Serving University: University of Applied Sciences Emden/Leer
Study course: M. Sc. Maritime Operations

Module description: Financial Business Administration and Cost Accounting

Semester	Frequency of offer	Duration	Type	ECTS-Points	Student Workload
2	SS	1 Sem	obligatory	**6**	(160) 48/112

Preliminaries for attendances	Used for	Conditions to give ECTS Points	Teaching method	Responsible
Yes, (will be specified in the course plan by semester start)		Portfolio	Lectures, exercises, interactive discussions and Group work consisting of case studies, computer based management simulation and student presentations	Prof. Dr. Klaus Heilmann

Qualification aims

The student has broad knowledge in various aspects of financial Business Administration and cost accounting.

Knowledge:
The student has advanced knowledge:

- Can explain various principles for cost estimation, cost distribution, and product calculations.
- Is familiar with budgeting as a management tool, and can explain how budgeting processes are organized and carried out.
- Can explain how enterprises are financed, new investments are considered, and how annual accounts are prepared and analyzed.
- Can explain and use the basis for the time value of money and the relationship between the use of net current value as a decision making criterion for investments.
- Can account for the relationship between net current value and the internal rate of return.
- Knows the purpose of a financial statement.
- Knows the concepts of expenses, costs, expenditures, revenues and payments and has acquired a good understanding of the cost concept and cost variation in order to synthesizing the different aspects.
- Knows about various principles for cost distribution, and product calculation in order to apply

them.
- Is familiar with budget as a management tool, and can account for how budget processes are organized and carried out.

Skills:
The Student:
- Can budget cash flows that are relevant for decision-making concerning investment and financial decisions.
- Can carry out profitability analyses based on net current value.
- Can calculate an internal rate of return.
- Is able to carry out cost, profit and volume analyzes.
- Can apply the most common instruments of strategic management accounting to evaluate an organization's performance and to support strategic decision-making.
- Can calculate financial performance measures.
- Is able to develop pre and post calculations using the self-cost and contribution principles for firms in various business sectors.
- Can perform traditional calculations based on the normal and standard costing methods.
- Can design and use a balanced scorecard for evaluating performance.
- Can set up budgets (result, liquidity, and balance budgets) based on the company's plans and activities for a given period, and see the connection between the company's various subordinate budgets.
- Can apply knowledge from the various academic fields to practical problems in the workplace, and can collect and analyze relevant information in order to solve a wide specter of problems within business administration and management.
- Is able to update his/her own knowledge throughout his/her working life.

General Qualifications:
The student is able to:
- Has basic academic insight, analytical training, and an understanding of problems within the general fields of financial business administration and cost accounting.
- Can plan and carry out his/her own analyses of practical problems and make decisions based on these analyses.
- Can convey academic material both orally and in writing, and can exchange views and experience, thereby contributing towards the development of good work experiences.
- Can ask critical questions about and reflect upon central prerequisites and assumptions within this academic field.

Content

The course covers the most important aspects of financial Business Administration and cost accounting for technical oriented participants in the maritime industry. The course provides an introduction to the foundations of investments and finance, several aspects of management accounting & control as well as the practical application of the acquired theoretical knowledge trough participating in a computer based management simulation. The Course is divided into 3 main parts.

Part 1 focusses on the prerequisites and foundations for investments and finance including the following areas (but not restricted to): calculating cash flows relevant for decision making, interest calculations and financial mathematics, net present value calculations, investment analysis and methods & sources of financing.

Part 2 covers the area of management accounting especially introducing key ideas, concepts, and tools of strategic management accounting and control. Including the following content (but not restricted to): Income and cost control, models for internal accounts including the use of normal and standard costing, cost distribution, decision-relevant costs and income, budgeting, performance measurement, and balanced scorecard.

Part 3 is integrating the theoretical knowledge of the above parts through a practical application. For a better understanding of the complex interactions within a maritime company the students participate in a computer based management simulation. They take the role of the board of executives of a maritime company and experience typical conflicts in corporate governance. The Participants learn to apply business economic methods and information resources as well as how to deal with the uncertainty of decision-making usually in a team, often under time pressure.

Lectures		
Lecturer	**Title of lecture**	**Contact hours**
Prof. Dr. Klaus Heilmann	Financial Business Administration and Cost Accounting	48

Serving University: University of Applied Sciences Emden/Leer
Study course: M. Sc. Maritime Operations

Module description: Scientific Approach of Complex Problems

Semester	Frequency of offer	Duration	Type	ECTS-Points	Student Workload
2	SS	1 Sem	obligatory	**6**	(160) 48/112

Preliminaries for attendances	Used for	Conditions to give ECTS Points	Teaching method	Responsible
		Portfolio	lectures, project-oriented conceptual exercises	Prof. Dr. Jann Strybny

Qualification aims

Knowledge:
The student has advanced knowledge:

- on the need and availability of appropriate measurement techniques for the understanding of involved processes and the steering, calibration and verification of models
- on maritime measurement techniques in laboratory and nature to apply them
- evaluating collecting data via market-/opinion research
- on the intended application of a broad range of different types of mathematical models in the maritime sciences: assistance “Which model is useful when?” a guide from the feasibility of cellular automata in traffic simulation to the performance of computational fluid dynamics for the design of sailing systems or offshore structures.
- knowledge on limitations of mathematical models, risk of empirical approaches included in mathematical models to evaluate the model
- limits of accuracy of different modeling concepts to evaluate the purpose of the model
- error propagation along a model chain for the description of a complex maritime system to evaluate the model

