Title: THEORY and DESIGN OF FLOATING AND FOUNDED OFFSHORE SYSTEMS
6 credits

Ref (URO): 1551080
Prof. Sascha Kosleck

EMSHIP+: M2- URO-1
Teaching Period: October – January

Link - web: https://www.lsk.uni-rostock.de/en/education/organisation/international/
Link- document: https://www.lsk.uni-rostock.de/storages/uni-rostock/Alle_MSF/LSK/BilderStudium/Courses_at_URO_2022_-_EMShip_.pdf

Course contents

1. *Introduction*
   significance of the ocean for mankind
2. *Overview of Ocean Engineering*
   summary of technical developments and state-of-the-art in floating and fixed offshore structures
3. *Marine environment*
   environmental conditions and challenges; general assumptions; statistical description of waves, wind, current; concepts of time- and frequency-domain
4. *Basics of loads and motions on ships and offshore structures*
   basic theory; definition and problems; classification of structures based on hydrodynamic aspects
5. *Linear wave-induced loads and motions of floating structures*
   regular and irregular waves; linear wave theory; Froude-Krylov-force; added mass; damping forces; resonance frequency; transfer functions/response amplitude operators; motion analysis in time and frequency domain
6. *Morrison equation*
7. *Wave energy*
   potential and kinetic energy in a wave; energy dispersion
8. *Introductions into non-linear problems*

Learning outcomes of the course

The module provides an introduction to basic engineering principles for offshore structure design - for floating and fixed type structures alike. Here, students acquire general knowledge on past and current technical developments in the field of ocean engineering, especially regarding large scale floating and founded offshore structures, e.g. for harvesting renewable energies, marine seafood production, ocean research and oil and gas exploration. They learn to estimate and analyse environmental forces and undertake complex sizing and design calculations for typical offshore systems. In particular, students learn to recognise and understand the complex interactions between waves and fixed or floating platforms. Therefore, this unit is to provide knowledge and understanding of ocean waves including the basics of linear wave mechanics and wave induced hydrodynamic forces acting on small and large offshore structures. In particular, students will make themselves familiar with methods of linear and non-linear mathematical modelling as well as experimental methods. They are qualified to elect the most suited methods regarding the respective task. Finally, they will be able to apply methods for hydrodynamic analyses of offshore structures and evaluate results.

Prerequisites

Although this course has no pre-requisites, basic knowledge about vector analysis, differential equations, potential and viscous flow are recommended.

Title: SELECTED TOPICS OF THE ANALYSIS OF MARINE STRUCTURES

6 credits

Ref (URO): 1551190

EMSHIP+ M2- URO-2

Prof. Patrick Kaeding

Teaching Period: October – January

Link - web: https://www.lsk.uni-rostock.de/en/education/organisation/international/
Link- document: https://www.lsk.uni-rostock.de/storages/uni-rostock/Alle_MSF/LSK/BilderStudium/Courses_at_URO_2022_-_EMShip_.pdf

Course contents

1. Theory of Shear Force Application
2. Warping Torsion Theory
3. Elastic Foundation
4. Beam Element Formulation
5. Response Spectrum Analysis
6. Newton-Raphson Schemes
7. Arc-Length Control
8. Convergence Criteria
9. Ultimate Strength
10. Constraint Equations

Learning outcomes of the course

Students will understand the fundamentals of different methods to analyse marine structures and to judge upon its structural behaviour. The theory of shear force application and the warping torsion theory will be introduced especially for thin-walled closed frame structures. The knowledge of the fundamentals is very important to perform structural analyses of marine structures efficiently. It is also the basis to improve structural systems or to develop new design variants. The students will apply the Finite Element Method (FEM) as a feasible tool to analyse various structural systems. Different element types will be introduced and its applicability will be investigated. To perform nonlinear Finite Element Analyses (FEA) successfully the knowledge of appropriate solution methods is very imported. In frame of this course, different solution methods implemented commonly in finite element software packages will be presented. Finally, the students will develop a more comprehensive understanding to perform structural analyses of complex systems.

