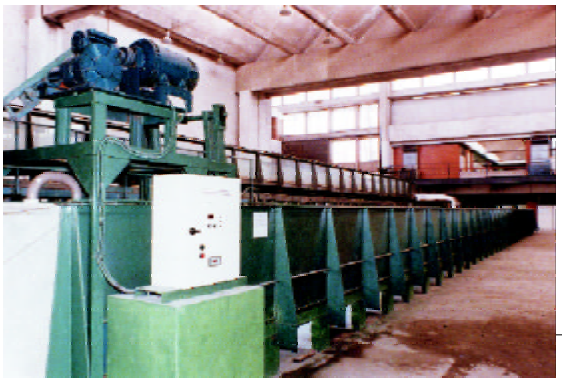

Ocean
Engineering

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General Information

The Department of Ocean Engineering began its graduate teaching and research activities in 1967. Initially a graduate program in Naval Architecture and Shipbuilding, its denomination changed as new areas such as ocean engineering, coastal engineering, underwater acoustics, oceanographic instrumentation and transportation were gradually incorporated. Since the very beginning the Department aimed at improving the development of human resources and of scientific and technological research, seeking to accompany the needs of the country as well as to establish a reputation as a research and teaching center. The Department activities are concentrated in two major areas, namely Naval Architecture & Offshore Engineering and Coastal & Oceanographical Engineering.

The Naval Architecture & Offshore Engineering area deals with design, construction and operation of ships and offshore structures.

The Coastal and Oceanographical area deals with the physical aspects of the ocean environment and the effects of the interaction between the sea, the atmosphere and the coastal areas as well as the human intervention in this system. These two areas develop joint research projects in port planning and inland navigation.

The Department of Ocean Engineering is closely linked with the undergraduate Department of Naval Architecture & Ocean Engineering and the Department of Hydraulics & Sanitary Engineering of the School of Engineering. Following the international trend, since 1977 the Department has had a strong orientation toward Offshore Engineering. More recently, as the Brazilian oil company Petrobras advanced its activities to deep water the Department, conscious of the role the University plays in the education and technological development processes, focused research and teaching activities on deep water technology. As a consequence, two emphasis in the Master's and the Doctoral programs have been developed: Floating Ocean Systems (including Hydrodynamics, System Dynamics, Structures and Supply) and Underwater Technology. At present, the Department has among its facilities two hyperbaric cameras, a flume, and a wind tunnel used in studies with scaled physical models and specialized measuring equipment to analyze motions, forces and other phenomena related with the installation and operation of floating structures, submarine pipelines, risers and subsea equipment.

In its quest for scientific and technological development and development of specialized human resources the Ocean Engineering Department has graduated over 200 M.Sc. and 50 D.Sc. students and published well over 500 technical papers in conferences, seminars and books, and developed around 350 technological projects for clients such as shipyards, consulting firms, the Brazilian Navy, Petrobras, and several other governmental and private companies in Brazil and abroad. PEnO holds a leading position in Latin America and has signed scientific and technological agreements for joint research and exchange of personnel with many prestigious research centers and universities such as University of California, University of Florida, MIT, University of Newcastle, University of Strathclyde, Heriot-Watt University and Norwegian University of Science and Technology.

Research Activities

The research activities are concentrated in two broad areas, namely:

Hyperbaric Chambers, created and designed by the Submarine Technology Laboratory

Naval Architecture & Offshore Engineering

Ocean Structures and Underwater Technology

- buckling of stiffened panels for ships and floating production systems.
- ultimate strength of submarine pipelines and steel catenary risers.
- structural behavior of subsea umbilicals and flexible risers.
- risk analysis in offshore operations.
- reliability analysis applied to ocean structures and subsea equipment.
- vibration signature diagnostics of mechanical failure.
- dynamic behavior of ocean structures.
- failure modes of composite structures.

Hydrodynamics of Floating Systems
- analytical and numerical methods in water wave problems.
- computational fluid mechanics.
- computer methods in propulsion.
- seakeeping experimental techniques.
- dynamical stability of ships and floating systems.
- vortex induced vibration (numerical and physical models).

