (HYDRAULICS, COASTAL AND HARBOUR ENGINEERING)
HCH – FOUR SEMESTER COURSE
SCHEME OF INSTRUCTION AND EXAMINATION

I – SEMESTER

Code No.	Course title	Scheme of Instruction		Scheme of Examination			Total	Credits
		Lec.	Tut/drw.	Duration of Exam. (hrs)	Theory/ Lab./Viva	Sess.		
HCH 1.1	Advanced Mathematics	4	--	3	70	30	100	4
HCH 1.2	Advanced Fluid Mechanics-I	4	--	3	70	30	100	4
HCH 1.3	Nearshore Oceanography & Littoral Processes	4	--	3	70	30	100	4
HCH 1.4	Wave Hydrodynamics	4	--	3	70	30	100	5
HCH 1.5	Hydraulic Structures	4	--	3	70	30	100	4
HCH 1.6	Computer Programming and Numerical Techniques	--	4	-	50	50	100	3
	Total	20 + 4 = 24			400	200	600	24

II – SEMESTER

Code No.	Course title	Scheme of Instruction		Scheme of Examination			Total	Credits
		Lec.	Tut./drw	Duration of Exam. (hrs)	Theory/ Lab./Viva	Sess.		
HCH 2.1	Advanced Fluid Mechanics-II	4	--	3	70	30	100	4
HCH 2.2	Free Surface Flow	4	--	3	70	30	100	4
HCH 2.3	Siting and Planning of Port & Harbour Installations	4	--	3	70	30	100	4
HCH 2.4	Design of Onshore Structures	4	--	3	70	30	100	5
HCH 2.5	Sediment Transport & Dredging	4	--	3	70	30	100	4
HCH 2.6	Hydraulics & Coastal Engineering Lab.	--	4	-	50	50	100	3
Total		20 + 4 = 24			400	200	600	24

III – SEMESTER

Code No.	Course title	Scheme of Instruction		Scheme of Examination			Total	Credits
		Lec.	Tut./ Drg.	Duration of Exam. (hrs)	Theory/ Lab./Viva	Sess.		
HCH 3.1	Design of Offshore Structures	4	—	3	70	30	100	5
HCH 3.2	Hydrology & Water Resources Engineering	4	—	3	70	30	100	4
HCH 3.3	Seminar	—	4	--	50	50	100	3
HCH 3.4	Thesis	—	—	—				
Total		8 + 4 = 12			190	110	300	12

IV-SEMESTER

HCH 4.1	Thesis/Dissertation	100 Marks	Credits: 20
GRAND TOTAL		1600	80

CIVIL ENGINEERING
M.E. (HYDRAULICS, COASTAL AND HARBOUR ENGINEERING)
HCH – FOUR SEMESTER COURSE

HCH 1.1Advanced Mathematics

HCH 1.1 and SMFE 1.1 are Common to Hydraulic egineering / Coastal & Harbour Engineering and Soil Mechanics and Foundation Engineering

Special Function (2 Questions):

Bessel functions of order 'n' of first and second kind values of $J_n(x)$ and $Y_n(x)$ for large and small values of x- Expression for $J_n(x)$ when n is half or an odd Integer – Bessel functions of order n of their kind or Hankel functions of order functions of second kind – generating function or $P_n(x)$ – Orthogonality of $P_n(x)$.

Partial Differential Equations (1 Question):

Laplace equation, Wave equation and Heat equation in cartesian, cylindrical and spherical coordinate systems and their simple solutions.

Integral Transforms:

Fourier transform – Sine and Cosine transform – Transforms of derivates – Finite Fourier transforms – Multiple Fourier transforms – Application of transform techniques to solve differential equations.

Numerical Analysis (3 Questions):

Approximate solutions of first order ordinary differential equations – Euler's method – Error propagation – Runge Kutta method – Simultaneous ordinary differential equations – Multistep method – Predictor corrector methods – Boundary value problems – Simple parabolic differential equations – types of boundary conditions – explicit form of the difference equation – convergence of the implicit form – Solution of equations resulting from implicits method – Consistency – Crank Nicolson scheme for time stepping.

Stochastic Process (3 Questions):

Concept of random variable – Distributions and density functions conditional distribution and density functions – Functions of one and two random variables – Many random variables – Concept of Stochastic Process – Stationary and ergodic process – Transformation of Stochastic processes.

Statistical Methods and Stochastic Process – Correlation – Regression Analysis.

Axioms of Probability, Addition and Multiplication Theories with Random Concept.

Discrete Distributions: Bionomial, Poisson Distribution.

Theoretical Distribution: Normal Distribution.

