6.1 Summary of Postgraduate Courses

Course No	Subject Title	Credit Hours
Math 6903	Advanced Mathematics	3
NAME 6000	Thesis	M.Sc.Engg.: 18 Ph.D.: 45
NAME 6002	Project	M.Engg.: 6
NAME 6101	Ship Structures-I	3
NAME 6102	Ship Structures-II	3
NAME 6103	Finite Element Methods	3
NAME 6201	Ship Propulsion	3
NAME 6202	Theory of Wave Making Resistance	3
NAME 6203	Sea keeping Performance	3
NAME 6204	Weather Routing of Ships	3
NAME 6205	Boundary Layer Theory	3
NAME 6206	Advanced Computational Fluid Dynamics	3
NAME 6301	Analysis and Design of Welded Structures	3
NAME 6302	Ship Production Technology	3
NAME 6303	Computer Aided Hull Design	3
NAME 6401	Marine Transportation System	3
NAME 6402	Design of Cargo Access Equipment	3
NAME 6403	Computer Simulation	3
NAME 6501	Advanced Marine Engineering	3
NAME 6502	Marine Transmission Systems	3
NAME 6503	Control Theory in Marine System Design	3
NAME 6601	Mechanics of Water Waves	3
NAME 6602	Harbor Engineering	3

NAME 6603	Analysis of Offshore Structures	3
NAME 6604	Hydrodynamic Loading of Floating Bodies	3
NAME 6700	Seminar	0

One Non-Departmental Course other than Math 6903 may be registered.

6.2 Detailed Syllabus of Postgraduate Courses

Math 6903: Advanced Mathematics

3 Credit, 3 hrs. /wk.

Statistics: The Normal distribution. Correlation and Regression. Coefficient of Correlation. Correlation of time series. Characteristic Movements of time series. Moving averages. Measurement of seasonal variation, Forecasting. Chain Base Method and Cost of living index.

Numerical Analysis: Numerical solution of ordinary differential equation, Taylor series Method, Euler's method, Runge-Kutta method. Accuracy of one step method, multistep method. System of differential equation.

Boundary value and Engineering problems (linear and non linear). Shooting method (linear and non linear), finite difference method. Solution of applied problems. Solution of partial differential equation-Elliptic, Parabolic, Hyperbolic partial differential equation with special consideration to Heat Equation.

Fourier Analysis: Fourier series expansion for a single variable, Real and complex form, Convergent Fourier series, Calculus of Fourier series, Fourier integral formula and Fourier transforms. Fourier transform and its properties. Convergence of Fourier series, Fourier transforms for single and multivariable. The discrete Fourier transform and properties. Application in solving boundary value problems.

Advanced Vector Analysis: Kinematics and Differential Geometry, Elementary theory of surfaces, Metric.

NAME 6101: Ship Structures-I
3 Credit, 3 hrs. /wk.

Elastic Analysis-stiffness and flexibility, the equilibrium matrix, rigid and semi-rigid joint connections. Theory of plates and shells, the rectangular plates, large deflection theory of plates, membrane theory of shells. Introduction to finite element methods to simple ship structural problems.

NAME 6102: Ship Structures-II
3 Credit, 3 hrs. /wk.

Analysis of structural failure, plasticity, beam and frame analysis, yield line theory. Analysis of strength of welded ship grillage, optimum design. Mechanics of fracture-brittle and fatigue fractures, design application fracture mechanics. Materials for marine vehicles-the selection of construction steels, fiber reinforced plastics, concrete as a shipbuilding material. Simple economics for rivalries between materials. Design for production.

NAME 6103: Finite Element Methods
3 Credit, 3 hrs. /wk.

Introduction: influence co-efficient and stiffness matrices. Formulation and calculation of the finite element matrices using the principles of virtual displacements. Preparing computer programs. Introduction to the isoperimetric family of elements.

Familiarization with and use of existing finite element programs

developed for marine structural analysis and design. Pre- and post-processors for data processing.

NAME 6201: Ship Propulsion
3 Credit, 3 hrs. /wk.

Introduction: Propeller Theory: Blade element theory, vortex theory-lifting line, lifting surface, lifting body; Propulsive Devices: Fixed pitch propeller, Ducted propeller, Contra Rotating propeller, Controllable pitch propeller; Propulsion Machinery: Selection of main machinery and auxiliaries.

NAME 6202: Theory of Wave Making Resistance
3 Credit, 3 hrs. /wk.

Ship wave making resistance; Ship wave systems; Wave making resistance of surface ship; Theoretical calculation of wave making resistance; Interference effects; Effects of viscosity; Scale effects; Comparison between calculated and observed wave making resistance; Design of bulbous bow; Recent developments in wave making resistance of ships.

