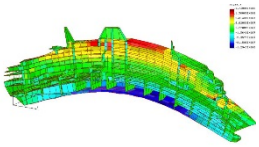
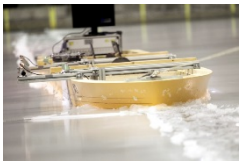
Marine Technology

Marine Technology education package gives an in-depth understanding of the maritime engineering. Teaching provides principles for construction and design, including hydrodynamics, loads, structural analyses, stability, safety of marine traffic and winter navigation. Teaching is carried out by assignments, project work, lectures, and workshops. Theory within this education package is supported by experimental work, and computer simulations are used to convey concepts. Student can select, for instance, the following study paths:

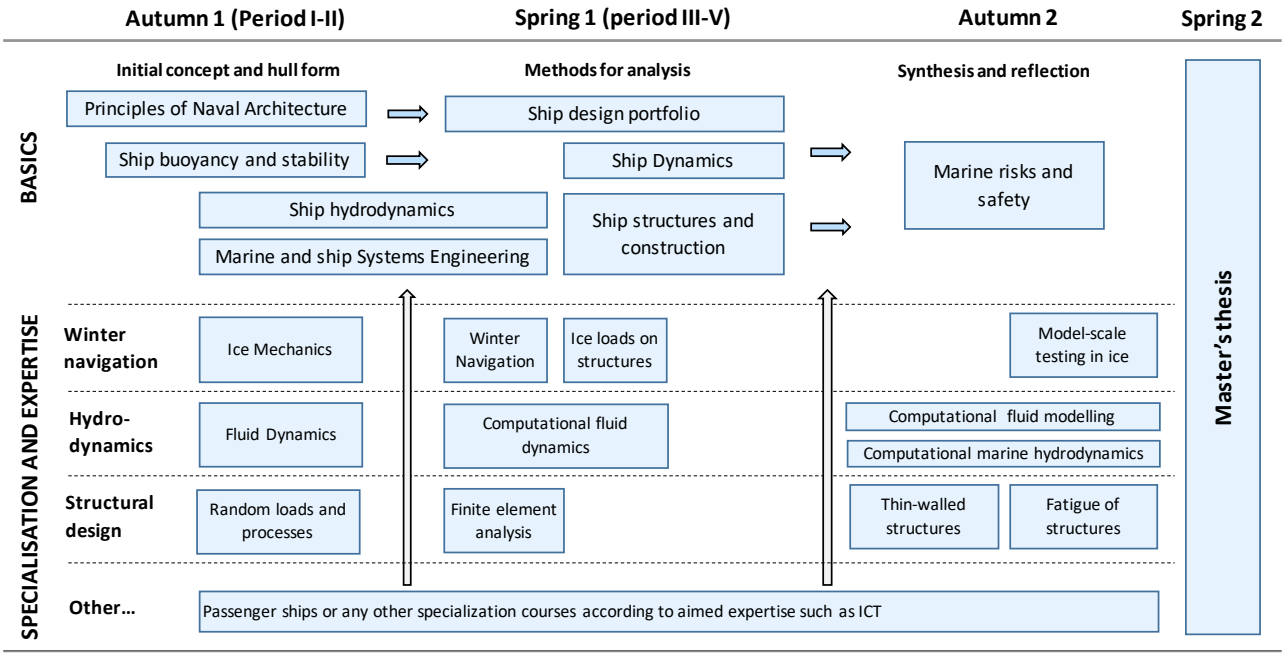
- **Naval Architecture**
- **Arctic Marine Technology**
- **Ship Project Engineer**
- **Structural Expert**
- **Hydrodynamic Expert**
- **Smart Maritime Operations**





The selected study path can be modified and focused based on student interest by specialisation courses from other education packages and Master programme. For instance, the courses form other Aalto schools extends the engineering studies to design and business. **Marine Technology minor** provides good basic knowledge of the maritime engineering for students from other Master's Programmes at Aalto and FITech Universities, e.g. a student with major on ICT and digitalisation fields.

The education package provides students capability to perform design and research in marine industry. The majority of graduates work in design and research positions in shipyards, research institutes, design offices, shipping companies and regulatory institutions.