Reference Books:

1. Applied Mathematics for Engineering and Physicists by Louis A. Pipes.
2. The use of Integral Transforms by I.N. Sneedon.
3. Probability (SI (Metric)) edition Schaums outline series by Semmour Lipschutz.
4. Numerical Methods by S. Arumugam, A. Thangapandi Isaac and A. Somasundaram – Scitech Publications
5. Engineering Maths by S. Arumugam, A. Thangapandi Isaac and A. Somasundaram.

HCH 1.2 Advanced Fluid Mechanics – I

1. Basic concepts: Introduction – Role of Fluid Properties in Fluid Motion – Flow Variables – Continuum – Equation of Continuity – Boundary Conditions – Equations of Stream lines, Path lines and streak lines.
2. Kinematics of Flow: Translation, Deformation and Rotation of a Fluid Element – Vorticity and Circulation – Mathematical Notion of Irrotational Motion – Definition and Properties of Stream Functions – Definition and Properties of Velocity Potential Functions – Definition and Characteristics of Flow Nets – Method of Construction – Seepage Flow Nets for Confined and Unconfined Flows – Numerical Analysis – Experimental Analogies, Membrane, Electrical and Viscous Flow Analogies.
3. Dynamics of Ideal Fluid Flow: Eulers Equation of Motion for a Nonviscous Fluid – Bernoullis Equation – Velocity and Pressure Distribution – Energy Considerations – Determination of Flow Patterns.
4. 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.
5. Three Dimensional Irrotational Flow: Spherical and Cylindrical Coordinates – Stokes Stream Function – Velocity Potential Function – Standard Irrotational Axisymmetric Flow Patterns (Uniform Flow, Source, Doublet, Line Source) – Flow Past a Half Body – Flow Past a Sphere – Flow Past a Rankine Body – Flow Past a Stream Lined Body.
6. Principle of Conformal Transformation: Complex Numbers – Functions of a Complex Variable – Cauchy Riemann equations – Complex Velocity – Theory of Conformal Transformations – Application of Conformal Transformations to Single Cases (Uniform Flow, Source, Vortex, Doublet, Source and Sink, Flow near a Corner, Flow Past a Cylinder with and without Circulation).

Reference books:

1. Applied Hydrodynamics – H.R. Vallentine
2. Engineering Fluid Mechanics – Ed. S. Narasimhan.

HCH 1.3 Near Shore Oceanography and Littoral Processes

Beach and shoreline development – Deltas and Estuaries – Water movement in near shore area – Wave climate in near shore area. Wave generation – Wave decay – Wave reflection – Wave refraction – Wave diffraction – Wave forecasting for deepwater waves – SMB wave spectra or PNJ method for forecasting.

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.

Corrosion and corrosion prevention – Fouling and fouling prevention on Marine Material.

Reference Books:

1. Shore Protection Manual C E R C (US Army).
2. Handbook of Ocean and Under Water Engineering by J.J. Myers.

HCH 1.4 Wave Hydrodynamics

1. The basics for the application of potential theory to water wave problems – General governing equations – Bernoulli's generalized equation and general boundary conditions.

2. 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.
3. 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.
4. Wave refraction – Graphical techniques – wave diffraction around breakwater and through breakwater gaps.
5. 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.
6. Wave forces on piles – Basic assumptions – Values of the inertia and drag coefficients and their dependence on the wave theory used.

References:

1. Shore Protection Manual, U.S. Army Coastal Engineering Research Centre.
2. Estuary and Coastline Hydrodynamics: Ippen.
3. Coastal Engineering Vols. I & II: Sivester.
4. Oceanographical Engineering Structures: Minikin
5. Winds, Wave and Maritime Structures: Minikin.
6. Coastal Hydraulics: A.M. Muir Wood & Fleming.

HCH 1.5 Hydraulic Structures

1. Dams: Types, choice of type of dam, forces acting on dams, requirements of stability, causes of failure.
2. Gravity dams: Non-overflow and overflow types, single step and multistep design, different types of spillways and their design principles, stress concentration around openings in dams.
3. Arch dams: Types, loads on arch dams, cylinder theory – constant radius, constant angle, variable radius types, principles of elastic theory and Trial load method of analysis.
4. Buttress dams: Components, advantages and disadvantages, types, forces, theory of buttress design, buttress spacing and buttress construction details.
5. Earth dams: 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.
6. Appurtenance works: Design principles of various types of crest gates, stilling basins, and drainage galleries.
7. What hammer analysis and design of surge tanks, penstocks, draft tubes and scroll cases.

