ANNEX 1

EMSHIP+ COURSE CONTENT

Sem 1: M1 at ULiège – Fundamental lectures

Sem 2: M1 at ULiège – Naval Architecture

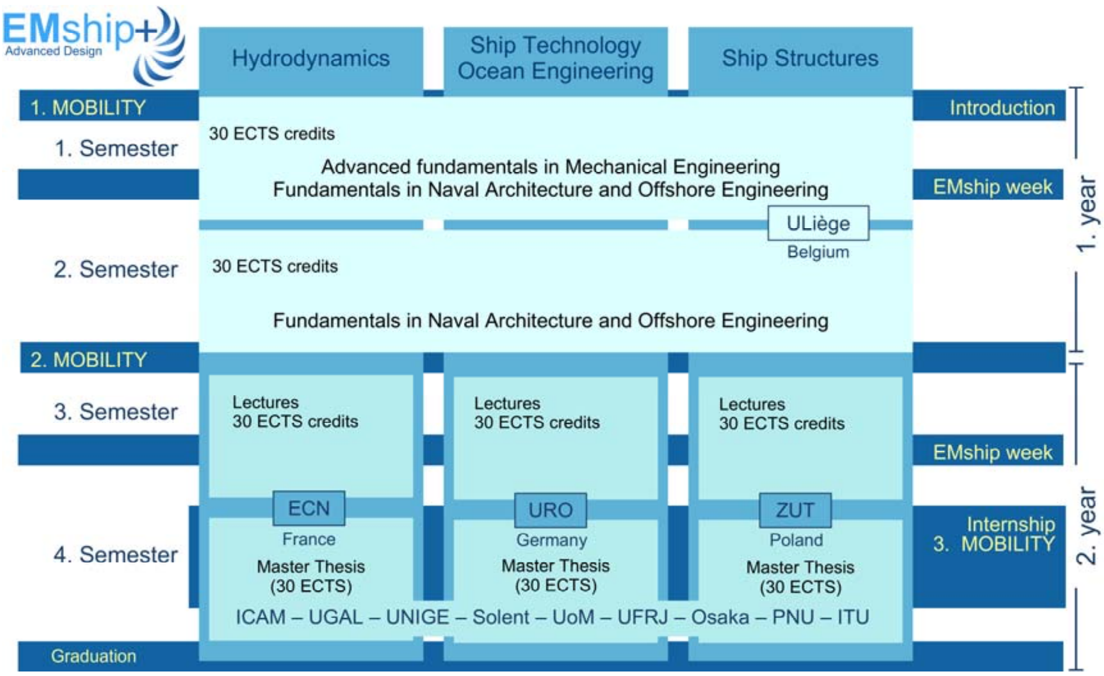
Sem 3a: Master lectures M2 at ECN

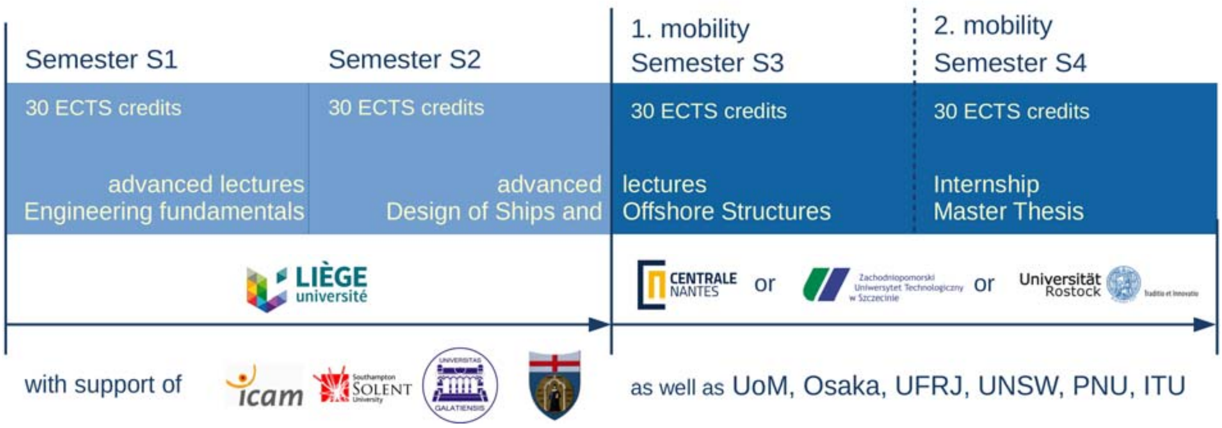
Sem 3b: Master lectures M2 at URO

Sem 3c: Master lectures M2 at ZUT

Sem 4: Internship and Master Thesis

(with support of UNIGE, UGAL, ICAM and SOLENT)





