EMSHIP+ Course Content and learning outcomes

Sem 1: **M1 at ULiège – Fundamental lectures in Engineering**
Sem 2: **M1 at ULiège – Naval Architecture and Offshore Engineering**

Sem 3a: **Master lectures M2 at ECN**
Sem 3b: **Master lectures M2 at URO**
Sem 3c **Master lectures M2 at UPM (join master)**

Sem 4: **Internship and Master Thesis** (with support of ZUT, UGAL, UNIGE, ICAM and SOLENT)

Sem 1: **Master 1 at ULiège**

LIST OF LECTURES (in **Mechanical Engineering**) in M1 at ULiège

Course titles	ECTS
Compulsory courses: 20 ECTS	
Theory of vibration **Course contents**: This course provides a solid background in vibration theory for engineering applications. Course outline: introduction and analytical dynamics of discrete systems, undamped vibrations of n-degree-of-freedom systems, damped vibrations systems, continuous systems, Rayleigh-Ritz and finite element method, solution methods for the eigenvalue problem, direct time-integration methods, introduction to nonlinear dynamics. **Learning outcomes**: The students will be familiar to analytical and computational methods for predicting the dynamic response of practical engineering structures.	5
Manufacturing Process **Course contents**: This course is devoted to manufacturing processes, with and without chips. It is a necessary complement to design, as any designed machine element has to be produced. **Learning outcomes**: After this course, the student will be able to conceive a pertinent manufacturing process of a mechanical parts, which are easy to conceive and cheap to produce.	5
Materials Selection **Course contents**: Description and application of different types of materials: metals, ceramics, polymers, composites and biological materials. Origin and optimisation of mechanical and physical properties of materials. Selection of the optimal material. Selection of materials for a typical application. Practical cases of materials selection. **Learning outcomes**: At the end of the course, students will be familiar with the selection the best material required for a specific application or property.	5
Principles of Management **Course contents**: This course introduces the four main dimensions of company management: strategy and marketing, human resources and company organization, accounting and financial analysis, supply chain management. **Learning outcomes**: At the end of the course students will be able to define and apply the management core concepts, apply academic knowledge and critical thinking skills to address situations and challenges that arise in 21st-century work environments.	5
Elective courses: 10 ECTS 10 ECTS to take in block "Computational Mechanics" of the master in Mechanics (ULiège). The students have to select two courses among a series (two of them are listed here as examples)	
Finite Element Method **Course contents**: The course provides both theoretical concepts and practical use of the method. Starting from the mechanical behavior of simple structures like pin jointed structures; fundamental concepts of the structural analysis are introduced. Then, it is shown how the general elastic equations (continuum mechanics) can be discretized and how it is possible to obtain an approximate solution for these equations. **Learning outcomes**: The students will be able to understand the fundamental theory of the FEM, develop skills to model the behavior of elastic structures using a commercial FE software for structural analysis.	5
Structural and Multidisciplinary Optimization **Course contents**: Systematic and critical overview of the various numerical methods available to solve optimization problems. Familiarize students with the introduction of optimization concepts into the design process in mechanical engineering. **Learning outcomes**: At the end students are familiar with the fundamental optimization concepts applied to automatic design process.	5

Sem 2: **Master 1 at ULiège**

LIST OF LECTURES (in **Advanced Ship Design**) in M1 at ULiège

Course title	**ECTS**
Compulsory courses: 30 ECTS	
Integrated design project of ships, small crafts and high speed vessels **Course contents**: The course includes initiation to Ship Theory, Ship Structure, Ship propulsion and Ship production. **Learning outcomes**: This course will result in a presentation of a comprehensive (integrated) ship project where all the naval architecture problematic is considered.	**15**
Ship theory: statics and dynamics **Course contents**: The course includes initiation to the concepts required for ship manoeuvrability studies; description and practice of the principal scientific methods ahttps://www.google.fr/nd tools in optimization for naval, architects and ship designers; initiation to CFD application to ship simulation. **Learning outcomes**: This course prepares students to master the basic notions relating to the behaviour of floating and naval structures.	**5**
Ship and offshore structures **Course contents**: The course includes fundamentals of ship structures, ultimate strength, reliability analysis, fatigue, vibration, optimisation, shipyards & ship production, composite materials. **Learning outcomes**: This course will give students a general overview of the structural problems that must be considered at the conceptual design stage, early design stage and detailed design stage.	**7**
Ship equipment and propulsion systems **Course contents**: This course includes equipment and on-board electricity, energy production, energy users, electric and turbo-electric diesel propellers. Propulsion Systems for naval and commercial vessels. Marine diesel engines. Overheating. Injection and combustion.. Emissions and reduction of pollutants. **Learning outcomes**: The main objective is to give a general overview of the definition of the outfitting problem (including the propulsion aspects) that has a large influence at the conceptual design stage.	**3**

