MASTER IN NAVAL ARCHITECTURE AND OCEAN ENGINEERING

1. SUBJECT DISTRIBUTION

FIRST COURSE (60 ECTS)

SEMESTER	SUBJECT	ECTS
1st	ADVANCED NUMERICAL METHODS	6.0
1st	NUMERICAL METHODS IN SOLID MECHANICS	4.5
1st	ECONOMY AND MANAGEMENT OF MARITIME COMPANIES	4.5
1st	SHIP DYNAMICS	6.0
1st	SEA TRADE AND MARITIME TRANSPORT	4.5
1st	OCEANOGRAPHY	4.5
2nd	ENERGY PLANTS AND PROPULSION	6.0
2nd	ADVANCED NAVAL HIDRODYNAMICS	6.0
2nd	APPLIED SYSTEM ENGINEERING	6.0
2nd	PLATFORM AND ARTEFACT PROJECT AND CONSTRUCTION	7.5
2nd	ADVANCED MARINE STRUCTURES CALCULATIONS	4.5

SECOND COURSE (60 ECTS)

SEMESTER	SUBJECT	ECTS
1st	FISHING SYSTEMS AND AQUACULTURE	6.0
1st	LOGISTICS, MAINTENANCE AND REPAIRING	6.0
1st	SHIP PROJECT	6.0
1st	SHIPBUILDING AND SHIP REPAIRING	6.0
1st	DYNAMICS OF PLATFORMS AND ARTEFACTS	6.0
	OPTATIVE SUBJECTS	
2nd	ANALYSIS AND MODELLING OF SHIP VIBROACUSTICS	4.5
2nd	MARINE RENEWABLE ENERGIES AND OFFSHORE WIND ENERGY	4.5
2nd	INSPECTION AND QUALITY CONTROL IN SUBMARINES	4.5
2nd	PROJECT MANAGEMENT	4.5
2nd	INTRODUCTION TO SUBMARINE PROJECT AND CONSTRUCTION	4.5
2nd	ENGINE TECHNOLOGY AND TERMAL INSTALLATIONS	4.5
2nd	MANAGEMENT OF CRUISE SHIPS AND TERMINALS	4.5
2nd	MASTER THESIS	12
2nd	OUTSIDE INTERSHIP	18

2. CONTENTS AND UNITS

FIRST YEAR 1st SEMESTER

ADVANCED NUMERICAL METHODS	
COURSE: 1º (6 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Basics of numerical methods. Runge-Kutta methods for EDOs. Numerical modelling of fluid dynamics: Navier-Stokes equations, Euler equations. Runge-Kutta with TVD. Finite Difference and Finite volume methods applied in 1 D equations. Implementation of numerical methods. Order, convergence and stability Extension to system of equations and multi-dimensional spaces	
UNITS:	
Chapter 1. Basics of Numerical Analysis. Chapter 2. Runge-Kutta methods for ODEs. Chapter 3. Runge - Kutta methods with TVD. Chapter 4. Method of Finite Differences and Finite Volumes.	

NUMERICAL METHODS IN SOLID MECHANICS	
COURSE: 1º (4.5 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Introduction to FEM using the stress wire equation. Treatment of the theory of elasticity with the FEM. Numerical treatment of slender elements: the FEM in the Theory of Plates and Sheets and in the treatment of bars and structural systems. Basics of FEM programming in solid mechanics. Simulations of FEM.	
UNITS:	
Chapter 1. Introduction to the Finite Element Method (FEM). Chapter 2. Structures and its treatment by FEM. Chapter 3. Theory of plates and its treatment by FEM. Chapter 4. Elasticity theory and its treatment by FEM. Chapter 5. Isoparametric Elements. Programming the FEM.	

MANAGEMENT AND ECONOMY OF MARITIME COMPANIES	
COURSE: 1º (4.5 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
The maritime Company as socio-economic reality. Business management. Planning and control applied to maritime business. Cost control. Product and system design and application to maritime industry. Quality and location decisions. Investment decisions. Use and management models. Application of Project management in maritime industry.	
UNITS:	
Chapter 1. The company and its structure. Chapter 2. Business management, staff planning and structural analysis. Chapter 3. Market analysis and strategy. Part I. Chapter 4. Market analysis and strategy. Part II. Chapter 5. The productive system. Provisions. Chapter 6. Control of costs, financing and treasury. Chapter 7. Models of project management.	

