Advanced Analysis of Marine Structures

Category	Content
Modul name	Advanced Analysis of Marine Structures
Credit points	6
Responsibility	MSF/Schiffstechnische Konstruktionen
Contact person	Prof. Dr. Patrick Kaeding
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Basic knowledge to analyse marine structures. Fundamentals of Engineering Mechanics with respect to Statics, Dynamics and Mechanics of Materials. Fundamentals in Mathematics with respect to Analysis, Linear Algebra and Geometry as well as Differential Equations and Multivariable Calculus. Fundamentals of Ship and Offshore Structures as well as Ship Design.
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	Students determine the nonlinear structural behaviour of marine structures. The knowledge of the strength reserve of structural systems is very important to ensure a save and economic design. Students know the physics of different nonlinearities in structural mechanics. Kinematic nonlinear effects, material nonlinear effects and contact problems are considered separately. The Finite Element Method (FEM) is applied by the students to solve mathematical models of nonlinear physical problems in engineering practice. They perform nonlinear structural analyses of marine structures and obtain a critical evaluation of the numerical results. The FEM is an essential approach for linear and nonlinear structural analyses and for many other engineering applications.
Content	• Kinematic Nonlinear Problems in Engineering Mechanics • Material Nonlinear Problems in Engineering Mechanics • Contact Problems in Engineering Mechanics • Fluid-Structure-Interaction (FSI) • Formulations of different Finite Element Types • Finite Element Method for Dynamic Analyses
Literature	• K.-J. Bathe, Finite Element Procedures, Prentice Hall, 2007 • O.C. Zienkiewicz, R.L. Taylor, The Finite Element Method, Elsevier Butter- worth-Heinemann, 2005 • E. Lehmann, L. Zhang, Nichtlineares Verhalten von ausgesteiften Tragwerken, Springer, 1998 (in German)
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 50 hrs Exercises 20 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to examination	3 assignments, to be announced no later than in the second week of lectures.
Examinations / Assessments required for a successful completion of the module	Type of examination: Oral examination (30 minutes) or written examination (180 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study

	regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552350

Advanced Analysis of Offshore Systems

Category	Content
Modul name	Advanced Analysis of Offshore Systems
Credit points	6
Responsibility	MSF/Meerestechnik
Contact person	Prof. Dr. Sascha Kosleck
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	none
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	This course builds upon the module "Design of Offshore Structures" and advances the students capabilities to analyse and evaluate complex motions of floating structures in 6 degrees of freedom. The concept of response amplitude operators (RAOs) for parameters such as velocities and accelerations will be discussed. Students will learn to implement these concepts and to calculate and evaluate combined RAOs as well as relative RAOs for multi body problems. They will learn to assess long term predictions for the seakeeping behaviour of floating structures. Therefore, students will be familiarised with different models used to represent naturals sea states. To analyse and evaluate the operability and down time of offshore structures, they will learn to combine sea state representations with the idea of the significant RAO. Additionally, they will learn to relate the influence of the Froude number on the structure's responses. Finally, students will develop the generalised Morison Equation and learn to identify and explain non-linearities the sea state structure interaction.
Content	• Representation of natural sea states: stochastic, statistic and mathematical models, likelihood of occurrence of sea states • Typical sea state representations: differences, similarities, applications • Design sea states • Definition of extreme scenarios • From single degree of freedom response amplitude operators (RAOs) to RAOs for combined motions • Relative RAOs for multi-body problems • From motion RAOs to RAOs for velocities, accelerations, forces, etc. • The effects of forward speed on RAOs: doppler shift and encountering sea state • The concept of significant RAOs • Estimation of downtime for maritime structures • Non-linearities in ocean systems: non-linear sea states and motion behaviour • Station keeping • The generalised Morison Equation
Literature	• Lecture handouts/ Vorlesungsunterlagen • Presentations/ Präsentationen • Faltinsen, O.: Sea Loads on Ships and Offshore Structures • Clauss, G.F.: Offshore Structures, Vol. 1 • Chakrabarti, S.K.: Hydrodynamics of Offshore Structures • Journée, J.M.J., Massie, W.W.: Offshore Hydromechanics, First Edition
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Presentations, Discussions, Literature study, solving tutorial questions, self-study, lab experiments, excursions
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs

	Self-study	50 hrs
	Exercises	20 hrs
	Assessed coursework and preparation for exam	30 hrs
	Total	180 hrs
Prerequisites for admission to examination	Experimental report or assignment (approx. 15 pages).	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (150 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552360	

CFD in Maritime Engineering

Category	Content
Modul name	CFD in Maritime Engineering
Credit points	6
Responsibility	MSF/Modellierung und Simulation in Maschinenbau und Schiffstechnik
Contact person	Prof. Dr. Nikolai Kornev
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	• Fundamentals of fluid Mechanics • Fundamentals of turbulence models • Principles of ship theory
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	Students have in-depth knowledge of the basics of numerical modelling in the ship theory. They are able to determine the forces acting on marine engineering constructions as well as the ship dynamics using modern, numerical CFD methods. Students are proficient in the use of problem-specific software codes Strip and OpenFOAM. They apply numerical CFD methods to develop new marine technologies.
Content	• Panel methods for ships in waves. • Kelvin sources. • Slender ships. • Rankine sources. • Arbitrary ship forms. • Introduction into Finite Volume Methods. • Grids used in ship hydromechanics. • Collocated and staggered grids, Rhie Chow interpolation. • Free surface modelling in CFD. • Overview of turbulence models used in ship hydromechanics. • Moving frame of reference. • Samples of CFD application to ship oscillations and manoeuvrability.
Literature	• Lecture Notes • Kornev N. and Cherunova I. (2014). Lectures on computational fluid dynamics and heat transfer with applications to human thermodynamics. Bookboon Publisher • Ferziger J., Peric M., Numerische Strömungsmechanik, 2008. • Bertram, V.: Practical Ship Hydrodynamics; Butterworth-Heinemann, 2000. • Lewandowski, E.: Dynamics of Marine Craft; 2004.
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 20 hrs Assessed coursework and preparation for exam 80 hrs Total 180 hrs
Prerequisites for admission to examination	none
Examinations / Assessments required for a successful completion of the module	Type of examination: Report / written assignment (20–30 pages, 50 hours) This examination accounts for 50% of the module grade. Oral examination (20 minutes) This examination accounts for 50% of the module grade

Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552370

Coding of Finite Elements

Category	Content	
Modul name	Coding of Finite Elements	
Credit points	6	
Responsibility	MSF/Schiffstechnische Konstruktionen	
Contact person	Prof. Dr. Patrick Kaeding	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites		
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Summer semester	
Learning outcomes	Students adopt special knowledge and skills for the numerical implementation of finite element formulations. The script-based creation, processing and evaluation of finite calculation models is developed and implemented. The students learn how to control solution procedures for the numerical analysis of finite calculation models and they evaluate the results.	
Content	• Finite Element Models • Finite Element Formulations • Internal FE Code Scripting • Application of Initial Deflections and Stresses • Solution Procedure and Postprocessing • Fundamentals of Finite Element Scripting • Application of Finite Element Scripting	
Literature	• Lecture Notes	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 20 hrs 50 hrs 20 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	3 assignments, to be announced no later than in the second week of lectures.	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (180 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552380	

Composite Material Design

Category	Content	
Modul name	Composite Material Design	
Credit points	6	
Responsibility	MSF/Leichtbau	
Contact person	Prof. Dr. Philipp Weißgraeber	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	Knowledge in: fundamentals of lightweight design, mechanics of composite materials, engineering mechanics	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Winter semester	
Learning outcomes	The students • understand the mechanical behaviour for composite materials • are able to use state-of-the-art methods for design and pre-dimensioning of composite structures for lightweight design • can apply advanced state-of-the-art concepts for the analysis of composite materials • can use rule of thumbs and design guidelines to avoid pitfalls in the design of lightweight composite structures • know the current frontiers of research in the field of composite materials design	
Content	In this course the design of structures by using fiber-reinforced plastics – typically referred to as composites – is considered in detail. Based on the mechanics of laminated plates advanced models for the preliminary analysis and pre-dimensio- ning of various structural composite elements is discussed. Many examples are studied in detail, e.g., by performing pre-dimensioning of composite structures with Python calculations in practical classes covering applications of composite materials in various applications and industries. Scope: • Advanced laminate analysis • Choice of laminates and pre-dimensioning • Failure modes of composite structures • Fastening and joining of composite materials • Stiffened Panels • Sandwich structures • Architecture of composite structures elements • Analysis methods for selected structural elements	
Literature	• Own lecture materials • D Gay (2022). Composite materials: design and applications, 4th edition, CRC press. • Further reading is specified in the course.	
Type of course	Integrated course Total	4 SWS 4 SWS
Learning activities	Literature study, self-study	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 30 hrs 20 hrs 40 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	none	

Examinations / Assessments required for a successful completion of the module	Type of examination:	Written examination (60 minutes) or oral examination (20 minutes) or report with presentation – 20-minute colloquium. The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552390	

Continuum Mechanics

Category	Content	
Modul name	Continuum Mechanics	
Credit points	6	
Responsibility	MSF/Schiffstechnische Konstruktionen	
Contact person	Prof. Dr. Patrick Kaeding	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	Basic knowledge of Engineering Mechanics with respect to Statics, Dynamics and Mechanics of Materials. Fundamentals in Mathematics with respect to Analysis, Linear Algebra and Geometry as well as Differential Equations and Multivariable Calculus. Basic knowledge to analyse structural components of marine structures. Fundamentals of Finite Element Method and its application to solve linear and nonlinear structural problems. Fundamentals of Ship and Offshore Structures as well as Ship Design.	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Winter semester	
Learning outcomes	Students understand the fundamentals of continuum mechanics to solve mathematically described physical problems for engineering applications. In continuum theory the discrete structure of materials is neglected but assumed to be indefinitely divisible. For such a continuum the field variables can be described as continuous functions. Therefore, the development of mathematical formulations for kinematics, forces and stresses as well as constitutive equations are of main importance. Students use strain tensors to describe the deformation of bodies for large displacements and rotations. They investigate stress tensors to describe the true stress state within a reference configuration. The relation between the stresses and deformation theories is given by the constitutive equations. Students apply plasticity formulations to describe the behavior of isotropic materials use for marine structures. Different boundary value problems respectively its "weak formulation" are introduce and students can transfer analytical formulations to the concept of the finite element method.	
Content	• Introduction to Tensors • Kinematics • Forces and Stresses • Constitutive Equations • Plasticity Formulations • Finite Element Formulations	
Literature	• Lecture Notes • Reddy, J.N. "An Introduction to Continuum Mechanics" 2nd ed., Cambridge University Press, 2013.	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 20 hrs 50 hrs 20 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	3 assignments, to be announced no later than in the second week of lectures.	
Examinations / Assessments	Type of examination: Oral examination (30 minutes) or	

required for a successful completion of the module		written examination (180 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552400	

Deep-Sea Technology and Practical applications of Underwater Technology

Category	Content	
Modul name	Deep-Sea Technology and Practical applications of Underwater Technology	
Credit points	6	
Responsibility	MSF/Meerestechnik	
Contact person	Prof. Dr. Sascha Kosleck	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	none	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Winter semester	
Learning outcomes	This course is designed to furnish students with a comprehensive grasp of Deep-Sea Technology, emphasizing the acquisition of knowledge and skills crucial for navigating the challenges of underwater exploration. Topics covered include defining mission requirements and undertaking a holistic system design to operate effectively under extreme environmental conditions. Participants will also delve into aspects such as underwater communication and positioning, emphasizing the importance of redundancy and safety measures in addressing the complexities of the deep-sea.	
Content	• Definition and description of the deep sea (areas in the oceans, international conventions) • Missions and objectives for deep-sea technologies (information, materials and resources) • Special deep-sea environmental and operational conditions • the sea floor habitat • teaching content: 1. housings (pressure resilient/pressure tolerant -> comparison) 2. pressure hulls: design, calculation, materials according to standards 3. requirements for pressure tolerant systems (electronics, degassing) 4. design and materials for pressure tolerant systems (selection of electronics and dedicated casting materials) 5. technologies for long-distance communication (fibre optics, sound waves, digital subscriber lines (DSL), multi transmitter networks …) 6. surveying (sonar and exploration techniques) 7. positioning: 1. local and wide area positioning 2. baseline systems 3. geo-referencing 4. optical systems 8. power supply and power management, batteries, high voltage systems 9. forces (on cables throughout the water column, damping, currents,…) 10. requirements for top side and supporting units 11 examples of the latest deep-sea technologies	
Literature	• Lecture handouts • Presentations	
Type of course	Lecture Exercise laboratory / practical class (compulsory attendance) Total	2 SWS 1 SWS 1 SWS 4 SWS
Learning activities	Presentations, discussions, literature study, solving tutorial questions, self-study, lab experiments, excursions	
Learning hours	Attendance Weekly preparation	60 hrs 20 hrs

	Self-study	50 hrs
	Exercises	20 hrs
	Assessed coursework and preparation for exam	30 hrs
	Total	180 hrs
Prerequisites for admission to examination	Mandatory attendance in the following course types: laboratory / practical class. Laboratory report or written assignment (approx. 15 pages).	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (150 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552410	

