Lecture description Galati University Erasmus+

Master 1

	NA student track		NON-NA student track	ECTS
	SEMESTER 1			**30**
1	**Ship Structural Analysis and Design**	**1**	**Ship Structural Analysis and Design**	5
2	**Computational Fluid Dynamics 1**	**2**	**Computational Fluid Dynamics 1**	4
3	**Advanced Shipbuilding Technology**	**3**	**Advanced Shipbuilding Technology**	4
4	**Analysis of Noise and Vibration**	**4**	**Analysis of Noise and Vibration**	5
5a	**Composite structure in naval architecture**	**5b**	**Seakeeping**	5
6a	**Ship Design Project I**	**6b**	**Ship Design Project I** ***[Marine hydrostatics and stability; Ship resistance]***	7
	SEMESTER 2			**30**
7	**Complements in Propulsion Dynamics**	**7**	**Complements in Propulsion Dynamics**	5
8	**Offshore Units and Systems**	**8**	**Offshore Units and Systems**	5
9	**Structural Analysis and Hydroelasticity**	**9**	**Structural Analysis and Hydroelasticity**	5
10	**Computational Fluid Dynamics 2**	**10**	**Computational Fluid Dynamics 2**	4
11a	**Elective course:** 1. Project management 2. The Marine Environmental Protection Technologies 3. Ship Commissioning	**11b**	**Manoeuvring**	4
12	**Ship Design Project II**		**Ship Design Project II**	7

Student track – M1 UGAL

Student background	**I semester**						**ECTS**
Naval architect	**1**	**2**	**3**	**4**	**5a**	**6a**	
Non-naval architect					**5b**	**6b**	
ECTS	**5**	**4**	**4**	**5**	**5**	**7**	**30**
	II semester						
Naval architect	**7**	**8**	**9**	**10**	**11a**	**12**	
Non-naval architect					**11b**		
Students that follow M2 **- ECN track**	**7**	**8**	**9**	**11a***	**11**	**12**	
ECTS	**5**	**5**	**5**	**4**	**4**	**7**	**30**
Students that follow M2 **- ECN track should s*elect* a second elective from 11 instead of 10**							

1st semester – 30 Credits

	ECTS
1. Ship Structural Analysis and Design	**5**

Course description

The course provides a fundamental structural analysis background which is established by understanding the basic principles of beams and columns analysis and design, distribution of normal and shear stresses, buckling of plates, theory and design of stiffened panels. Then the course will help the student in performing the preliminary structural design of a midship section. The course also provides a fundamental of the Finite Element Method (FEM) formulations and solution principles followed by a Finite Element Analysis (FEA) and its applications in marine and offshore structures assessment.

Course contents

- Introduction to ship structural analysis;
- Beams and columns analysis;
- Normal stresses; shear stress and shear lag;
- Basic theory of plates, plate bending, plate buckling;
- Theory and design of stiffened panels;
- Midship section design;
- Finite Element Method (FEM) fundamentals and applications in marine industry
- Numerical applications of FEM using computer software with application on a ship hull or hull structural compartments.

Outcomes

After attending the course the student should be able to

- Understand the basic principles of structural analysis and its marine applications;
- Understand and resolve simple problems for beams and columns;
- Understand the different stresses applied on a structural element such as normal and shear stresses, and understand the shear lag concept;
- Understand and resolve basic problems regarding plate loading in case of normal and buckling loads;
- Apply the previous experience gained from the individual analysis of structure members to analyze a complex stiffened panel;
- Learn and understand the basic formulations of finite element method and its applications in marine and offshore industry;
- Apply all the gained experience in solving a real case for a ship hull model or a stiffened panel such as the ship deck, double bottom, bulkhead, using the finite element method applied on FEM computer software.

Prerequisites

- Mechanics;
- Strengths of materials.

	ECTS
2. Computational Fluid Dynamics 1 – Numerical Methods	**4**

Course Description

The course provides an introduction to the Computational Fluid Dynamics (CFD) and its applications in marine hydrodynamics. The course focuses on the numerical approach of CFD including the basic discretization methods, CFD process, spatial and temporal discretization methods and techniques, the solution of the Navier-Stokes equations.