Prerequisites

Knowledge in “Fundamentals of the analysis of marine structures”, “Finite Element Method”, “Ship design”, “Ship structural design” or similar.

Title: MATHEMATICAL MODELS IN SHIP THEORY

6 credits

Ref (URO): 1551360
Prof. Nikolai Kornev

EMSHIP+: M2- URO-3
Teaching Period: October – January

Link - internal: http://bookboon.com/de/lectures-on-ship-manoeuvrability-ebook
Link - web: https://www.lsk.uni-rostock.de/en/education/organisation/international/
Link- document: https://www.lsk.uni-rostock.de/storages/uni-rostock/Alle_MSF/LSK/BilderStudium/Courses_at_URO_2022_-_EMShip_.pdf

Course contents

Differential equation of motion of arbitrary objects in different media. Equations of ship manoeuvring. Determination of added mass. Steady manoeuvring forces. Determination of steady manoeuvring forces using measurements. Forces on ship rudders and propeller. Yaw stability. Manoeuvrability Diagram. Experimental study of the manoeuvrability. Ship oscillations equations. Free oscillations. Oscillations in regular and irregular waves. Experimental study of ship oscillations.

More detailed information on course content can be taken from the textbook "Lectures on ship manoeuvrability" which can be downloaded from http://bookboon.com/de/lectures-on-ship-manoeuvrability-ebook

Learning outcomes of the course

The main objective is to give a general overview of mathematical models used in ship dynamics, ship maneuverability and ship dynamics in waves. Having successfully completed the module, the student will be able to demonstrate knowledge and understanding of ship and offshore structures motion at different operational conditions.

Prerequisites

Students must have a Bachelor degree in Engineering. They must have knowledge in mechanical engineering, naval architecture, marine or offshore engineering, aerospace engineering, or similar.

Title: IT IN SHIP DESIGN AND PRODUCTION

6 credits

Ref (URO): 1550940
Prof. Florian Sprenger

EMSHIP+: M2- URO-4
Teaching Period: October – January

Link - web: https://www.lsk.uni-rostock.de/en/education/organisation/international/
Link- document: https://www.lsk.uni-rostock.de/storages/uni-rostock/Alle_MSF/LSK/BilderStudium/Courses_at_URO_2022_-_EMShip_.pdf

Course contents

1. Process analysis in ship design, production and operation: identification of roles (partners), tasks, tools and information flows in international ship design and production networks.
2. Fundamentals in mathematical curve, surface and shape modelling in CAD tools
3. Process and Product modelling techniques, examples from shipbuilding processes product modelling, focus on different ship product data sets for different views in interdisciplinary tasks to be performed.
4. Optimization processes: fundamentals, selected methods
5. The role of CAx in the ship production process
6. Digitalization of ship operation: data sources, challenges in data analysis, performance assessment, digital twins

Learning outcomes of the course

Students will understand the fundamentals and mathematical modelling techniques implemented in modern CAD tools. They will be able to formulate target functions and set up an optimization procedure in the ship design process. The understood necessity of an efficient information exchange between partners and tasks involved leads to the knowledge of suitable information exchange methods and tools. Process and product modelling techniques as a prerequisite for a successful information exchange can be applied by the students in specific exchange scenarios of ship product model data.

The students will understand the role and potential of IT in the ship production process. Based on selected examples of operational data from a real ship, they will explore the potential and experience the challenges and of heterogenous big data resources collected from multiple sources during ship operation by an introduction to selected data science techniques.

Prerequisites

Basic knowledge about the ship design process, basic experience with CAD tools, basic knowledge in data analysis.