NAME 6203: Sea-keeping Performance
3 Credit, 3 hrs. /wk.

Introduction: Sea-keeping theories, Added resistance due to ship motion in regular and irregular waves, added resistance due to wave reflection; Methods of predicting added resistance in wave. Added resistance due to wind. Methods of predicting added resistance due to wind, Resistance increase due to steering on a straight course, Sea spectra, Response spectra, Involuntary speed loss and power increase at constant power and constant speed approach, Voluntary speed reduction in seaways, Weather routing of ships.

NAME 6204: Weather Routing of Ships
3 Credit, 3 hrs. /wk.

Introduction: Climatology, Seasonal Climatology of different ships, Trading routes, Coastal and landlocked areas, Storm pattern, Total marine environment, Wave theory and wave height, Wind speed relationship. Wave spectral families. Behavior of ships at sea, Routing methods, Climate routing, Strategic Routing, Tactical routing, Case studies, Selected papers on weather routings.

NAME 6205: Boundary Layer Theory
3 Credit, 3 hrs. /wk.

Outline of boundary layer theory, Derivation of Navier-Stokes equations, Exact solutions of the Navier-Strokes equations. Very slow motions, Boundary layer equations for two dimensional flow, Boundary layer on a flat plate, Boundary layer development on actual ships. Boundary layer formation over large hull projections and appendage. Detailed effects of hull roughness on the ship boundary layer. Friction formulations taking account of curvature and roughness. Separation of boundary layers around ship components. Separation control.

NAME 6206: Advanced Computational Fluid Dynamics
3 Credit, 3 hrs. /wk.

Potential flow: Vorticity and circulation, Kelvin's theorem, Biot-Savart law, velocity induced by a straight vortex segment, statement of the potential flow problem, general solution based on Green's identity, basic solution based on source, sink, doublet and vortex.

Flow over three dimensional wings: Definition of the problem, separation of the thickness and the lifting problem, symmetric wing with non-zero thickness at zero angle of attack, zero thickness cambered wing

at angle of attack-lifting surfaces, the aerodynamic loads.

Perturbation methods: Thin airfoil problem, second order solution, leading edge solution, matched asymptotic expansions, lifting line model, slender wing theory, slender body theory.

Boundary element method: Basic formulation, reduction of the problem to a set of linear algebraic equations, lower and higher order singularity elements, influence coefficients and solutions using Neumann and Dirichlet boundary conditions, lifting line solution by horseshoe elements, lifting surface solution by vortex ring elements.

Statement of the ship-wave problem: Rankine source panel method, finite volume method and RANS equations, Virtual towing tank.

NAME 6301: Analysis and Design of Welded Structures
3 Credit, 3 hrs. /wk.

Residual stresses in welded joints; Distortion in weldments; Fracture toughness; Brittle and fatigue fracture of welded structure; Effects of distortion and residual stress on buckling strength of welded structures; Welded cracking and joint restraint. Effects of weld defects on service behaviors; Nondestructive testing of welded joints.
Strength of welded structures; Design of welded connections; miscellaneous structural design; Joint design and production for static and dynamic welded structures.

NAME 6302: Ship Production Technology
3 Credit, 3 hrs. /wk.

The ideal layout of shipyard: Material handling facilities; Production Process; Advanced fabrication processes (N/C flame cutting, double curvature bending by Universal Press and Line Heating etc.); Component

assembly; Sub-assembly, assembly and grand assembly; Block assembly; Advanced outfitting; Zone outfitting: Block erection. Machinery installation, Launching; Pier outfitting, trial and delivery.

Production planning, Scheduling and line charts; production piling charts; Man-hour control, Subcontracting: Quality control; Application of the critical path analysis.

NAME 6303: Computer Aided Hull Design
3 Credit, 3 hrs. /wk.

Analytic representation of a curve, Advanced interpolation and control polygon techniques, Bezier and B-spline approximations, B-spline curve fitting.

Form parameter of curves, Development of lines plan, Parametric surface representation, Blend generation, Partial differential equation (PDE) method for surface generation, Free form surface generation, Bezier surfaces, B-spline surfaces, Non-uniform rational B-spline (NURBS) surfaces, Surface design with volume constraints, Gaussian curvature and surface fairness. Generation and optimization of ship hull and propeller blade geometry.

NAME 6401: Marine Transportation System
3 Credit, 3 hrs. /wk.

Trade and markets, International trade, operation research technique used in marine transportation problem, through transportation system, Marine transportation system design, Operation and economics of marine transportation system.

NAME 6402: Design of Cargo Access Equipment
3 Credit, 3 hrs. /wk.

Influence of cargo access equipment of ships performance, Hatch-covers, Cargoes and ships, General requirement for access equipment; Access equipment for vertical and horizontal loading ships, Ship design and selection of access equipment, Specific design requirements of access equipment, Access equipment in service, Recent developments and prospects, Economic aspects.