Course Contents

- Introduction to CFD and its applications in marine engineering;
- The CFD process;
- Discretization method: Finite difference method, finite volume method, finite element method.
- Boundary element method.
- Grid generation, structured and unstructured grids; moving, rotating and overset grids
- Adaptive grid refinement;
- Solution of a linear system of equations, direct and indirect methods;
- Methods for unsteady problem, explicit and implicit methods.
- Solution of Navier-Stokes Equations.

Outcomes

After attending the course the student should be able to

- Gain the principle knowledge of CFD and its applications in marine hydrodynamics;
- Understand the basic process for CFD simulation and simulation preparation;
- Understand the basic discretization techniques and their applications in marine hydrodynamics;
- Learn the grid generation methods and acquire the basic understanding of complex grids generation and their applications in marine hydrodynamics;
- Learn the basic methods to solve a system of algebraic equations;
- Learn the basic temporal discretization techniques;
- Apply the gained knowledge in solving a ship hydrodynamic problem using dedicated CFD software.

Prerequisites

- Mathematics;
- Fluid mechanics;
- Numerical methods;
- Programming.

	ECTS
3. Advanced Shipbuilding Technology	**4**

Course Description

The course is focusing on the modern shipyards technologies and gives a general background on their major aspects. Topics covered in this course include the basic elements for shipbuilding technology and rules, materials used for construction, inspection methods, painting and antifouling, the integrity of ship structure w.r.t. fire, launching process, sear and harbor trials, and finally a focused part regarding the welding techniques and its main aspects in shipyards.

Course Contents

- General elements, terms and rules in shipbuilding technology;
- Materials and welding in ship construction;
- Non-destructive inspection in ship construction;
- Ship painting and antifouling systems;
- Fire structural integrity of ships;
- Ship launching; Harbor and sea trials tests (HAT & SAT);
- Welding processes of metals: DC and AC electric arc;
- Stability of the electric arc and welding process;
- Power sources for welding and their selection;
- Automatic and semiautomatic welding Equipment for gas welding;
- Welded joints; Welding supplies used in shipbuilding;
- Calculation of general deformations of welding hull units.

Outcomes

After attending the course the student should be able to

- Gain the necessary knowledge regarding shipbuilding technology;
- Have an insight about the basic materials used in ship construction;
- Learn the essential non-destructive tests used for inspection;
- Gain information regarding ship hull corrosion protection by means of painting and antifouling;
- Learn the main launching techniques and their applications in shipyards;
- Study and understand the basic tests in harbor and at sea;
- Study and understand all the important aspects regarding the welding process in ship technology.

Prerequisite

- Materials;
- Ship structure concepts.

	ECTS
4. Analysis of Noise and Vibration	**5**

Course description

The course is dedicated for understanding the theory and characteristics of noise and vibration including their effects on ships and other marine structures. The course also provides a fundamental learning for the techniques in predicting and analyzing the sources of noise and vibration, data collection and data analysis. Also, it highlights the possible solutions for reducing noise and vibration in marine applications following the classification societies' rules and applying the principle of design against noise and vibration.

Course Contents

- Ship Noise and Vibration;
- Underwater noise;
- Noise prediction;
- Noise by safety reason;
- Limits for noise and vibrations on board ships.

Outcomes

After attending the course the student should be able to

- Understand the basic principles and characteristics of noise and vibration, including their sources;
- Gain the main information regarding the underwater noise;
- Learn the fundamental methods for predicting noise and vibration;
- Cultivate the necessary experience of collecting data and analyzing the data collected for noise and vibration;
- Learning the limits and the allowable levels of noise and vibration on board to keep the design aspects within the allowed level;
- Implement the knowledge gained in decisions regarding the reduction of noise and vibration by means of classification societies rules and previous experience from actual cases;
- Integrate basic knowledge, mathematical formulations and computer software in order to estimate all the necessary aspects and data processing for noise and vibration.

Prerequisites

- Fundamental Mathematics
- Mechanics;
- Advanced ship structures.

ECTS

5.a Composite structure in naval architecture 5

Course description

The course provides a complete overview on the implementation of composite material in marine structures starting with their historical background, classification of composite material, properties, pros and cons, types of metal/composites interface and future directions. The course also includes the construction methods of composites materials and specific structural approach. The basic theories are also included such as the theory of elasticity principles, stress/strains theory. And finally, the calculation methods regarding the use of composite materials and numerical modeling for composite materials are also emphasized.

