Chapter 5

Rules and Regulation for Postgraduate Program

5.1 For Master's and M. Phil. Degrees

For all post graduate degrees in Engineering, Architecture, Urban and Regional Planning and Physics, Chemistry and Mathematics, in addition to test, assignments and/or examinations during the semester may be given by the teacher(s) concerned, there shall be a written examination and/or other test for each of the subjects offered in a semester at the end of that semester. The dates of which shall be announced by the Dean of the respective faculties at least two weeks before the commencement of the examination. The final grade in a subject shall be based on the performance in all tests, assignments and/or examinations.

5.1.1 Grading System

Final grades for courses shall be recorded as follows:

Grade	Merit Description	Grade Points	Numerical Markings
A (Plus)	Excellent	4.0	90% and above
A	Very good	3.5	80% to below 90%
B (Plus)	Good	3.0	70% to below 80%
B	Average	2.5	60% to below 70%
C	Pass	2.0	50% to below 60%
F	Failure	0	Below 50%
I	Incomplete	-	
S	Satisfactory	-	
U	Unsatisfactory	-	
W	Withdrawn	-	

Note:

- Courses in which the student gets F grades shall not be counted towards credit hour requirements and for the calculation of Grade Point Average (GPA).
- Grade I is given only a student is unable to sit for the examination of a

course at the end of the semester because of circumstances beyond his/her control. He/she must apply to the Head of the Department within one week after the examination to get an I grade in that course. It must be completed within the next two semesters, otherwise, the I grade becomes an F grade. He/she may, however, be allowed to register without further payment of tuition fees for that course.

- Satisfactory or Unsatisfactory- used only as final grades for thesis/project and non-credit courses. Grade for thesis/project "In Progress" shall be so recorded. If, however, thesis/project is discontinued an I grade shall be recorded.

5.1.2 Qualifying Requirements

The qualifying requirement for graduation is that a student must earn a minimum grade point of 2.65 based on the weighted average in his course work.

A student obtaining F grade in a course may be allowed to repeat the course with the prior approval of Head of the Department on the recommendation of the Supervisor/Advisor. Such approval shall be reported to the BPGS.

A student shall not be allowed to continue the program if he/she obtains a total of three or more F grades in one or more than one subjects taken together, during the course of his/her studies.

If at the end of the second or any subsequent semester, the cumulative GPA falls below 2.5, he/she shall not be allowed to continue in the program.

5.1.3 Thesis/Project

In addition to successful completion of course works every student shall submit a thesis on his/her research work or a report on his/her project work, fulfilling the requirements as detailed below.

Every student submitting a thesis/project in partial fulfillment of the requirements of a degree, shall be required to appear at an oral examination, on a date or dates fixed by the Supervisor concerned in consultation with the Head of the Department and must satisfy the examiners that he/she is capable of intelligently applying the results of this research to the solution of problems, of undertaking independent work, and also afford evidence of satisfactory knowledge related to the theory and technique used in his/her research work.

5.2 For Doctoral (Ph. D.) Degree

5.2.1 Grading System:

As in Art. 5.1.1 above for Master's Degrees.

5.2.2 Qualifying Requirements

5.2.2.1 Course Work

To qualify for the degree a student must earn a minimum grade point average (GPA) of 2.75 based on the weighted average of grade points (GP) in his/her course work.

A student obtaining F grade in a course may be allowed to repeat the course with the prior approval of Head of the Department on the recommendation of the supervisor. Such approval shall be reported to the BPGS.

A student shall not be allowed to continue the program if he/she obtains a total of three or more F grades in one or more than one subjects taken together, during the course of his/her studies.

5.2.2.2 Comprehensive Examination

The date(s) and time of the comprehensive examination shall be fixed by the Doctoral Committee on the request of the supervisor. Comprehensive examination shall be held after the completion of the course work by the student.