Skills:
The Student:

- can indicate the truly relevant processes of complex maritime systems

- can create measurement campaigns for understanding the identified processes in a targeted manner
- can design a modeling concept for understanding a complex system including empirical and mathematical models

General Qualifications:
The student is able to:
- can plan, conduct and evaluate smaller investigations of complex problems on the basis of models
- can supervise the quality of ordered investigations on the basis of models

Content
The students attending successful the course acquire an advanced understanding of the conceptual design of models in the field of maritime sciences. The way is shown to a suitable modeling strategy of a complex maritime system. Special emphasis will be placed on a broad introduction of the scientific term “modeling”. The most relevant scientific modeling concepts will be introduced both from engineering and economic points of view. Close links to applied maritime topics: • specific scope on translating the parameters of complex maritime business processes into stochastic models. Possible example for exercises: aspects of insurance mathematics with regard to georisks for vessels and maritime structures • scope on special engineering applications such as the theory of similarity. Possible example for exercises: opportunities and limits of generating solutions on the basis of fluid dynamic scale models for the hulls of vessels or marine processes such as sediment transport in waterways

Lectures		
Lecturer	**Title of lecture**	**Contact hours**
Prof. Dr. Jann Strybny	Scientific Approach of Complex Problems	48

Serving University: University of Applied Sciences Emden/Leer
Study course: M. Sc. Maritime Operations

Module description: Applied Approach to Tools of Optimization and Simulation

Semester	Frequency of offer	Duration	Type	ECTS-Points	Student Workload
2	SS	1 Sem	obligatory	**6**	(160) 48/112

Preliminaries for attendances	Used for	Conditions to give ECTS Points	Teaching method	Responsible
		Portfolio	lectures, supervision, net discussions, net based resources and work with portfolio elements. Lecturers and students will collaborate and communicate through the Internet-based system for teaching and learning; Moodle	Prof. Dr. Marcus Bentin

Qualification aims

This module aims to introduce students to use quantitive methods and techniques for effective decisions making; model formulation and applications that are used in solving business decision problems.

Knowledge:
The student has advanced knowledge:

- about OR science and its models and methods to apply them
- about the fundamentals of artificial intelligence its background and application possibilities to apply them
- has an understanding of the limits of the different optimization methods to evaluate the results of the methods.
- about probability concept, understand the theory of statistics and can use it on practical problems
- how to interprete optimization results

Skills:
The Student:

- can solve analytic optimization problems using popular tools

- can program the basics of a numerical optimization method
- can use software for optimizing a real world maritime problem

General Qualifications:
The student is able to:

- can analyze and structure a problem to extract the main parameters of a problem and describe the objects for optimization
- can plan, conduct and evaluate the problem in an interdisciplinary framework

Content
Operations research helps in solving problems in different environments that needs decisions. The module covers tradition topics of Operational research (OR) that include: linear programming, Transportation, Assignment. But this is not only limited to business problems, also technical problems have to optimized, for example weight and strength of a construction, resistance of a vessel by variating the shiphull. In these cases heuristic optimisation approach know as artificial intelligence are used. At least but not at last many processes are probilistic hence the optimum has to be found for unsure situation. For all of this a kind of simulation model is needed. These can be analytic ones but often they are a kind of discrete / numerical simulation model. Analytic techniques and computer packages will be used to solve problems facing business managers in decision environments. - Introduction to Operations Research (OR) - Introduction to Foundation mathematics and statistics - Linear Programming (LP), LP and allocation of resources, LP definition, Linearity requirement - Maximization Then Minimization problems. - Graphical LP Minimization solution, Introduction, Simplex method definition, formulating the Simplex model. - Linear Programming ¿ Simplex Method for Maximizing. - Simplex maximizing example for similar limitations, Mixed limitations - Example containing mixed constraints, Minimization example for similar limitations. - Introduction to Genetic Algorithms and Neural Networks - Introduction to simulated aneeling and branch and bound methods - Using an optimisation algorithm on a maritime challenge (Logistic, resistance, strength, ...) - Probability concepts and simulation, Monte Carlo Methods

Lectures		
Lecturer	**Title of lecture**	**Contact hours**
Prof. Dr. Marcus Bentin	Applied Approach to Tools of Optimization and Simulation	48

Serving University: University of Applied Sciences Emden/Leer
Study course: M. Sc. Maritime Operations

Module description: Ship Propulsion Systems

Semester	Frequency of offer	Duration	Type	ECTS-Points	Student Workload
2	SS	1 Sem	obligatory	**6**	(160) 48/112

Preliminaries for attendances	Used for	Conditions to give ECTS Points	Teaching method	Responsible
		Portfolio	lectures; work in groups (layout work, experiments/ measurements)	Prof. Freerk Meyer

Qualification aims

Theoretic and practical knowledge in ship technology.