Sem 1: **Master 1 at ULiège**

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

Course titles	ECTS credits
Type of courses: Compulsory, 20 credits	
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 of the course students will be familiar with the fundamental optimization concepts applied to automatic design process.	5
Manufacturing Process **Course contents**: This course is devoted to manufacturing processes, with and without chips. It is a necessary complement to design, a 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 Sem. He will also be able to conceive mechanical Sems which are easy to produce and thus cheap.	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 by a Semicular application or for Semicular properties.	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
Type of course: Elective, 10 Credits 10 credits to take in block "**Computational Mechanics**". The students select two courses among a series (2 are listed as examples)	
Finite Element Method **Course contents**: The course provides both theoretical concepts as well as 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. Subsequently, it is shown how the general elastic equations established in continuum mechanics can be discretized and how it is possible to obtain an approximate solution for these equations. **Learning outcomes**: At the and of the course the students will be able to understand the fundamental theory of the finite elements, develop skills to model the behavior of elastic structures, use a commercial finite element software for structural analysis.	5
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 of n-degree-of-freedom systems, continuous systems, approximation of continuous systems by displacement methods, Rayleigh-Ritz and finite element method, solution methods for the eigenvalue problem, direct time-integration methods, introduction to nonlinear dynamics. **Learning outcomes**: At the and of the course the students will be familiar to analytical and computational methods for predicting the dynamic response of practical engineering structures.	5

Sem 2: **Master 1 at ULiège**

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

Course title	ECTS credits
Type of course: Compulsory, 30 credits	
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 and 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. Classification regulations. Propulsion Systems for naval and commercial vessels. Marine diesel engines. Overheating. Injection and combustion. Engines powered by heavy fuel. 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 credits
Type of courses: Compulsory, 30 credits	
Prerequisites **Course contents**: Reminders basics of Fluid mechanics and mathematics which are essential for a good understanding of all courses of the semester. **Learning outcomes**: At the and of the course the students will be comfortable with basics of Fluid Mechanics and Mathematics for Engineers.	NA
General concepts of hydrodynamics **Course contents**: The purpose of this course is to give the students a general introduction to hydrodynamics preparing them to take the best out of more focused courses proposed in the sequel of the program. **Learning outcomes**: At the and of the course the students will know how hydrodynamics is used today in naval and offshore engineering, to be able to define what mathematical model is adapted to a given problem in hydrodynamics.	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 and 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 **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 and 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 and 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 and 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.	5
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 and of the course the students will be familiar with theory and principles of numerical modelling for selected problems. They will be able to use an optimization software for a practical case of hull optimization.	5
French language **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.	3

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

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

Course title	ECTS credits
Type of courses: 4 Elective courses plus the Team project (compulsory): 30 credits	
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. The student 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 of a damage. Regulation regarding ship safety in damaged conditions. Safety against capsizing of ships in waves. Ship accidents due to excessive roll motions, pure loss of stability, broaching, accidental shift of loads and combinations thereof. **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 ZUT**

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

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Course title	ECTS credits
Type of courses: Compulsory, 24 credits	
Design of ship and offshore structures **Course contents**: Design loads. Hull structure design system. Design of stiffeners, girders, pillars, plates, design of stiffened panel, optimization of grillage structure, structural methods for mitigation of vibrations. Structural regions. Design of specific types of ships. Oil platforms. Application of composites in marine structures. **Learning outcomes**: On successful completion of this course, students should be able to: perform structural design of various types of marine structures, apply knowledge to various types of marine structures, select relevant structural materials as well as structural components application to marine structures.	6
Mechanics of ship and offshore structures **Course contents**: Strength ship and offshore structures. Wave loads acting on offshore structures. Analysis of structural strength and buckling of pipelines, risers, drillstrings. Stability of plates and stiffened plates, modes of failure. Mechanics of composites. Fatigue of ship structural details. Application of FEM in analysis of ship and offshore structures. Stress concentrations and fatigue analysis. Structural modelling of offshore installations. Vibrations of ships and offshore structures. FE formulation of vibration problem. Reliability analysis. **Learning outcomes**: On successful completion of this lecture, students should be able to: perform numerical analysis of strength of ships and offshore structures, apply knowledge to various types of ships and offshore structures, explain the reason of strength deficiencies, apply appropriate measures to eliminate strength deficiencies.	6
Production technology of ship and offshore structures **Course contents**: Introductory information on ship productions technology. Outline of the welding metal alloys applied in offshore and large-scale structures. Manufacturability of large-scale and offshore structures. Welding-induced stresses and deformations. Storage of materials. Pre-treatment workshop and processing centre. Cutting and bending metal sheets and profiles. Prefabrication processes. Processes of hull fitting. Transport in shipyard. Launching ships. Technology of building specific ship types. Technology of building offshore steel and concrete structures and pipe systems on sea bed. **Learning outcomes**: On successful completion of this course, students should be able to: prepare of technological procedures for ship and offshore structure production, construct the technological process for ship and offshore structure production, apply the knowledge to the different kind of ships and offshore structures, explain what is the best production process for selected ship and offshore structures.	6