Design of Offshore Aquaculture Systems

Category	Content
Modul name	Design of Offshore Aquaculture Systems
Credit points	6
Responsibility	MSF/Meerestechnik
Contact person	Prof. Dr. Sascha Kosleck
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Fluid Mechanics: Types of Flow, Continuity Equation, Bernoulli's Equation, Reynolds Number, Flow Resistance, Hydrostatics Mathematics: Linear Algebra, Vector Analysis, Calculus, Geometry Mechanics: Statics, Dynamics of rigid bodies
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	This course is designed to equip participants with the knowledge and skills necessary for the effective design of offshore aquaculture systems. Through a combination of theoretical instruction and practical exercises, students will gain a comprehensive understanding of the key elements involved in creating sustainable and efficient aquaculture systems in offshore environments. They will learn to appreciate the major differences between near-/onshore aquaculture systems and offshore systems including the immense technical challenges arousing in offshore environments. Beyond that, they will also learn to understand special requirements with regard to the health and welfare of specific species to be grown in such systems
Content	• Fundamental Principles of Offshore Aquaculture - Develop a solid foundation in the principles and concepts underlying offshore aquaculture, including environmental considerations, species selection, and ecological impact assessment. • System Design and Engineering - Acquire practical skills in designing offshore aquaculture systems, covering aspects such as cage and pen design, anchoring systems, materials selection, and the integration of technology for monitoring and control. • Site Selection and Risk Assessment - Learn the criteria for effective site selection in offshore aquaculture, considering factors such as water quality, current patterns, depth, and proximity to infrastructure. Understand and apply risk assessment methodologies to ensure the resilience of aquaculture installations. • Environmental Monitoring and Management - Explore methods for monitoring and managing the environmental impact of offshore aquaculture systems, including strategies for waste management, disease prevention, and the promotion of overall ecosystem health. • Economic Feasibility and Cost-Benefit Analysis - Develop the skills to conduct economic feasibility studies and cost-benefit analyses for offshore aquacul- ture projects. Understand the financial considerations involved in designing and implementing aquaculture systems. • Integration of Technology and Innovation - Explore cutting-edge technologies and innovative approaches in offshore aquaculture design. Learn how to integrate automation, sensing, and data analytics to enhance efficiency, productivity, and sustainability. • Health and Welfare of Aquatic Species - Gain insights into the principles of fish and shellfish health and welfare in offshore aquaculture. Understand how design choices impact the well-being of aquatic species and learn best practices for promoting animal welfare
Literature	• Lecture handouts • Presentations
Type of course	Lecture 2 SWS

	Exercise	2 SWS
	Total	4 SWS
Learning activities	Presentations, discussions, literature study, solving tutorial questions, self-study, lab experiments, excursion	
Learning hours	Attendance	60 hrs
	Weekly preparation	20 hrs
	Self-study	50 hrs
	Exercises	20 hrs
	Assessed coursework and preparation for exam	30 hrs
	Total	180 hrs
Prerequisites for admission to examination	Laboratory report or written assignment (approx. 15 pages)	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (150 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552420	

Design of Offshore Systems

Category	Content
Modul name	Design of Offshore Systems
Credit points	6
Responsibility	MSF/Meerestechnik
Contact person	Prof. Dr. Sascha Kosleck
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Fluid Mechanics: Types of Flow, Continuity Equation, Bernoulli's Equation, Reynolds Number, Flow Resistance, Hydrostatics Mathematics: Linear Algebra, Vector Analysis, Calculus, Geometry Mechanics: Statics, Dynamics of rigid bodies
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering; EMShip, M.Sc. Bauingenieurwesen
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	Students will get acquainted with different types of maritime structures, their function, installation procedures and sub-systems. They will learn to understand the physical and mathematical modelling of maritime systems exposed to a marine environment including waves, wind and ocean currents. These models are the basis for the analysis of hydrodynamic and aerodynamic loads on ships and marine structures as well as their wave, wind and current induced motions. Furthermore, students gain in-depth knowledge of linear and nonlinear mathematical models as well as selected experimental methods. They will be able to predict loads and movements of maritime structures, floating and fixed, selecting and applying the most suitable methods according to the specific technical task. Finally, they will be able to evaluate and synthesize the results of theoretical and experimental analyses in a professional and qualified manner.
Content	• The marine environment: wind, surface waves, statistical representation of wind driven waves and swells, ocean currents, general ocean knowledge • Introduction of offshore structures, their definition, tasks and hydrodynamic classification • Selected topics of fluid mechanics: basics laws for the conservation of mass or continuity, velocity potential, Laplace's differential equation, Euler's equations of motion, Bernoulli's equation, momentum and angular momentum theorem for incompressible fluids • Linear wave theory according to AIRY • Representation of natural sea states • Hydrodynamically transparent vs. compact structure • The semi-submersible • Wave induced loads and motions of floating structures, added mass, the Froude-Krylov-Force, linearised damping, potential damping, equation of motions for floating structures, natural frequencies, response amplitude operators and the magnification function • Morison equation - constituents and scope, Keulegan-Carpenter number • Energy of water waves • A short introduction to the nonlinear wave theory according to Stokes, wave drift forces
Literature	• Lecture handouts/ Vorlesungsunterlagen • Presentations/ Präsentationen • Faltinsen, O.: Sea Loads on Ships and Offshore Structures • Clauss, G.F.: Offshore Structures, Vol. 1 • Chakrabarti, S.K.: Hydrodynamics of Offshore Structures • Journée, J.M.J., Massie, W.W.: Offshore Hydromechanics, First Edition
Type of course	Lecture 2 SWS Exercise 2 SWS

	Total	4 SWS
Learning activities	Presentations, discussions, literature study, solving tutorial questions, self-study, lab experiments, excursion	
Learning hours	Attendance	60 hrs
	Weekly preparation	20 hrs
	Self-study	50 hrs
	Exercises	20 hrs
	Assessed coursework and preparation for exam	30 hrs
	Total	180 hrs
Prerequisites for admission to examination	Laboratory report or written assignment (approx. 15 pages)	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (150 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552430	

Design of Underwater Systems

Category	Content	
Modul name	Design of Underwater Systems	
Credit points	6	
Responsibility	MSF/Meerestechnik	
Contact person	Prof. Dr. Sascha Kosleck	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	Fluid Mechanics: Types of Flow, Continuity Equation, Bernoulli's Equation, Reynolds Number, Flow Resistance, Hydrostatics Mathematics: Linear Algebra, Vector Analysis, Calculus, Geometry Mechanics: Statics, Dynamics of rigid bodies	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Summer semester	
Learning outcomes	Students will understand essential underwater systems used for research, surveillance, monitoring and industrial applications. The focus is put on unmanned underwater vehicles. The students will be able to understand the different underwater systems and vehicles with regard to their basic modular structure and can specify and justify their main dimensions as well as their subsystems for different tasks. They will be able to understand environmental challenges and to address these during a design process. Students learn to apply the fundamentals of fluid mechanics to optimise specific underwater systems. They can predict controlled movements of different underwater vehicles and are able to analyse their static and dynamic stability. Pressure-neutral, pressure-compensated and pressure-resistant concepts are presented and discussed. Based on examples, the applicability of the methods taught is demonstrated and their validity limits are discussed.	
Content	• Tasks and classes of manned and unmanned underwater vehicles • Design and operational modes of towed, free-moving (autonomous) and cable-bound equipment carriers • Body shapes, basic and additional elements, flooded, pressure-neutral, pressure-compensated and pressure-resistant systems • Flow induced forces on underwater vehicles: dynamic lift and drag with a special focus on wing theory, hydrodynamics of the wing-fuselage arrangement • Analysis of stability, controllability, vibrations of towed underwater vehicles Definition of static and dynamic stability, controllability, manoeuvrability; numerical models for predicting the motion behaviour (after the initiation of manoeuvres), numerical analysis of the static and dynamic behaviour • Determination of parameters relevant to control technology, influence of ship movements on the movements of towed underwater vehicles • Modelling and calculation of flow induced loads on lines (analytical methods for the calculation of force and shapes of ideally flexible threads/ropes/cables) • Hydrodynamic design of a selected underwater vehicle	
Literature	• Lecture handouts • Presentations	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Presentations, discussions, literature study, solving tutorial questions, self-study, lab experiments, excursion	
Learning hours	Attendance Weekly preparation Self-study	60 hrs 20 hrs 50 hrs

	Exercises	20 hrs
	Assessed coursework and preparation for exam	30 hrs
	Total	180 hrs
Prerequisites for admission to examination	Laboratory report or written assignment (approx. 15 pages)	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (150 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552440	

German A1.1 GER

Category	Content
Modul name	German A1.1 GER (CEFR)
Credit points	6
Responsibility	Sprachenzentrum (SZ)
Contact person	Heide-Marlen Tiedje MA
Language	German
Admission restrictions	None
Level	Language level A1 GER (CEFR)
Mandatory prerequisites	None
Recommended prerequisites	None
This module is part of the following curricula	M.Sc. Computer Science International M.Sc. Sustainable Maritime Engineering M.Sc. Visual Intelligent Computing M.Sc. Electrical Engineering 21.02.2024
Module duration	1 semester
Integration into curricula	Every semester
Learning outcomes	Basic training in skills and competences at level A1 of the Common European Framework of Reference for Languages (CEFR), enabling elementary communicative ability in everyday as well as higher-education related contexts. Students will be able to: Reception • understand simple spoken texts when these are delivered slowly and clearly • apply strategies for listening comprehension • read short, simple written everyday texts on familiar topics (globally and selectively) in order to extract important, concrete information • apply reading strategies • infer the meaning of unknown words referring to a concrete object or action, provided the surrounding text is very simple and relates to familiar everyday topics Interaction • establish elementary social contact, requiring cooperative effort on the part of the interlocutor • express themselves on everyday topics, exchange information, and respond appropriately with memorised simple words and phrases Production • express themselves in isolated phrases, individual words, or simple sentences on personal topics, persons, and places, both in writing and orally Linguistic Competence • acquire simple grammatical structures and a limited basic vocabulary corresponding to level A1.1 • learn orthography, correct pronunciation, and sentence intonation, with some effort required on the part of the interlocutor Mediation • employ compensatory strategies (simple expressions, gestures, or non-verbal signals) in everyday situations in order to cope with them Plurilingual and Pluricultural Competence • use plurilingual strategies (e.g. internationalisms) to manage communicative situations and support language learning • begin to cope with pluricultural situations • acquire introductory intercultural orientation knowledge General Strategies • use simple strategies that allow communication despite limited language skills • use strategies to make their own learning process more effective and

	thereby improve their learning ability
Content	The course teaches and applies: • morpho-syntactic, lexical, and textual means in order to o greet and say goodbye, ask about someone's well-being, introduce oneself and others o understand and answer questions about person, studies, and family o establish elementary social contact (give compliments, talk about hobbies, abilities, preferences, eating habits, make appointments, make suggestions and respond to them, invite someone, make requests, express thanks) o write simple personal emails and text messages as well as fill in forms o cope with shopping situations (ask for prices, ask for and offer help, make evaluations) o describe objects, understand product information, state needs o ask about unknown words, spell words, ask for repetition o apply learning strategies such as vocabulary work with colour coding, mind maps o use strategies for handling dictionaries
Literature	none
Type of course	Exercise (mandatory attendance) 4 SWS Total 4 SWS
Learning activities	group work, completion of exercises, structured independent study
Learning hours	Attendance 60 hrs Weekly preparation 60 hrs Self-study 40 hrs Assessed coursework and preparation for exam 20 hrs Total 180 hrs
Prerequisites for admission to examination	Mandatory attendance in the following course type: tutorial. Maximum of 5 compulsory assignments, e.g. written texts of approx. 30–60 words each, oral tasks (approx. 3–5 minutes), or listening comprehension tasks (approx. 3 minutes), ILIAS tests (maximum of 3 hours).
Examinations / Assessments required for a successful completion of the module	Type of examination: Written examination (90 minutes) or report / documentation (14 weeks) – semester-long portfolio (5 pages) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	The examination board decides on the admission of auxiliary materials. The semester schedule may vary in exceptional cases. At the beginning of each semester, the current range of courses offered by the Language Centre can be found on the Language Centre's website. According to the Examination Regulations (RPO), the written examination may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	9109300

German A1.2 GER

Category	Content
Modul name	German A1.2 GER (CEFR)
Credit points	6
Responsibility	Sprachenzentrum (SZ)
Contact person	Heide-Marlen Tiedje MA
Language	German
Admission restrictions	A1.1/Placement test or similar
Level	Language level A2 GER (CEFR)
Mandatory prerequisites	Language level A1 GER (CEFR)
Recommended prerequisites	None
This module is part of the following curricula	M.Sc. Computer Science International M.Sc. Sustainable Maritime Engineering M.Sc. Visual Intelligent Computing M.Sc. Electrical Engineering 21.02.2024
Module duration	1 semester
Integration into curricula	Every semester
Learning outcomes	Basic training in skills and competences at level A1 of the Common European Framework of Reference for Languages (CEFR), enabling elementary communicative ability in everyday as well as higher-education related contexts. Students will be able to: Reception • understand simple spoken texts when these are delivered slowly and clearly • apply strategies for listening comprehension • read short, simple written everyday texts on familiar topics (globally and selectively) in order to extract important, concrete information • apply reading strategies • infer the meaning of unknown words referring to a concrete object or action, provided the surrounding text is very simple and relates to familiar everyday topics Interaction • establish elementary social contact, requiring cooperative effort on the part of the interlocutor • express themselves on everyday topics, exchange information, and respond appropriately with memorised simple words and phrases Production • express themselves in isolated phrases, individual words, or simple sentences on personal topics, persons, and places, both in writing and orally Linguistic Competence • acquire simple grammatical structures and a limited basic vocabulary corresponding to level A1.1 • learn orthography, correct pronunciation, and sentence intonation, with some effort required on the part of the interlocutor Mediation • employ compensatory strategies (simple expressions, gestures, or non-verbal signals) in everyday situations in order to cope with them Plurilingual and Pluricultural Competence • use plurilingual strategies (e.g. internationalisms) to manage communicative situations and support language learning • begin to cope with pluricultural situations • acquire introductory intercultural orientation knowledge General Strategies • use simple strategies that allow communication despite limited language skills • use strategies to make their own learning process more effective and

	thereby improve their learning ability	

Content	The course teaches and applies:
	• morpho-syntactic, lexical, and textual means in order to
	  • talk about past activities (weekend, daily routine, celebrations, and travel)
	  • give instructions and advice (describe a route, give tips for healthy living)
	  • provide information about one's living situation and understand housing advertisements (apartment, neighbourhood)
	  • cope with problem situations (ask for help, offer help, arrange, postpone, or cancel appointments, talk about pain and illnesses)
	  • express likes and dislikes
	  • express plans and wishes	