Knowledge:
The student has advanced knowledge:

- knowledge about ship propulsion systems, fuel consumption, environmental aspects and ship handling to evaluate a ship propulsion system in order to give optimized configuration hints for a vessel.
- knowledge about ship system layout and basic international rules for system layout to apply them in system design
- knowledge about major research methodologies for applied research to analyses propulsions and ship operation systems

Skills:
The Student:

- Able to analyze ship propulsion systems on different types of ships
- Able to layout the different systems on board
- Able to discuss/ work with the different partners in the ship building/ maritime industry

General Qualifications:

The student is able to:

- Able to work in groups, manage report writing, presentation, function in a multi-disciplinary and intercultural team

Content
- Introduction to ship propulsion systems (Layout, Engines, Gears, Bearings, Seals, Shafts, Propeller, Diesel- Electric systems, ...) - Introduction to ship operating systems (Layout, pipework, devices, fittings, ¿) - Introduction to ship engines (2 stroke engines, 4 stroke engines, gas turbines) - Introduction to ship fuels (todays fuels and future fuels) - Different Fuel systems according the fuel (tanks, handling, safety) - Thermodynamics of combustion engines => todays and future fuels - Combustion => todays and future fuels - Propulsion system dynamics, Safety and Availability, installation complexity of the different propulsion systems /propulsion engines - Environmental aspects / efficiency, exhaust gas composition - Calculation and measurement methods for engine power output, fuel consumption, heat exchange, temperatures, pressures, flows, speed, exhaust gas composition,

Lectures		
Lecturer	**Title of lecture**	**Contact hours**
Prof. Freerk Meyer	Ship Propulsion Systems	48

Serving University: University of Applied Sciences Emden/Leer
Study course: M. Sc. Maritime Operations

Module description: Quality and Risk Management

Semester	Frequency of offer	Duration	Type	ECTS-Points	Student Workload
2	SS	1 Sem	obligatory	**6**	(160) 48/112

Preliminaries for attendances	Used for	Conditions to give ECTS Points	Teaching method	Responsible
		Portfolio	lectures, supervision, net discussions, net based resources and work with portfolio elements	Prof. Rudolf Kreutzer

Qualification aims

This module aims to introduce students to use quantitive methods and techniques for effective decisions making; model formulation and applications that are used in solving business decision problems in regard to QMS.

Knowledge:
The student has advanced knowledge:

- about the risk based approach to apply it in maritime operations
- about the principles of risk management (e.g. HAZID, HAZOP, ALARP) to apply it in maritime operations
- to evaluate and differentiate the existing quality management systems (QMS)
- to specify QMS used in the maritime environment (e.g. ISM, TMSA, OVMSA)
- understanding the need for change management

Skills:
The Student:

- can plan the risk management processes of a company in regard to technical safety and safe working operations
- can integrate QMS into existing management structures of a company
- can manage quality management systems purpose-oriented in the maritime environment

- can analyze quality management systems, formulate corrective actions and support the implementation
- can implement an effective change management
- can derive appropriate measures to improve the safety of ship operations
- can conduct incident/accident investigations

General Qualifications:
The student is able to:

- can analyze and structure a problem to extract the main parameters of a problem and describe the objects for optimization
- can plan, conduct and evaluate a problem in an interdisciplinary framework

Content
Shipping is a process that that is linked to operational (e.g. navigational risks), safety (e.g. fire, abandoning ship risks) and environmental (e.g. handling of cargos and bunkers) risks and is taking place in a global competition. Similar problems can be found in varying degrees in all industries (e.g. offshore, aviation, automotive). The student should be able to understand and apply the generic philosophy of the risk based approach and quality management. He is a specialist in maritime processes regarding the operation of a ship, as well as for offshore structures. He can analyze the potential risks to human safety and to the environment and is familiar with the process of safety management and environmental protection. - The term "quality" in the maritime environment - Fundamentals of quality management systems (QMS) - Quality Management Standards (e.g. ISO 9000, ISO 14000, ISO 18000, ISO 50000) - Introduction into "Quality Management Systems" in the maritime environment (ISM, TMSA, OVMSA) - Analysis of the cost / benefit of a QMS - Prerequisites for a successful use of QMS in companies - Strategies for creating, implementing, auditing, improvements (e.g. quality indicators, handling of deviations, Plan-Do-Check-Act cycle) of QMS - Methods to conduct incident/accident investigations (e.g. Bow Tie, STEP, MSACT) - Introduction into the risk management process (Identification, Assessment, Evaluation and control of risks) in the maritime environment - Fundamental aspects of accident prevention and safe working procedures on ships and offshore installations - Management of change

Lectures		
Lecturer	**Title of lecture**	**Contact hours**
Prof. Rudolf Kreutzer	Quality and Risk Management	48

Serving University: University of Applied Sciences Emden/Leer
Study course: M. Sc. Maritime Operations, Profile: Sustainable Maritime Operations

Module description: Economical Aspects of Sustainable Maritime Operations

Semester	Frequency of offer	Duration	Type	ECTS-Points	Student Workload
3rd	WS	1 Sem	Obligatory	6	(160) 48/112

Preliminaries for attendances	Used for	Conditions to give ECTS Points	Teaching method	Responsible
		Portfolio	lectures, group work, supervision, net discussions, net based resources and work with portfolio elements, as well as with project software, simulation systems combined with virtual reality	Prof. Dr. Marcus Bentin

Qualification aims

Knowledge:
The students, depending on the their maritime project:

- deepen the knowledge of management and decision methods to apply them
- show/analyze the managerial view on a maritime problem
- highlight and analyze the relation between environmental and business aspects
- understand project terminology to apply them
- can describe the process of project work from the beginning to finished results
- understands methods for creating goals, planning, execution, and control
- has practical and theoretical knowledge of the various stages about modelling and simulation of different port terminals
- has knowledge about major research methodologies for visualization of new terminals
- has knowledge for integration of ecological aspects in models
- understand the structure and mechanisms of shipbuilding and ship purchase contracts