SHIP DYNAMICS	
COURSE: 1º (6 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Wave Theories. Energy of irregular sea. Standard wave models. Equations of ship motions. Response Amplitude Operator. Dynamic effects of ship motions. Movement stabilisation. Manoeuvrability. Rudder design.	
UNITS:	
Chapter 1. Introduction and historical evolution. Chapter 2. Regulars waves. Chapter 3. The movements of sea and ship. Chapter 4. Formation of the waves: Waves origins. Swell. Chapter 5. Probabilistic model: Stationary, homogeneous and ergodic process. Chapter 6. Irregular waves and energy spectrum. Chapter 7. Movement in short-crested seaway. Three-dimensional sea. Chapter 8. Coupled heaving and pitching motions: Coordinate systems. Chapter 9. Propulsion in irregular waves: Added resistance. Chapter 10. Loads due to motion. Chapter 11. Stabilisation: Bilge keels. Active roll stabilisers. Stabiliser tanks. Chapter 12. Effects in seakeeping: Slamming. Deck wetness. Propeller emergence. Influence in design. Chapter 13. Effects on persons. Chapter 14. Controllability and manoeuvrability. Chapter 15. Rudder design: Rudders loads. Rudder design.	

SEA TRADE AND MARITIME TRANSPORT	
COURSE: 1º (4.5 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Main flows of maritime transport. Main maritime routes. Transport flows. Main ports. Liquid bulk shipping. Dry Bulk shipping: main and secondary bulk. Perishable and special transports. Maritime passenger transport. Technical and economic study of the transport. Risk in maritime transport. Usual document in maritime transport. Rules of maritime transport. IMDG code. MARPOL code. ESC code.	
UNITS:	
Chapter 1: Transportation. Chapter 2: Liquid bulk shipping Chapter 3: Dry bulk shipping. Chapter 4: Container shipping. Chapter 5: Ship port call. Chapter 6: Maritime insurance. Chapter 7: Overview of legislation on Safety in Maritime Transport. Chapter 8: International Maritime Dangerous Goods Code. Chapter 10: Code of safe practice for cargo stowage and securing.	

OCEANOGRAPHY	
COURSE: 1º (4.5 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Instrumentation. Ocean Basins. Ocean chemistry. Chemical composition of seawater. Density. Propagation of light and sound. Balance of water, salt and heat. Waves. Wave energy. Tides and currents. Water movement equations. Types of currents. General models of ocean circulation (GCMs). Atmosphere – ocean interaction. El Niño phenomena and South oscillations. Modelling and treatment of ship pollutions. Environmental Impact of ships.	
UNITS:	
Chapter 1. Introduction. Chapter 2. Ocean basins: structure and evolution. Chapter 3. Ocean chemistry. Chapter 4. Physical properties and behaviour of seawater. Chapter 5. Propagation of light and sound. Chapter 6. Balance of water, salt and heat. Chapter 7. Waves. Chapter 8. Tides. Chapter 9. Ocean Circulation I. Chapter 10. Ocean Circulation II. Chapter 11. Descriptive Oceanography: Major ocean currents. Chapter 12. The ocean as climate regulator.	

FIRST YEAR 2nd SEMESTER

PLATFORM AND ARTEFACT PROJECT CONSTRUCTION	
COURSE: 1º (7,5 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
History development of ocean technology. Technical aspect of ocean ambient to be considered in the offshore design. Wave theories. Loads on offshore structures. Marine structure classification. Equipment of offshore structures. Fixed structures. Floating structures. Basic principles of offshore platform design. Mooring design. Process construction of offshore platforms. Construction and operation of offshore structures.	
UNITS:	
Chapter 1. History of Ocean Technology. Chapter 2. Classification and description of offshore structures. Chapter 3. Introduction to environmental aspect on Ocean Technology. Chapter 4. Loads on Ocean structures. Chapter 5. Design principles. Chapter 6. Equipment and services on offshore installations. Chapter 7. Positioning on floating ocean structures. Chapter 8. Construction principles. Chapter 9. Installation and operation in offshore structures.	