Texts / References:

1. Creager, Justin and Hinds – Engineering for dams, Vols. I, II & III.
2. Davis and Soresen – Hand Book of Applied Hydraulics, Third Edition, McGraw Hill Book Co.
3. Varshney, R.S., Gupta, S.C., Theory and Design of Hydraulic Structures, Vol. I & II, Second Edition.
4. Khushlani, K.B. and Khushalani, M., Dams Part I & II, Third Edition. Oxford of IBH Publishing House, New Dehli.

HCH 1.6 Computer Programming and Numerical Techniques

1. Introduction to Programming and Flow Charts: Digital and analog computers functional organisation of a digital computer – counting – techniques binary – binary – numbers storage and retrieval of information – programming language – applicability of Fortran – flow chart concept – few examples.
2. Arithmetic Expressions and Statements: Arithmetic expressions – Fortran constants – Integer, real and complex constants – Fortran variables – Integer and real variables – rulef 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.
3. 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 conding sheets.
4. Control Statements: Unconditional and conditional fication of control statements- Unconditional and conditional control statements – small programmes.
5. 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.
6. Sub-Programming: Subroutines sub-programme statements – rules regarding subroutine subprogrammes – call statements – common statement – rules regarding common statement – examples with small programmes.
7. Some Aspects of for train IV: 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.

8. Fortran applied to Numerical Methods: Calculation of mean, variance and correlation coefficient – linear regression – simple linear programming – Matrix inversion by Partitioning method linear interpolation – Teylor's series – Real roots by iteration – Newton Repsan method – Von Misses method – Chordes 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.

Reference Books:

1. A text book on "Computer Programming" by S. Ramani, N.V. Koteswara Rao, R. Nagarajan.
2. Principles of Computer Programming by V. Rajaraman.
3. Numerical methods in Fortran by John M. Msccormic & M.G. Salvadori.

HCH 2.1 Advanced Fluid Mechanics – II

1. 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.
2. 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.
3. 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.
4. Lift and Drag: Circulation and Magnus Effect – Lift and Drag of a Rotating Cylinder – Lift and Drag of the airfoil – Polar Diagram.

Reference Books:

1. Engineering Fluid Mechanics – Ed. S. Narasimhan.
2. Boundary layer theory – H. Schlichting.
3. Elementary Mechanics of Fluid – Rouse.

HCH 2.2 Free Surface Flow

1. Derivation of the general one-dimensional equations of continuity, momentum and energy used in open channel flow analysis.
2. Steady non-uniform flows, channel transitions and controls, hydraulic jumps surges.
3. Surface profile for gradually varied flow.

4. Unsteady flow in open channels, Method of characteristics, surge formation. Kinematics of waves, flood routing and overhead flow.
5. Inland navigation: Introduction, Various Requirements of Navigable Waterways, Various Measures Adopted for Achieving Navigability, India's Navigable Waterways.
6. River Engineering: Classification of Rivers, Causes of Meandering, The Aggrading type of River, Degrading type of River, Cutoffs, River Training, Types of Training Works.

References Books:

1. Open Channel Flow – Henderson.
2. Open Channel Hydraulics – Chow.
3. Engineering Hydraulics – Rouse.
4. Irrigation Engineering and Hydraulic Structures – Santhosh Kumar Garg.
5. Irrigation and Water Power Engineering – DR. B.C. Punmia, Dr. Pande B.B. Lal.

HCH 2.3 Siting and Planning of Port and Harbour Installations

1. History of port growth – Factors affecting growth of port.
2. 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.
3. 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.
4. 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.
5. Shore facilities for Marine terminals and fishing harbours.

Reference Books:

1. Dock and Harbour Engineering by Cornick.
2. Design & Construction of ports and Marine structures by Alanzo De F.Quinn.
3. Port Engineering by Perbrun.

HCH 2.4 Design of On-Shore Structures

1. Introduction.
2. Coastal Protection works – Seawall – Groins – Structural aspects – Sand dunes – Vegetation – Beach nourishment.
3. 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.
4. Wharves and Jetties – Types – Materials of Construction – Design Principles – Deck for fenders – Types – Design.
5. Dolphins – Mooring Accessories.

References:

1. Shore Protection Manual.
2. Design and Constructional of Ports and Marine Structures by A.D.F. Quinn.
3. Dock and Harbour Engieering Vols. I – IV by A.D.F. Quinn.
4. Foundation Design by V.C.W. Teng.
5. Coastal Engineering Vols. I & II by R. Silvester.
6. Port Engineering – Perbrun.

