

**Curriculum for the Degree of Master of Eng. in Civil Engineering,
Major *Hydraulic Structures Engineering***

COURSE CODE	COURSE TITLE	CREDITS
Semester I (Fall)		
1610500	Engineering Mathematics	3
1614575	Advanced Hydraulics	3
1614600	Concrete Dams	3
1614577	Hydrodynamics	3
Semester II (Spring)		
1612529	Finite Element Method	3
1614598	Hydraulic Structures	3
2 Elective Courses From		
1614578	Numerical Methods in Water Engineering	3
1614602	Hydraulic Models	3
1616557	Earth Dams	3
1612528	Theory of Plates and Shells	3
1612527	Dynamics of Structures	3
1614604	Marine Structures	3
Semester III (Fall)		
9010503	Seminar	2
9010606	M.Sc. Project	6
Semester IV (Spring)		
9010606	M.Sc. Project (Continue)	0

COURSE DESCRIPTIONS

1614575 Advanced Hydraulics 3 Cr. Cavitations control in rapidly varied flow. Supercritical flow in open channels. Specially varied flow. Gradually varied and rapidly varied unsteady flow. Storage and river flow roofing.

1614577 Hydrodynamics 3 Cr. Flow of an ideal fluid, flow of a real fluid, graphical flow nets, numerical analysis and experimental analogies, standard patterns of flow, conformal transformation

1614578 Numerical Methods in Water Engineering 3 Cr. Basic partial differential equations used in surface and subsurface hydrology. Basic concepts of finite difference and finite element methods. Application of numerical methods using the related equations.

1616557 Earth Dams 3 Cr. In this course the design and analyses of earth and rockfill dams are discussed and it can be divided into five basic subjects as: Materials cut off methods, drainage systems, design and foundations.

1614598 Hydraulic Structures 3 Cr. Elements of dam engineering, embankment dam engineering, concrete dam engineering, dam outlet works, energy dissipation, gates and valves, dam safety, diversion works, hydroelectric power development

1612527 Dynamics of Structures 3 Cr. Fundamentals of dynamic of particles & rigid bodies, differential equations, single degree freedom systems, Duhamel's integral, response spectrum, multi-degree freedom systems, systems with distributed mass & elasticity, analysis of frames under base motion for shear & axial forces & bending moments.

1612528 Theory of Plates and Shells 3 Cr. Introduction, circular plates, rectangular plates, plates of various geometrical forms, plate bending by numerical method, plates under combined lateral and direct loads, membrane stresses in shells.

1612529 Finite Element Method 3 Cr. **Introduction to the Use of Finite Elements:** Physical Problems and Mathematical Models, **Formulation:** Mathematical Fundamentals, Weighted Residual Approximations, Weak Formulation and Galerkin Method, Approximation in Solution of Differential Equations , Approximate Solution to Systems of Differential Equations, Differential Equations in Engineering Problems (Solid Mechanics, Heat Conduction), Virtual Work for Solid Problems, Variational Principles in FE Formulation, Continuity Requirements, Piecewise Trial Functions, **The Concepts of Element and Shape-Function:** One Dimensional Lagrange Shape-Functions (Linear and Higher Order Elements), Hermite Polynomials for Shape-Functions with Higher Continuity, Two Dimensional Quadrilateral Elements with Lagrange Polynomials, The Concept of Mapping, Isoparametric, Sub-Parametric and Super-Parametric 2D/3D Elements, Triangular and Tetrahedral Elements, Numerical Integration, Plate Formulation and Elements, Axisymmetric Solid/Shell Problems and the Associated Elements .

1614600 Concrete Dams 3 Cr. An introduction to dam engineering, Definition of concrete dam, Types of concrete dams, Site assessment and selection and selection of type of dam criteria, Gravity dams analysis, Arch dams analysis, Buttress dams analysis, Loads on dams, Stability of dams, Earthquake loading and risk analysis, Dynamic loading, Thermal loading, Reservoir and its equation of motion; Boundary conditions, Fluid-structure interaction, Modeling of the dam-reservoir system, Experimental studies of small scale dam models, Concrete dam construction, Dam safety, Instrumentation and surveillance

1614604 Marine Structures 3 Cr. An Introduction to Hydrodynamics, Airy Wave Theory, Higher order and stretch wave theories, Irregular Sea States, Environmental Loads on Offshore Structures, Wind Loads, Wave Loads, Transverse (Lift) wave loads, Diffraction wave forces, Effect of compliancy (relative motion), Seismic Loads, Types of Offshore structures, Structural Analysis, Foundation Design

1612600 Marine Structures 3 Cr. Earthquake Ground Motion, Seismic Behavior of Structures Ductility and Modeling of Load Bearing Systems, Elastic and Inelastic Earthquake Analyses of Structures Introduction to Performance Based Design, Structural Control, Soil-Structure Interaction