Common studies and other supportive courses are selected based on the study path and student's interest

Study path: Naval Architecture

Profile

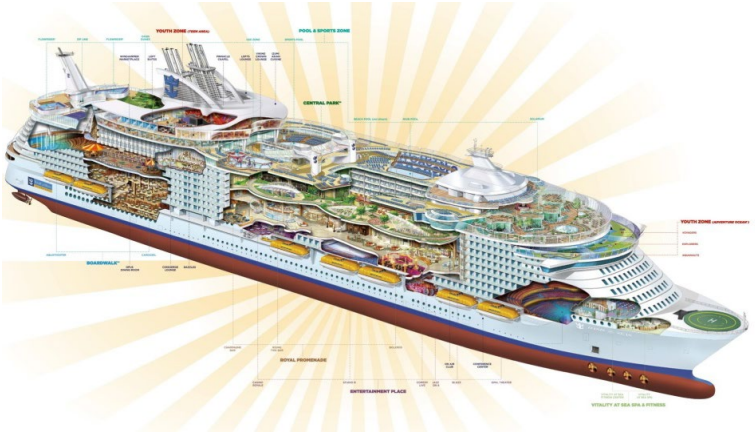
Naval architect understands the ship as a system and the relation between different disciplines. Basic knowledge in fluid mechanics is essential to design the outer shape of the ship, which needs least amount of energy to be transported and is comfortable for the passengers. Ships can operate in ice-covered seas thus certain knowledge of ice mechanics is necessary. Main areas of ship design are covered: buoyancy and stability, dynamics, structure, systems, and risk assessment. Ship concept design is developed in one course and improved in the other with justification for the courses chosen and final expert profile.

Studies

List of suitable courses for this study path is shown on the right, with recommended (RE) and optional (O) courses. All courses are 5 ECTS.

Work environment

Shipyard and design office, where innovative ship designs are created. Alumni example is a person, who is behind ground-breaking concepts (e.g., “Oasis of the Seas” - the biggest cruise ship in the world) and out-of-the-box approaches to ship systems.



Courses

Common studies	
MEC-E1004 Principles of Naval Architecture [1]	RE
MEC-E1010 Dynamics of rigid body [1]	RE
MEC-E1020 Fluid dynamics [1]	RE
MEC-E1030 Random loads and processes	O
MEC-E1040 Dynamics of structures	O
MEC-E1050 Finite element method in solids	O
MEC-E1080 Production engineering	O
MEC-E1070 Selection of engineering materials	O
Marine Technology	
MEC-E2000 Marine and Ship Systems Engineering [1]	RE
MEC-E2001 Ship hydrodynamics [1]	RE
MEC-E2002 Ship buoyancy and stability [1]	RE
MEC-E2004 Ship dynamics	RE
MEC-E2007 Ship structures and construction	RE
MEC-E2009 Marine risks and safety	RE
MEC-E2011 Ship design portfolio	RE
MEC-E2003 Passenger ships	O
MEC-E2010 Computational fluid modelling	O
MEC-E2012 Computational marine hydrodynamics	O
Arctic	
MEC-E4001 Winter navigation	RE
MEC-E4004 Model scale testing in ice	O
Solid Mechanics	
MEC-E8001 Finite element analysis	O
MEC-E8005 Thin-walled structures	O

[1] Recommended to participate in the first-year autumn

Study path: Arctic Marine Technology

Profile

In Arctic marine technology the key competence is to understand the cold environment and its effects on the ship design, hull shape, power requirements, navigation in ice and safety of ships. This requires basic knowledge on ship design, risk analysis, solid and fluid mechanics and especially understanding of the characteristics of ice as a special material. Aalto ice tank will be utilised in the teaching as one course will concentrate on model scale testing in ice. In addition, a few-day excursion to the icebreaker operating in the northern Baltic Sea is organised every winter as part of the winter navigation course.

Studies

List of suitable courses for this study path is shown on the right, with recommended (RE) and optional (O) courses. All courses are 5 ECTS.

Work environment

Shipyard, design and consulting offices, ship owners operating in ice, offshore companies where innovative arctic ship designs and operational plans for ice environment are created. Alumni example is s person, who works in an oil company and has e.g. active role in the recent large LNG projects in the Russian Arctic.