Sem 3a: **Master 2 at ECN**

LIST OF LECTURES (in **Hydrodynamics for Ocean Engineering**) in M2 at ECN

Course title	**ECTS**
Compulsory courses: 30 ECTS	
General concepts of hydrodynamics **Course contents**: The purpose of this course is to give the students a general introduction to hydrodynamics for Ocean Engineering preparing them to take the best out of more focused courses proposed in the sequel of the program. A part of this course is dedicated to introduction of numerical simulation in hydrodynamics for Ocean Engineering and another one to theoretical and practical aspects of ship stability **Learning outcomes**: At the end of the course the students will know how hydrodynamics is used today in naval and offshore engineering, to be able to define which mathematical model and which numerical approach are adapted to a given problem in hydrodynamics. Moreover they will know how to compute the stability of a ship using state of art industry software.	4
Water waves and sea state modelling **Course contents**: This course intends to describe the main source of loading for structures at sea, namely ocean waves. This is essential for the design of such structures and is the starting point of all hydrodynamics' studies. **Learning outcomes**: At the end of the course the students will know what are hypothesis used to defined different wave models which can be found in literature or in marine engineering community.	4
Wave-structure interactions and moorings **Course contents**: A complete presentation of the available models for the determination of marine structures response in a seaway, emphasizing the advantages and drawbacks of each approach and make familiar with the modelling of mooring systems. **Learning outcomes**: At the end of the course the students will know hypothesis and limitations of seakeeping study done with a linearized potential flow model. They will be able to use a software simulating seakeeping.	4
Numerical hydrodynamics **Course contents**: The goal of this course is to provide students with an overview of the Computational Fluid Dynamics (CFD) methods and simulation environment for the computation free-surface unsteady flows of ocean engineering. **Learning outcomes**: At the end of the course the students will know different numerical methods which are existing, their capacities and their limitations and drawbacks.	5
Experimental hydrodynamics **Course contents**: The goal of this course is to provide students with the foundations of experimental fluid dynamics in the field of offshore renewable energy. Despite the development of numerical modelling, the experimental approach remains a major source of knowledge development in ship hydrodynamics and marine renewable energy. **Learning outcomes**: At the end of the course the students will be familiar with elements of capacities in experimental hydrodynamics, what phenomena can be studied, what measurements can be obtained.	4
Naval engineering **Course contents**: This course is oriented towards fundamental knowledge about ship design: ship manoeuvrability, optimization and computational fluid dynamics; principal scientific methods and tools in optimization for naval architects and ship designers; application of CFD tools to ship simulation. **Learning outcomes**: At the end of the course the students will be familiar with theory and principles of numerical modelling for selected problems. They will be able to use optimization software for a practical case of hull optimization.	5
French language and culture **Course contents**: The objective is to allow students to learn general French, develop language skills of oral and written comprehension and expression and familiarise with French culture. **Learning outcomes**: After completing this course, the students will be able to communicate in spoken and written French, in a simple but clear manner on familiar topics in the context of study, hobbies etc.	4

Sem 3b: **Master 2 at URO**

LIST OF LECTURES (in **Ship Technology – Ocean Engineering**) in M2 at URO

Universität Rostock Traditio et Innovatio

Course title	ECTS
Type of courses: Four Elective courses and in addition the Team Project (compulsory): 30 ECTS	
Theory and design of floating and founded offshore systems **Course contents**: Loads and motions of ships and offshore structures. Marine environment. Wave-induced loads and motions of floating structures. Numerical methods for prediction of linear wave-induced loads and motions of hydro-dynamically compact floating structures. **Learning outcomes**: Students acquire general knowledge about offshore structures for oil and gas exploration and production, for marine aquaculture as well as for underwater applications.	6
Selected topics of the analysis of marine structures **Course contents**: Introduction to selected topics of structural design and analysis. Shear force distribution in thin-walled structures with several cells. Warping torsion. Elastic foundation. Analysis under seismic loads. Selected advanced finite element formulations. Non-linear solution methods. Ultimate strength analyses. **Learning outcomes**: Students will be able to assess the behavior of marine structures under special and extreme loads. Students will know the background of the relevant methods so that they can apply them correctly and efficiently.	6
Mathematical models in ship theory **Course contents**: Differential equation of motion of arbitrary objects in different media. Equations of ship manoeuvring. Determination of added mass. Steady manoeuvring forces. Calculation of steady manoeuvring forces using slender body theory. Experimental study of the manoeuvrability. Influence of different factors on the manoeuvrability. Application of CFD for manoeuvrability problems. Dynamics of offshore structures. **Learning outcomes**: Students will be familiar with a general overview of mathematical models used in ship dynamics, ship maneuverability and offshore structures dynamics. They will be able to demonstrate knowledge and understanding of ship and offshore structures motion at different operational conditions.	6
IT in ship design and production **Course contents**: Process analysis in ship design, production and operation. Fundamental differences between mass production and one-of-a-kind products like ships and offshore structures. CA-tools applied in ship design. Process modelling techniques, examples from shipbuilding processes product modelling. Modelling and transformation of information. Integration strategies. System architecture of selected tools specifically used in ship design. **Learning outcomes**: Students will understand the fundamentals and will be able to judge upon the capabilities of IT-tools in ship design and production. They will be able to identify requirements on these software systems based on a sound knowledge of the ship design and operation life cycle.	6
Safety of ships under damaged conditions in waves **Course contents**: Hydrostatics and stability repetition. Lost buoyancy and floating condition after a damage. Floodable length curve, criteria freeboard and stability. Deterministic determination of ship safety. Probabilistic approach for a rational analysis of the effect of watertight internal subdivision. Rational methods to calculate the risk in case. Regulation regarding ship safety in damaged conditions. Safety against capsizing of ships in waves. **Learning outcomes**: Having successfully completed the module, the student will be able to demonstrate knowledge and understanding of the physics of floating objects like ships and offshore structures taking into account a damaged condition.	6
Ocean research technology **Course contents**: Measurement and sampling procedures and methods in marine science and underwater monitoring. System theory and life assessment concepts. **Learning outcomes**: Students will be able to recognize and understand relevant issues of in situ – working disciplines of marine sciences.	6
Team project **Course contents**: This module is strictly linked to any course to be taken at URO. Depending on the topics of the selected course, a problem will have to be solved in a team. Students can select the course for the teamwork project according to their preference. **Learning outcomes**: Students will experience themselves in a team solving a defined problem in a defined time span.	6