APPLIED SYSTEM ENGINEERING	
COURSE: 1º (6 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
The systemic. Models in system engineering. Operational and logistic requirements. Life cycle phases and its relations with logistic requirement. System logistic. Life cycle systems and costs. Application to system engineering to ship or marine artefact definition. Operational and logistic stablishing. Definition of essential systems. Reliability, maintainability, mission security and performance estimations. Methods for cost project.	
UNITS:	
Chapter 1: Introduction to the high complexity project management. Chapter 2: Definition of System Engineering. Chapter 3: General description of the process. Chapter 4: Milestones and phases defined by Systems Engineering. Chapter 5: Planning and Baseline. Chapter 6: Monitoring and Metrics (EVMS ES). Chapter 7: Risk Management. Chapter 8: Configuration Management. Chapter 9: Industry 4.0 applied to the naval sector (Shipbuilding 4.0).	

ADVANCED MARINE STRUCTURES CALCULATION	
COURSE: 1º (6 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Fundamentals of Finite Element Method applied to Marine Structures. Structural division. Elements applied to analysis and structural design. Hull modelling. Mesh analysis. Frame modelling. Reinforced panel modelling. Stiffness modelling. Load analysis. Symmetry of loads. Common Structural rules. Structure modal analysis. Nonlinear analysis.	
UNITS:	
Chapter 1. Fundamentals of the Finite Element Methods. Chapter 2. Fundamentals of finite element method programs. Chapter 3. Application of the finite element methods to marine structures. Chapter 4. Common structural rules (CSR-H). Chapter 5. Finite element method in marine composite structures. Chapter 6. Dynamics analysis using finite element method.	

ENGINE PLANTS AND PROPULSION	
COURSE: 1º (6 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Main engine room design and electric generation. Definition, estimation and optimization of energy and propulsion plant in ships. Conventional systems. Electrical propulsion. Combined propulsion. Cell fuel. Nuclear propulsion. Operative, economic and environmental study of different approaches.	
UNITS:	
Chapter 0. Introduction. Chapter 1. Steam machines. Chapter 2. The boilers. Chapter 3. The steam turbines. Chapter 4. Internal Combustion engines. Chapter 5. Comparison of Diesel engines. Chapter 6. Special features. Shock, vibration, noise and emissions. Chapter 7. Gas turbines. Chapter 8. The electric Propulsion. Chapter 9. The Nuclear-powered. Chapter 10. Propulsion systems for submarines. Chapter 11. Ship propeller.	

ADVANCED NAVAL HIDRODYNAMICS	
COURSE: 1º (6 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Introduction to numerical hydrodynamics. Mathematical and physic models. Boundary conditions. Boundary layers and free Surface problems in marine hydrodynamics. Introduction to turbulence models. Basic techniques and numerical models employed in Computational Fluids Dynamics. Hull shape optimization and appendage optimization using CFD. Propeller Project using direct calculation. Circulation theory applied to propeller design: lifting surfaces. New impulsion theory.	
UNITS:	
Chapter 1. Introduction to Advanced Naval Hydrodynamics. Chapter 2. Advanced experimental techniques in towing tanks. Chapter 3. Advanced shapes design. Influence of hull forms, bulb and appendices in drag. Chapter 4. Numerical Hydrodynamics. Chapter 5. Advanced design of marine propellers.	

SECOND YEAR 1st SEMESTER

FISHING SYSTEMS AND AQUACULTURE	
COURSE: 2º (4.5 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Fishing ordinance. Description of fishing vessels. Fishing systems. Fishing gear descriptions. Fishing ship Project. Aquaculture systems. Types and methods of cultivation. Installation types- Systems and equipment in aquaculture systems. Ships and auxiliary platforms. Installation design process.	
UNITS:	
Chapter 1. Introduction to fishing activities. Chapter 2. Types of Fishing. Chapter 3. Typology of the fishing vessel. Chapter 4. Fishing Legislation. Chapter 5. On board treatment of fish. Chapter 6. The design and construction of the fishing vessel. Chapter 7. The environment of aquaculture. Chapter 8. Types of marine farming. Chapter 9. Farming methods of different species. Chapter 10. Types of facilities. Chapter 11. Facilities design. Chapter 12. Ships and auxiliary platforms.	