- assess the legal implications with regard to drafting and negotiating of shipbuilding contracts
- explain the financing instruments in the framework of shipbuilding and ship purchase projects
- contrast various forms of financing in the general context of shipping economics

Skills:
The students depending on the their maritime project:

- use management tools
- analyse and structure maritime problems
- contribute towards developing project ideas / Specify project goals /
- plan projects / follow-up project work /
- organize and lead a project team
- use project software
- can analyze and structure a problem to extract the main parameters of a problem and describe the objects for optimization
- can plan, conduct and evaluate a the problem in an interdisciplinary framework
- understands the discipline's terminology and complexity, and has a critical insight into its methodology
- can apply knowledge and skills from the discipline in an independent manner in the various phases of a project by demonstrating cooperation, responsibility, and introspection
- can classify the respective aspects into the frame work of sustainability
- can estimate the impact of the discussed aspects on the sustainability of the maritime operations

General Qualifications:
The students:

- enlarging their skills in interdisciplinary works
- Identify and communicate the essential points of its scientific work
- enlarging their skills concerning self and time management when processing complex problems
- can evaluate the quality of existing research literature,
- can plan, conduct and evaluate a limited research project

Content

This module prepares the student for the managerial view on maritime project she/he has to prepare in the third semester. It is a substantial part of the project-oriented 3 lectures that fit best to his/her project together with the mentoring professor. The lectures will be fit to the student needs and depends on the projects decided for the third semester. In the following the learning outcome is described as a sum of all possible lectures that can be given. This module covers lectures with a number of different selectable topics listed below:
The course covers central themes concerning the organization and leadership of projects, as well as methods and techniques for analysis and management. The academic knowledge is founded on a basic understanding of what is involved in the management, organization, and leadership of projects. The course provides a uniform introduction to the ABCs of project work. First it focuses on terminology, initialization and management, and the organization and leadership of projects. The module provides the student with a general understanding of what project work is, in order to be able to manage and participate in projects in a rational manner and use project software. Then it covers the early evaluation of the project phases and systematically goes through the steps, from the idea phase through the concept definition/concept development, to the final project design.

Legal aspects of shipbuilding projects:

- Legal framework: standard contracts, applicable law, technical regulations
- Main elements and key issues of a shipbuilding contract
- Contract and claim management
- Liability, insurance and dispute settlement
- Ship repair and conversion contracts; ship sale and purchase contracts

Economic and financial aspects of shipbuilding projects:

- Financing of shipbuilding projects
- Refund and payment guarantees
- Shipyard management
- Controlling of shipbuilding projects
- Shipbuilding markets, business strategies and marketing

Harbor Logistics:
As a result of strong competition between the ports and terminals it is essential to use high sophisticated simulation systems. With the aid of simulation technology it is possible to analyze an existing or planned terminal as a virtual system in detail

Lectures		
Lecturer	**Title of lecture**	**Contact hours**
All lectures	Depends on the maritime project	48

Serving University: University of Applied Sciences Emden/Leer
Study course: M. Sc. Maritime Operations, Profile: Sustainable Maritime Operations

Module description: Maritime Project

Semester	Frequency of offer	Duration	Type	ECTS-Points	Student Workload
3rd	WS	1 Sem	obligatory	12	(320) 96/224

Preliminaries for attendances	Used for	Conditions to give ECTS Points	Teaching method	Responsible
		Term paper attendance of seminar "Sustainable Maritime Operations"	course contains supervision. Students will collaborate and communicate through our Internet-based system for teaching and learning; Moodle	Prof. Dr. Marcus Bentin

Qualification aims

Knowledge:
The students:
- have practical and theoretical knowledge of the topic he/she deepened in the project using scientific approaches
- know the theory and concepts of sustainability to apply them

Skills:
The students:
- can apply scientific methods on a specific task to solve a problem
- can critical evaluate the process of investigation under scientific aspects; correctly interpret
- find results and their own contribution to the solution
- can classify their results into the theory of sustainability

General Qualifications:
The students:
- enlarging their skills concerning self and time management when processing complex problems
- Identify and communicate the essential points of its scientific work

Content

A term paper is the self-written processing of a subject-specific or interdisciplinary task. The student shall work independently on the basic of scientific methods to solve the tasks of a maritime problem. These projects are often integrated in ongoing research projects. The necessary deepened theory for the project is prepared by several lectures and modules which are provided in the third semester. The offered lectures are clustered in three master modules:

- Technical Aspects of Sustainable Maritime Operations
- Operational Aspects of Sustainable Maritime Operations
- Economical Aspects of Sustainable Maritime Operations

This module includes a seminar on sustainability, where the theory of sustainability will be discussed. It is a holistic approach to understand the socio-ecological process of maritime operations characterized by the pursuit of a common ideal. Therefore the ideal has to be defined in a given time and space. However, it will be shown that persistently and dynamically approaching the ideal will be a process resulting in a sustainable system.