Sem 3c: **Master 2 at UPM**

LIST OF LECTURES (in **Advanced Ship and Offshore Structures**) in M2 at UPM

Course title	**ECTS**
Compulsory courses: 30 ECTS	
Oceanology • Understanding the offshore environmental conditions. • To gain the ability of building the environmental loads in order to properly model and design the structures. • Energy resource, characterization: waves, currents, wind-wave joint probability, long term descriptions.	1.5
Structural Design of OWT • Understanding site assessment, including dynamics of floating offshore structures, their mooring and their analysis. • Understanding the design of foundations of fixed OWT, including the comprehension of the structural design principles, integrated design, material technologies, cathodic protection principles and the Certification Process. • Gaining the knowledge about new technologies: floating support structures, and marine energy converters	8
Electric Generation and Export Technologies • To have a global vision of different Power Take Off (PTO) types and identify the basic model for blades power conversion • To understand the complete WTG's design process. This part will cover from the aero-servo-hydroelastic calculations for obtaining the load assessment to the dimensioning parameters for the main WTG components • To present a general model of annual energy estimation • To understand the operation and behavior of different types of generators and their connection to grid • To understand of operation aspects related to active and reactive power control • Knowledge about typologies and technologies of array and export cables	5.5
Manufacturing and Maritime Operations • Understanding the offshore fabrication techniques, relevance of interfaces and all activities for sail away. • Knowledge of marine vessels and ability to select the most appropriate offshore vessels set. Ability to define the most suitable transport and installation strategies. • Understanding the figures involved in granting permits for marine operations and decision-making procedures • Understanding of the construction phases happening offshore	7
Project Operation and Management • Sound knowledge of the political, economic and technological drivers guiding the development of the MRE • Full comprehension of the different phases of a MRE Project and the specific characteristics of each one of them: Development, Permits, Construction and Operation and its financial inputs and outputs • Knowledge of the different approaches to develop, build and operate a MRE project. Cost structure of the project and differences among the different possibilities. • Sound knowledge of the building up of a MRE Project business case and the different possibilities for its financing. • Robust knowledge of the different approaches to monetize risks. Contingency concept and valuation. • Understanding of the main risks arising during the different development phases of a RME Project. Classification, evaluation and mitigation of these risks. Contingency management.	4
Structural Analysis of Offshore Platforms • Preparation of a Finite Element model of a foundation and integration with tower & WTG models • Preparing the analysis: site description, load case definition and creating the load environment in the FEM. • Running the FEM analysis and assessment of results • Sizing the model for the test on a basin. • Selection of the load conditions and site constraints • Being able to perform results comparison between numerical models and experiments	4
ELECTIVE COURSES : 4 ECTS (The students select the course on the voluntary basis)	
Spanish Language and Culture	4

Sem 4: Internship and Master Thesis

with support of

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Compulsory courses: 30 ECTS	**ECTS**
Internship: Internship experience provides the student with an opportunity to explore career interests while applying knowledge and skills learned in the classroom in a work setting. The experience also helps students gain a clearer sense of what they still need to learn and provides an opportunity to build professional network. During the internship, the student will also carry out the research necessary to prepare the diploma thesis.	5
Master Thesis: Within the framework of the Master's Thesis course, students will explore different ways of finding information, defining the scope of a project and doing research, as well as different ways of communicating the results. The Master's thesis course includes the stages of defining a topic and formulating a problem statement, selecting and reviewing relevant literature, designing an empirical study as well as performing it, including data collection and analysis, analysing the empirical data, make theoretical conclusions and finally writing and rewriting a written report called a Master's thesis.	25