LOGISTICS, MAINTENANCE AND REPAIRING	
COURSE: 2º (4.5 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Reliability theory applied to naval maintenance. Scheduled maintenance at a fixed interval time. Predictive maintenance. Corrective maintenance. Planning and management of maintenance. Guidelines for the implementation of a maintenance plan. Maintenance logistics of ships and artefacts. Management of computer maintenance of ships and artefacts. Control and management of repairing.	
UNITS:	
Chapter 1. Maintenance and asset management. Chapter 2. Maintenance, organization and planning. Chapter 3. Reliability theory applied to naval maintenance. Chapter 4. Ship maintenance management. Chapter 5. Inspection techniques. Chapter 6. Repair management.	

SHIP PROJECT	
COURSE: 2º (6 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Shape hull generation and transformation. Techniques for measuring vessel shapes. Drawings. MARPOL and SOLAS rules. Project management. Stability criteria. Stability damage. Computer naval architecture design.	
UNITS:	
Chapter 1. Systematic series. Chapter 2. Common techniques for measuring vessel shapes. Chapter 3. Form plans. Chapter 4. Planes of propellers, rudders and appendices. Chapter 5. General disposition plans. Chapter 6. Master plan drawings and type sections. Chapter 7. Plans of the development of the lining. Chapter 8. Plans of tanks and machine room. Chapter 9. Objectives and functions of the IMO. Chapter 10. Organizational structure. Chapter 11. Scope and objectives of MARPOL regulations. Chapter 12. Requirements for machinery spaces. Chapter 13. Requirements for double hull and double bottom of tankers. Chapter 14. Calculation of the compartment subdivision index. Chapter 15. Calculation of the subdivision index prescribed on ships. Chapter 16. Stability experience procedure.	

SHIPBUILDING AND SHIP REPAIRING	
COURSE: 2º (6 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Main characteristics of the shipbuilding and ship repairing markets. Contract aspects. Demand adaptation. Obtaining and development of hull structural elements. Integrated and advanced shipbuilding. Shipbuilding strategies. Shipbuilding and repairing process control. Production management and workshops. Composites shipbuilding. Wooden shipbuilding. Launching.	
UNITS:	
Chapter 1. Shipbuilding and ship repairing markets. Chapter 2. Lines plans drawings. Chapter 3. Hull ship lofting. Chapter 4. Plates and profile preparation, cutting and forming. Chapter 5. Welding process in ship construction. Chapter 6. Modern systems of ship construction. Chapter 7. Integrated shipbuilding. Chapter 8. Pipe piece family manufacture. Chapter 9. Launching. Chapter 10. Ship construction in composites. Chapter 11. Wooden boatbuilding. Chapter 12. Ship structures damages. Inspection and repairing.	

DYNAMICS OF PLATFORMS AND ARTEFACTS	
COURSE: 2º (6 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Introduction to platform dynamics. Process statistics of ocean. Linear dynamics of marine systems. Nonlinear dynamics of marine system. Dynamic positioning systems. Fluid – structure interaction.	
UNITS:	
Chapter 1. Introduction. Chapter 2. Statistics of waves. Chapter 3. Linear response of marine structures. Chapter 4. Non-linear response of marine structures. Chapter 5. Dynamic mooring analysis of floating offshore structures. Chapter 6. Fundamentals of fluid-structure interaction.	

SECOND YEAR 2nd SEMESTER

ANALYSIS AND MODELLING OF SHIP VIBROACUSTICS	
COURSE: 2º (4.5 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Main sources of noise and vibration on-board. Ways to transmit noise and vibration on-board. Modelling of vibroacustics systems using numerical methods. Sea radiated noise in near and far field. Acoustic signature of ships. Advanced measuring techniques: modal analysis and acoustic intensity measurement.	
UNITS:	
Chapter 1. Description of the main noise and vibration sources on board. Chapter 2. Noise and vibration transmission paths. Structural noise. Chapter 3. Vibration isolation. Dynamic stiffness of the anti-vibratory mounts. Chapter 4. Active and passive vibration isolation. Chapter 5. Noise isolation Systems. Chapter 6. The Finite element method (FEM). Chapter 7. Application of FEM to the modelling of structures. Determination of natural frequencies. Chapter 8. Statistical Energy Analysis method (SEA). Chapter 9. Application of SEA to the modelling of ships. Determination of self-noise and acoustic signature of ships. Chapter 10. Modal analysis. Chapter 11. Acoustic intensity measurement.	