Literature	none	
Type of course	Exercise (mandatory attendance) Total	4 SWS 4 SWS
Learning activities	group work, completion of exercises, structured independent study	
Learning hours	Attendance Weekly preparation Self-study Assessed coursework and preparation for exam Total	60 hrs 60 hrs 40 hrs 20 hrs 180 hrs
Prerequisites for admission to examination	Mandatory attendance in the following course type: tutorial. Maximum of 5 compulsory assignments, e.g. written texts of approx. 30–60 words each, oral tasks (approx. 3–5 minutes), or listening comprehension tasks (approx. 3 minutes), ILIAS tests (maximum of 3 hours).	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Written examination (90 minutes) or report / documentation (14 weeks) – semester-long portfolio (5 pages) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	The examination board decides on the admission of auxiliary materials. The semester schedule may vary in exceptional cases. At the beginning of each semester, the current range of courses offered by the Language Centre can be found on the Language Centre's website. According to the Examination Regulations (RPO), the written examination may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	9109310	

Dynamics of Multibody Systems

Category	Content
Modul name	Dynamics of Multibody Systems
Credit points	6
Responsibility	MSF/Technische Mechanik / Dynamik
Contact person	Prof. Dr. Janos Zierath
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Fundamental knowledge in technical mechanics, in particular: • statics • strength theory • dynamics • machine dynamics
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	The students are enabled to build up task-specific models of mechanical systems based on the method of multibody system modelling, to conduct simulations in the time domain with common simulation tools and to interpret simulation results physically.
Content	1. Introduction 2. Fundamentals of vector calculus 3. Fundamentals of kinematics 4. Fundamentals of rigid-body dynamics 5. Holonomic mass point systems 6. Holonomic planar multibody systems 7. Holonomic spatial multibody systems 8. Nonholonomic systems 9. Constraints in multibody systems 10. Open multibody systems 11. Closed multibody systems
Literature	Woernle, C.: Multibody Systems; Springer, to appear 2024. Schiehlen, W.; Eberhard, P.: Applied Dynamics, Springer, 2009. • Shabana, A.:Computational Dynamics, John Wiley, 2001.
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 50 hrs Exercises 20 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to examination	Successful completion of three computer-based assignments.
Examinations / Assessments required for a successful completion of the module	Type of examination: Oral examination (30 minutes) or written examination (120 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are

	offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552450

Professional English for Engineering C1.2 GER (CEFR)

Category	Content
Modul name	Professional English for Engineering C1.2 GER (CEFR)
Credit points	6
Responsibility	Sprachenzentrum (SZ)
Contact person	Henrik Bönner M.A.
Language	English
Admission restrictions	None
Level	Language level English C1 GER (CEFR)
Mandatory prerequisites	Language level English C1.1 GER (CEFR)
Recommended prerequisites	None
This module is part of the following curricula	M.Sc. Computer Science International B.Sc. Computer Science M.Sc. Computer Science M.Sc. Sustainable Maritime Engineering B.Sc. Business Informatics 29 May 2024
Module duration	1 semester
Integration into curricula	Every semester
Learning outcomes	Advanced development of skills and competences at level C1 of the Common European Framework of Reference for Languages (CEFR), enabling appropriate academic communication in engineering-related contexts in every respect. Students will be able to: Reception • effortlessly comprehend a wide range of authentic texts and spoken contributions on engineering topics Production / Interaction • present a range of complex engineering topics orally in a detailed, logically structured, and linguistically coherent manner with natural fluency, while confidently applying a broad repertoire of linguistic resources and structures in a situationally and audience-appropriate way • produce complex texts, particularly argumentative ones (e.g. technical report, persuasive essay, project proposal), using correct language and stylistically appropriate forms, while observing the conventions of the respective text type as well as the specific requirements of the social, cultural, and professional context and audience Mediation • enable social interaction in interdisciplinary and multinational contexts through independent and appropriate linguistic action, thereby facilitating effective cooperation • identify verbal and non-verbal information and signals and apply them purposefully in oral communication Pluricultural Competence • build on a pluricultural repertoire, identify and critically reflect on differences in sociolinguistic and pragmatic conventions, cope with ambiguity in intercultural communication, and express oneself constructively and culturally appropriately in such situations
Content	The course develops in greater depth: the broad linguistic repertoire and the use of appropriate non-verbal communication for specialist presentations at conferences (use of attention-grabbing strategies, defining the take-home message, closing the loop) the linguistic repertoire and strategies for leading and participating in academic discussions and meetings on engineering topics and issues (activities included in chairing and participating in a meeting, e.g. turn-taking, negotiating, finding a compromise) the writing of longer, complex academic and professional texts (e.g. argumentative essay, technical report, project proposal, cover letter) the conscious use of appropriate devices for structuring and linking texts in oral and written communication (e.g. cohesive devices, paragraphing, paraphrasing)

	the application of peer feedback (e.g. peer evaluation of presentations, reports, etc.) awareness and sensitivity to intercultural issues relevant for successful communication in multinational learning and working environments (e.g. low-context vs. high-context cultures, different styles of small talk, concepts of politeness, direct vs. indirect communication style, communicating bad news)	
Literature	none	
Type of course	Exercise (mandatory attendance)	4 SWS
	Total	4 SWS
Learning activities	group work, project work, structured self-study, other forms of autonomous and media-assisted foreign language learning (blended learning)	
Learning hours	Attendance	60 hrs
	Weekly preparation	60 hrs
	Self-study	40 hrs
	Assessed coursework and preparation for exam	20 hrs
	Total	180 hrs
Prerequisites for admission to examination	Mandatory attendance in the following course type: tutorial. Possible pre-examination requirements (maximum of three individual requirements may be selected), e.g.: professionally or academically oriented written texts (approx. 500–600 words) oral tasks (e.g. conversations, meetings, presentations, approx. 15–20 minutes) reading of subject-related literature (scope depending on task: detailed reading approx. 3–4 pages, global reading approx. 15 pages) case study. The exact pre-examination requirement will be announced by the instructor no later than in the second week of the semester.	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Written examination (90-120 minutes) or report / documentation (14 weeks) – semester-long portfolio (5 pages) The examination format will be announced no later than in the second week of lectures. This examination accounts for 50% of the module grade. Oral examination (45 minutes). This examination accounts for 50% of the module grade.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	The examination board decides on the admission of auxiliary materials. The semester schedule may vary in exceptional cases. At the beginning of each semester, the current range of courses offered by the Language Centre can be found on the Language Centre's website. According to the Examination Regulations (RPO), the written examination may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	9101760	

Professional English for Engineering C1.1 GER (CEFR)

Category	Content
Modul name	Professional English for Mechanical Engineering C1.1 GER (CEFR)
Credit points	6
Responsibility	Sprachenzentrum (SZ)
Contact person	Henrik Bönner M.A.
Language	English
Admission restrictions	None
Level	Language level English C1 GER (CEFR)
Mandatory prerequisites	Language level English C1.1 GER (CEFR)
Recommended prerequisites	None
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	Further development of skills and competences at level C1 of the Common European Framework of Reference for Languages (CEFR), enabling appropriate academic communication in higher-education and professional, i.e. engineering-related, contexts. Students will be able to: Reception • comprehend almost effortlessly a wide range of original texts on engineering topics (from the fields of mechanical engineering, biomedical engineering, mechatronics, and industrial engineering) in terms of their overall and detailed content, their argumentative structure, and the specific features of their linguistic expression • understand almost effortlessly longer, content-rich and linguistically demanding spoken contributions (lectures, talks, discussions, negotiations) on topics from technology, business, and engineering, and identify the specific features of their linguistic expression Production / Interaction • present a wide range of technical topics orally with natural fluency, confidently selecting situationally and audience-appropriate formulations from a broad repertoire of linguistic resources and structures • produce technical and professional texts, particularly descriptive ones, using correct language and stylistically appropriate forms Mediation • process and prepare texts and visualisations relevant to communication among engineers for different purposes and audiences • identify verbal and non-verbal information and signals in spoken language and respond to them appropriately Pluricultural Competence • explain intercultural opinions and perspectives of their own or of other familiar cultures • respond appropriately and constructively to contradictions arising in intercultural communication situations
Content	The course teaches and applies: • typical speech acts necessary for academic and subject-specific communication in engineering (e.g. defining, classifying, comparing, commenting, interpreting, describing technical processes/procedures, presenting causal relationships, drawing conclusions) • speech acts required for oral communication in engineering (e.g. requesting opinions/information, agreeing, disagreeing, appropriately opening, structuring, and closing presentations; asking and responding to questions about presentations in an interculturally appropriate way) • general academic and subject-specific vocabulary, collocations, and morpho-syntactic structures

	• linguistic and structural characteristics of academic and technical texts such as research papers, review articles, engineering textbooks, case studies, technical reports • transferable strategies for text comprehension and text processing (e.g. summarising information from different sources) and effective reading strategies (global reading vs. reading for detail) • effective listening and audiovisual comprehension strategies (global listening vs. listening for detail)	
Literature	none	
Type of course	Exercise (mandatory attendance) Total	4 SWS 4 SWS
Learning activities	discussion rounds, group work, project work, structured self-study, other forms of autonomous and media-assisted foreign language learning	
Learning hours	Attendance Weekly preparation Self-study Assessed coursework and preparation for exam Total	60 hrs 60 hrs 40 hrs 20 hrs 180 hrs
Prerequisites for admission to examination	Mandatory attendance in the following course type: tutorial. Possible pre-examination requirements (maximum of three individual requirements may be selected), e.g.: professionally or academically oriented written texts (approx. 500–600 words) oral tasks (e.g. conversations, meetings, presentations, approx. 15–20 minutes) reading of subject-related literature (scope depending on task: detailed reading approx. 3–4 pages, global reading approx. 15 pages) case study. The exact pre-examination requirement will be announced by the instructor no later than in the second week of the semester.	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Written examination (90 minutes) The examination format will be announced no later than in the second week of lectures. This examination accounts for 50% of the module grade.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	The examination board decides on the admission of auxiliary materials. The semester schedule may vary in exceptional cases. At the beginning of each semester, the current range of courses offered by the Language Centre can be found on the Language Centre's website. According to the Examination Regulations (RPO), the written examination may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	9101300	

Essentials of Ocean Science and Sustainable Ocean Use

Category	Content	
Modul name	Essentials of Ocean Science and Sustainable Ocean Use	
Credit points	6	
Responsibility	MSF/Meerestechnik	
Contact person	Prof. Dr. Sascha Kosleck (MSF)/ Prof. dr. Oliver Zielinski (MNF)	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	None	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Summer semester	
Learning outcomes	This module provides students, who have little formal background in natural science, with an introduction to earth's largest feature – the ocean. By introducing them to the essentials of ocean science, it raises awareness and understanding of fundamental concepts about structure, functioning, observation and sustainable use of the ocean. It also discusses anthropogenic (human) impacts in the past and present. The module focuses on application areas for offshore technologies such as e.g. ocean renewable energies, the extraction of raw materials but also ocean food production, including fisheries. It puts these uses into perspective, discussing economical and societal needs, as well as environmental impacts in the short and long term. Together with the students, observation and mitigation strategies for a sustainable ocean use will be derived and adapted to common ocean engineering practises.	
Content	• Concepts of sustainability • Essentials of Ocean Science 1. Earth's climate system: Compartments and functioning global ocean structure and governing processes 2. Regional oceans and coastal systems 3. Ocean observing systems 4. Ocean and society 5. Hot topics in ocean science • Uses and Abuses of the Ocean 1. Ocean hydrocarbons and marine pollutants 2. Ocean and land food resources, and their ecosystem impacts 3. Anthropogenic impacts on ocean environments 4. Impact off offshore systems and engineering systems • Aspects of ocean health and sustainable use • Mitigation strategies	
Literature	• Lecture handouts • Presentations • Thomas & Bowers: Introducing Oceanography • Publications and fact sheet provided	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Presentations, discussions, literature study, solving tutorial questions, self-study, lab experiments, excursion	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 20 hrs 50 hrs 20 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	none	

Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (150 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552460	

Experimental Methods in Maritime Engineering

Category	Content
Modul name	Experimental Methods in Maritime Engineering
Credit points	6
Responsibility	MSF/Meerestechnik
Contact person	Prof. Dr. Sascha Kosleck, Prof. Florian Sprenger, Dr. Martin Brede
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	None
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	In this module, students actively engage with and acquire a thorough understanding of experimental methods employed in engineering, with a specific focus on naval architecture, ocean engineering, and fluid mechanics. They take a hands- on approach to discerning the fundamental distinctions between in situ investigations and model tests conducted in a lab setting. Throughout the module, students proactively organize, execute, assess, and critique a diverse range of experiments. This necessitates demonstrating a grasp of the significance of accurate scaling and showcasing the ability to implement dimensional analyses and corresponding scaling laws for each experimental setup. Students actively develop proficiency in designing and implementing suitable experimental methods, including various techniques for measuring mechanical forces and fluid flow quantities. The practical training component involves active participation in experiments conducted on typical marine setups, where students learn the intricacies of handling equipment and employing appropriate measurement techniques. The culmination of each experiment involves collaboratively preparing a comprehensive written group protocol.
Content	• Full scale vs. model tests and in situ vs. lab tests • Units, dimensional analyses, scaling laws and correct scaling • Typical/frequent model scaling laws and corresponding dimensional quantities • Mechanical and electrical measurements techniques for fluid flows (flow velocity, forces, moments), optical methods (flow field, concentration), design of flow channels • Lab tests: 1. The inclination test 2. Investigating current induced loads and forces (water and wind induced) using a wind tunnel 3. Investigating resistance and propulsion of surface and or sub surface vessels including 4. Open Water Test 5. Generation of regular waves, natural, irregular sea states 6. Hydrodynamic analyses of vessels and offshore structures different cruising speeds 7. Error analyses, the "Nyquist-Shannon-theorem", Filtering, Aliasing and other practical issues 8. Pressure measurements 9. Calibration of CTA probes 10f.low field measurements in a water channel using particle image velocimetry
Literature	• Tropea, C., Yarin, A.L., Foss, J.F. (2007) Springer Handbook of Experimental Fluid Mechanics, Springer Berlin, ISBN 978-3-540-30299-5 • Goldstein, R. (1996) Fluid Mechanics Measurements, Taylor & Francis, ISBN 9780203755723