Course Contents

- Basic introduction, composite materials, definition, classification, history, advantages, flaws types of metal/composites interface, future directions;
- Applications of composites in the marine industry;
- Construction methods of composites materials;
- Theory and specific approach;
- Theory of elasticity principles,
- Stress/Strains Theory;
- Calculation methods for composite materials;
- Numerical modeling for composite materials.

Outcomes

After attending the course the student should be able to

- Understand and learn the basic principles regarding the composite materials including their historical background, classification of composite material, properties, pros and cons, types of metal/composites interface and future directions;
- Learn the methods used for constructing the composite material;
- Gain the knowledge of types and how the composite material is constructed by means of theoretical and practical explanations;
- Understand the theories used for defining the structural properties of a composite material;
- Apply the knowledge gain in analyzing the composite material by means of analytical and numerical modeling;
- Integrate basic knowledge, mathematical formulations and computer software in order to calculate and evaluate a composite material using analytical methods and computer software.

Prerequisites

- Materials;
- Advanced ship structures.

ECTS

5.b Seakeeping **5**

Course description

Since ship motion in waves has a potential impact on ship from multiple points of view, such as ship operability, added resistance and safety in general, this course aims at increasing the awareness of students about the importance and the methodologies used in studying the seakeeping performance of a ship in regular and irregular waves. The course shall guide the students to understand the main aspects of ship seakeeping starting from its importance, principles, theory, applied methods, prediction and assessment techniques. Linear and nonlinear coupled motions and oscillations are described and explained in details. Dynamic response of ship girder, statistical analysis of ship responses, vibration, oscillation and slamming are also emphasized.

Course Contents

- Hydrodynamic added masses;
- Regular wave;
- Ship uncoupled rigid body oscillations;
- Ship coupled rigid body oscillations;
- Non-linear ship oscillations analysis;
- Statistical analysis of the ship of the ship dynamic response in real sea state condition.

Outcomes

After attending the course, the student should be able to

- Be familiar with the terminology used in seakeeping and understand and use the basic principles of seakeeping;
- Get familiar with the solution principle of seakeeping problems including the possible approaches (experimental, theoretical and numerical);
- Understand the concept of hydrodynamic added mass;
- Show the ability to describe regular and irregular waves in the frequency domain;
- Estimates the ship motions in waves;
- Apply techniques to predict the roll, pitch and heave motion of a vessel sailing in regular and irregular waves and assess vessel motions against seakeeping criteria;
- Use the equations of motions and probabilistic wave theory to evaluate a ships seakeeping characteristics and operability in a seaway
- Conclude the theoretical knowledge gained during the course by performing a final project to study the seakeeping performance of a selected ship.

Prerequisites

- Fluid mechanics;
- Ship hydrostatics and stability.

	ECTS
6.a Ship Design Project I	**7**

Description

Development of a ship design project.

Tools: CAD – AutoCAD, Rhinoceros, CAE – NAPA, AVEVA Marine, Simulations – CFD (Shipflow, FineMarine, OpenFoam), FEM (FEMAP).

Outcomes

After attending the course, the student should be able to understand and perform parts of the ship design process.

Prerequisites

- Basic knowledge of ship design principle.

ECTS

6.b Ship Hydrostatics and Stability **4**

Course description

The course establishes the essential knowledge of a naval architect through constructed syllabus that covers the main aspects of a ship as a floating structure. The course covers the main principles starting from ship types and purposes, ship description geometrically and mathematically, floatability and stability in case of intact and damage conditions. Several safety aspects are also taken into consideration in this subject such as the IMO requirements for ensuring ship safety during navigation. Finally, how the launching of a ship is performed, with special correlation to ship dimensions and the available ship yards facilities.

Course contents

- Ship Types, Geometry, Definition and Principal Characteristics;
- Numerical Integration in Marine Applications;
- Hydrostatic curves, form coefficients and Bonjean curves;
- Ship hydrostatics and initial stability;
- Transversal stability at small angles of heel;
- Longitudinal stability;
- Static stability at large angles of heel;
- Dynamic stability;
- Damage stability and subdivisions;
- Intact and damage stability regulations;
- Ship launching