Design of Ocean Systems
- computer-aided design of ships and ocean structures.
- modeling and design methods of small boats.
- high performance craft design methods.
- knowledge-based systems in the design process.
- expert systems applied to the design of ocean platforms.

Maritime Transportation
- maritime economics.
- maritime policies.
- shipping.
- logistics.
- port management.
- inland navigation.

Marine Engineering
- propeller-shaft-engine system analysis.
- ship power plant design.
- predictive maintenance.
- shaft vibration analysis.

Submarine Technology Laboratory

HIDROLAB
Wind tunnel for analysis of vortex induced vibrations

Coastal and Oceanographical Engineering

Marine Hydraulics
- sea state analysis techniques.
- mean sea level long term analysis.
- propagation and transformation of gravity waves in coastal areas.
- forecasting and observation of waves along the Brazilian coastal area.

Litoral Process
- numerical modeling of the evolution of coastal morphology.
- measurement of sediment transport.
- sedimentological characterization beaches.
- hydrodynamical behavior of sediment.

Sedimentological, morphological processes and water quality in estuarine systems
- cohesive sediment transport mechanisms.
- development of GIS tools for analysis of estuarine environments.
- hydrodynamical circulation modeling of water quality.

Maritime Works
- coastal protection and recovery works.
- artificial nourishment of beaches.
- artificial inlet design.

Oceanographical Instrumentation
- directional wave spectrum measuring equipment.
- systems for measuring waves and water levels in laboratories.
- systems for measuring water level in rivers, lagoons and coastal areas.

Underwater Acoustics
- underwater sound propagation models.
- sea resources exploitation technologies.
- techniques for spatial-temporal acoustic signal processing.
- development of sea measurement acoustic instrumentation.

Courses

COV710 Dynamics of Ships – Theory of ship motion with advance velocity. Behavior in irregular seas. Spectral analysis. Probabilities. Long-term and short-term responses. Seakeeping.

COV711 Reliability and Risk Analysis of Underwater Systems – Basic statistics and probability theory. Statistical inference. Fundamentals of reliability. System analysis. Risk analysis. Vulnerability analysis.

COV712 Underwater Production Systems II – Offshore production systems. Underwater layout. Wet Christmas tree. Storage systems. Computer simulation of storage and transference systems. Multiphase pumping systems. Underwater separation systems. Design methodology of underwater systems.

COV713 Topics in Signal Acquisition and Processing – Techniques for measuring displacements, velocities and accelerations. Conditioning and registration of dynamical signals. Data acquisition automatic systems. Deterministic and random signals. Time-domain processing. Frequency-domain processing. Random signals. Spectral analysis.

COV714 Topics in Artificial Intelligence – Forms of knowledge representation. Fuzzy systems. Expert systems. Artificial neural networks. Hybrid expert systems. Information fusion. Applications to pattern classification and function approximation.

COV715 Mechanical Condition Evaluation – Review of discrete vibration systems. Vibration signature. Techniques for monitoring rotating and alternating mechanical equipment. Off-line and on-line data acquisition systems. Computer data management. Mechanical problems diagnosis using vibration and artificial intelligence techniques. Trend analysis. Predictive maintenance.

COV716 Structural Integrity Evaluation – Deterministic and random dynamical response. Fatigue and fracture. Experimental data acquisition in operative structures. Dynamic behavior simulation and smoothing. Failure evaluation through dynamic response. Evaluation of cracking occurrence probability. Applied artificial intelligence techniques. Inspection orientation. Residual useful life prediction. Predictive maintenance.

COV 717 Ocean Floating Systems Design – Design processes, design methodologies, creative process synthesis and analysis, classification, design process organization. Design planning and performing of ocean floating systems: specifications, rules and regulations. General arrangement. Geometry and naval architecture. Structural configuration, compartmentation, lightweight and stability. Hydrodynamic behavior. Positioning, mooring, production system, etc.