	• Eckelmann, Helmut (1997) Einführung in die Strömungsmesstechnik, Vieweg Teubner, ISBN 9783519023791	
Type of course	Lecture Exercise Practical course Total	1 SWS 1 SWS 2 SWS 4 SWS
Learning activities	Presentations, discussions, literature study, solving tutorial questions, self-study, lab experiments, excursions	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 20 hrs 50 hrs 20 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	Attendance is compulsory in the following course types: practical course. Assessment: laboratory report or term paper (approx. 15 pages)	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (150 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552470	

Finite Element Analysis of Composite Structures

Category	Content	
Modul name	Finite Element Analysis of Composite Structures	
Credit points	6	
Responsibility	MSF/Leichtbau	
Contact person	Prof. Dr. Philipp Weißgraeber	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	Knowledge in: • fundamentals of lightweight design • mechanics of composite materials • finite element analysis methods • engineering mechanics	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Summer semester	
Learning outcomes	Students • understand the basic concepts of finite element analysis of composite structures. • have experience using commercial software to analyze various structural problems. • are able to create good and efficient models and identify possible limitations and errors. • are able to use numerical models for the dimensioning of composite structures and use the programming interfaces for advanced studies. • understand the current research frontiers in composite analysis.	
Content	Based on the fundamentals of the mechanical behavior of composite materials and the fundamentals of FEM, the students consider the efficient analysis of composite structures at various scales, both theoretically and practically. They will learn how to define structural analyses, set up the models, perform linear and nonlinear analyses, and interpret the results, addressing common pitfalls and problems. Scope: • Mechanics of composite materials • Introduction to FEA and Abaqus • Strength and elasticity of laminates • Buckling analysis • Numerical micromechanics • Viscoelasticity of polymer matrix composites • Modelling damage and fatigue • Efficient modelling and programming interfaces	
Literature	• Lecture notes • E.J. Barbero, Finite Element Analysis of Composite Materials using Abaqus, 2023, 2nd edition, CRC Press. • Further reading is specified in the course	
Type of course	Integrated course Total	4 SWS 4 SWS
Learning activities	Literature study, self-study	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 30 hrs 20 hrs 40 hrs 30 hrs 180 hrs
Prerequisites for admission to	none	

examination

Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (20 minutes) or written examination (60 minutes) or Report and Presentation (20 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552480	

Introduction to Applied Programming in C++

Category	Content
Modul name	Introduction to Applied Programming in C++
Credit points	6
Responsibility	MSF/Modellierung und Simulation in Maschinenbau und Schiffstechnik
Contact person	Prof. Dr. Nikolai Kornev
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	Experience with a programming language, basic knowledge of C is desirable
Recommended prerequisites	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	By using various data types, instructions, control structures, functions as well as pointers and I/O operators of the C programming language, students are enabled to develop simple programs in the first part of the module. By completing the second part of the module, students will be able to write more complex, object-oriented C ++ programs. In addition, they deepen their skills in the development of practice-relevant C++ software tools by working on applied, practice-related questions from the field of engineering.
Content	Principles of C++ Coding: • Data types/Date structures • Arithmetic Operations • Variables/Constants • Logical Operator/Loops • Input/Output • Static und dynamic Containers • Pointer/References • Functions Principles of the object- oriented C++ Coding: • Class • Inheritance • Polymorphism
Literature	• Bjarne Stroustrup "C++ Programming Language", Pearson publisher
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Presentations, discussions, literature study, solving tutorial questions, self-study, lab experiments, excursion
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 50 hrs Exercises 20 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to examination	none
Examinations / Assessments required for a successful completion of the module	Type of examination: Other form of assessment – 4 assignments, 15 pages, including C++ code text.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.

Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552490

Introduction to Data Science in Materials Science and Engineering

Category	Content
Modul name	Introduction to Data Science in Materials Science and Engineering
Credit points	6
Responsibility	MSF/Data-Driven Analysis and Design of Materials
Contact person	Prof. Dr. Berit Zeller-Plumhoff
Language	English
Admission restrictions	none
Level	Bachelor' degree specialisation
Mandatory prerequisites	none
Recommended prerequisites	Basic knowledge of: • Mathematics (according to the modules "Mathematik für Ingenieure 1-3") Programming (according to the module "Einführung in die Programmierung")
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	The students will know fundamental methods in data science and have practised applying these to scientific questions in materials science and engineering. The students are able to assess the suitability of different methods for a given task and compare these. The students are capable to implement the methods in Python for a given question and can interpret the results.
Content	• Mathematical foundations • Linear and polynomial regression • Optimization and error metrics • Logistic regression • Decision trees and random forests • Support vector machines • Neural networks • Unsupervised methods • Dimensionality reduction
Literature	• Lecture Notes • Open lecture: introduction to machine learning https://slds-lmu.github.io/i2ml/
Type of course	Lecture 1 SWS Practical course 3 SWS Total 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 20 hrs Exercises 20 hrs Practical course 20 hrs Assessed coursework and preparation for exam 40 hrs Total 180 hrs
Prerequisites for admission to examination	None
Examinations / Assessments required for a successful completion of the module	Type of examination: Oral presentation (45 minutes) with accompanying written report.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be

	conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1501760

Large Engines, Energy Converters and Fuels for Climate Neutral Marine Applications

Category	Content
Modul name	Large Engines, Energy Converters and Fuels for Climate Neutral Marine Applications
Credit points	6
Responsibility	MSF/Kolbenmaschinen und Verbrennungsmotoren
Contact person	Prof. Dr. Bert Buchholz
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	• Basics of Thermodynamics • Basic knowledge in power and working machines – energy machines
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	Students gain specific knowledge of energy converters for maritime applications and power generation, such as large engines, large gas engines, gas turbines and fuel cells. Physical and chemical properties of relevant energy carriers (existing fossil and future climate-neutral fuels) are taught. The students know about the relationships between fuel properties and their storage and usage aboard of ships and other marine structures. The consequences of fuel choice, design and operation on efficiency, emissions and greenhouse gas balances of energy converters are discussed. The students learn about the design and operational specifics of maritime energy converters and differences to engines for on-highway applications. The students are enabled to consider and calculate the requirements from the operation of ships and other marine structures and their impact on design, operation and emission behaviour of engines and energy converters. Strong focus is given to considerations of the environmental and climate effects. The students know about special measures to reduce emissions in ship operation and onshore applications. The requirements of the maritime energy transition and solution strategies for the necessary comprehensive CO2 reduction are explained, students are able to evaluate advantages and risks of different solutions.
Content	The following main topics are covered in the lecture and exercise: • Theoretical basics, functionality and energy balances of energy converters for maritime applications: combustion engines for liquid and gaseous fuels, dual-fuel engines, gas turbines, fuel cells • Energy carriers for maritime applications: properties, special features, on-board handling, safety aspects, resulting requirements for converters • Design specifics of large engines (low-speed, medium-speed, high-speed), gas turbines and fuel cells and their auxiliary systems • Installation on board, integration into ship propulsion and power systems, specific requirements on engines from ship operation • Hybrid energy system concepts: layouts, potentials regarding efficiency and emissions, operational aspects • Emissions: Limit values for maritime applications, internal and external reduction measures • Future trends: exhaust gas treatment, fuels and strategies for the maritime energy transition • Excursion aboard a modern ferry: evaluation of the energy and propulsion system – layout, functionality, operational and safety aspects
Literature	• Latarche, M.: Pounder's Marine Diesel Engines and Gas Turbines; Butter- • worth-Heinemann Ltd, 10th Edition, 2020. • Tschöke, H., Mollenhauer, K.: Handbook of Diesel Engines; Springer-Verlag, Auflage 2010

	• Meier-Peter, H., Bernhardt, F., (Hrsg.): Handbuch Schiffsbetriebstechnik, DVV Media Group, 2. Auflage, 2012 • Bilousov, I., Bulgakov, M., Savchuk, V.: Modern Marine Internal Combustion Engines: A Technical and Historical Overview, Springer Verlag, 2020 • Elvers, B.;Schütze, A.; Handbook of Fuels – Energy Sources for Transportation, Wiley-VCH, 2021	
Type of course	Lecture Practical course Total	2 SWS 2 SWS 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 20 hrs 50 hrs 20 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	none	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552510	

Maritime Graphics

Category	Content
Modul name	Maritime Graphics
Credit points	6
Responsibility	IEF/IN/VAC/Maritime Graphics (ThürM)
Contact person	Prof. Dr. Uwe Lukas
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Basics of computer graphics
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering M.Sc. Visual Intelligent Computing
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	Technical: Comprehensive and in-depth knowledge in the acquisition, management, and both interactive and automated analysis of maritime sensor data Methodological: Specialization of the individual methodological portfolio in the field of maritime visual computing specifics Social: Ability to engage with and follow English-language courses Personal: Specialization according to individual career objectives
Content	• Physical fundamentals • Marine measurement technology • Storage and provision of maritime sensor data • Underwater image enhancement • Automated analysis of maritime sensor data • Visualization of maritime sensor data Further topics may arise from the ongoing development of the field and from new research perspectives.
Literature	Up-to-date literature references will be provided at the start of each lecture.
Type of course	Integrated course 4 SWS Total 4 SWS
Learning activities	Literature study, self-study
Learning hours	Attendance 60 hrs Self-study 50 hrs Practical course 40 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to examination	none
Examinations / Assessments required for a successful completion of the module	Type of examination: Oral examination (20 minutes) or written examination (120 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1151740

Master Thesis Sustainable Maritime Engineering

Category	Content
Modul name	Master Thesis Sustainable Maritime Engineering
Credit points	30
Responsibility	Fakultät für Maschinenbau und Schiffstechnik (MSF)
Contact person	Prof. Florian Sprenger, Prof. Sascha Kosleck, Prof. Patrick Kaeding, Prof. Nikolai Kornev
Language	English
Admission restrictions	Admission regulations in accordance with the Study and Examination Regulations (SPSO)
Level	Master's degree
Mandatory prerequisites	Before registering the Master's thesis, at least 84 credit points must have been earned, including the modules "Design of Offshore Systems," "Principle Analysis of Marine Structures," "Principles of Marine Fluid Mechanics," "Safety of Maritime Systems," and "Ship Design." Participation in at least two excursions must also be documented.
Recommended prerequisites	none
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Every semester
Learning outcomes	Students demonstrate that they are able to work independently and successfully on a specific task under supervision within a specified period of time and that they can contribute scientifically based theoretical and practical knowledge to the solution of a problem.
Content	The task can be both practical and theoretical in nature. It should correspond to the • advanced level of knowledge in the specialised discipline and, as a rule, deal with problems that arise in professional life. The Master's thesis consists of the written paper (which may also contain hardware and/or software components as well as experimental tasks) and the colloquium.
Literature	• depending on the topic of the Master's thesis
Type of course	none
Learning activities	none
Learning hours	Assessed coursework and preparation for exam 900 hrs Total 900 hrs
Prerequisites for admission to examination	none
Examinations / Assessments required for a successful completion of the module	Type of examination: Master's thesis (20 weeks) – 60–100 pages This examination accounts for 66.6% of the module grade.r Colloquium (40 minutes) – 20 minutes presentation + 20 minutes discussion This examination accounts for 33.3% of the module grade.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552500

Mathematical Models in Ship Theory

Category	Content
Modul name	Mathematical Models in Ship Theory
Credit points	6
Responsibility	MSF/Schiffbau
Contact person	Prof. Dr. Florian Sprenger
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Basic knowledge of: • different ship types and their subsystems • ship main parameters and their interaction • energy efficiency measures for ships • relevant environmental and safety regulations • Linear wave theory • Regular und irregular waves • Sea spectra
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	This module covers two topics, that are to design a ship for safe operation: seakeeping, which describes the responses of a ship encountering waves at sea and manoeuvrability, which describes the capability of a ship to perform certain manoeuvres such as turning, course-keeping or stopping. The students understand the physical background that is necessary to comprehend the interaction of ships and waves as well as the theoretical principles of manoeuvrability. They are able to compare the operability of different ship design variants based on seakeeping performance indicators. Based on this foundation, they know different methods (empirical, numerical, experimental approach) to assess the seakeeping and manoeuvring performance of a ship, and are qualified to critically review the capabilities and limitations of state-of-the-art approaches and write their own program codes. Furthermore, the students are aware of the procedures of manoeuvring sea trials.
Content	• Linearized small amplitude ship motions • Roll damping • Ship motions in regular waves (RAOs) • Ship motions in irregular waves (spectra, stochastic properties) • Added resistance and involuntary speed loss • Seakeeping criteria and operability • Ship controllability, rigid body dynamics • Hydrodynamic forces in manoeuvring • Equations of motion • Turning, rudder design • Experiments and sea trials
Literature	• Lecture Notes • Lloyd, A. R. J. M.: Seakeeping: Ship Behavior in Rough Weather • Faltinsen, O. M.: Sea Loads on Ships and Offshore Structures • Fossen, T. I.: Handbook of of Marine Craft Hydrodynamics and Motion Control • Bertram, V.: Practical Ship Hydrodynamics • el Moctar, B. O. et al.: Numerical Methods for Seakeeping Problems • Brix, J.: Manoeuvring Technical Manual • Lewis, E. V.: Principles of Naval Architecture (Volume III) • Lewandowski, E. M.: The Dynamics of Marine Craft (Advanced Series on Ocean Engineering Volume 22)
Type of course	Lecture 2 SWS Exercise 2 SWS