- Three pillars of sustainability with environment, social and economic pillars.
- The requirements of UN and IMO on a sustainable maritime industry
- Resiliency of the maritime environment and ocean
- Measurement of sustainability
- Consumption as major driver of human impact on earth
- Impact of human on the Ecosystem
- Sustainable development goals and how the maritime industry can participate
- How to decouple environmental degradation and economic growth in maritime industry
- The social dimension of the maritime industry
- The cultural dimension of the maritime industry

Together with the project mentoring professor the student selects the lectures that fit best to his/her project. Following scopes, covered by research projects, for the projects can be offered:

- Wind propulsion systems (MariGreen & GreenSailer)
    - can comprise the following lectures depending on the agreed topics:
        a) Forces on Vessels (Technical Aspects)
        b) Modeling and Simulation of Fluid Dynamics (Technical Aspects)
        c) Interaction of sailing system and vessel (Technical Aspects)
        d) Physical and mechanical properties of materials for energy sustainability (Technical Aspects)
        e) Operation of wind powered ships (Operational Aspects)
        f) Economic and financial aspects of shipbuilding projects (Economical Aspects)
    - Maritime Project Topics can be:
        - Design a sailing system to an existing shiphull (a, c, e)
        - Optimising a sailing system concerning operational and
        - economical aspects (c, e, f)
        - Design the rig of a sailing system (a, c, d)
        - Calculating saving potentials for the use of windpropulsion systems (a, e, f)
        - Optimizing routes for wind powered ships (a,e, f)
- low carbon and environmental friendly propulsion systems (MariGreen & GreenSailer)
    - can comprise the following lectures depending on the agreed topic:

a) Low Emission Ship Propulsion Systems (Technical Aspects)
b) Forces on Vessels (Technical Aspects)
c) Design of environmental safe Ship Operation Systems (Technical Aspects)
d) Vessel monitoring and optimization (Operational Aspects)
e) Maritime modeling and simulation applications (Operational Aspects)
f) Economic and financial aspects of shipbuilding projects (Economical Aspects)

- Maritime Project Topics can be:
  - Design /Optimize a LNG propulsion system concept for a given vessel (a, b, c)
  - Comparison of different low carbon technologies (a,d,e or f)
  - Operational aspects low emission propulsion system versus standard propulsion systems for a given vessel (a,b,d or e)

- Vessel monitoring and optimization (MariGreen)
  - can comprise the following lectures depending on the agreed topic:
    a) Vessel monitoring and optimization (Operational Aspects)
    b) Forces on Vessels (Technical Aspects)
    c) Economic and financial aspects of shipbuilding projects (Economical Aspects)
  - Maritime Project Topics can be:
    - Analyse the vessel condition of a given ship according ship resistance and potential fuel safings (a, b, c)
- Maritime Environmental Monitoring/Research Shipping (GreenSailer)
  - can comprise the following lectures depending on the agreed topic:
    a) Maritime Environmental Monitoring and Research Shipping (Operational Aspects)
    b) Vessel monitoring and optimization (Operational Aspects)
    c) Maritime modeling and simulation applications (Operational Aspects)
  - Maritime Project Topics can be:
    - micro plastic in the North Sea and its impact on nature (a, b, c)
    - How to identify micro plastic in water and sand samples (a, b, c)
- Green Harbour (MariGreen)
  - can containing the following lectures depending on the agreed topic:
    a) Harbor Logistics (Economical Aspects)
    b) Maritime modeling and simulation applications (Operational Aspects)
    c) Legal aspects of shipbuilding projects (Economical Aspects)
  - Maritime Project Topics can be:
    - Necessity of logistic infrastructure in harbors to enable green shipping (a, b, c)

Lectures		
Lecturer	**Title of lecture**	**Contact hours**
All lectures	supervision	96
Prof. Schlaak	Sustainable Maritime Operations	24

Serving University: University of Applied Sciences Emden/Leer
Study course: M. Sc. Maritime Operations, Profile: Sustainable Maritime Operations

Module description: Operational Aspects of Sustainable Maritime Operations

Semester	Frequency of offer	Duration	Type	ECTS-Points	Student Workload
3rd	WS	1 Sem	Obligatory	6	(160) 48/112

Preliminaries for attendances	Used for	Conditions to give ECTS Points (Prüfungsform/ Prüfungsdauer	Teaching method	Responsible
		Portfolio	lectures, supervision, net discussions, net based resources and work with portfolio elements	Prof. Dr. Marcus Bentin

Qualification aims

Knowledge:
The students, depending on the their maritime project:

- know the parameters in operation that influence the sustainability and can analyze them
- have knowledge about environmental legislation to apply them
- have knowledge of the different simulation technics needed to understand, analyze and train maritime operations. As well as the relations and dependencies between each simulation system.
- have deep knowledge about nautical operations to discuss and evaluate them.
- have knowledge about different maintenance concepts and knows which one should be applied when
- know the parameter to optimize the fleet to analyze the fleet
- know several sensors and methods to retrieve data
- know concept that describe the ship performance like EEDI and EEOI and can apply them
- know concept to manage sustainability like SEEMP to apply them
- have practical and theoretical knowledge about the tools used to measure a broad range of Ocean parameters, e.g. water sampling technology, CTD, Secchi disk, bottom samplers, plankton and micro plastic nets
- have practical and theoretical knowledge about sonar systems and underwater camera systems.
- have practical and theoretical knowledge about the interaction between shipping and aquatic

ecosystems
- have knowledge about the navigational aspects such measurement campaigns
- have knowledge about the different wind propulsion systems and can evaluate them. Their efficiency, pro and cons
- know the main parameters in operating to evaluate the different propulsion systems to maximize their efficiency on sustainability and economic.
- can synthesizing the necessary nautical operations for these systems.