The comprehensive examination shall comprise a written examination and/ or an oral examination to test the knowledge of the student in his/her field of study and research. The Doctoral Committee shall conduct the comprehensive examination. If a student fails to qualify in a comprehensive examination, he/she shall be given one more chance to appear at the examination as scheduled by the Doctoral Committee.

In addition to successful completion of course works and comprehensive examination every student shall submit a thesis on his/her research work fulfilling the requirements.

5.2.3 Thesis

At the end of the student's research work, the student shall submit a thesis, which must be an original contribution to engineering/sciences and worthy of publication. At least six type written copies of the thesis in the final form must be submitted to the Head of the Department.

The student shall certify that the research work was done by him/her and that this work has not been submitted elsewhere for any other purpose (except for publication).

On completion of the research work and submission of the thesis an oral examination shall be arranged on a date or dates fixed by the supervisor in consultation with the Head of the Department in which the student shall defend his/her thesis.The student must satisfy the examiners that he/she is capable of intelligently applying the results of his/her research to the solution of problems, of undertaking independent research and afford evidence of satisfactory knowledge related to the theory and technique used in his/her research work.

Chapter 6

Postgraduate Courses

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	Advanced Finite Element Method for Ship Structure	3
NAME 6104	Composite Materials for Marine Application	3
NAME 6201	Ship Propulsion	3
NAME 6202	Theory of Wave Making Resistance	3
NAME 6203	Sea-keeping Performance	3
NAME 6204	Weather Routine of Ships	3
NAME 6205	Boundary Layer Theory	3
NAME 6206	Advanced Computational Fluid Dynamics	3
NAME 6207	Turbulence Modeling	3
NAME 6208	Theory of Experimental Ship Hydrodynamics	3
NAME 6301	Analysis and Design of Welded Structures	3
NAME 6302	Ship Production Technology	3

Course No	Subject Title	Credit Hours
NAME 6303	Computer Aided Hull Design	3
NAME 6304	Cavitation on Marine Propeller	3
NAME 6401	Marine Transportation System	3
NAME 6402	Design of Cargo Access Equipment	3
NAME 6403	Computer Simulation	3
NAME 6404	Risk Analysis of Maritime Transport	3
NAME 6405	Artificial Intelligence for Marine Engineering	3
NAME 6406	Advanced Maritime Economics	3
NAME 6407	Buoy Engineering	3
NAME 6408	Design of Sailing Yacht	3
NAME 6501	Advanced Marine Engineering	3
NAME 6502	Marine Transmission Systems	3
NAME 6503	Control Theory in Marine System Design	3
NAME 6504	Ship Maneuvering and Control Surfaces	3
NAME 6505	Marine Renewable Energy	3
NAME 6506	Port Planning and Operation	3
NAME 6508	Measurement and Data Analysis	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 6605	Advanced Dredging Technology	3
NAME 6606	High Speed Marine Vehicles	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: Advanced Finite Element Method for Ship Structures
3.00 Credit, 3 hrs./wk.
Isoparametric elements, plate, and shell elements. Vibration frequency analysis of ship structures. Linear dynamic response analysis of ship structures. Nonlinear analysis in solid and structural mechanics, geometric nonlinearities, nonlinear material behavior. Pre- and post-processing, use of computer graphics in analysis.

NAME 6104: Composite Materials for Marine Application
3.00 Credit, 3 hrs./wk.
Basic concepts. Constituent materials for composites. Elements of mechanical behavior of composites. Micromechanics. Strength of a continuous, and discontinuous fiber-reinforced laminas. Maximum stress criteria, Maximum strain criteria. Analysis of laminates. Nanocomposite Finite element analysis of composite structures. Marine composites. Elements of boat scantling system.

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

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 6207: Turbulence Modeling

3 Credit, 3 hrs./wk.

Introduction to turbulent flows: Governing equations for turbulent flows: Decomposition and averaging of instantaneous quantities; Velocity correlations. Reynolds-averaged Navier-Stokes (RANS) equations, Turbulent kinetic energy equation, Dissipation rate equation.