	Total	4 SWS
Learning activities	Literature study, solving of exercises, self-study, discussions, excursions	
Learning hours	Attendance	60 hrs
	Weekly preparation	20 hrs
	Self-study	50 hrs
	Exercises	20 hrs
	Assessed coursework and preparation for exam	30 hrs
	Total	180 hrs
Prerequisites for admission to examination	1 coursework assignment	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552520	

Metallic Engineering Materials

Category	Content
Modul name	Metallic Engineering Materials
Credit points	6
Responsibility	MSF/Werkstofftechnik
Contact person	PD Dr. Benjamin Milkereit, Prof. Dr. Olaf Hermann Keßler
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Basic knowledge of materials engineering: main material groups (metallic materials, polymer materials, ceramic materials, composite materials); Structure of metallic materials: grain structure, crystal lattice, lattice disorder, fundamentals of dislocation theory; Properties of metallic materials, solidification mechanisms; Alloy theory, solid solutions, compound phases, phase diagrams, iron-carbon diagram; Basic knowledge of most important metallic materials, in particular steels, aluminium alloys, heat treatment; Basics of materials testing: metallography, hardness testing, tensile testing.
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	The students learn about essential metallic construction materials in Maritime Engineering regarding their chemical composition, production chains (especially heat treatment), microstructure, properties and possible applications. These include in particular iron alloys, aluminium alloys and copper alloys. The students learn how metallic construction materials are specifically selected for different applications. The students learn how material structures and properties can be specifically adjusted for different applications.
Content	Metallic construction materials • Steels: General structural steels, case hardening steels, quenched and tempered steels, corrosion resistant steels, tool steels. • Aluminium alloys: Wrought/cast alloys (age-hardenable, non-age-hardenable) • Copper-alloys • Annealing process: Normalising, soft annealing, stress relief annealing, recrystallisation annealing, diffusion annealing, coarse grain annealing • Hardening processes: Martensitic hardening and tempering (quenching and tempering), surface hardening • Thermochemical heat treatment: case hardening, nitriding • Precipitation/age hardening
Literature	• Eric J. Mittemeijer, Fundamentals of Materials Science, 2nd edition 2021, Springer, https://doi.org/10.1007/978-3-030-60056-3 • Bhadeshia, Theory of Transformations in Steels, CRC Press 2021 • Polmear, I. J.: Light Alloys; Elsevier, 2007. • Ashby, Jones, Engineering Materials 2, Butterworth-Heineman 2013; https://www.sciencedirect.com/book/9780080966687/engineering-materials-2 • González, Physical Metallurgy and Heat Treatment of Steel, Springer 2022; https://doi.org/10.1007/978-3-031-05702-1 • Davis, Copper and copper alloys, ASM International 2001 • Callister Jr., W. D. and Rethwisch, D. G., Materials science and engineering: an introduction, Wiley 2018 • Askeland, D. R. and Wright, J. W., The science and engineering of materials, Cengage Learning 2021
Type of course	Lecture 3 SWS Exercise 1 SWS Total 4 SWS
Learning activities	Literature study, self-study

Learning hours	Attendance	60 hrs
	Weekly preparation	20 hrs
	Self-study	50 hrs
	Exercises	20 hrs
	Assessed coursework and preparation for exam	30 hrs
	Total	180 hrs
Prerequisites for admission to examination	none	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552530	

Modelling and Simulation of Turbulent Flows

Category	Content
Modul name	Modelling and Simulation of Turbulent Flows
Credit points	6
Responsibility	MSF/Modellierung und Simulation in Maschinenbau und Schiffstechnik
Contact person	Prof. Dr. Nikolai Kornev
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Fundamentals of fluid mechanics / fluid dynamics
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	Students gain background knowledge about aspects of turbulence physics, statistical turbulence theory and modern techniques of turbulence simulation. They are able to choose the methods and software codes that are optimal for solving different technical problems. Using the acquired knowledge, students are able to analyse complex turbulent flows in technical devices. By participation in exercises, students are proficient in the utilization of the license-free software code OpenFoam, which is widely used for simulating various turbulent flows.
Content	Physics of turbulence. Vortex dynamics. Basic definitions of the statistical theory of • turbulence. Reynolds averaging. Isotropic and homogeneous turbulence. Correlation function. Kolmogorov theory K41. Dissipation rate. Kolmogorov hypotheses. Classification of methods for calculating turbulent flows. Reynolds-averaged Navier- Stokes equations. Reynolds stress models. K-Epsilon model. K-Omega model. Method of wall functions. Large eddy simulation. Filtering. LES equations. Smagorinsky model. Germano's model, scale similarity models, mixed models. A posteriori and a priori tests. Hybrid URANS-LES methods. DES, DDES, IDDES approaches. URO hybrid method.
Literature	• Kornev N. and Cherunova I. (2014). Lectures on computational fluid dynamics and heat transfer with applications to human thermodynamics. Bookboon Publisher. • Sagaut, P.; Large, Eddy: Simulation for Incompressible Flows; Springer, 2001, pp.319. • Pope S.B.: Turbulent Flows; Cambridge University Press, 2000, pp.771
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Presentations, discussion sessions, literature review, problem-solving exercises, independent study, laboratory experiments, excursions
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 30 hrs Exercises 40 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to examination	Report (appr. 20 pages)
Examinations / Assessments required for a successful completion of the module	Type of examination: Oral examination (30 minutes) or written examination (120 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are

	offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552540

Navigation, control and vehicle autonomy of maritime systems

Category	Content
Modul name	Navigation, control and vehicle autonomy of maritime systems
Credit points	6
Responsibility	IEF/IAT/Regelungstechnik
Contact person	Prof. Dr. Torsten Jeinsch
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	None
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	Knowledge and skills in sensor and navigation systems for maritime applications, especially for surface and underwater vessels. Knowledge and skills in modelling and control of maritime processes, especially for surface and underwater vessels. Simulation and analysis with tools using MATLAB/Simulink and its toolboxes. Understanding the instrumentation and physical principles of sensors for the measurement of variables of the navigation process in the maritime environment. Systematic approach towards automation of maritime processes, introduction to modelling tools and automation structures for use in the context of maritime systems. Self and social competence: Independence and self-responsibility, General learning and working techniques, self-organization, project organization and implementation, cooperation and team working, presentation and communication, professional discourse in English, Interdisciplinary thinking
Content	Introduction and basics of the navigation process, classification of sensor and navigation systems Basics and sensing principles of heading sensors, hydroacoustic sensors for depth (echosounder), velocity (DVL) and current (ADCP) sensing, global navigation satellite systems (GNSS), integrated navigation systems (INS), their structural characteristics and applications Outlook on sensor solutions for future autonomous ship operations Basics on automation of maritime processes, characteristics in the maritime context, automation structures Control-oriented modelling of marine vehicles for different degrees of freedom and for surface and underwater vehicles, abstraction of hydrodynamic forces and moments acting on the vehicle body and actuators, disturbance models, analysis of dynamic properties of the maritime processes Methods for experimental parameter identification of maritime processes and marine vehicles, basic principles, data acquisition and processing, test runs, parameter estimation methods Design of specific control cascades for velocity, heading and trajectory control as well as dynamic positioning and manoeuvring surface and underwater vehicles Design methods for state space controllers, 2-DOF control systems, adaptive systems, cascaded control systems, and MIMO control systems for fully actuated vehicles Analysis and evaluation of control performance and robustness to disturbances and parameter uncertainties Application and design of nautical assistance systems in human-machine systems
Literature	J. Majohr, M. Kurowski, Maritime Regelungs- und Sensorsysteme: Automatisierte Schiffsführung – mit MATLAB® und Simulink®, Springer Vieweg, 2021. T. Fossen, Handbook of Marine Craft Hydrodynamics and Motion Control. John Wiley & Sons, 2011. B. Berking und W. Huth, (Hrsg.), Handbuch Nautik - Navigatorische Schiffsführung,

	2. Auflage. Hamburg: DVV Media Group, Seehafen Verlag, 2016. K. Benedict und C. Wand, (Hrsg.), Handbuch Nautik II. Hamburg: DVV Media Group, Seehafen Verlag, 2011. K. Do und J. Pan, Control of Ships and Underwater Vehicles: Design for Underactuated and Nonlinear Marine Systems, Ser. Advances in Industrial Control. London: Springer, 2009. A. Molland und S. Turnock, Hrsg., Marine Rudders and Control Surfaces: Principles, Data, Design and Applications. Oxford, UK: Elsevier, 2007. A. Molland, S. Turnock und D. Hudson, Hrsg., Ship Resistance and Propulsion: Practical Estimation of Propulsive Power. Cambridge: Cambridge University Press, 2011. K. Nomoto, T. Taguchi, K. Honda und S. Herano, ”On the steering qualities of ships”, Int. Shipbuilding Progress, Jg. 4, S. 354–370, 1957. J. Balchen, N. Jenssen, E. Mathisen und S. Sælid, ”A dynamic positioning system based on Kalman filtering and optimal control”, Modeling, Identification and Control, Jg. 1(3), S. 135–163, 1980. T. Perez, Hrsg., Ship Motion Control - Course Keeping and Roll Stabilisation Using Rudder and Fins. Springer, 2005. U. Scharnow, Seemannschaft 3: Schiff und Manöver. Berlin: transpress VEB Verlag für Verkehrswesen, 1987. The Society of Naval Architects and Marine Engineers, ”Nomenclature for Treating the Motion of a Submerged Body Through a Fluid.”, The Society of Naval Architects und Marine Engineers, Technical and Research Bulletin No. 1–5, 1950. R.D. Christ, R. Wernli, The ROV Manual: A User Guide for Remotely Operated Vehicles. Second Edition, Butterworth-Heinemann, 2018.	
Type of course	Lecture Exercise Practical course Total	2 SWS 1 SWS 1 SWS 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study	
Learning hours	Attendance Weekly preparation Self-study Assessed coursework and preparation for exam Total	60 hrs 40 hrs 40 hrs 40 hrs 180 hrs
Prerequisites for admission to examination	None	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (150 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1351950	

Numerical Fluid Mechanics and Turbulent Flows

Category	Content
Modul name	Numerical Fluid Mechanics and Turbulent Flows
Credit points	6
Responsibility	MSF/Strömungsmechanik
Contact person	Prof. Dr. Sven Olaf Grundmann
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Knowledge in: • fundamentals of fluid dynamics • fundamentals of aerodynamics • applied numerical fluid mechanics • experimental fluid mechanics
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	Students gain a deeper understanding of computational fluid dynamics (CFD) methods and the physics of turbulent flows. They understand the possibilities and limitations of various simulation methods, particularly in relation to turbulence and other fluid mechanical phenomena. The knowledge acquired enables the students to apply computational fluid dynamics scientifically to fluid mechanical problems and to interpret the results.
Content	Recommended for students specialising in mechanical, maritime and biomedical engineering, as well as for students interested in fluid mechanics from engineering and natural science subjects. The following topics are covered in the lecture: • Methodology for numerical flow simulations • Fundamental structure and components of CFD codes • Turbulent flows: Transition; stability of laminar flows; Energy cascade, Kolmogorov scales; DNS, LES and RANS methods • Reynolds equations and Reynolds stresses; turbulence models: algebraic and multi-equation models; • Isotropic and anisotropic turbulence • Turbulent boundary layers • In the corresponding exercise, students work on practical exercises and numerical applications on the topics discussed in the lecture.
Literature	none
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Literature study, solving tutorial questions, project work, self-study
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 50 hrs Exercises 20 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to examination	none
Examinations / Assessments required for a successful completion of the module	Type of examination: Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study

	regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552550

Numerical and Experimental Hydroacoustics

Category	Content	
Modul name	Numerical and Experimental Hydroacoustics	
Credit points	6	
Responsibility	MSF/Strömungsmaschinen	
Contact person	Dr. Matthias Witte, Prof. Dr. Frank-Hendrik Wurm	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	Basic knowledge of mathematical description of dynamic systems, analysis of dynamic systems and fundamentals of control engineering	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Summer semester	
Learning outcomes	The objective of this module is to provide essential knowledge in the fields of hydroacoustics, flow acoustics, and signal processing. The fundamental equations of fluid mechanics and acoustics will be deviated and the numerical solution techniques will be explained. In addition, it covers experimental techniques for locating and quantifying sound sources, as well as numerical methods for calculating three-dimensional sound fields. The theoretical foundations presented are further reinforced through practical coursework, which includes the utilization of specific software such as Bempp (acoustic boundary element method) and Matlab exercises for analysing acoustic signals. The course content is closely linked to technically significant issues within the maritime sector, with a focus on the hydrodynamic sound generation and radiation of ships and propellers as illustrative examples.	
Content	1. Basic equations of hydroacoustics and numerical solution methods 2. Experimental methods of hydroacoustics and signal analysis for sound source localization and quantification - sound intensity and sound power determination, beamforming and acoustic holography • Sound generation and radiation of ships and propellers	
Literature	Springer Handbook of Acoustics; Computational Acoustics (Bergman); Techni- • sche Akustik-Grundlagen und Anwendungen (Lerch, Sessler, Wolf); Numerische Methoden der Technischen Akustik (Müller, Möser); Technische Akustik (Möser); Underwater Acoustic Signal Processing (Abraham); Applied Underwater Acoustics (Bjørnø)	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Literature study, self-study	
Learning hours	Attendance Weekly preparation Self-study Exercises Practical course Assessed coursework and preparation for exam Total	60 hrs 30 hrs 15 hrs 15 hrs 15 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	none	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of	