Title: **SAFETY OF SHIPS UNDER DAMAGED CONDITIONS, IN WAVES**

6 credits

Ref (URO): 1551230
Prof. Florian Sprenger

EMSHIP$^+$: M2- URO-5
Teaching Period: October – January

Link - web: https://www.lsk.uni-rostock.de/en/education/organisation/international/
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Course contents

1. Repetition of the principles of ship intact stability in calm water
2. Principles of ship intact stability in waves
3. Second generation intact stability criteria: dead ship, excessive accelerations, pure loss of stability, parametric rolling, surf-riding/broaching-to
4. Lost buoyancy and added weight methods to calculate the floating condition after a damage
5. Deterministic damage stability: Floodable length curve, freeboard and stability criteria, compartmentalization
6. Probabilistic damage stability: side damages, bottom damages, bow damages, subdivision survivability, SOLAS
7. Safe marine operations: operational limitations, safety criteria, ship motion reduction

Learning outcomes of the course

1) Knowledge and understanding
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 damaged conditions in calm water as well as intact conditions in waves. Ship safety assessment methods will be known for which deterministic and probabilistic approaches can be distinguished. The importance of ship safety aspects in the overall ship design process will be known, consequences will be understood.

2) Intellectual skills
Having successfully completed the module, the student will be able to apply risk based methods in ship design. She/he will be aware of the limitations and deficiencies of deterministic approaches. She/he will be able to fundamentally question regulations with respect to their defined goals and methods formulated.

3) Practical skills
Having successfully completed this module, the student will be able to calculate the floating position of a damaged vessel to evaluate its remaining stability capacities. She/he will be able to perform calculation to check a given ship design against SOLAS requirements.

4) General transferable (key) skills
Having successfully completed the module, the students will be aware of the limitations of deterministic approaches to solve design problems, she/he understands the advantages of probabilistic design methods to reduce risk in the operation of complex technical objects like ships or offshore structures.

Prerequisites

Sound knowledge is required in hydrostatics, basic knowledge in seakeeping, integral and differential calculus, statistics as well as probability calculations.

Title: OCEAN RESEARCH TECHNOLOGY

6 credits

Ref (URO): 1552220
Prof. Sascha Kosleck

EMSHIP+: M2- URO-6
Teaching Period: October – January

Link - web: https://www.lsk.uni-rostock.de/en/education/organisation/international/
Link- document: https://www.lsk.uni-rostock.de/storages/uni-rostock/Alle_MSF/LSK/BilderStudium/Courses_at_URO_2022_-_EMShip_.pdf

Course contents

Measurement and sampling procedures and methods in marine science and underwater monitoring

1. Introduction
2. Selected challenges in marine research and observation
3. Measurement principles and methods
4. Methods for data storage and transfer
5. Sampling methods and procedures
6. Autonomously and manually operated underwater vehicles
7. Research platforms and research vessels

Learning outcomes of the course

During this course a variety of measurements, observations and sampling methods for marine research are presented and discussed. Students will be enabled to recognise and understand relevant issues of in situ working disciplines and general principles of natural scientific marine research. This knowledge and professional communication skills will enable students to specify essential requirements for ocean going devices – regarding task, function, dimensions as well operating principles and accuracy. They can evaluate interactions between sensors and objects to be measured which may be stationary, mobile or even alive. Furthermore, problems of range, resolution and errors will be discussed. Finally, students can identify and develop optimised concepts for specific devices and processes required for marine research and are able to make informed and substantiated recommendations for action.

Prerequisites

Very basic knowledge is required in hydrodynamics and material science.

Title: **TEAM PROJECT**

6 credits

Ref (URO): 1551490
Prof. Patrick Kaeding and colleagues

EMSHIP^{+}: M2- URO-8
Teaching Period: October – January

Link - web: https://www.lsk.uni-rostock.de/en/education/organisation/international/
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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 of the course

Students will experience themselves in a team solving a defined problem in a defined time span. Depending on the course, the teamwork is linked to students that will intensively make use of different computer programs to solve the assigned task or will perform their own programming and experiments. While doing so, students will have a better understanding of the topics taught as they will work on a real world problem.

In teamwork students will develop to work effectively with a group as leader or member, they can clarify tasks and make appropriate use of the capacities of group members. They are able to negotiate and handle conflicts with confidence in a project in which the participants contribute with different but integrated software components.

Students will be able to demonstrate initiative and originality in problem solving, can act autonomously in planning and implementing tasks at a professional level while making decisions in complex and unpredictable situations. They will develop a comprehensive understanding of techniques and methodologies applicable to their own work.

Prerequisites

Students have to register in the course, the team project is linked to.