COV718 Special Topics in Logistics and Transportation – Cycle of seminars and round-tables according to master's students and doctoral candidates research projects, including issues such as global logistics strategies for integrating transportation corridors. Transportation management systems and information technology for the logistics management. Operations management methods for analyzing logistics problems. Data acquisition methodology for logistics information systems implementation. Structuring oil and gas supply chain management strategies for competitiveness at the global market.

COV719 Mathematical Methods for Floating Systems – Nonlinear differential equations: stability, bifurcation and chaos. Analysis of a FPSO in a SPM system. Finite difference method: consistency, stability and convergence. Analysis of a vertical riser under vortex shedding action. Boundary integral method. Flow around an oscillating body on the free surface.

COV720 Numerical Methods in Hydrodynamics I – Finite difference and finite volume methods: consistency, stability and convergence. Integration of differential equations. Interactive methods of solution. Application to the diffusion and Burgers equation. Galerkin method, finite element method and boundary element methods.

COV721 Mechanics for Ocean Engineering – One-degree of freedom systems: free and forced vibration. N-degree of freedom systems: free and forced vibration. Variational analysis of the equations of motion. Stresses. Strains. Deformation. Linear elasticity general equations. Plane problems in rectangular and polar coordinates. Bending of long rectangular plates on cylindrical surface. Plate bending. Small deflections of laterally loaded plates.

COV722 Special Topics in Hydrodynamics – Additional topics aimed at fulfilling specific needs of students.

COV723 Hydrodynamics for Ocean Engineering – Basic concepts. Kinematics. Conservation of mass. Equations of fluid dynamics: Navier-Stokes, Euler, Bernoulli. Potential theory: forces and moments on a rigid body. Laminar viscous flow, boundary layer, separation and vortex shedding. Transition and turbulence. Vortex motion. Flow around wing sections. Wings. Linear theory of surface waves. Nonlinear effects. Forces on floating bodies. Morison formulation: Keulegan-carpenter and Sarpkaya experiments.

COV724 Dynamics of Floating Systems I – Statics and stability. Newtonian mechanics. Dynamics of rigid bodies in inertial and solidary coordinate systems. Euler angles. Mass-spring-damping system with one and two degrees of freedom: homogeneous and particular solutions for harmonic excitation, solutions for impulse and irregular excitation. Continuous systems: vibration, natural modes, Eigenvectors, modal analysis.

COV725 Dynamics of Floating Systems II – Responses of a linear system to random excitation. Review of spectral analysis and probability theory applied to responses analysis. Effects of currents, wind and waves on floating systems. Mooring systems. Mooring line damping. Dynamics of FPSO, FPS, etc. in a SPM, mono-buoy, turret. System storage and shuttle ships: approximation and offloading maneuvers.

COV726 Ship Maneuverability – General equations of motion. Fluid memory effect. Linearized equations of motion. Added masses and damping. Exciting forces. Directional stability. Routh-Hurwitz stability criteria. Stability of towed bodies and single point mooring systems. Steering of ships. Standard maneuvers: turning, zigzag, spiral. Simulations. Nonlinear maneuvers. Auto-pilot. Gains. Stabilizers. Maneuvering in waves.

COV727 Ship Resistance and Propulsion – Introduction to ship resistance. Viscous resistance. Navier-Stokes equation: numerical solutions and applications. Wave resistance. Kelvin potential. Slender body theory. Michell theory. Hull-propeller interaction. Flow around wings. Boundary elements applied to the analysis of propellers.

COV728 Hydrodynamics of Floating Systems I – Current forces on floating system: maneuvering and cross-flow methods. Behavior of stationary floating system in waves: frequency and time domain analysis, retardation function (memory effects), second order forces. Hydrodynamical analysis of semi-submersibles, spar, TLP and ships behavior. Maneuvering simulation with a simulator.