	the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552560

Ocean Renewable Energies

Category	Content
Modul name	Ocean Renewable Energies
Credit points	6
Responsibility	MSF/Meerestechnik
Contact person	Prof. Dr. Sascha Kosleck
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Fluid Mechanics: Types of Flow, Continuity Equation, Bernoulli's Equation, Reynolds Number, Flow Resistance, Hydrostatics Mathematics: Linear Algebra, Vector Analysis, Calculus, Geometry Mechanics: Statics, Dynamics of rigid bodies
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	Students are enabled to design and dimension technical systems for harvesting ocean energy. To this end, they learn the theoretical and technical potentials of the various forms of ocean energy as well as the principles of action for their technical use. After successfully attending this module, students will be able to determine the loads occurring on the equipment and the generated power using engineering methods. They can assess the different operating principles regarding the degree of utilisation of the energy supplied by the ocean. Furthermore, they learn about and assess foundation techniques for marine structures.
Content	• Introduction to renewable ocean energies, classification of ocean energies • Offshore wind energy • Energie from ocean currents • Tidal energy • Ocean wave energy • Thermal power and osmosis • Levelized cost of electricity (LCoE) • Support structures, energy grids, land connection
Literature	• Lecture handouts • Presentations
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Presentations, discussions, literature study, solving tutorial questions, self-study, lab experiments, excursions
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 50 hrs Exercises 20 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to examination	Experimental report (approx. 15 pages) and, where applicable, a 20-minute presentation
Examinations / Assessments required for a successful completion of the module	Type of examination: Oral examination (30 minutes) or written examination (150 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of

	the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552570

Ocean Research Technologies

Category	Content
Modul name	Ocean Research Technologies
Credit points	6
Responsibility	MSF/Meerestechnik
Contact person	Prof. Dr. Sascha Kosleck
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	none
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	In this module, students will explore and discuss various measurement, observation, and sampling methods used in marine research. They'll gain insights into the practical aspects of in situ and lab work, allowing them to comprehend key considerations. Armed with this knowledge, students will actively communicate vital requirements and operational modes, delving into operating principles and precision aspects. They will analyse potential interactions among the object being measured, the research instruments, and the observer. Consequently, students will possess the ability to identify and formulate optimized concepts for equipment and processes tailored to specific tasks in marine research.
Content	Measuring, observation and sampling methods for marine research: • Fundamental basics of measurements and measurement campaigns in ocean research • Environmental conditions • Selected principles and their technical applications • Hydro acoustics for sub-surface applications • performance and limitations of individual methods, reproducibility of test conditions and accuracy considerations • Theoretical/mathematical models for numerical simulation of selected application scenarios • Autonomously operating and manually controlled underwater systems • Research platforms and vessels
Literature	• Lecture handouts • Presentations
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Presentations, discussions, literature study, solving tutorial questions, self-study, lab experiments, excursions
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 50 hrs Exercises 20 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to examination	Experimental report (approx. 15 pages) and, where applicable, a 20-minute presentation
Examinations / Assessments required for a successful completion of the module	Type of examination: Oral examination (30 minutes) or written examination (150 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of

	the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552580

Ocean Waves

Category	Content	
Modul name	Ocean Waves	
Credit points	6	
Responsibility	MSF/Meerestechnik	
Contact person	Prof. Dr. Sascha Kosleck	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	Fluid Mechanics: Types of Flow, Continuity Equation, Bernoulli's Equation, Reynolds Number, Flow Resistance, Hydrostatics Mathematics: Linear Algebra, Vector Analysis, Calculus, Geometry Mechanics: Statics, Dynamics of rigid bodies	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Summer semester	
Learning outcomes	In this module, students will acquire a thorough understanding of wind-driven ocean waves. The generation and propagation of waves across oceans will be explored and discussed. Students will engage with various mathematical concepts to articulate ocean waves and their movement through space and time. They will possess the capability to analyse and assess natural sea states using Linear Wave Theory, which includes examining the energy propagation in advancing waves. Utilizing wave statistics, students can compare and evaluate provided representations of sea states, as well as construct design sea states for subsequent analyses of offshore structures. Additionally, they will develop the skill to identify the pros and cons of higher-order wave theories in practical offshore design.	
Content	• Wind driven waves and swells • Regular waves and irregular sea states • Stochastic analyses of ocean waves • Time and frequency domain representations and their analyses • Typical sea state spectra • The Linear Wave Theory according to AIRY • Deep water, transitional and shallow water waves • Stokes' higher order theories • Other higher order approaches • Wave statistics, short- and long-term predictions and design sea states • Extreme seas • The energy of the advancing wave • Measuring waves and sea state	
Literature	• Lecture handouts • Presentations • Faltinsen, O.: Sea Loads on Ships and Offshore Structures • Clauss, G.F.: Offshore Structures, Vol. 1 • Clauss, G.F.: Offshore Structures, Vol. 1 • Chakrabarti, S.K.: Hydrodynamics of Offshore Structures • Journée, J.M.J., Massie, W.W.: Offshore Hydromechanics, First Edition	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Presentations, discussions, literature study, solving tutorial questions, self-study, lab experiments, excursions	
Learning hours	Attendance Weekly preparation Self-study Exercises	60 hrs 20 hrs 50 hrs 20 hrs

	Assessed coursework and preparation for exam	30 hrs
	Total	180 hrs
Prerequisites for admission to examination	Experimental report or coursework assignment (approx. 15 pages)	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (150 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552590	

Offshore Wind Energy

Category	Content	
Modul name	Offshore Wind Energy	
Credit points	6	
Responsibility	MSF/ Meerestechnik	
Contact person	Dr. Frank Adam Prof. Dr. Sascha Kosleck	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	Basic knowledge to analyse marine structures. Fundamentals of Enginee- ring Mechanics with respect to Statics, Dynamics and Mechanics of Materi- als. Fundamentals in Mathematics with respect to Analysis, Linear Algebra and Geometry as well as Differential Equations and Multivariable Calculus. Fundamentals of renewable energies and aerodynamics.	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Summer semester	
Learning outcomes	Offshore wind is a key pillar of the global energy transition. This course is dedicated to this subject. It provides knowledge on analysing wind availability, estimating annual energy production, and understanding wind turbine performance curves. Relevant standards and guidelines are also introduced. Building on this foundation, the course covers offshore wind turbines and their design, including various substructures as well as foundation and anchoring systems. Beyond the technical aspects, ecological and economic dimensions of offshore wind are equally important and will be addressed in the final section.	
Content	• Introduction to offshore wind, Trends and markets Norms, standards, and guidelines • Wind availability, AEP, and wind farm development • Offshore wind turbines & substructures & foundations | design & calculation • Grid connection, farm cabling, and AC/DC platforms • Ecological and economic aspects, including sustainability	
Literature	• Robert Gasch: Windkraftanlagen: Grundlagen, Entwurf, Planung und Betrieb • BSH Standard Konstruktion, IEC61400-3-1 und IEC61400-3-2, DNV-ST-119 • Uwe Ritschel & Michael Beyer: Designing Wind Turbines: Engineering and Manufacturing Process in the Industrial Context	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 20 hrs 50 hrs 20 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	One coursework assignment	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (180 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of	

	the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	tba

Principle Analysis of Marine Structures

Category	Content	
Modul name	Principle Analysis of Marine Structures	
Credit points	6	
Responsibility	MSF/Schiffstechnische Konstruktionen	
Contact person	Prof. Dr. Patrick Kaeding	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	Basic knowledge of Engineering Mechanics with respect to Statics, Dynamics and Mechanics of Materials. Fundamentals in Mathematics with respect to Analysis, Linear Algebra and Geometry as well as Differential Equations and Multivariable Calculus. Fundamentals of Ship and Offshore Structures as well as Ship Design.	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Winter semester	
Learning outcomes	Students perform strength assessment for marine structures, which is a basic ingredient for a save and economic design. Fundamentals of engineering mechanics to describe boundary value problems by differential equations in context of maritime applications are known. The Finite Element Method (FEM) is applied to solve mathematical models of physical problems in engineering analysis and maritime structural design. Students have basic knowledge of the FEM and the corresponding background. They perform linear structural analyses and obtain a critical evaluation of the numerical results. The FEM is an essential numerical method for structural analyses and for many other engineering applications	
Content	• Theory of Linear Elasticity • Kirchhoff Plate Bending Theory • Saint Venant Torsion Theory • Torsion of Thin-Walled Structures • Energy Methods and Variational Principles • Analysis of Grillages • Direct Stiffness Method • Fundamentals of Finite Element Method (FEM)	
Literature	• Lecture Notes • S. Timoshenko and J.N. Goodier, Theory of Elasticity (3rd Edition), McGraw-Hill, 1970 • K.-J. Bathe, Finite Element Procedures, Prentice Hall, 2007 • O.C. Zienkiewicz, R.L. Taylor, The Finite Element Method, Elsevier Butter- worth-Heinemann, 2005	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 20 hrs 50 hrs 20 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	3 assignments.	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (180 minutes) The examination format will be announced no later than in the second week of lectures.

Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552600

Principles of Marine Fluid Mechanics

Category	Content	
Modul name	Principles of Marine Fluid Mechanics	
Credit points	6	
Responsibility	MSF/Modellierung und Simulation in Maschinenbau und Schiffstechnik	
Contact person	Prof. Dr. Nikolai Kornev	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	Fundamentals of fluid mechanics	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Winter semester	
Learning outcomes	Students understand principles of specific fluid mechanics subjects related to marine hydrodynamics. Students are able to classify forces acting on ship and offshore structures during complex motion and to choose the methodology for their determination. They are capable of solving engineering problems of fluid statics and fluid dynamics using analytical solutions, simple engineering estimations and numerical methods. Based on the knowledge gained, they explain complex phenomena in technical flows and find solutions to improve the efficiency of technical devices.	
Content	Fluid properties. Main equations: continuity equation, Euler equations, Navier-Stokes equation, Bernoulli equation in different forms. Potential flows: hydrodynamic singularities, boundary element method in ship hydromechanics, ship added mass theory. Cavitation. Airfoil theory: geometric and hydrodynamic parameters of wings, Kutta condition, panel method, vortex lattice method. Theory of hydrodynamic similarity in marine hydrodynamics. Potential wave theory. Airy and Stokes waves. Turbulent and laminar flows. Boundary layer. Flow separation. Reynolds approach, Reynolds averaged Navier-Stokes equations. Large Eddy Simulation.	
Literature	• Kornev N., Fluid dynamics. Manuscript, 2023. • Katz J., Plotkin A., Low-Speed Aerodynamics, Cambridge University Press, 2010. • Smith A.J., A Physical Introduction to Fluid Mechanics, 2014. • Spurk J., Fluid Mechanics, 2020. • J.N. Newman, Marine Hydrodynamics, MIT Press, 1977	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Presentations, discussions, literature study, solving tutorial questions, self-study, lab experiments, excursions	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 20 hrs 50 hrs 20 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	none	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (120 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of	

	the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552610

Principles of energy technology: systems & applications in a maritime context

Category	Content	
Modul name	Principles of energy technology: systems & applications in a maritime context	
Credit points	6	
Responsibility	MSF/Technische Thermodynamik	
Contact person	Prof. Dr. Karsten Müller	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	none	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Winter semester	
Learning outcomes	The students learn the fundamentals of energy technologies with a particular focus on their application in maritime contexts. Additionally, they acquire the basics of modelling relevant processes.	
Content	• Foundations of Energy Engineering and Energy System Analysis • Fundamentals of Technologies for Energy Storage and Transport at Sea • Technologies for Providing Propulsion Energy for Ships and Enhancing Their Energy Efficiency • Introduction to Energy System Modelling Using the Example of Energy Flows on • Large Ships	
Literature	Andrew I. L. Payne, Mark A. Shields, „Marine Renewable Energy Technology and • Environmental Interactions", Springer, 2014	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study	
Learning hours	Attendance Weekly preparation Self-study Exercises Practical course Assessed coursework and preparation for exam Total	60 hrs 20 hrs 20 hrs 20 hrs 30 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	None	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552620	

Reasoning under Uncertainty

Category	Content
Modul name	Reasoning under Uncertainty
Credit points	6
Responsibility	IEF/IN/VAC/Mobile Multimediale Informationssysteme
Contact person	Dr. Sebastian Bader
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Fundamental knowledge of probability theory and artificial intelligence, as well as programming skills in Python or Julia
This module is part of the following curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Sustainable Maritime Engineering M.Sc. Visual Intelligent Computing M.Sc. Wirtschaftsinformatik 29.05.2024
Module duration	1 semester
Integration into curricula	Offered irregularly in the winter semester
Learning outcomes	Technical: • Knowledge of probability theory concepts • Knowledge of methods and techniques for representing and reasoning under uncertainty • Implementation of the necessary algorithms Methodological: • Ability to analyse a given domain and translate it into a probabilistic model • Application of appropriate methods Social: • Ability to collaborate in small groups • Ability to discuss probabilistic problems Personal: • Awareness of the complexity of probabilistic models • Recognition of the opportunities and risks of reasoning under uncertainty
Content	The module covers approaches and algorithms for automated reasoning under uncertainty. To make rational decisions in the real world, intelligent agents must account for the omnipresent uncertainty regarding observable data. Examples include the interpretation of noisy sensor data or the selection of one among several non-deterministic actions. Within the module, various techniques and approaches for representing and reasoning under uncertainty are introduced. The underlying mathematical concepts, as well as the corresponding algorithms, are presented and discussed in detail. Students will learn to model a given domain within probabilistic frameworks and to draw conclusions from new observations. Topics include: • Fundamentals of probability theory (axiomatic definition, independence, Bayes' theorem, …) • Bayesian networks • Markov chains and Hidden Markov Models • Markov Decision Processes (MDPs) and Partially Observable Markov Decision Processes (POMDPs) • Reinforcement Learning (RL) and Inverse Reinforcement Learning (iRL) • Advanced models (MRF, CRF)
Literature	• Reinforcement Learning, MIT Press • AI Foundations of Computational Agents, Cambridge University Press • AI A Modern Approach, Pearson
Type of course	Integrated lecture 4 SWS Total