Courses

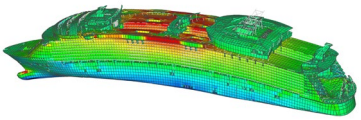
Common studies	
MEC-E1004 Principles of Naval Architecture [1]	RE
MEC-E1010 Dynamics of rigid body [1]	RE
MEC-E1030 Random loads and processes [1]	RE
MEC-E1040 Dynamics of structures	RE
MEC-E1020 Fluid dynamics	O
MEC-E1050 Finite element method in solids	O
MEC-E1070 Selection of engineering materials	O
Marine Technology	
MEC-E2000 Marine and Ship Systems Engineering [1]	RE
MEC-E2001 Ship hydrodynamics [1]	RE
MEC-E2002 Ship buoyancy and stability [1]	RE
MEC-E2004 Ship dynamics	RE
MEC-E2007 Ship structures and construction	RE
MEC-E2009 Marine risks and safety	RE
MEC-E2011 Ship design portfolio	RE
Arctic	
MEC-E4001 Winter navigation	RE
MEC-E4002 Ice loads on structures	RE
MEC-E4003 Ice mechanics [1]	RE
MEC-E4004 Model scale testing in ice	RE
Solid Mechanics	
MEC-E8001 Finite element analysis	O
MEC-E8003 Beam, Plate and Shell Models	O
MEC-E8005 Thin-walled structures	O
MEC-E8006 Fatigue of structures	O
MEC-E8007 Fracture mechanics	O

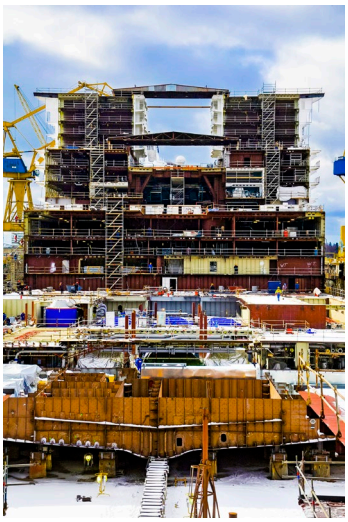
[1] Recommended to participate in the first-year autumn

Study path: Project Engineer

Profile

The project engineer must understand the interlinked design and production processes and manage the economical, production and technological risks associated with large one-off prototype projects. It is essential to understand manufacturing methods and quality management methods as well as the role of material selection. Holistic project-based thinking and basic knowledge on ship technology is needed to create the future product in competitive fashion.





Studies

List of suitable courses for this study path is shown on the right, with recommended (RE) and optional (O) courses. All courses are 5 ECTS.

Work environment

Shipyard and equipment suppliers where innovative ship designs are created and building processes managed. Alumni example is a person who is behind managing the building of ground-breaking prototype projects (e.g., "Oasis of the Seas" - the biggest cruise ship in the world) utilizing large supplier networks and extremely tight schedules.

Courses

Common studies	
MEC-E1004 Principles of Naval Architecture [1]	RE
MEC-E1070 Selection of engineering materials [1]	RE
MEC-E1080 Production engineering [1]	RE
MEC-E1090 Quality management and metrology [1]	RE
MEC-E1010 Dynamics of rigid body	O
MEC-E1020 Fluid dynamics	O
MEC-E1030 Random loads and processes	O
MEC-E1040 Dynamics of structures	O
MEC-E1060 Machine design	O
MEC-E1050 Finite element method in solids	O
MEC-E1070 Selection of engineering materials	O
Marine Technology	
MEC-E2000 Marine and Ship Systems Engineering [1]	RE
MEC-E2001 Ship hydrodynamics [1]	RE
MEC-E2002 Ship buoyancy and stability [1]	RE
MEC-E2003 Passenger ships	RE
MEC-E2004 Ship dynamics	RE
MEC-E2007 Ship structures and construction	RE
MEC-E2009 Marine risks and safety	RE
MEC-E2011 Ship design portfolio	RE
Engineering Materials	
MEC-E6001 Engineering Metals and Alloys	O
MEC-E6002 Welding Technology and Design	O
MEC-E6004 Non-destructive testing	O
Production Engineering	
MEC-E7001 Production Systems Modelling	RE
MEC-E7002 Manufacturing methods I	RE
MEC-E7003 Manufacturing methods II	O
MEC-E7004 Industrial Project	O
MEC-E7006 Advanced manufacturing	O