COV730 Experimental Methods in Hydrodynamics – Dimensional analysis and similarity. Laboratory and actual structures measurement techniques. Use of measurement equipment: load cell, accelerometers, strain gage, etc. Data analysis techniques. Development of laboratory tests: floating structures in waves; towing tests, hydrodynamic derivatives, stability and bifurcation tests.

COV740 Finite Element Method for Ocean Engineering – Fundamentals of discrete and continuous systems analysis. Fem formulation in linear analysis. Isoparametric element matrices: formulation and calculation. Solution of equilibrium equations in static analysis. Gauss elimination, static condensation, substructuring and Gauss-Seidl iterative solution.

COV741 Ocean Systems Structural Analysis – Solution of equilibrium equations in dynamical analysis. Direct integration and modal superposition methods of solution. Introduction to linear analysis. Incremental formulation of the equations of motion. Constitutive relationships. Newton-Raphson solution methods. Applications in ocean engineering.

COV742 Introduction to Structural Reliability – Random variables and probability distribution functions: review. Structural reliability theory. Probability of failure methods of calculation. Probability of failure of structural members under static and dynamic loading. Analysis of design rules. Applications.

COV745 Mechanics of Composite Materials I – Introduction to composite materials. Characterization of fibers and resins. Micro and macromechanical behavior of a layer. Failure modes in tension, compression, shear and bending. Experimental characterization of composite materials. Fem panel analysis.

COV746 Mechanics of Composite Materials II – Effects of temperature and humidity on composite materials. Fatigue and impact resistance. Buckling analysis. Matrix – reinforcements interface. Fracture mechanics in high strength composite materials.

COV748 Special Topics in Predictive Maintenance – Additional topics aimed at fulfilling specific needs of students.

COV749 Ocean Structures Experimental Analysis – Static and dynamic signal acquisition and processing systems. Strain measurement and stress experimental analysis. Measurement of motions: displacement, velocity and acceleration transducers. Calibration, accuracy and linearity. Digitizing. Time and frequency domain signal analysis. Applications of the fast Fourier transform. Vibration monitoring. Data acquisition systems. Laboratory practices.

COV753 Acoustic Systems – Fundamentals of electro-acoustic transducers. Time and space processing of acoustic systems. Basic adaptive techniques. System performance appraisal.

COV755 Special Topics in Structural Design – Additional topics aimed at fulfilling specific needs of students.

COV757 Structural Design of Submarine Flowlines and Risers – Local and global behavior of flexible risers and umbilicals. Design of Submarine pipelines using limit states. Pipelines and risers under combined axial tension, internal/external pressure and bending. Initiation and propagation buckling of damaged pipelines. Laboratory tests using hyperbaric chambers. Design codes. Fatigue evaluation of on-bottom pipelines and risers. Installation methods for pipelines, steel catenary risers, flexible risers and umbilicals.

COV759 Special Problems in Offshore Platforms – Review of fundamental concepts. Dimensional analysis. Added mass and damping. Morison equation. Regular wave. Random waves. Fixed platforms. Floating platforms. Natural frequencies. Behavior in waves, wind and currents. Second order problems: slow and mean drift. Wave drift damping. Mooring analysis. Mooring line damping. Dynamic and static stability.

COV760 Ship Design Theory – The ship system: subsystems and operating domain (economic, ecological, political and social, etc.). Structuring the design problem: objectives, functional analysis; design requirements; generating design alternatives. Structuring the design process: feasibility and conceptual design; design evolution; design process organization. Optimization in ship design. Concurrent design. Quality in ship design.

COV 761 Introduction to Optimal Ship Design – Design problems formulation. Optimal numerical solutions by linear and nonlinear programming techniques. Unconstrained optimization algorithms: direct methods and methods that use derivatives. Equality and inequality constraints. Necessary and sufficient conditions. Penalty function methods. Optimal design with continuous and discrete variables.

COV762 Advanced Marine Vehicles Design – History. Classification of marine craft by their means of support. Planing boats, hydrofoils, hovercraft, wings in ground effect. Principles and design features of each concept. Analytical empirical methods for lift and drag determination; qualitative seakeeping evaluation. Design process and dynamic equilibrium.