NAME 6403: Computer Simulation
3 Credit, 3 hrs. /wk.

Simulation as an operation research techniques, General procedure for simulation, Simulation types, Probability concepts in simulation, Random number generation with arbitrary distribution, Random sequence tests, Simulation languages, Use of *FORTRAN* in simulation, Extended control simulation language, Computer simulation model in marine transportation system.

NAME 6501: Advanced Marine Engineering
3 Credit, 3 hrs. /wk.

Analysis of power plant including mathematical representation of steam turbine, Gas turbine and diesel plant. Auxiliary system " Evaluation including clutch and gear box control-Total system" performance when subjected to full ahead to crash strop maneuver, Control systems philosophy, design and application to machinery set combinations.

Design of marine transmission devices-spur, helical, bevel, worm gears and wheel systems. Lubrication and cooling, Wear characteristics, Clutch design and operation.

NAME 6502: Marine Transmission Systems
3 Credit, 3 hrs. /wk.

Detailed assessment spur, Helical Cross-Axial Helical, Bevel Worm and Wheel systems, Principles of engagement, Generation analytical geometry, Measurement and detailed specification. Manufacturing methods and acceptable tolerances, Lubrication, Cooling power dissipation, Efficiency and wear characteristics. Clutch design and operation, friction self synchronizing and shaft types, Performance Characteristics, Hydraulic coupling types performance analysis, Heat transfer principles, Controllable pitch propeller operation and control of pneumatic and hydraulic types actuation systems.

NAME 6503: Control Theory in Marine System Design
3 Credit, 3 hrs. /wk.

Revision of the fundamentals of control, Transient and Frequency Response, Stability analysis, Root locus, Rough Hurwitz-Nichol Chart representation, Comprehensive methods, Application of stability criteria to system design, Application to hydraulic, pneumatic and electronic systems, principles of Analogue computing the operational amplifier and its application to inversion, integration, multiplication and function generation, problem definition, Simulation of marine systems. Introduction to digital simulation methods interfacing requirements, Simulation as a design process, Optimization of control schemes and Marine plant performance, Demonstration of Hybrid techniques in the analysis of fast ship performance.

NAME 6601: Mechanics of Water Waves
3 Credit, 3 hrs. /wk.

Review of Hydrodynamics: Hydrostatics, Equation of Continuity, Rotational and Irrotational Flows, The Dynamical Equations of Motion, Viscous Flows. Surface Waves: Small Amplitude Wave Theory, Finite Amplitude Waves, Waves creation by winds. Fixed Structure in Waves:

Hydrostatic pressure beneath a surface waves, Waves at a vertical Flat Barrier, Consequences of Viscosity, Wave induced forces on a pile, Wave induced vibrations of fixed structures, Wave making drag, Flooding structures in waves, Coupled Heaving and Pitching, Moored and Towed bodies.

NAME 6602: Harbor Engineering
3 Credit, 3 hrs. /wk.

Tides and harmonic analysis: Equilibrium theory of the tides, harmonic analysis of tides, harmonic Analysis and Continuous spectra. Harbor Resonance: Free Oscillation in closed basins, Forced oscillations in basins of sample platform, Modeling of resonance phenomenon in the laboratory. Wave spectra: Statistical properties of individual waves, wave spectrum and wave transformation. Harbor Planning: Ship Characteristics, Elements of Harbor layouts, Hydraulic aspects of harbor layout, Layout of Docks and Breakwaters. Break Water Design: Information on Mound Breakwater, wave pressure formula for composite breakwater, principles of the design of composite breakwaters, wave force calculation for composite breakwater, design of Breakwater Caissons.

NAME 6603: Analysis of Offshore Structures
3 Credit, 3 hrs. /wk.

Classification of different types of offshore structures and their conceptual design. Features of Drilling and production rigs, fixed structures, floating structures, complaint structures, Linked multi-body systems. Comparison of different designs of offshore production platforms. Analysis of Fundamentals of hydromechanics, Wave theories; Hydrostatic Analysis, Hydrostatic forces and stability of offshore structures; Hydrodynamic Analysis, Wave forces on hydro dynamically transparent structures, Motion of hydro dynamically transparent

structures in a seaway, Forces and motions of hydro dynamically compact structures in a seaway.

NAME 6604: Hydrodynamic Loading of Floating Bodies
3 Credit, 3 hrs. /wk.

Overview of fluid mechanics, Linear wave theory, Morrison equation and diffraction theory, Numerical solution of Green function and fluid forces on floating bodies, Governing equation of second order wave drift forces, Wind and current forces and their effects on floating bodies, Response of floating bodies to regular and irregular waves.