Skills:
The students depending on the their maritime project:
- work with scientific methods
- analyze the problem, build models
- use tools for monitoring and measuring
- can evaluate the results of the simulation model against reality at least roughly
- are able to use at least one of the simulation tools to model a part of the simulation chain
- can document an “How to” of their simulation model and describe its results
- can analyze statistical data and draw the right conclusion
- can use optimization techniques to give advices for the most important parameters for sustainability
- can work out a scientific measurement campaign
- can critical evaluate and analyze the measured parameters according international and national standards.
- can operate the different tools e.g. sonar system, underwater camera, water sampling technology, CTD, Secchi disk, bottom samplers, plankton and micro plastic nets
- can evaluate the efficiency of the different propulsion systems in the frame of service/ ship
- estimate their influence on the safety of the ship.
- can formulate a project structure to realize renewables for ship propulsion
- can classify the respective aspects into the frame work of sustainability
- can estimate the impact of the discussed aspects on the sustainability of the maritime operations

General Qualifications:
The students:
- enlarging their skills in interdisciplinary works
- Identify and communicate the essential points of its scientific work
- enlarging their skills concerning self and time management when processing complex problems
- can evaluate the quality of existing research literature,
- can plan, conduct and evaluate a limited research project

Content
This module prepares the student for the operational view on maritime project she/he has to prepare in the third semester. The lecture will be fit to the student needs and depends on the projects decided for the third semester. In the following the learning outcome is described as a sum of all possible lectures that can be given. The operational aspect can be trained, understand and analyzed by different simulation systems. Therefore this module gives a complete introduction into the chain of computational maritime modeling and simulation techniques in the course of lab exercises:

- Computer Aided Geometric Modeling
- Computational Fluid Dynamics (CFD)
- Ship Handling Simulation, Offshore- and DP-Simulation
- Engine Room Simulation, Liquid Cargo Handling Simulation
- Modeling and Simulation of the sustainable operation of vessels
- Interaction of vessels with other vessels, waterways, harbours, various coastal and offshore structures
- Modeling navigational aspects on the engineering of waterways and port structures
- Investigation of maritime activities influencing the marine environment
- Visualization
- Scientific reporting

The efficiency and sustainability of ships have to be enlarged steadily. Therefore the condition of a vessel as to be determined to know the potential of improvement or to ensure that a safe and environmental operation is obtained. This is a large field of data collection using sensors or manual stored data from all relevant systems of the vessel including the ship hull. All these data have to be interpreted to draw the right conclusion. There are questions like:

- optimal trim
- optimal speed
- optimal maintenance concept for each system
- managing the fleet and its sustainability

Preparation and conduct of expedition cruises:

- Research expedition cruises (e.g. 1 week)
- Operation of sailing research vessels to achieve nearly undisturbed areas of investigation
- Conception of measurement campaigns on research vessels
- Field exercises regarding the measuring of a broad range of ocean parameters:
    - marine weather observation
    - usage of water sampling technology, CTD, Secchi disk, bottom samplers, plankton and micro plastic nets

Operation of sonar imaging systems and underwater camera systems, influencing the results by means of navigational aspects

- Laboratory exercises regarding the interaction between shipping and aquatic ecosystems e.g.:
    - control of the operational reliability of ballastwater treatment technologies with systems proofed by IMO, US-Coastguard
    - effectiveness of environmental friendly anti fouling systems
- Analysis, scientific reporting

Operation of wind powered ships: different technologies, on-board implementation, operation, potentials and limitations:

- Technologies: soft sails, rigid wing sails, Flettner rotors, kites, others
- Implementation: system instability, impact on ship design, new-build and retrofit
- System operation: handling, efficiency, stability, maneuvering characteristics, other safety aspects, hybrid mode
- Economic considerations: analysis of cost structure, savings
- Case studies (from current research projects)

Lectures		
Lecturer	**Title of lecture**	**Contact hours**
All lectures	Depends on the maritime project	48

Serving University: Western Norway University of Applied Sciences
Study course: M. Sc. Maritime Operations, Profile: Offshore and Subsea Operations

Module description: Introduction to sea-keeping

Semester	Frequency of offer	Duration	Type	ECTS-Points	Student Workload
3rd	WS	1 Sem	obligatory	10	(267) 80/187

Preliminaries for attendances	Used for	Conditions to give ECTS Points	Teaching method	Responsible
		A number of compulsory written assignments must be approved, Oral Exam	Lectures, calculation exercises, laboratory exercises, project work and guest lecture	Prof. Egil Pedersen

Qualification aims

Knowledge:
The students have advanced knowledge:

- about principles of marine operations in the oceans space with emphasis on how the environment affects the operations.
- on analyzing the key environmental factors affecting the performance of marine operations in the ocean space.
- on hydrodynamics as a theoretical basis to evaluate operations in the surface zone.
- on principles in determining the operational window based on weather conditions.
- in weather-routing systems to evaluate its applications, possibilities and limitations.
- on an overview of the principles and operational challenges of station-keeping.
- how marine operations can be modelled and simulated.

Skills:
The students are able to:

- use appropriate SW tools to perform static and dynamic analysis of marine operations.
- understand limitations in modelling and simulation of marine operations.
- propose and evaluate solutions for planning of effective operations.