COV763 Computational Methods in Ship Design – Basic computational geometry: 2D and 3D modeling of geometric objects; geometric transformations (scaling, rotation, translation, mirror effect); perspective projections. Modeling of three dimensional design objects; parametric curves and surfaces; modeling of hull geometry: body plan. Design problem formulation; computational tools for design; planning and developing prototypes. Case studies.

COV765 Design and Operation of Inland Vessels – Ship types, large vessels: river crafts, supply vessels, passenger vessels. Design requirements. Design characteristics, basic naval architecture. The structural problem. Amazon river boats, tandem arrangements of barges, river tugs.

COV766 Operations Research in Transportation I – Synthesis of the main or methods for freight transportation analysis in general and water transportation in particular. Consolidation and distribution problems revisited and their solution algorithms. Building mathematical models of special problems as integer linear programming problems. Some concerns about the duality theory. Sensitivity analysis. Exercises with LINDO and What's Best.

COV767 Operations Research in Transportation II – Fundamentals of dynamic programming. An introductory overview of nonlinear methods. Fundamentals of goal programming. Fundamentals of stock control modeling. Seminars concerning the production, and transportation-

related problems and a selection of the newest and/or revised or methods and methodologies for solving logistics problems.

COV768 Forecasting Techniques for Decision Planning I – Forecasting as part of a decision process. The right choice of the technique. Trend and autocorrelation analysis. Linear moving averages, exponential smoothing, winter's and other methods. Classical decomposition analysis. Introduction to Box-Jenkins methodology and residual analysis. Fundamentals of regression analysis: the basic assumptions violation. Forecasting with a singular equation model. Presentation of advances in forecasting theory and practice. Exercises with MINITAB and SPSS. Prerequisite: basic statistics.

COV769 Maritime Transportation I – Elements of naval architecture. Operational features. Dry/liquid bulk cargoes, general cargoes, special cargoes, container shipping, roll-on-roll-off. Elements of maritime economics. Inland navigation.

COV770 Maritime Transportation II – International shipping. Maritime economics. Shipping policies. Shipping law.

COV771 Statistical Methods in Maritime Transportation – Probability models and distributions. Random variables functions. Estimation. Inference. Nonparametric tests. Regression analysis. Simultaneous equations. Applications.

COV772 Quantitative Methods in Maritime Transportation – Linear programming. Integer programming. Non-linear programming. Dynamic programming. Topics in operational research. Applications to maritime transportation systems.

COV773 Investment Analysis in Maritime Transportation – Mathematics of finance. Investment appraisal and decision-making criteria. Finance and subsidies national policies. Fiscal regimes. Sources of finance. Uncertainty and risk. Public investment.

COV774 Stochastic Processes and Simulation in Maritime Transportation – Poisson process. Markov chains. Birth and death homogeneous processes. Queue models. Inventory models. Monte Carlo method. Simulation models. Model validation. Simulation languages. Applications to maritime transportation systems.

COV775 International Economics – International flow of capital and goods. Economic blocs. International economics theory. International trade and Brazil. Adjustment policies in open economies. Freight policies. Transnational companies. Trends in world economics.

COV776 Logistics and Transportation Systems Analysis –
An overview of logistics management: definition, evolution, acting viewpoints. Key decisions on the logistics systems design. Basic concepts: total cost, cost-service frontier, flexibility. Techniques for logistics problems solving. Developing strategic logistics plans. Analyzing international logistics providers viewpoints. Analysis of components of a logistics system. Routing and location problems and their solution by heuristics methods. Models of stock control on the logistics chains. The strategic profit model and the financial performance of logistics plans. Building cases studies for improving logistics management skills. Prerequisite: COV766 or similar.

COV777 Analysis of Maritime Transportation Systems – Analysis of demand. Systems for design, analysis and control of ship and terminal operations. Integrated waterborne transportation systems analysis and design.