Outcomes

After attending the course the student should be able to

- gain the basic knowledge regarding the various types of ships and their purposes;
- learn ship terminologies and how to describe a ship geometrically and mathematically;
- learn how to calculate the ship form coefficients, hydrostatics and Bonjean curves,
- understand the basic principles of ship equilibrium and stability,
- understand the mechanism of transverse stability and the factors affecting it regarding the weights onboard and free-surface effect in tanks;
- learn how the vertical position of the center of gravity of the ship is estimated using the inclining experiment;
- understand the importance and definition of longitudinal stability and learn how to estimate the final drafts of the ship;
- learn the basic principles of static and dynamic stability;
- understand the basic principles of subdivisions and ship stability in damage conditions;
- increase the awareness by learning the IMO regulations that are concerned with ship safety in case of intact and damage conditions;
- learn the main categories and fundamentals of ship launching and;
- conclude the gained knowledge from the course by performing ship hydrostatics and stability calculations for a chosen type of ships.

Prerequisites: Mathematics; Mechanics.

	ECTS
6.b Ship resistance	**3**

Course description

The course provides a complete overview on ship resistance in the context of ship hydrodynamics performance estimation and explores resistance components to better understand how characteristics of the ship and the fluid contribute to the resultant force. Flow phenomena associated with the moving vessel are described and how they affect the resistance. Main methods for ship resistance prediction are presented and practically applied.

Course Contents

- General considerations on ship resistance;
- Wave resistance;
- Viscous resistance;
- Other resistance components and effects on ship resistance;
- Estimation methods for ship resistance;
- Chain of propulsion and corresponding power/Ship drive power train;
- The influence of shape parameters on the ship resistance.

Outcomes

After attending the course the student should be able to

- Understand the role of ship resistance in ship design;
- Explain the concepts of calm water;
- Discuss the concept of calm water total resistance;
- Distinguish flow phenomena around a ship hull;
- Define components of ship resistance;
- Understand the origin of flat plate friction coefficients;
- Estimate effects of surface roughness;
- Discuss viscous pressure resistance;
- Understand the origin and mechanism of wave resistance;
- Describe ship wave patterns;
- Discuss favorable and unfavorable wave interference;
- Distinguish the tools to predict and investigate hydrodynamic performance and understand the basics of resistance estimates;
- Understand layout and function of scale models and testing facilities;
- Make full scale resistance predictions based on model test results;
- Apply standard series/statistical methods to estimate ship resistance;
- Define power and efficiencies related to ship propulsion;
- Study the relationships between main particulars and ship resistance in calm water.

Prerequisites

Fluid mechanics.

2nd semester – 30 Credits

ECTS

7. **Complements in Propulsion Dynamics** **5**

Course Description

The course is dedicated for marine propeller and propulsion. Advanced topics are handled such as the ship propulsion systems analysis, propeller geometry description representation: mathematically and using CAD/CAM tools, propeller experiments: open water and self-propulsion, analysis methods for marine propellers: theoretical and numerical approaches, propeller design and analysis, hydrodynamic performance of marine propeller, noise and vibrations from marine propellers and how to avoid it and finally unconventional marine propulsors.

Course Contents

i. Ship as a complex system. Ship propulsion systems analysis. Actual trends in ship propulsion.
ii. Marine propellers. 2D and 3D Geometry. Mathematical description of propeller geometry related to CAD/CAM systems and CFD applications. Propeller materials. Manufacturing technology.
iii. Propeller experimental approach. Law of similarity in practice. Hydrodynamic characteristics. Wake measurements, propeller open-water tests, self-propulsion tests and cavitation experimental investigation.
iv. Propeller theoretical approach. Overview of methods. Momentum theory. Blade element theory. Circulation theories: Lifting-line and Lifting-surface methods. CFD methods: Panel methods and RANS methods.
v. Propeller design. Preliminary design (using systematic series chart). Propeller design (using lifting line method with lifting surface corrections). Propeller analysis (study of propeller behavior in steady and unsteady flow).
vi. Hydrodynamic performances of marine propeller in unsteady flow. Wake field. Propeller unsteady forces: bearing forces and pressure pulses. Propeller as a source of noise and vibrations. Further devices to avoid noise and vibrations induced by the propeller.
vii. Unconventional propulsors and devices for improved propulsive efficiency.