		4 SWS
Learning activities	Lecture with slides and notes, group work, problem-solving exercises, subject-specific discussions, implementation of examples, self-study	
Learning hours	Attendance	60 hrs
	Weekly preparation	30 hrs
	Self-study	20 hrs
	Exercises	30 hrs
	Assessed coursework and preparation for exam	40 hrs
	Total	180 hrs
Prerequisites for admission to examination	none	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (20 minutes) or written examination (120 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1151720	

Resistance and Propulsion

Category	Content
Modul name	Resistance and Propulsion
Credit points	6
Responsibility	MSF/Schiffbau
Contact person	Prof. Dr. Florian Sprenger
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Basic knowledge of • different ship types and their subsystems • ship main parameters and their interaction • energy efficiency measures for ships • relevant environmental and safetyregulations
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	The students are familiar with the physical fundamentals of the different components of resistance acting on a body on the interface of the two-phase flow air/water as well as the theoretical principles of thrust generation by propellers. Taking into account interaction effect between propeller, hull and engine, the students have insight into different state-of-the-art methods (empirical, analytical, numerical and experimental) to assess the resistance and propulsion performance of a ship, which qualifies them to critically review the capabilities and limitations of state-of-the-art approaches and write their own program codes. They are qualified to develop energy efficient hull shapes and propulsion systems for given boundary conditions and to evaluate the performance of such systems holistically.
Content	• Resistance components • Similarity laws • Model tests, extrapolation methods • Resistance reduction • Propeller types and design parameters • Propeller theory • Cavitation • Hull-propeller interaction, wake, thrust deduction • Determination of the required propulsion power • Emission regulations and reduction, increasing efficiency
Literature	• Lecture Notes • Bertram, V.: Practical Ship Hydrodynamics • Newman, J. N., Marine Hydrodynamics • Rawson G. J. and Tupper, E. C.: Basic Ship Theory (Volume 2) • Carlton, J.: Marine Propellers and Propulsion • Breslin, J. and Andersen, P.: Hydrodynamics of Ship Propellers • Lewis, E. V.: Principles of Naval Architecture (Volume II)
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study, lab exercises, excursions
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 50 hrs Exercises 20 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to	1 assignment

examination

Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552630	

Robust Control and State Estimation

Category	Content
Modul name	Robust Control and State Estimation
Credit points	6
Responsibility	MSF/Mechatronik
Contact person	Prof. Dr. Harald Aschemann
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Good knowledge in: • State-space system modelling in continuous and discrete time • Canonical system representations • Analysis of structural system properties • Feedforward control design for trajectory tracking • State feedback design by eigenvalue placement and LQR techniques • Design of state and disturbance observers by eigenvalue placement and optimization techniques
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	The students understand and are able to apply basic concepts of robust control and state estimation in a targeted manner. For this purpose, problem-adapted solution methods and exemplary software implementations are taught in the lecture, the exercise, and the practical course for linear and nonlinear dynamic systems.
Content	• Introduction • Modelling of systems with uncertainties and disturbances • Stability analysis of uncertain systems • Robust feedback control design • Robust state and disturbance estimation • Model-free control • Learning control
Literature	• Aschemann, H., Lecture Notes „Robuste Regelung und Zustandsschätzung". • Ackermann, J.: Robust Control, Springer, 2002. • Gu, D.-W.; Petkov, P.H.; Konstantinov, M.M.: Robust Control Design with MATLAB, Springer, 2013. • Zhou,.K.; and Doyle, J.C.: Essentials of Robust Control, Prentice Hall, 1998. • Skogestad, S.;Postlethwaite, I.: Multivariable Feedback Control, Wiley, 2005. • Ostertag, E.: Mono- and Multivariable Control and Estimation, Springer, 2011. • Weinmann, A.: Uncertain Models and Robust Control, Springer, 1991.
Type of course	Lecture 3 SWS Exercise 1 SWS Laboratory/practical class (compulsory attendance) 1 SWS Total 4 SWS
Learning activities	Literature study, solving of exercises and laboratory tasks, self-study
Learning hours	Attendance 75 hrs Weekly preparation 15 hrs Self-study 40 hrs Exercises 20 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to examination	Compulsory attendance in the laboratory course and successful completion of 3 laboratory experiments.
Examinations / Assessments required for a successful completion of the module	Type of examination: written examination (120 minutes)

Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552640

Safety of Maritime Systems

Category	Content	
Modul name	Safety of Maritime Systems	
Credit points	6	
Responsibility	MSF/Schiffbau	
Contact person	Prof. Dr. Florian Sprenger	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	Basic knowledge of • different ship types and their subsystems • ship main parameters and their interaction • relevant environmental and safety regulations • principles of intact stability	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Winter semester	
Learning outcomes	The first focus of this module is on the intact stability of ships in calm water as well as waves. The students learn how to derive the metacentric height, righting lever and KN-curves for a given ship design and loading condition. They are further qualified to assess the risk of capsizing in waves, define risk mitigation strategies and to discuss the failure modes related to the second-generation intact stability criteria. The second topic of the module is damage stability in calm water. The students learn how to assess the safety of ships and offshore structures after damage with water ingress. They know the deterministic and probabilistic approach for damage stability assessment and can critically review and discuss the different methods in the context of ship design.	
Content	• Intact stability in calm water • Intact stability in waves • IMO codes and intact stability criteria • Assessment of floating position and stability after hull damage • Floodable length, compartmentalisation • Deterministic assessment of damage stability for tankers and bulkers • Probabilistic assessment of damage stability according to SOLAS	
Literature	• Lecture notes • IMO: Intact Stability Code, International Load Lines Convention, SOLAS • Kobylinski, L. K. and Kastner, S.: Stability and Safety of Ships • Barras B. and Derrett, D. R.: Ship Stability for Master and Mates • Biran, A.B.: Ship Hydrostatics and Stability • Neves, M. A. S. et al.: Contemporary Ideas on Ship Stability and Capsizing in Waves • Lewis, E. V.: Principles of Naval Architecture (Volume I)	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study, discussions, excursions	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 20 hrs 50 hrs 20 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	One coursework assignment	

Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552650	

Sailing Theory

Category	Content
Modul name	Sailing Theory
Credit points	6
Responsibility	MSF/Schiffbau
Contact person	Prof. Dr. Florian Sprenger
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	none
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	The students know the basic design principles of wind-powered ships. They are able to determine the acting forces and the attainable speed of a ship under sail. Based on an understanding of the acting lift and drag components, they understand how to maximise thrust and minimise drag in smooth water and waves. Students are able to determine the resulting force and moment equilibria, taking into account the actual attitude of a wind-powered ship. In addition to classic sails, students have the knowledge to analyse also rigid sails, kite sails and rotor sails and integrate them into a ship design. They are furthermore familiar with the basic functional principles and design of rudders, foils and fins.
Content	• Velocities and Forces • Attainable speed of sailing crafts • Fluid dynamic lift and its components • Fluid dynamic drag and its components • Viscous drag and phenomena of the boundary layer • Wave induced drag • Force and moment equilibria • Rudders, foils and fins • Sail types
Literature	• Lecture Notes • Van Oossanen, P.: The Science of Sailing (Part 1-5) • Fossati, F.: Aero-Hydrodynamics and the Performance of Sailing Yachts • Larsson, L. and Eliasson, R.: Principles of Yacht Design • Lewis, E. V.: Principles of Naval Architecture (Volumes II, III)
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study, discussions, excursions
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 50 hrs Exercises 20 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to examination	One coursework assignment or a presentation (approx. 20 minutes)
Examinations / Assessments required for a successful completion of the module	Type of examination: Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of

	the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552660

Seakeeping and Manoeuvring

Category	Content
Modul name	Seakeeping and Manoeuvring
Credit points	6
Responsibility	MSF/Schiffbau
Contact person	Prof. Dr. Florian Sprenger
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Basic knowledge of: • different ship types and their subsystems • ship main parameters and their interaction • energy efficiency measures for ships • relevant environmental and safety regulations • Linear wave theory • Regular und irregular waves • Sea spectra
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	This module covers two topics, that are to design a ship for safe operation: seakeeping, which describes the responses of a ship encountering waves at sea and manoeuvrability, which describes the capability of a ship to perform certain manoeuvres such as turning, course-keeping or stopping. The students understand the physical background that is necessary to comprehend the interaction of ships and waves as well as the theoretical principles of manoeuvrability. They are able to compare the operability of different ship design variants based on seakeeping performance indicators. Based on this foundation, they know different methods (empirical, numerical, experimental approach) to assess the seakeeping and manoeuvring performance of a ship and are qualified to critically review the capabilities and limitations of state-of-the-art approaches and write their own program codes. Furthermore, the students are aware of the procedures of manoeuvring sea trials.
Content	• Linearized small amplitude ship motions • Roll damping • Ship motions in regular waves (RAOs) • Ship motions in irregular waves (spectra, stochastic properties) • Added resistance and involuntary speed loss • Seakeeping criteria and operability • Ship controllability, rigid body dynamics • Hydrodynamic forces in manoeuvring • Equations of motion • Turning, rudder design • Experiments and sea trials
Literature	• Lecture Notes • Lloyd, A. R. J. M.: Seakeeping: Ship Behavior in Rough Weather • Faltinsen, O. M.: Sea Loads on Ships and Offshore Structures • Fossen, T. I.: Handbook of of Marine Craft Hydrodynamics and Motion Control • Bertram, V.: Practical Ship Hydrodynamics • el Moctar, B. O. et al.: Numerical Methods for Seakeeping Problems • Brix, J.: Manoeuvring Technical Manual • Lewis, E. V.: Principles of Naval Architecture (Volume III) • Lewandowski, E. M.: The Dynamics of Marine Craft (Advanced Series on Ocean Engineering Volume 22)
Type of course	Lecture 2 SWS

	Exercise	2 SWS
	Total	4 SWS
Learning activities	Literature study, solving tutorial questions, self-study, discussions, excursions	
Learning hours	Attendance	60 hrs
	Weekly preparation	20 hrs
	Self-study	50 hrs
	Exercises	20 hrs
	Assessed coursework and preparation for exam	30 hrs
	Total	180 hrs
Prerequisites for admission to examination	1 coursework assignment	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552670	

Selected Topics for the Analysis of Marine Structures

Category	Content	
Modul name	Selected Topics for the Analysis of Marine Structures	
Credit points	6	
Responsibility	MSF/Schiffstechnische Konstruktionen	
Contact person	Prof. Dr. Patrick Kaeding	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	Basic knowledge to analyse structural components of marine structures. Fundamentals of Finite Element Method and its application to solve linear and nonlinear structural problems. Fundamentals of Ship and Offshore Structures as well as Ship Design.	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Winter semester	
Learning outcomes	Students know the fundamentals of different methods to analyse marine structures and to judge upon its structural behaviour. They apply the shear force and the warping torsion theory to 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 apply the Finite Element Method (FEM) as a feasible tool to analyse various structural systems. Different element types and its applicability are investigated. The students perform nonlinear Finite Element Analyses (FEA) to develop a profound knowledge of appropriate solution methods. In frame of this course different solution methods implemented commonly in finite element software packages are applied. Finally, the students have a more comprehensive understanding to perform structural analyses of complex systems.	
Content	• General Review of the Analysis and Design of Marine Structures • Theory of Shear Force Application • Warping Torsion Theory • Elastic Foundation • Response Spectrum Analysis • Beam Element Formulations • Newton-Raphson Schemes • Arc-Length Method • Displacement Control • Introduction to Ultimate Strength	
Literature	Lecture notes	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 20 hrs 50 hrs 20 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	3 coursework assignments, to be announced no later than in the second week of lectures.	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (180 minutes) The examination format will be announced no later than in the second week of lectures.

Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552680

Ship Design

Category	Content
Modul name	Ship Design
Credit points	6
Responsibility	MSF/Schiffbau
Contact person	Prof. Dr. Florian Sprenger
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Basic knowledge of: • different ship types and their subsystems • ship main parameters and their interaction • energy efficiency measures for ships • relevant environmental and safety regulations • principles of intact stability
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	The students understand the ship design process from the first idea to the delivery of the vessel to the new owner. They can implement process steps themselves and are able to specify the relevant parameters of the complex system ship towards a given transportation task. They are qualified to evaluate the influence of global economic developments on transport demand and understand the significance of current environmental and safety regulations on ship design. The students are able to develop concepts and specify ship design parameters that are optimised based on the analysis of this given set of boundary conditions. They can apply different methods to compare the economic viability of ship design variants and are able implement different decision support strategies to find the best solution when a wide range of technological options is available for a given task.
Content	• Development of selected ship types • Global trade and markets • Design process, stakeholder, roles • Boundary conditions, rules and regulations • Design tools • Evaluation of economic viability, CAPEX, OPEX, freight rates • Decision making processes • Design methods and parameters
Literature	• Lecture Notes • Schneekluth H. and Bertram V.: Ship Design for Efficiency and Economy • Roh, M.-I., Computational Ship Design • Watson, D. G. M.: Practical Ship Design • Barras, B.: Ship Design and Performance for Masters and Mates • Papanikolaou, A.: Ship Design: Methodologies of Preliminary Design • Papanikolaou, A.: A Holistic Approach to Ship Design (Volumes 1-2)
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study, discussions, excursions
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 50 hrs Exercises 20 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to	One coursework assignment or a presentation (approx. 20 minutes)