COV779 Special Topics in Maritime Transportation – Additional topics aimed at fulfilling specific needs of students.

COV780 Special Topics in Inland Navigation – Additional topics aimed at fulfilling specific needs of students.

COV782 Inland Navigation Ship Design and Operation I – Barge main characteristics, inland navigation barge operational attributes, load and unload problems, hydrostatic and stability, speed and performance, standard maneuvers, barge preliminary design.

COV783 Mathematics for Ocean Engineering I – Function. Limit. Derivative. Integral. Series of ordinary differential equations. Power series solution of ODE. Laplace transform. Fourier series and transform. Systems of ordinary differential equations. Partial differential equations. Heat diffusion. Laplace equation. Separation of variables. Sturm-Liouville problem. Linear algebra.

COV784 Mathematics for Ocean Engineering II – Taylor series representation of functions and derivatives. Roots of equations(bisection, Newton-Raphson). Systems of linear algebraic equations (Gauss, Lu, Cholesky). Curve fitting: regression and interpolation. Numerical integration (Gauss and Simpson. Ordinary differential equations (Runge-Kutta, Eigenvalues). Partial differential equations (finite differences, finite elements).

COV785 Mathematics for Ocean Engineering III – Complex analytic functions. Differentiation: Cauchy-Riemann. Conditions. Line Integrals. Cauchy theorem. Power series (Laurent, Taylor). Calculus of residues. Laplace and Fourier transforms. Conformal mapping (application to Joukowsky wing sections). Cauchy principal value integral.

COV786 Elements of River Hydraulics for Inland Navigation – River basins and navigation. Hydraulic characteristics of the main Brazilian waterways. Environmental aspects of the human impingements on river systems. Elements of waterways hydraulic developments.

COV790 Computer Applications in Ship Design – Computer representation of design objects: algorithmic and descriptive modeling; combined formulation. Design data bases. Computer graphics and graphical interface in design tools. The design process. Executive systems. Artificial intelligence and expert systems. Technological trends.

COV793 Rules and Regulations in Ship Design – IMO rules and regulations. MARPOL, SOLAS, COLREG, ICTMS, ICLL, etc. Critical analysis of regulations. History and impact of regulations on safety, pollution, taxation, living ambience, etc. Stability regulations of IMO. Responsibilities and statutory appointments.

COV796 Structural Aspects in the Design of Special Ship Types – Principles of elasticity. Stress, strain and displacement – mathematical modeling. Structural arrangements of typical vessels. Structural collapse: tension, compression, shear force, deflection and torsion. Structural analysis. Finite element method in special ship type design.

COV811 Advanced Topics in Predictive Maintenance – Additional advanced topics aimed at fulfilling specific needs of students.

COV820 Free Surface Flows – Transient wave propagation: uniform depth, non-uniform depth and current interaction. Long waves. Nonlinear wave theory. Numerical and analytic solutions applied to the behavior of floating systems.

COV821 Special Topics in Hydrodynamics – Additional topics aimed at fulfilling specific needs of students.

COV822 Hydrodynamics of Floating Systems II – Linear hydrodynamic theory of rigid body motion in waves with forward speed: time domain and frequency domain analysis. Green's function. Perturbation methods. Slender body theory: method of asymptotic expansions. Reciprocity relationships. Second-order analysis: slow drift, mean drift and wave drift damping.

COV824 Dynamic Stability of Ocean Systems – Stability of multi-degree-of-freedom systems. Eigenvalues. Linear systems with periodic coefficients. Floquet's theory. Nonlinear equations. Duffing's equation. Jump effect. Bifurcation and chaos. Stability of floating bodies in regular waves. Fluid memory effects on stability. Linear stability criteria. Hydrostatic and hydrodynamic nonlinearities. Parametric resonance. Broaching of ships.

COV825 Ship Resistance – Potential theory applied to wave resistance. Study of simplified hulls. Form optimization for minimum wave resistance. Viscous resistance determination.

COV826 Propellers – Vorticity surface theory applied to the design of helicoidal propellers. Propeller induced vibration problems.