Outcomes

After attending the course the student should be able to

- Learn the fundamentals of marine propulsion and the components of marine propulsion systems;
- Be able to represent and read the geometry of marine propeller using 2D and 3D geometry;
- Learn the capability of drawing the marine propeller using CAD/CAM tools and the mathematical concept behind it;
- Gain awareness of the basic experiments for marine propellers, their purposes and outcomes;
- Learn how to perform a design for marine propellers using theoretical and modern approaches;

- Learn the basic skills to analyze the propeller performance in steady and unsteady flows;
- Estimate the propeller wake and propeller forces and pressure pulses;
- Understand the undesired propeller induced noise and vibrations and how to reduce or avoid them;
- Expand knowledge regarding the unconventional marine propulsors and
- Learn how to improve the propulsion efficiency by means of energy saving devices and other aspects;
- Apply the gained knowledge in practical propulsion simulations using mathematical formulations and computer software.

Prerequisites

- Fluid mechanics;
- Methods for preliminary ship design;
- Computational Fluid Dynamics 1.

ECTS

8. Offshore Units and Systems **5**

Course description

The course focuses on the main aspects of offshore engineering, offshore units and systems by giving an initial background about the environmental loads, especially the waves and the wave excitation forces. The course gives a general background about the classification of offshore structures and the associated design principles. Plus, the stability of floating offshore structures based on the geometrical aspects of the offshore structures. The effect of wind loads and design aspects based on installation location and fixation to the seabed are also emphasized.

Course Contents

i. The finite amplitude waves. Wave Spectrum. Metocean. Elementary wave (Airy) and finite amplitude wave (Stokes). Influence of wave theory on hydrodynamic excitation forces. Application limits of wave theory and spectral formulations.
ii. Types of offshore structures and methods for assessing their dynamics under environmental factors. The diversity of offshore structures correlated with adaptation to location features. Spectral and stochastic analysis for the dynamics of offshore structures. Extreme phenomena. Evaluation of operational and survival limits. Induced hydrodynamic forces and design wave loads.
iii. Elements regarding the stability of floating offshore structures in calm water and waves. The case of specific ship-shaped structures. The case of multi-body structures. Stability analysis for typical loading cases. Influence of aerodynamic forces, the criterion of wind.
iv. Specific elements for the transport and location of offshore structures. Modes of transport by location. Keeping on location. Location of jacket structures. The case of multiple anchoring. Location and anchor dynamics for on-site maintenance. The pre-tensioning as a parameter for adjusting the dynamics of anchored bodies. Particular aspects of operating at zero speed.

Outcomes

After attending the course the student should be able to

- Understand the fundamentals of ocean waves and wave induced loads on marine structures;
- Learn the different types of offshore structures and understand their design principles based on multiple factors, such as purpose, function, operational location, etc.
- Understand and analyze the stability condition of floating offshore structures and the influence of their geometry on the design aspects;
- Learn the main aspects for the transport of offshore structure and installation onsite for different offshore platforms;
- Learn the main aspects regarding the anchoring of offshore structures;
- Study the main aspects of structural behavior at zero speed.

Prerequisites: Fluid mechanics; Methods for preliminary ship design.

	ECTS
9. Structural Analysis and Hydroelasticity	**5**

Course description

The course continues from the ship structural analysis course in semester 1 to provide advance applications for ship structural analysis based on a 3D-FEM hull modeling. The course covers the buckling assessment, static and dynamic analysis of ship hull structures. The hydroelasticity of ship is explained. Linear and nonlinear analysis of ship response at coupled oscillation-vibration is emphasized with practical applications.

Course contents

i. The ship structures analyses with the finite element method (advanced chapters). The analysis of the global ship strengths in vertical plane with 3D-FEM hull models. The global ship hull vibrations analyses based on 3D-FEM models. The buckling structural analysis of the ship's hull structure based on the finite element method. Non-linear static and dynamic analyses based on the finite element method (elastic-plastic material behavior).

ii. Ship hydroelasticity. Special phenomena induced by the waves (hydroelasticity). The linear dynamic response at coupled oscillations and vibrations in the vertical plane. The dynamic response at horizontal-torsional coupled ship oscillations and vibrations. Transient dynamic response whipping and bottom slamming. The non-linear analysis of the ship dynamic response at coupled oscillations-vibrations in the vertical plane, non-linear hydroelasticity. The analysis of fatigue resistance and the estimation of the exploitation period of the ship hull structure.