MARINE RENEWABLE ENERGIES AND OFFSHORE WIND ENERGY	
COURSE: 2º (4.5 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
History of wind energy. Introduction to wind energy. Classification and applications of wind power. Wind characteristics. Wind Measurement and Treatment. Parts of a wind system. Aerodynamic principles. Design of wind rotors. Calculation of the energy produced by a wind turbine. Description of the general operation of a wind farm. Description of components of a wind farm. Applications of small wind power systems. Types of wind machines. Components of an isolated wind system. Design of small power facilities. Wave theory and performances at Sea. Tidal power descriptions and plants. Sea wave energy and converters. Ocean thermal, osmotic and current energy	
UNITS:	
Chapter 1 Overview of wind energy. Chapter 2 Harnessing the wind resource. Chapter 3 Description of the use of wind systems. Chapter 4 Operation of wind farms. Chapter 5 design isolated small wind power systems. Chapter 6 Ocean Power.	

INSPECTION AND QUALITY CONTROL IN SUBMARINES	
COURSE: 2º (4.5 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Quality control through product life cycle. Feasibility and reliability of production process. Capacity and process measurement. Preparation and qualification of welding procedures and welders. Fundamentals, applications and limitations of non-destructive testing. Inspection and testing of welded joints. Codes, rules and technical specification of Classification Societies.	
UNITS:	
Chapter 1. Phases of a quality control program. Stage inspection plans. Chapter 2. Certification and quality requirements in the construction and maintenance of welded elements (UNE-EN ISO 3834). Chapter 3. Preparation and qualification of welding procedures and welders. Chapter 4. Inspection and testing of welded joints. Chapter 5. Dimensional requirements. Dimensional Control techniques and measuring devices. Chapter 6. Quality control throughout the life of the product. Quality Assurance. Quality Improvement. Chapter 7. Quality audits in accordance with UNE EN ISO 9001 and EN ISO 9100. Process management. Monitoring and improvement through performance indicators. Chapter 8. Sampling techniques.	

PROJECT MANAGEMENT	
COURSE: 2º (4.5 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Quality control through product life cycle. Feasibility and reliability of production process. Capacity and process measurement. Preparation and qualification of welding procedures and welders. Fundamentals, applications and limitations of non-destructive testing. Inspection and testing of welded joints. Codes, rules and technical specification of Classification Societies.	
UNITS:	
Chapter 1: Introduction to project management. Chapter 2: Project management process. Chapter 3: Project integration management. Chapter 4: Project scope management. Chapter 5: Project schedule management. Chapter 6: Project cost management. Chapter 7: Project quality management. Chapter 8: Project resource management. Chapter 9: Project communications management. Chapter 10: Project risk management. Chapter 11: Project procurement management. Chapter 12: Project stakeholder management. Chapter 13: Agile Methodologies in project management.	

INTRODUCTION TO SUBMARINE PROJECT AND CONSTRUCTION	
COURSE: 2º (4.5 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Introduction to submarine design. Hydrostatic and hydrodynamics of submarines. Manoeuvrability of submarines. Structures subjected to high external pressure. Process construction of submerged structures.	
UNITS:	
Chapter 1 Introduction. Sizing. General layout. Chapter 2. Naval architecture in submarines. Chapter 3. Shapes design. Hydrodynamics of submarine. Chapter 4. Submarine structures. Chapter 5. Shock resistance. Chapter 6. Construction processes of submarine. Chapter 7. Specific systems of submarines.	

ENGINE TECHNOLOGY AND TERMAL INSTALLATIONS	
TEACHING LANGUAGE: SPANISH	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Not available.	
UNITS:	
Not available.	

MANAGEMENT OF CRUISE SHIPS AND TERMINALS	
COURSE: 2º (4.5 ECTS)	**TEACHING LANGUAGE: SPANISH**
CONTENTS:	
Type of cruise ships. Main destination regions: ports and itineraries. Cruise market segmentation. Cruise lines market structure. Operation of cruise ships. Rules and Regulations of the International Maritime Organization for passenger vessels.	
UNITS:	
Chapter 1: Areas of deployment of cruise ships. Chapter 2: Cruise ships. Chapter 3: Cruise market stakeholders. Chapter 4: Types of cruise ports. Chapter 5: Hinterland of a cruise port. Chapter 6: International Ship and Port Facility Security Code (PBIP/ISPS). Chapter 7: Procedure of ship's port call. Chapter 8: SOLAS Code. Chapter 9: Introduction to maritime transport research.	