[1] Recommended to participate in the first-year autumn

Study path: Structural Expert

Profile

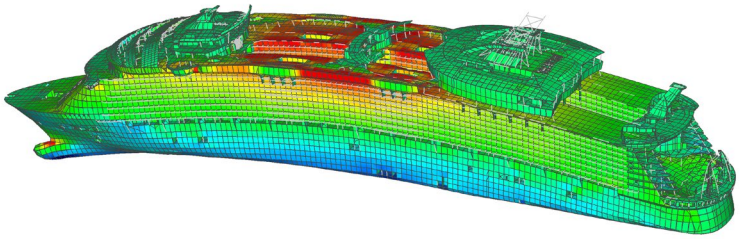
Structural designer needs to understand structural design as part of overall design process and especially the random loads and the response and strength obtained. Rarely strength itself is selling argument for the ship, but it must be guaranteed and built in the way that ship is aesthetic yet strong and lightweight. Numerical methods for loads and strength assessment are essential tools, thus solid basis on mechanics is needed. Decision making, ship architecture and design and risk assessment are extensions to the professional profile that guarantee competitiveness in the markets.

Studies

List of suitable courses for this study path is shown on the right, with recommended (RE) and optional (O) ECTS.

Work environment

Shipyard, design offices and authorities where innovative ship designs are created, built and structural safety managed. Alumni example is a person who is behind managing the classification of architecturally extremely challenging structural concepts that have very high comfort and safety levels.



Courses

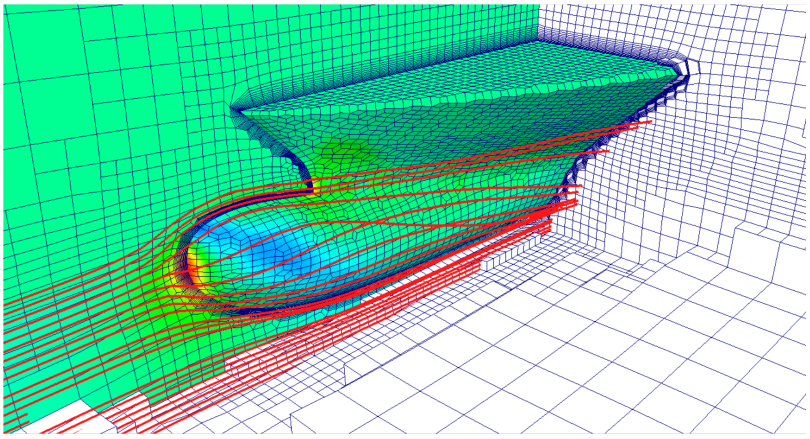
Common studies	
MEC-E1004 Principles of Naval Architecture [1]	RE
MEC-E1010 Dynamics of rigid body [1]	RE
MEC-E1030 Random loads and processes [1]	RE
MEC-E1040 Dynamics of structures	RE
MEC-E1050 Finite element method in solids [1]	RE
MEC-E1070 Selection of engineering materials	RE
MEC-E1020 Fluid dynamics	O
Marine Technology	
MEC-E2000 Marine and Ship Systems Engineering [1]	RE
MEC-E2001 Ship hydrodynamics [1]	RE
MEC-E2002 Ship buoyancy and stability [1]	RE
MEC-E2004 Ship dynamics	RE
MEC-E2007 Ship structures and construction	RE
MEC-E2009 Marine risks and safety	RE
MEC-E2011 Ship design portfolio	RE
MEC-E2003 Passenger ships	O
MEC-E2012 Computational marine hydrodynamics	O
Arctic	
MEC-E4001 Winter navigation	O
MEC-E4002 Ice loads on structures	O
MEC-E4003 Ice mechanics	O
Solid Mechanics	
MEC-E8001 Finite element analysis	RE
MEC-E8005 Thin-walled structures	RE
MEC-E8006 Fatigue of structures	RE
MEC-E8003 Beam, Plate and Shell Models	O
MEC-E8007 Fracture mechanics	O
Engineering Materials	
MEC-E6002 Welding Technology and Design	O

[1] Recommended to participate in the first-year autumn

Study path: Hydrodynamic Expert

Profile

An expert on hydrodynamics needs to understand the basic phenomena in fluid mechanics, the hydrodynamic design as part of the overall design process and the hydrodynamic performance as a whole covering the various aspects of ship hydrodynamics. Relevant field specific topics include static and dynamic stability, calm water resistance, propulsion, hydrodynamic loads and wave induced motions. The increasing role of computational fluid dynamics (CFD) in the design and analysis of ship flows means that an expert on hydrodynamics should have a solid understanding of the relevant computational methods.