examination

Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552690	

Ship Life Cycle Digitalization

Category	Content
Modul name	Ship Life Cycle Digitalization
Credit points	6
Responsibility	MSF/Schiffbau
Contact person	Prof. Dr. Florian Sprenger
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Basic knowledge of • ship design process • geometric modelling • data analysis methods
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Winter semester
Learning outcomes	Students understand the fundamentals and mathematical modelling techniques implemented in modern CAD tools. They are able to formulate target functions and set up an optimization procedure in the ship design process. They understand the necessity of an efficient information exchange between partners and tasks over the entire ship life cycle, and they can apply suitable information exchange methods and tools. The students understand the role and potential of IT in the ship production process. Based on selected examples of operational data from a real ship, they are aware of the potential and experience the challenges of heterogenous big data collected from multiple sources during ship operation. They can apply selected data science techniques to analyse large data sets.
Content	• Product life cycle, process modelling, product data • Digitalisation of ship design: tools and methods • Fundamentals of shape definition • Fundamentals of curve and surface modelling • Digitalisation of the ship production process • Digitalisation of ship operation: tools and methods • Sensors, data evaluation and processing • Decision support systems, automation
Literature	• Lecture Notes • Lind, M. et al., Maritime Informatics • Piegl, L. and Tiller, W.: The NURBS Book • Nocedal, J. and Wright, S. L.: Numerical Optimization • Booch, G. et al.: Object-Oriented Analysis and Design with Applications • Halpin, T. A.: Information Modeling and Relational Databases
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study, discussions, excursions
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 50 hrs Exercises 20 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to examination	One coursework assignment or a presentation (approx. 20 minutes)
Examinations / Assessments required for a successful completion of the module	Type of examination: Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the

	second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552700

Structural Design of Marine Structures

Category	Content
Modul name	Structural Design of Marine Structures
Credit points	6
Responsibility	MSF/Schiffstechnische Konstruktionen
Contact person	Prof. Dr. Patrick Kaeding
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Basic knowledge of Engineering Mechanics with respect to Statics, Dynamics and Mechanics of Materials. Fundamentals in Mathematics with respect to Analysis, Linear Algebra and Geometry as well as Differential Equations and Multivariable Calculus. Fundamentals of Ship and Offshore Structures as well as Ship Design.
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	Students adopt special knowledge and skills to design ship and offshore structures. Scantlings of different structural components are determined and dimensioned for a save and economic design. Here, different designs and structural details are taken into account. Students know the relationship between the structural design process and structural analysis methods. This is required for a goal-oriented construction of ship and offshore structures and also applicable to many other engineering disciplines.
Content	• Construction and Sections • Effective Width of Plates • Foundation of Machinery and Appendages • Detailed Design • Differences of Structural Design Concepts • Equipment • Production-Oriented Dimensioning • Vibration and Fatigue • Buckling and Ultimate Strength • Design, Analysis, Assessment
Literature	• Lecture Notes • Lamb, Th.: Ship Design and Construction, Vol. 1+2, Society of Naval Architects and Marine Engineers, 2003+2004. • Lewis, E.V.: Principles of Naval Architecture, Vol. 1, Stability and Strength, Society of Naval Architects and Marine Engineers, 1988.
Type of course	Lecture 2 SWS Exercise 2 SWS Total 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study
Learning hours	Attendance 60 hrs Weekly preparation 20 hrs Self-study 50 hrs Exercises 20 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to examination	3 coursework assignments, to be announced no later than in the second week of lectures.
Examinations / Assessments required for a successful completion of the module	Type of examination: Oral examination (30 minutes) or written examination (180 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study

	regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552710

Structural Durability

Category	Content
Modul name	Structural Durability
Credit points	6
Responsibility	MSF/Strukturmechanik
Contact person	Dr. Patrick Mutschler M.Sc.
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Fundamental knowledge in mechanics, in particular: • strength of materials • strenth theory • structural mechanics • FEM
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	The course shall deliver the basics of strength and lifetime calculations for cyclically loaded components. This enables students to design reliable technical products and components using engineering methods
Content	• Introduction • Service loads, Load time histories, counting methods and load and frequency distributions • Material parameters for cyclic loading • Concepts for lifetime calculations, e.g. stress- and strain-based concepts or hot spot stress method • Fundamentals of Very High Cycle Fatigue (VHCF) • Practical exercises based on selected tasks with specific software and experimental procedures
Literature	• Sander, M.: Sicherheit und Betriebsfestigkeit von Maschinen und Anlagen. Springer-Verlag, Berlin, 2018 • Gudehus, H., Zenner, H.: Leitfaden für eine Betriebsfestigkeitsberechnung, Stahleisen-Verlag, Düsseldorf, 1999 • Richard, H.A., Sander, M.: Fatigue crack growth – Detect, Assess, Avoid. Springer International Publishing, 2016 • Lecture Notes / Vorlesungsunterlagen
Type of course	Lecture 1 SWS Exercise 2 SWS Total 3 SWS
Learning activities	Discussions, literature study, solving tutorial questions, self-study, lab exercises
Learning hours	Attendance 45 hrs Weekly preparation 30 hrs Self-study 55 hrs Exercises 20 hrs Assessed coursework and preparation for exam 30 hrs Total 180 hrs
Prerequisites for admission to examination	none
Examinations / Assessments required for a successful completion of the module	Type of examination: Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of

	the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552720

Team Project

Category	Content	
Modul name	Team Project	
Credit points	6	
Responsibility	MSF/ Fakultät für Maschinenbau und Schiffstechnik (MSF)	
Contact person	Prof. Dr. Patrick Kaeding	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	none	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Winter semester	
Learning outcomes	Students demonstrate initiative and originality in problem solving. They act autonomously in planning and implementing of tasks at a professional level while making decisions in complex and unpredictable situations. The students develop a comprehensive understanding of techniques and methodologies applicable to their own work.	
Content	Different topics will be offered – all linked to other courses. A problem will have to be solved in a team.	
Literature	Lecture notes	
Type of course	Lecture Laboratory/practical class (compulsory attendance) Total	1 SWS 3 SWS 4 SWS
Learning activities	Discussion sessions, group work, student presentations, literature review, project work, independent study	
Learning hours	Attendance Assessed coursework and preparation for exam Total	60 hrs 120 hrs 180 hrs
Prerequisites for admission to examination	Mandatory attendance in the laboratory course	
Examinations / Assessments required for a successful completion of the module	Type of examination:	written report (~ 20 pages)
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552730	

Technical Fluids for Sustainable Maritime Applications

Category	Content
Modul name	Technical Fluids for Sustainable Maritime Applications
Credit points	6
Responsibility	MSF/Kolbenmaschinen und Verbrennungsmotoren
Contact person	Prof. Dr. Bert Buchholz
Language	English
Admission restrictions	none
Level	Master's degree
Mandatory prerequisites	none
Recommended prerequisites	Basics of Thermodynamics Basics of Chemistry
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering
Module duration	1 semester
Integration into curricula	Summer semester
Learning outcomes	The students gain knowledge about the different types and areas of application of technical fluids. Based on the technical and ecological requirements, the physical and chemical properties of technical fluids as well as their significance for the operation of maritime facilities and their effects on the environment are discussed. The focus is on all fluids that are used in mechanical engineering applications in complex systems, e. g. ships, offshore or subsea plants (fuels, lubricating oils and greases, hydraulic oils, compressor oils, gear oils, process water as well as coolants and cleaning agents). Students will be able to define the complex requirements for the practical application of technical fluids and, on this basis, to define criteria for the correct selection of technical fluids. In particular, they can identify and minimise the ecological impact on the marine environment (water and air). The life cycles of technical fluids, i. e. production, use and disposal, are dealt with from the point of view of sustainability. In a laboratory course, the determination of chemical-physical characteristic values and their evaluation is taught. The module enables students to select suitable and sustainable technical fluids for the various applications or to integrate them into new or existing application environments.
Content	The following topics will be covered • Types & areas of application of technical fluids, technical requirements • Chemical and physical properties of technical fluids and their significance for applicability and application safety • Basic functional principles and examples of additives in different technical fluids • Selection, use and proper disposal of technical fluids • Sustainability aspects, measurement and evaluation of environmental impacts, replacement of crude oil-based products with synthetic or bio-based working fluids • Life cycle cost reduction, fluid care, filtration systems • Fluid conditioning systems: pumps, filters, heat exchangers, separators • Fluid condition monitoring, possibilities for monitoring and consumption reduction • Standardization and specification • Research and development needs
Literature	• Elvers, B.; Schütze, A.; Handbook of Fuels – Energy Sources for Transportation, Wiley-VCH, 2021 • Pirro, D.M., Webster, M., Maus, W.: Zukünftige Kraftstoffe, Springer Vieweg 2019 • Daschner, E.: Lubrication Fundamentals, Third Edition, Taylor & Francis Group, LLC, 2016 • Grollius, Horst-W.: Grundlagen der Hydraulik, Carl Hanser Verlag, 2022 • Meier-Peter, H., Bernhardt, F., (Hrsg.): Handbuch Schiffsbetriebstechnik, DVV Media Group, 2. Auflage, 2012 • Bauer, G., Niebergall, M.: Ölhydraulik, Springer Verlag 2020 • Möller, U.J., Nasser J.: Schmierstoffe im Betrieb, Springer Verlag 2002 • Brugger, K.: Schmierstoffseminar, Nold, 2018

Type of course	Lecture Exercise Practical course Total	2 SWS 1 SWS 1 SWS 4 SWS
Learning activities	Group work, Literature study, self-study, practical exercises	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 20 hrs 50 hrs 20 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	none	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (90 minutes) The examination format will be announced no later than in the second week of lectures.
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.	
Module number	1552740	

Technical production processes of maritime structures and ships

Category	Content	
Modul name	Technical production processes of maritime structures and ships	
Credit points	6	
Responsibility	MSF/Fertigungstechnik	
Contact person	Dr. Ulrich Kothe, Prof. Dr. Wilko Flügge	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	none	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Summer semester	
Learning outcomes	The students understand the basic interrelationships of the production of maritime structures. They have a deeper understanding of the individual stages of the manufacturing process. In addition, students have a deeper understanding of supporting processes that have a strong influence on the production result.	
Content	1. Fundamentals of maritime manufacturing/shipyard concepts (history) 2. Processes in the construction of ships 3. Processes in the construction of maritime structures (Aquacultures, Offshore-Wind, …) 4. Welding processes in maritime production 5. Forming and cutting processes in maritime production 6. Accuracy-controlled methodology of fabrication and metrology of large-scale structures 7. Outfitting processes using the example of pipeline assembly 8. Assembly of maritime structures; Pre-assembly and final assembly as well as parts production 9. Construction of underwater tools / ROV's 10. Maintenance and repair and conversion of ships 11. Maintenance and repair of offshore structures	
Literature	none	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study	
Learning hours	Attendance Weekly preparation Self-study Exercises Practical course Assessed coursework and preparation for exam Total	60 hrs 20 hrs 40 hrs 20 hrs 10 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	none	
Examinations / Assessments required for a successful completion of the module	Type of examination:	written examination (60 minutes)
Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.	
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.	
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online.	

	According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552750

Ultimate Strength Assessment of Marine Structures

Category	Content	
Modul name	Ultimate Strength Assessment of Marine Structures	
Credit points	6	
Responsibility	MSF/Schiffstechnische Konstruktionen	
Contact person	Prof. Dr. Patrick Kaeding	
Language	English	
Admission restrictions	none	
Level	Master's degree	
Mandatory prerequisites	none	
Recommended prerequisites	Basic knowledge to analyse structural components of marine structures. Fundamentals of Finite Element Method and its application to solve linear and nonlinear structural problems. Fundamentals of Ship and Offshore Structures as well as Ship Design.	
This module is part of the following curricula	M.Sc. Sustainable Maritime Engineering	
Module duration	1 semester	
Integration into curricula	Winter semester	
Learning outcomes	Students understand the fundamentals of different methods to determine the ultimate strength of marine structures. Ships and offshore structures are composed of welded plates and stiffened plate panels. Students apply appropriate models to introduce welding related initial deflections as well as residual stresses to structural components. The influence of initial imperfections due to welding on the buckling/ plastic collapse behaviour of plates and stiffened plate structures is investigated. Students perform progressive collapse analyses exemplarily with the nonlinear finite element method to determine the ultimate strength of plate structures and they obtain a critical evaluation of the numerical results.	
Content	• Principles of Ultimate Strength Assessment • Numerical Methods for Ultimate Strength Assessment • Initial Imperfections due to Welding • Buckling/Plastic Collapse Behaviour of Plates • Buckling/Plastic Collapse Behaviour of Stiffened Plates • Buckling/Plastic Collapse Behaviour of Stiffened Plate Panels • Buckling/Plastic Collapse Behaviour of Stiffened Plate Assemblies • Ultimate Strength of Ship Hull Girders	
Literature	• Lecture Notes • Yao, Tetsuya and Fujikubo, Masahiko. Buckling and Ultimate Strength of Ship and Ship-like Floating Structures. Butterworth-Heinemann, Elsevier Inc. Amsterdam, 2016. • Paik, Jeom K. Ultimate Limit State Analysis and Design of Plated Structures. 2nd ed. Wiley. Chichester, 2018.	
Type of course	Lecture Exercise Total	2 SWS 2 SWS 4 SWS
Learning activities	Literature study, solving tutorial questions, self-study	
Learning hours	Attendance Weekly preparation Self-study Exercises Assessed coursework and preparation for exam Total	60 hrs 20 hrs 50 hrs 20 hrs 30 hrs 180 hrs
Prerequisites for admission to examination	3 assignments, to be announced no later than in the second week of lectures.	
Examinations / Assessments required for a successful completion of the module	Type of examination:	Oral examination (30 minutes) or written examination (180 minutes) The examination format will be announced no later than in the second week of lectures.

Examination schedule	Regular examination date according to the respective valid examination and study regulations of the degree program.
Assessment	Assessment according to the respective valid examination and study regulations of the degree program.
Comments	Oral examinations are offered in either English or German; written examinations are offered exclusively in English. Examinations may take place on-site or online. According to the Examination Regulations (RPO), the written exam may also be conducted as a multiple-choice test, an e-exam, or a take-home exam. The examination format must be announced by the examiner no later than in the second week of lectures.
Module number	1552760

- SWS (Semesterwochenstunden) = contact hours per week