Outcomes

After attending the course the student should be able to

- Increase the capabilities of applying the FEM method to resolve ship structural problems;
- create a 3D_FEM model and perform structural integrity and buckling analysis;
- estimate the linear, nonlinear ship response at coupled oscillations-vibrations in the vertical plane;
- estimate the dynamic response at horizontal-torsional coupled ship oscillations and vibrations;
- perform the analysis for transient dynamic response whipping and bottom slamming;
- Execute the analysis of fatigue resistance and the estimation of the exploitation period of the ship hull structure;
- Apply the gained knowledge in solving a ship structural and hydroelasticity real case using a 3D_FEM modeling.

Prerequisites

- Strength of Materials;
- Mechanics;
- Methods for ship structures analysis.

ECTS

10. Computational Fluid Dynamics 2 **4**

Course Description

The course continues from the CFD1 subject to cover new areas in CFD by giving the fundamentals for turbulent flows, solution of Navier-Stokes Equations using either Direct Numerical Simulation or filtered NSE. The course also covers the free-surface modeling using the volume of fluid approach. A special concern is also paid for best practice CFD simulations, how to increase the accuracy and stability of CFD simulations and verification and validation methods to evaluate the numerical errors.

Course contents

i. Turbulence modeling in engineering. Characteristics of turbulent flows. CFD and turbulence modeling. Length scales in turbulent flows.
ii. Governing equations. Reynolds averaging. The Boussinesq hypothesis. Reynolds-averaged Navier-Stokes equations (RANS). Formulation of boundary conditions.
iii. Overview of turbulence modeling approaches. Turbulence models. Algebraic models. One equation model. Two equation models. Reynolds stress models (RSM). Unsteady RANS simulations (URANS). Wall modeling and wall resolving simulations. Scale-resolving simulations. DES, LES, DNS.
iv. Finite Volume Method. Navier-Stokes equations and pressure-velocity coupling.
v. Multiphase flows. Volume-of-Fluid (VOF) method.
vi. Best practices in CFD. Numerical considerations. Validation and verification. Mesh dependency studies. Accuracy and reliability of simulations.

Outcomes

After attending the course the student should be able to

- Increase knowledge regarding the CFD methodology and applications in marine hydrodynamics;
- Understand the basic concepts regarding the turbulence flow modeling;
- Learn the levels of simulations in marine hydrodynamics based on the filtering of Nanier-Stokes Equations: DNS, LES, RANS and Hybrid RANS/LES (DES, DDES, IDDED) and their applications in marine hydrodynamics;
- Learn and apply the RANS modeling to resolve simple marine hydrodynamic problems such as (ship resistance, marine propulsion, seakeeping or maneuvering)
- Understand and validate the difference between the various models of turbulence (one-equation, two-equations, Reynolds stress models etc.)
- Understand and perform free-surface simulations based on the VOF technique;
- Estimate, validate and assess numerical errors associated in CFD simulations and learn how to reduce them by best practice CFD simulations;
- Apply all the gained knowledge in solving a ship hydrodynamic problems using dedicated CFD software.

Prerequisites: Fluid mechanics; Numerical methods; Computational Fluid Dynamics 1.

Elective lecture | ECTS

11. 1 Project Management **4**

Course description

The course helps the student understand the fundamentals of marine project management including its applications in ship and offshore technologies such as work breakdown structures, cost estimation, risk management, scheduling, hierarchical planning, project strategy development, performance measurement, progress monitoring and post project evaluation.

Course Contents

- Project Process Management;
- Project Integration Management;
- Project Time Management;
- Project Risk Management;
- Project Cost Management;
- Project Human Resource Management;
- Post Project Evaluation.

Outcomes

After attending the course the student should be able to

- Understand the basic principles of marine project management;
- Understand the fundamentals of organizing and handling marine project process;
- Gain the capabilities for planning, scheduling and monitoring of marine projects;
- Understand the risk management process, defining the main hazards associated with the project, planning for unexpected scenarios, implementing solutions to prevent, mitigate or reduce the project risks;
- Receive the required explanation for project cost estimation and accounting for all the possible costs such as material costs, overhead, running, maintenance, transportation, operational cost, unexpected costs, etc.;
- Understand the basic ideas regarding human resources management and their link to project process and integration management;
- Learn the basic principles of post project evaluation;
- Integrate basic knowledge, mathematical formulations and computer software in order to estimate all the necessary aspects of the project process.

Prerequisites

- Basic knowledge of marine, ship and offshore operations;
- Basic Mathematics.

Elective lecture	ECTS
11. 2 Ship Commissioning	**4**

Course Description

The commissioning of ship and different ship systems onboard is covered in this course.