Studies

List of suitable courses for this study path is shown on the right, with recommended (RE) and optional (O) courses. All courses are 5 ECTS.

Work environment

Shipyards, propulsion equipment suppliers, ship design offices, consultancies, testing facilities and research institutes focusing on power requirements, motions, and loads. Alumni example is a person working on the design of the state-of-the-art ship forms using the latest tools and technologies for minimum propulsion power and vibration levels.

Courses

Common studies	
MEC-E1004 Principles of Naval Architecture [1]	RE
MEC-E1010 Dynamics of rigid body [1]	RE
MEC-E1030 Random loads and processes [1]	RE
MEC-E1020 Fluid dynamics [1]	RE
MEC-E1040 Dynamics of structures	O
MEC-E1050 Finite element method in solids	O
Marine Technology	
MEC-E2000 Marine and Ship Systems Engineering [1]	RE
MEC-E2001 Ship hydrodynamics [1]	RE
MEC-E2002 Ship buoyancy and stability [1]	RE
MEC-E2004 Ship dynamics	RE
MEC-E2007 Ship structures and construction	RE
MEC-E2009 Marine risks and safety	RE
MEC-E2010 Computational fluid modelling	RE
MEC-E2011 Ship design portfolio	RE
MEC-E2012 Computational marine hydrodynamics	RE
EEN-E2001 Computational fluid dynamics	RE
MEC-E2003 Passenger ships	O
Arctic	
MEC-E4001 Winter navigation	O
MEC-E4003 Ice mechanics	O
MEC-E4004 Model scale testing in ice	O

[1] Recommended to participate in the first-year autumn

Study path: Smart Maritime Operations

Profile

Digitalisation has a growing impact on the marine industry with increasingly automated ship on-board control, navigation, and communication systems as well as big data and optimization driven decision-making in operations.
The trend is from on-board monitoring, automation & control to wider utilisation, optimisation and connectivity of data including remote support and ultimately control and autonomy. This requires sound understanding of principles of naval architecture and related physics combined with a basic understanding of ICT to fully utilise novel solutions in the maritime business.

Studies

List of suitable courses for this study path is shown on the right, with recommended (RE) and optional (O) courses. All courses are 5 ECTS.

Work environment

Ship design companies, shipyards, component & technology suppliers, application developers, ship-owners or authorities developing ICT solutions for e.g. design tools, lifecycle modelling, concept optimisation, systems integration, data analytics, operations management and optimisation, sensors, health monitoring, safety management, novel user interfaces and user applications, e-navigation and autonomous operations.

Courses

Common studies	
MEC-E1004 Principles of Naval Architecture [1]	RE
Marine Technology	
MEC-E2000 Marine and Ship Systems Engineering [1]	RE
MEC-E2001 Ship hydrodynamics [1]	RE
MEC-E2002 Ship buoyancy and stability [1]	RE
MEC-E2004 Ship dynamics	RE
MEC-E2007 Ship structures and construction	RE
MEC-E2009 Marine risks and safety	RE
MEC-E2011 Ship design portfolio	RE
MEC-E2003 Passenger ships	O
MEC-E2012 Computational marine hydrodynamics	O
Computer Science	
CS-C3120 Human-Computer Interaction	RE
CS-C3130 Information Security	O
CS-C3150 Software Engineering	RE
CS-C3160 Data Science	RE
CS-E3210 Machine Learning: Basic Principles	RE
CS-E4800 Artificial Intelligence	O
CS-E4900 User-Cent. Meth. for Product and Service	O
CS-E4930 Software Processes and Projects	O
CS-E4940 Requirements Engineering	O
CS-E4950 Software Architectures	O
CS-E4960 Software Testing and Quality Assurance	O
CS-E5220 User Interface Construction	O
CS-E5310 ICT Enabled Service Business and	O
CS-E5340 Introduction to Industrial Internet	O
CS-E5360 Systems of Systems	RE
CS-E5795 Computational Methods in Stochastics	O

[1] Recommended to participate in the first-year autumn