Marine power engineering **Course contents**: Classification of energy sources. Ecological aspects of energy use. Energy conservation, conversion and efficiency. General description of marine power plants. Machinery service systems and equipment. Ship service systems and equipment. Emissions and abatement technology. Devices for use of renewable and unconventional energy sources on ships. **Learning outcomes**: On successful completion of this lecture, students should be able to: know types of marine power plants, auxiliary machinery, how different energy sources can use apply knowledge to various solution of marine power systems.	3
Cost-benefit analysis and optimisation of business projects in marine industry **Course contents**: Introduction. Economic profitability: introduction, Payback Period analysis, time value of money, discount rate, Net Present Value, Internal Rate of Return, a profitability example. Financial feasibility: introduction, feasibility calculation, feasibility example. Final comment. **Learning outcomes**: Upon successful completion of this course, students will be able to effectively use cost-benefit analysis and optimization for practical problems in marine industry.	3
Type of courses: Elective, 6 Credits	
Equipment of ship and offshore structures **Course contents**: Basic information, types of equipment mounted on board of ships and offshore platforms. Basic information about types of cargoes, pulley block systems, ropes, deck cranes, deck gantries, deck mooring and anchor winches, lashing system of containers, hatch covers, hydraulics and pneumatics on ships, cargo systems on tankers, horizontal loading systems, rescue boats and rescue special systems, extinguishing and fire system on offshore platforms, water injection systems mounted on offshore platforms, drilling systems, offshore platforms lowering/hoisting mechanisms, drilling stabilization system. **Learning outcomes**: On successful completion of this lecture, students should be able to: know types of equipment mounted on board of ships and offshore platforms, apply knowledge to various types of ships, explain the advantages and disadvantages of various solutions, apply appropriate types of equipment in design.	3
Nonlinear finite element analysis **Course contents**: Introduction to tensor calculus. Continuum mechanics. Formulations for large displacement analysis. Constitutive equations, nonlinear elasticity, theory of plasticity. Variational principles. Methods of solution. Formulation of dynamic problems. Formulation of contact-impact problem. Nonlinear FE analysis of ship structures. Equilibrium curves, ultimate capacity. Influence of initial deformations and stresses. **Learning outcomes**: On successful completion of this lecture, students should be able to: know formulations and methods of solution applied in finite element analysis, apply these methods to solution of nonlinear problems, explain advantages and disadvantages of various solutions.	3
Offshore mariculture installations **Course contents**: Foundations of hydrochemistry. Foundations of mariculture. Recirculation mariculture systems. Water quality and water treatment. Heating and cooling systems. Cage culture. Offshore mariculture installations, elements of installations. **Learning outcomes**: On successful completion of this course, students should be able to: apply the knowledge to the different type of mariculture systems, explain basic process in water treatment and biogenes removal from RAS.	3
Maritime transport **Course contents**: Technical and operational parameters of ships. Linear and irregular shipping. Types of transportation strategies. Cargo types in maritime transport. Safety problems in maritime cargo transport. Seaports classification, port infrastructure and equipment. Characteristics of services provided in seaports. Phases of ship service in seaport area. **Learning outcomes**: On successful completion of this lecture, students should be able to: know basic phases of ship service at the seaport territory, apply knowledge to various cargo types transportation, apply knowledge to ship service at the seaport territory.	3
Type of course: Voluntary, 4 Credits (The students select the course on the voluntary basis)	
Polish Language and Culture	4

Sem 4: **Internship and Master Thesis**

with support of

UNIGE, UGAL, ICAM and SOLENT

Course title	ECTS credits
Type of course: Compulsory, 30 credits	
Internship An 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