COV827 Numerical Methods in Hydrodynamics II – Special topics in numerical methods: finite element, finite volume, finite difference and spectral methods. Navier-Stokes equation. Projection method and others methods for decoupling pressure and velocity. Transient problems.

COV828 Dynamics of Floating Systems III – Advanced topics in dynamic analysis of floating systems: SPM, turret, mono-buoy. Time domain nonlinear simulation. Bifurcation and chaos. Linear stability criteria. Use of stabilizers.

COV 830 Sediment Transport – Origin and presence of sediments in open channel flows. Sediment properties. Sediment discharge formulas: total sediment, suspended load and bed load transport formulas in fluvial and estuarine environments. Studies of impact caused by civil engineering works in sedimentological and morphological processes. Reservoir sedimentation management. Erosive processes below reservoirs. Sedimentation in urban open channel flows. Sediment movements as stochastic processes. Recent researches in sedimentation. Case studies.

COV 831 Cohesive Sediments Transport – Cohesive sediments in fluvial and estuarine environments. Origin and presence of cohesive sediments in open channel flows. Clay properties. Cohesive sediments dynamic: transport, dispersion, sedimentation and deposit consolidation. Measurements techniques. Use of tracers: dyes and radioisotopes. Case studies.

COV840 Collapse of Submarine Ducts – Criteria of failure. Theory of shells applied to the collapse of submarine ducts internal-external pressure combined loading. Axial tension and longitudinal bending. Collapse of damaged ducts: initialization pressure, propagation pressure. Limit-state equations.

COV841 Fatigue of Ocean Structures – Probabilistic representation of the sea. Structural transfer functions. Stress concentration. Linear cumulative damage. Empirical fatigue data (S-N curves). Fracture mechanics. Fatigue prediction in ships and ocean platforms.

COV844 Structural Reliability – Uncertainties in structural analysis and design. Advanced methods in structural reliability. Load modeling. Structural systems strength modeling. Design criteria.

COV848 Analysis of Laminate Composites – Laminate materials classical theory. Beam elements, plane state, plates and shells. Determination of stresses and strains in layers. Coupling effects. Interlayer stresses and free-end effects.

COV850 Advanced Topics in Maritime Transportation – Additional advanced topics aimed at fulfilling specific needs of students.

COV853 Special Topics in Structural Reliability – Additional topics aimed at fulfilling specific needs of students.

COV855 Special Topics in Structural Design – Additional topics aimed at fulfilling specific needs of students.

COV870 Topics in Logistics – Cycle of seminars and round-tables according to research issues in supply chain management and or models. Modeling synchronous and asynchronous processes and activities for establishing logistic chains. Structuring oil and gas supply chain management strategies for competitiveness at the global market. Issues on data acquisition and its computational architecture for implementing logistics information system. Understanding and formulating global logistics systems under the DRP II modeling approach.

COV872 Forecasting Techniques for Decision Planning – Autocorrelation analysis. Box-Jenkins methodology. Econometric models. Advances in time series analysis. Cycle of doctoral candidates' seminars.

COV881 Modal Experimental Analysis – Dynamic behavior of structures review. Signal acquisition and processing techniques review. Expert systems. Neural networks. Hybrid systems. Parameter identification. Numerical-experimental fitting of computational models. Failure identification.

COV890 Particular Aspects of Computer Aids in Ship Design – Courses involving theoretical problems in computer-aided ship design methodology. Computational modeling of ship design process. Computer models of design objects.

COV891 Theoretical Approach to Design Methodology – The design process. Engineering design methods and their evolution. Design methodology. Design models. Philosophical aspects of design methodology. Theory of engineering design methods.

COV893 Rational Design of Sailing Boats – Mechanical elements in yacht design. Models of the dynamic balance for design operating conditions of sailing boats; hydrodynamic forces on body and appendages. Aerodynamic forces on sails. Ship resistance to movements; velocity prediction programs. Computational fluid dynamics. Design models for racing yachts.