HCH 2.5 Sediment Transport & Dredging Sediment Transport

1. Mode of transport of sediment in open channel – Properties of sediment, critical velocity concept, critical shear stress, lift force mechanism, shield's criterion.
2. Regimes of flow: Description, types of regimes importance of regimes of flow, resistance to flow in alluvial streams, velocity distribution in alluvial streams.
3. Bed load: Du Boy's, Meyer Peter Muller's Equation, Einsteins Theory of bed load movement, Garde and Albertson's Equations.
4. Suspended load: Diffusion – dispersion model, Lane's and Einstein's approaches.
5. Total load: Einsteins bed load function, Modified Einstein's procedure, Laursen's method of estimation of Total load.
6. Dimensional Analysis as applied to sediment transport phenomenon.
7. Sediment samplers and sampling: Bed load sampling, suspended load sampling and computation of total load.

Definition: Objectives of dredging, types of dredging, dredgers and their classification, Mechanical dredgers – Bucket dredger, Grab dredger, dipper dredger, rock breaker, back hoe dredger. Hydraulic dredgers: Plain suction dredger, cutter suction dredger, wheel dredger, trailer suction dredger. Pneumatic dredger, special dredger equipments, underwater drilling and blasting. Improving the efficiency of surface blasting. Disposal of dredged materials.

Texts / References:

1. Garde, R.J. and Ranga Raju, K.G., Mechanics of Sediment Transportation and Alluvial steam problems, Second Edition, Wiley Eastern Limited, 46254/21, Daryaganj, New Delhi.
2. Graf, H.W., Hydraulics of Sediment Transport, McGraw Hill Book Co. New York 1971.
3. Raudkivi, A.J., Loose Boundary Hydraulics, Pergamon press, Landon 1967.
4. Copper Practical Dredging.
5. Cormick, Vol. I & II, Dock and Harbour Engineering.
6. Seetharaman, S. Umesh Publication, 5 – B, Nath Market nai Sarkar, Delhi.

HCH 2.6 Hydraulics and Coastal Engineering Laboratory

1. Pressure distribution and D/S profiles over a spillway.
2. Measurement of velocities is using a Pitot tube and current meter in open channel.
3. Calibration of a venturiflume.
4. Measurement of wave height, wave length and wave period.
5. Measurement of wave reflection from beach.
6. Measurement of wave force on a cylindrical member.
7. Measurement of displacement of a floating body under waves.

HCH 3.1 Design Offshore Structures

1. 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.
2. Load Calculations:
   - I. Environmental loads on offshore structures due to
     - a) Wind b) Wave c) Current d) Ice e) Earth quake
   - II. Functional loads.
   - III. Buoyant Forces
   - IV. Installation forces, Soil structure interaction.

   Wave force calculation on a Jacket platform and Semi submersible.

3. Analysis of Offshore structural member using matrix methods, plane truss, plane frame and space frame. Analysis of Jacket plat form under wave loading.
4. Introduction to dynamic analysis and calculation of responses of semisubmersible and TLP's under wave loading.
5. Preliminary design aspects of offshore structures. Construction, Towing and installation procedure of Jacket platforms and Gravity platforms.

Reference Books:

1. Hydrodynamics of Offshore structures by: S.K. Chakravarthy.
2. Offshore Structural Engineering by: Thomas H Dawson.
3. Mechanics of Wave Forces on Offshore structures by: Turgut Sarpkaya & M. Issacson.
4. API code.

HCH 3.2 Hydrology & Water Resources Engineering

PART – A

(Hydrology)

1. 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, Nash and Dooge's and Kulendaiswamy's model. Nolinearity of runoff-distribution – Overland flow steam flow – Flow duration and mass curves and Time series analysis.
2. 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)

1. Introduction to Water Resources – Hydrological – 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.
2. Site investigations and design aspects of Water Resources:
   - i) Surface water resources : 1) Minor tanks
     2) Reservoirs
     3) Diversion head works
   - ii) Ground water resources : 1) Tube wells
     2) Open wells

   Rainwater harvesting and artificial recharge of ground water.

2. 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.

Books / References:

1. Hydrology by Wisler & Brater.
2. Geo-Hydrology by R.J.M.De Wiest.
3. Hydrology for Engineers by Linskey, Kohler & Paulus.
4. Water Resources Engineering by Linsely & Franzini.
5. Irrigation Engineering and Hydraulic Structures by Santhosh Kumar Garg.
6. Principles of Geographical Information Systems for land resource assessment – P.A. Burrough (Clarendon press, Oxford).
7. Remote Sensing in Civil Engineering – Kennie, J.J.M., Matthews, M.C.
8. Remote Sensing Principles and Interpretation – Floyd F. Sabims, Jr. W.H. Freeman & Co.