Scalar transport equation: Zero equation models: Algebraic models: eddy viscosity and mixing length hypothesis; Cebeci-Smith and Baldwin-Lomax models, one- and two- equation models; Low-Reynolds number effects, effects of compressibility: Reynolds stress transport equations; Second-order closure models: Reynolds- stress and algebraic stress models: Introduction to large-eddy Simulation (LES). Detached-eddy simulation (DES) and direct numerical simulation (DNS).

NAME 6208: Theory of Experimental Ship Hydrodynamics

3.00 Credit, 3 hrs./wk.

Basic instrumentation techniques, measurement using strain gauges, equipment, und methods for data acquisition. Introduction to advanced measurement techniques: Particle Image Velocimetry, Laser Doppler Velocimetry, Laser-Induced Fluorescence, Calibration of measurement equipment. Techniques for model construction: modelling law, model design. Typical model tests: resistance, propulsion, propeller open water, cavitation tests, seakeeping tests, tests with slender structures. Uncertainty Analysis. Error sources in experiments. Special considerations for full scale measurements.

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 bucking strength of welded structure; 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 (NC 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 6304: Cavitation on Marine Propeller

3.00 Credit, 3 hrs./wk.

Physics of cavitation: gas content and nuclei, cavitation. Types of cavitation: bubble cavitation, sheet cavitation, vortex cavitation. Artificial roughness and viscous effects on inception of sheet cavitation. Process of cavitation in marine propellers, Detrimental effects of cavitation. Prevention of cavitation. Super cavitation. Different cavitation models. Simulation of cavitation on marine propeller, propeller-induced hull pressures fluctuations.

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 technique, 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 6404: Risk Analysis of Maritime Transport

3.00 Credit, 3 hrs./wk.

Introduction to the risk concept and other key concepts. Description of the risk picture based on accident statistics, accident theories, accident investigation and analysis Common methods for risk analysis. Methods for calculating risk for maritime accidents Human reliability: error mechanisms, influencing factors and modelling approaches. Risk objectives, data and risk acceptance criteria. Risk control measures and options, including cost-benefit analysis.

NAME 6405: Artificial Intelligence for Marine Engineering

3.00 Credit, 3 hrs. /wk.

Introduction to variant of machine learning methods and application for ship autonomy, potential use of machine learning methods for solving specific problems on autonomous ships, path planning, auto-docking and motion prediction, case studies for each of introduced machine learning methods. Dijkstra method. A^* method for path planning for close-range maneuvering. Neural network architecture for ship motion prediction, and force allocation to thrusters. Deep learning method for maritime application.

NAME 6406: Advanced Maritime Economics

3.00 Credit, 3 hrs./wk.

Sea transport and the global economy. The organization of the shipping market. Shipping cycles and forecasting. The shipping market model. Key influences on supply and demand. The demand for see transport. The supply of sea transport. The freight rate mechanism. The freight market, the freight derivatives market, the sale and purchase market, the newbuilding market, the demolition (recycling) market. Economics of dry bulk shipping, tanker shipping, liner shipping Maritime finance and risk management. Outsourcing and ship management. Quality shipping. Green shipping. Inter-modular transport system.

NAME 6407: Buoy Engineering

3.00 Credit, 3 hrs./wk.

Statics of mooring lines. Dynamics of mooring lines. Classes and description of oceanographic buoy systems: moored systems, free drifting systems. Buoy system design: system design logic, classes of buoys, external forces to consider in buoy design, materials and fabrication, practical design considerations, metallic and non-metallic mooring lines, chain connecting hardware ancillary equipment, anchors. Environmental problems and corrective measures. Deployment and retrieval techniques.

NAME 6408: Design of Sailing Yacht

3.00 Credit, 3hrs./wk.

Hydrodynamic and aerodynamic forces acting on a sailboat. Equilibrium sailing speed, speed polar diagram. Airfoil theory: fluid drag, two-dimensional airfoil theory, three- dimensional airfoil theory. Hydrodynamic and structural aspects of keel and rudder design. Yacht model testing, Sail design Rigging design and analysis. Rules for sailing yachts and their influence on design.