General Qualifications:
The students:

- Is able to work in project teams of marine operations, including international and interdisciplinary project teams.

- Has the foundation to acquire new and more advanced knowledge related to work tasks and operations within the maritime field.
- Is able to contribute in discussions regarding relevant marine operations

Content

Introduction
- The ocean environment
- Operational challenges in the ocean space and surface border
- Engineering tools with emphasis on Orcaflex

Advanced marine hydrodynamics
- Kinematics and dynamics of ocean waves
- Natural frequencies, frequency encounter, resonance
- Wave-induced loads and motions
- Strip theory
- Green's theorems
- Haskind relation of existing forces
- Response Ampliture Operators (RAOs)
- Minimization of vessel motions

Environmental criteria
- Weather window
- Uncertainties in weather forecasting
- Weather-routing systems

Station-keeping
- Principle of Dynamic Positioning
- Catenary and mooring analysis

Modelling and simulation of case studies
- Marine seismic operations
- Cable operations
- Anchor handling
- Bow loading
- ROV/UAV operations

Lectures

Lecturer	Title of lecture	Contact hours
Prof. Egil Pedersen	Introduction to sea-keeping	80

Serving University: University of Applied Sciences Emden/Leer
Study course: M. Sc. Maritime Operations, Profile: Sustainable Maritime Operations

Module description: Technical Aspects of Sustainable Maritime Operations

Semester	Frequency of offer	Duration	Type	ECTS-Points	Student Workload
3rd	WS	1 Sem	Obligatory	6	(160) 48/112

Preliminaries for attendances	Used for	Conditions to give ECTS Points	Teaching method	Responsible
		Portfolio	lectures, supervision, and work in groups (layout work, experiments / measurements in the ship propulsion and operation labor), net discussions, net based resources and work with portfolio elements	Prof. Dr. Marcus Bentin

Qualification aims

Knowledge:
The student, depending on the his maritime project:

- analyzing the forces acting on a ship
- know new materials and their properties
- understanding a design brief
- analyzes the main parameters of the forces in ship operation that influence the sustainability
- stating the effects of the forces on the ship design.
- understands methods of potential flow to apply them.
- advanced understanding of the conceptual design of models in the field of engineering sciences. Special emphasis is on identifying the significant physical processes and the choice of the most efficient modelling type
- has knowledge about the basic understanding of the relationships between microstructure and mechanical behavior of light metals, as well as its damping behavior,

- has knowledge evaluating the methods for influencing and determining material properties,
- has an insight into the methodology of selection of materials
- has knowledge evaluating the methods for influencing and determining material damping,
- has an insight into the performance of damping measurements
- knowledge to analyze ship propulsion systems, fuel consumption, environmental aspects and ship handling
- knowledge to evaluate modern ship system layout and basic international rules for system layout

Skills:
The students depending on the their maritime project:

- working with engineering methods
- design parts of a vessel respecting the environment
- analyze, measuring and structure maritime problems
- can calculate forces according thump rules and classification society
- can use different programs to calculate resistance and maneuvering forces
- can discuss the interaction of numerical simulations with field measurements and laboratory
- measurements including the theory of similarity
- modelling and simulation of fluid dynamics in small scales and close to structures
- can calculate the stress in the rig and foundation
- can design the sails for the required ship speed
- can estimate the maneuverability and design a rudder good for sailing operation
- can work on materials science problem areas,
- can show the advantages and disadvantages of light metals compared to other common metals,
- can understand and discuss material models
- can work in the area of vibration problems,
- can distinguish between high and low damping materials,
- can understand and discuss models of material damping
- able to analysis ship propulsion systems on different types of ships
- able to layout the different systems on board (according todays and future rules for environmental safe ship design)
- able to work in groups, manage report writing, presentation, function in a multi-disciplinary and intercultural team
- can classify the respective aspects into the frame work of sustainability
- can estimate the impact of the discussed aspects on the sustainability of the maritime operations

General Qualifications:
The students:

- enlarging their skills in interdisciplinary works
- Identify and communicate the essential points of its scientific work
- enlarging their skills concerning self and time management when processing complex problems
- can evaluate the quality of existing research literature,
- can plan, conduct and evaluate a limited research project

Content
This module prepares the student for the technical view on maritime project she/he has to prepare in the third semester. The lecture will be fit to the student needs and depends on the projects decided for the

third semester. In the following the learning outcome is described as a sum of all possible lectures that can be given.

To understand the potential of sustainable operations the forces acting on a vessel have to be understood. There are on the one hand forces due to load and bouncy a ship has to be designed for. On the other hand there are also forces due to wind and waves that influences the steel structure for safe shipping. The vessel is moving true the water therefore it needs power to overcome the resistance. At last but not at least it needs power for maneuvering to overcome the hydrodynamic forces in that case. All these forces have to be understood and calculated. For some forces formulas in rules from classification societies can be found or some thump rules for estimation exists. But all these forces can also be calculated by numerical methods. Some can be verified by measuring at models to get force coefficients that can be used for the real case. The module will discuss the following forces:

- Bending moments and shear forces due to load
- Forces due to wind and waves, seakeeping of vessel
- Dynamic loads and frequencies
- Maneuvering forces
- Resistance
- Understanding of advanced fluid dynamics including three-dimensional, transient and compressible processes.
- Identifying the significant physical processes, defining the dimensionality and relevant scales in time and space.
- Theory of similarity, range of dimensionless numbers