Course Contents

i. General considerations. Preparing the commissioning program. Planning and coordination of the commissioning program;
ii. Commissioning of the electrical systems;
iii. Commissioning of the propulsion systems;
iv. Commissioning of the primary and secondary systems;
v. Commissioning of the deck equipment;
vi. Commissioning of the safety systems;
vii. Commissioning of the navigation equipment.

Outcomes

After attending the course the student should be able to understand and be aware of planning and coordinating the main commissioning of systems and equipment onboard ships.

Prerequisites

- Basic knowledge about marine systems and equipment.

Elective lecture

ECTS

11.3 The Marine Environmental Protection Technologies **4**

Course Description

The course is dedicated for marine environmental protection by highlighting the main concept of green ship. The course also focuses about the IMO regulations regarding the reduction of emissions, Energy Efficiency Design Index (EEDI); Ship energy efficiency management plan (SEEMP). Also the noise pollution is covered.

Course Contents

i. Green ship concept;
ii. Energy Efficiency Design Index (EEDI); Ship energy efficiency management plan (SEEMP);
iii. Green passport (GP);
iv. Pollution by noise: code on noise levels on board ship.

Outcomes

After attending the course the student should be able to

- understand and be aware of the ship impacts on marine environment;
- learn the basic concepts regarding the green ship concept;
- learn the IMO regulations regarding marine pollutions and emissions;
- Understand the EEDI and SEEMP concepts and learn how to account for them;
- Gain knowledge regarding the sources of noise onboard and the codes for noise levels.

11.b Ship Maneuvering	ECTS 4

Course description

The ship maneuvering stands as one of the major topics when talking about ship hydrodynamics after resistance, propulsion and after or on the same scale as ship seakeeping. This course is dedicated to understand and highlight the main aspects of ship maneuvering considering mathematical and physical concepts, how the motion in horizontal plan is described and correspondingly controlled. The prediction of ship maneuvering performance is covered by means of explanation of experimental and numerical methods. Considerably, the rudder performance and design as an essential control element in ship maneuvering is illustrated and explained. The main requirements of IMO and ITTC regarding the standard maneuvers of a ship are also covered.

Course contents

- Introduction and Basic Principles;
- Mathematical Modeling of Ship Maneuvering;
- Experimental Prediction of Ship Hydrodynamic Derivatives;
- Ship Standard Maneuvers;
- Rudder and Control Surfaces;
- Active Control Surfaces;
- External Factors Affecting Ship Maneuverability;
- Prediction of Ship Maneuvering using CFD.

Outcomes

After attending the course the student should be able to

- understand the principle of ship maneuvering and understand the major concept of ship motion in horizontal plan;
- learn how to derive the main equations of ship motion in horizontal plan using linear and nonlinear equations of motion;
- understand the basic concept of ship directional stability and directional control in ship maneuvering;
- learn the meaning of ship hydrodynamic derivatives and understand how to estimate them;
- gain the necessary knowledge regarding the experimental prediction of ship hydrodynamic derivatives and understand the basic ship experiments (PMM and turning);
- learn and understand the standard ship maneuvering tests required by IMO and ITTC such as turning circle, zig-zag, man overboard, spiral test, pull-out and stopping test maneuvers;
- understand the concept of rudder as a passive control surface including main aspects like types of rudders, design considerations, interaction between ship-propeller and rudder and rudder cavitation, etc.;
- learn the function and design principles of active control surfaces, such as transversal and azimuth thrusters;
- understand the problems associated with maneuvering because of external effects such as wind, ship-ship interaction, shallow water, navigation in narrow channels and sip squat;
- gain the basic knowledge regarding the computational fluid dynamics and its applications in ship maneuvering;

- concluding the gained information from the course in a final project that is concerned with studying the ship maneuvering performance of a selected ship using CFD method.

Prerequisites: Mathematics; Mechanics; Basic Naval Architecture; Ship Hydrostatics and Stability.

	ECTS
12. Ship Design Project II	**7**

Description

Development of a ship design project.

Tools: CAD – AutoCAD, Rhinoceros, CAE – NAPA, AVEVA Marine, Simulations – CFD (Shipflow, FineMarine, OpenFoam), FEM (FEMAP).

Outcomes

After attending the course, the student should be able to understand and perform parts of the ship design process.

Prerequisites

- Basic knowledge of ship design principle.