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, Rout 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 6504: Ship Maneuvering and Control Surfaces

3.00 Credit, 3 hrs./wk.

Mathematical models of the ship maneuvering: Abkowitz Model, Mathematical Maneuvering Group (MMG) model, K-T Model. Determination of hydrodynamic derivatives. Standard maneuvering tests of the ship. Regulations related to Ship Maneuvering. Introduction to ship control surfaces. Passive and active control devices. Influence of External forces on ship maneuverability. Ship maneuverability in shallow and confined waters. Measures to improve ship maneuverability.

NAME 6505: Marine Renewable Energy

3.00 Credit, 3 hrs./wk.

Renewable ocean energy. Wave energy conversion, storage, and performance. Marine current conversion: tidal devices, and practical resource. Tidal phasing Ocean thermal energy conversion (OTEC) systems: applicability, thermodynamics, design challenges. Wave energy converters, floating devices, oscillating water column, optimal hydrodynamic performance, current, tidal and offshore wind power. Offshore wind energy: turbine types, fundamentals of operation, airfoils and blades, device and farm scale flow phenomena. Floating and foundations, installation and maintenance, logistics and decommissioning, environmental impact. Electrical systems for renewable energy. Renewable energy integration to grid.

NAME 6506: Port Planning and Operation

3.00 Credit, 3 hrs./wk.

Port development and organization: history of part development, part roles and function, port users and stakeholders, port administration and organizational structure, traditional vs. emerging port management model, recent trend in port development. Port planning: infrastructure and capacity, evaluation and

management of port projects, long term port planning, modelling port demand and supply, port traffic forecasting, strategic port planning, operational part planning, terminal planning module, multi-modal connectivity. Pont investment and financing.

NAME 6508: Measurement and Data Analysis

3.00 Credit, 3 hrs./wk.

Types of measurements and instrumentation in ocean exploration and oceanography, Sensors, and Sampling. Measurements as a function of time and space: A/D converters, Dynamic range, Sampling and Aliasing, Averaging, Time series. Stochastic Processes: Expected values, Probability Density Functions, Stationary and Ergodic Processes, Standard Deviation, Confidence Intervals and Sample Size, Central Limit Theorem Correlation functions: Auto Correlation, Cross Correlation, Noise Reduction. Spectrum. Analysis. Fast Fourier Transforms and Fourier Transforms, Correlation and Spectra, Wavenumber Spectra Inverse Problems: Concept of Inverse Problems, Linear Problems, Least Squares Estimates, Fitting Curves and Surfaces, Underdetermined Problems.

NAME 6601: Mechanics of Water Waves

3 Credit, 3 hrs. /wk.

Review of Hydrodynamics: Hydrostatics, Equation of Continuity, Rotational and Irrational 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 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.

NAME 6605: Advanced Dredging Technology

3 Credit, 3 hrs./wk.

Sediment characteristics and classification; Pipe line transport of dredged materials; Dredge production evaluation; Dredge instrumentation: cutters, drag heads; Environmental evaluation of dredge materials for disposal; Hydraulic analysis and design of confined disposal facilities; Open water placement of dredge materials; Numerical models: Short Term FATE (STFATE), Long Term FATE (LTFATE) and Multiple Dump FATE (MDFATE) etc.; Removal of contaminated sediment by dredging: Capping of contaminated sediments; Resuspension of dredge sediments; Monitoring of dredging operations.

NAME 6606: High speed Marine Vehicles

3 Credit, 3 hrs./wk.

Introduction to high speed vehicles; Types, general characteristics, hull form and geometry of Semi-planning hull, planning bull, Hydrofoil vessels and Surface Effect Ships (SES); Important design parameters; Hydrodynamic design aspects; Resistance; Power prediction; Propulsion systems and Stability evaluation.