Potential Theory

- Numerical Algorithms and possibilities of independent coding of simplest mathematical models
- Limitations of numerical models, risk of empirical approaches included in numerical models
- Introduction of a complete chain of Open-Source-CFD-Tools, considering preprocessing, processing and postprocessing tools
- Need and availability of appropriate measurement techniques for the steering, calibration and verification of models
- Use of contactless high-resolving measuring techniques in the fluid dynamics
- Limits of accuracy of different modelling and simulation concepts

To design a sailing system the overall concept has to be considered. Hence the sailing capacities of the ship hull in respect of stability and maneuverability is important. The maneuverability is influenced by the sails as well as from the ship hull and rudder. On the other side stress calculations for the rig and its foundations are necessary. In order to calculate the stress, the forces has to be known. But these depend also on the ship hull and the requirements given from the planned ship operations and scenarios. The required ship speed influences directly the size of the sailing systems and therefore the forces.

- Calculating stress using classical and Finite Element methods
- layout of sailing system and choosing the material
- estimating the maneuverability and sailing ability of ship hull
- calculating ship stability under sailing condition

Layout of Low Emission Ship Propulsion Systems

- Basic Understanding of the different Ship Propulsion Systems (Combustion Engines, Gas Turbines, Electric Systems (e.g. Fuel Cells), Sailing Systems e.g. Flettner Rotors, Modern Sailing Arrangements, …)
- Basic Understanding: Power Supply / Power Need of different ship types and ship size
- Combustion Engines

    - Different Ship Fuels (Comparison: “classic” and “new” fuels according: tanks, handling, efficiency, safety, ….)
    - New fuels: Environmental aspects, efficiency, availability, costs, exhaust gas composition, ….
    - New technologies to reduce environmental impact of ship propulsion systems (e.g. exhaust gas cleaning systems, systems to increase the propulsion efficiency…)
- Sailing Systems
    - Modern Technologies to use Wind and Sun for Ship Propulsion

Design of environmental safe Ship Operation Systems

- Basic Understanding of the different Ship Operation Systems (Cooling Systems, Ballast
- Water Systems, Drinking Water Systems, Waste Water Systems, Bilge Systems,….)
- New Technologies to reduce environmental Impact of Ship Operation Systems (Energy consumption, chemical waste water, …)

The fundamentals for understanding of light metals will be placed. Knowledge of metal physics and material science of this group of materials is necessary to carry out a targeted material substitution. The skills acquired can be exploited for various areas of transport in which among other things it comes to energy savings. Material damping is the ability of a material to absorb vibrational energy. On the one hand material damping has a high importance in industrial applications, on the other hand its value act as an analytical tool in modern science because it is used to study diffusion, solubility, plastic deformation, alloy segregation, and a number of other physical and mechanical phenomena associated with material behavior. The fundamentals for understanding the microstructural mechanisms for the material damping are taught.

Lectures		
Lecturer	**Title of lecture**	**Contact hours**
All lectures	Depends on the maritime project	48

Serving University: University of Applied Sciences Emden/Leer & Western Norway University of Applied Sciences
Study course: M. Sc. Maritime Operations

Module description: Economical Aspects of Sustainable Maritime Operations

Semester	Frequency of offer	Duration	Type	ECTS-Points	Student Workload
4th	SS	1 Sem	Obligatory	30	(800) 10/790

Preliminaries for attendances	Used for	Conditions to give ECTS Points	Teaching method	Responsible
		Thesis and presentation	supervision	Prof. Dr. Marcus Bentin

Qualification aims

Knowledge:
The students:

- have knowledge to evaluate key directions within scientific theory
- have knowledge to evaluate key research methods within maritime research
- have insight into what scientific knowledge is and how this is developed
- have practical and theoretical knowledge of the phases of a research project to apply them
- have knowledge of applicable norms for research ethics to apply them

Skills:
The students:

- are able to develop a research design and do theoretical and/or empirical analyses on own or existing material
- can analyze and critically assess different sources of information
- can reflect on research ethics and related issues
- can formulate research questions and relate these to different methods
- are able to use software for analysis of qualitative and quantitative data
- can carry out an independent, limited research project under supervision and in accordance with applicable norms for research ethics

General Qualifications:
The students:
can reflect on and critically assess own and other people's work
can communicate extensive independent work and masters language and terminology of both the academic and maritime field
can analyze problems related to the profession, academia and research ethics
can discuss own and other's work with both specialists and the general public
are able to evaluate the quality of existing research literature
can use the knowledge and skills achieved through the work on the master's thesis on future research projects

Content
The master's thesis is an independent, empirical and scientific work in which the student documents insight into research and development work, relevant theory and methods relevant for the problem examined in the thesis. Based on the students profile choice the subject will provide the student with the ability to deepen their knowledge about a specific topic within the maritime field. Through the independent work the students shall develop their analytical abilities and achieve a deeper understanding of theoretical and/or empirical possibilities and challenges within the chosen field of study The work on the master's thesis is to be carried out in accordance with ethical guidelines for research and rules and regulations at the partner institutions. In total, the master's thesis will document understanding, reflection and maturity. The master's thesis will include: - academic and scientific theory positioning of the problem area and issue - justification of the theory and method selection - implementation of a research project in the chosen practice field - presentation, analysis and discussion of results

Lectures		
Lecturer	**Title of lecture**	**Contact hours**
All lecturers	Supervision	10