Programme syllabus

Master's Programme, Naval Architecture, 120 credits
Masterprogram, marina system
120.0 credits

Valid for students admitted to the education from autumn 10 (HT - Autumn term; VT - Spring term).

This is a translation of the Swedish, legally binding, programme syllabus.

Programme objectives

The main objective of this program is to educate skilled engineers for industry and research institutions. The subject is multi-disciplinary with strong emphasis on systems engineering. A naval architect needs knowledge about the complete processes of design, implementation and operation of marine vessels which can be very large and complex systems, as well as deep understanding in subjects such as structural and fluid mechanics and related applications. The program further enables specialization within the different profile areas *Lightweight Structures*, *Fluid Mechanics*, *Sound & Vibration*, *Management*, and *Sustainable Development*. The subject hence is attractive also for students who are not devoted to work in the maritime sector and relevant for careers also in other fields.

Knowledge and understanding

A Master of Science in Naval Architecture will:

- have the knowledge and understanding of the topic enough to be employable as a Naval Architect and in other fields of engineering in Sweden and internationally,
- possess a systems perspective on engineering,
- have confidence in hers/his base of engineering fundamentals,
- be aware of the general professional conditions in the industry,
- be familiar with the needs and conditions for sustainable development.

Skills and abilities

A Master of Science in Naval Architecture will:

- have the ability to independently and creatively formulate and critically and systematically handle and analyze complex problems and situations, using relevant modern methods and tools,
- have the ability to *Conceive*, *Design*, *Implement* and *Operate* boats, ships and complex value-added naval systems in modern team-based environments,

- have the ability to, both orally and in writing, communicate and discuss conclusions and the underlying theory and argumentation,
- have good individual and group interactions abilities, such as, teamwork, leadership, and communication skills,
- be able to follow and participate in research and development work in the field of naval architecture.

Ability to make judgements and adopt a standpoint

A Master of Science in Naval Architecture will:

- have the ability to in the field of naval architecture make decisions regarding research and development work based on relevant scientific, societal and ethical aspects,
- show insight regarding the possibilities and limitations of engineering science and its role in the society,
- have ability to identify the need for further knowledge in the field and take responsibility for keeping their personal knowledge up to date.

Complete information on the degree requirements can found at the local degree policy of KTH, see http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/examina/1.27227

Extent and content of the programme

Naval Architecture at KTH is a two-year (120 university credits) master program on the advanced level (second cycle) starting every year in late August. The instruction language is English. The program contains a naval architecture specific core, referred to as the *Major*, which covers the international understanding of the theoretical contents of a master program in naval architecture. In addition to the Major each student also choose one out of five different profile areas – *Lightweight Structures*, *Fluid Mechanics*, *Sound & Vibration*, *Management*, and *Sustainable Development*. There are also a large set of elective courses, which enables complementation or further specialization in naval architecture theory and application and in the profile areas or generalization and broadening of the education depending on the preferences of the individual student.

Eligibility and selection

Basic eligibility requirements

A completed Bachelor's degree, equivalent to a Swedish Bachelor's degree (180 university credits), from a university recognized by government or accredited by other recognized organization. A good knowledge of written and spoken English. Applicants must provide proof of their proficiency in English.

Specific eligibility requirements

A completed Bachelor's degree in vehicle engineering, mechanical engineering or similar is required.

Selection process

The selection process is based on a total evaluation of the following criteria: University, Grade Point Average (GPA), and motivation letter. Courses on relevant topics such as fluid mechanics, structure

mechanics, complex analysis, partial differential equations, and control theory are considered an additional qualification, Complete information on the eligibility requirements can be found at the local admission policy of KTH, see http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/antagning/1.27186

Implementation of the education

Structure of the education

The academic year at KTH is divided into four periods. Each period lasts approximately seven weeks with at least 33 days of study. Each period is followed by an exam period. In addition to the four regular exam periods, there are three additional re-examination periods: after Christmas, after May and immediately proceeding the first study period of the academic year. The academic year has a duration of 40 weeks. Teaching activities may, if necessary, be scheduled outside the academic year. The first three quarters of the program (90 university credits) is course based, while the last half year (30 university credits) is devoted to the degree project.

Courses

The programme is course-based. Lists of courses are included in appendix 1.

Of the course based part of the program (the first 90 university credits), the *Major* which corresponds to approximately 40 university credits and the chosen *profile* which corresponds to approximately 20 university credits are mandatory. Courses should also be selected from the pool of *conditionally selective* courses to reach a total of 75 credits. This leaves 15 credits for totally free courses. A comprehensive list of the courses in the *Major*, the *profiles* and the *conditionally selective* courses is included in Appendix 1.

Grading system

Courses in the first and the second cycle are graded on a scale from A to F. A-E are passing grades, A is the highest grade. The grades pass (P) and fail (F) are used for courses under certain circumstances.

Conditions for participation in the programme

No later than November 15 and May 15 each academic year, respectively, the students are required to make a study registration and course selection for the coming term. At least 45 university credits have to be completed during the first academic year (including the re-examination period in August) in order for the student to be promoted to the second year of the program. New students have to make a decision about their *Profile* in the very beginning of the program.

Recognition of previous academic studies

Under certain circumstances, and in agreement with the program director, credits for previous studies can be received according to the local policy of KTH, see http://intra.kth.se/regelverk/utbildning-forskning /grundutbildning/prestationer/1.27200

Degree project

Students admitted to the program are required to perform an independent study in the form of a thesis project corresponding to 30 university credits. To begin the thesis project, a student must have completed at least 60 university credits of the total course work including at least two of the three compulsory courses in the chosen profile. The purpose of the thesis project is that the student should demonstrate the ability to perform independent project work, using and developing the knowledge and skills obtained from the courses in the program. The thesis project can either be performed at a university or, more commonly, at a company in the naval architecture sector or in the sector of the chosen profile with suitable infrastructure to provide sufficient supervision and resources for the project. The student must actively search for a suitable thesis project in industry; however KTH will provide some assistance with information on suitable points of contact. Exchange students are recommended to find a thesis project in their country of permanent residence or in the country where they intend to start their professional careers. More information on the KTH policy on the degree project can be found at http://intra.kth.se/regelverk /utbildning-forskning/grundutbildning/examensarbete/1.27212

Degree

Students who fulfill all the requirements will be awarded a Degree of Master of Science (two years). Students must apply for the degree and also show proof of their basic degree (Bachelor's or similar). Complete information on the degree requirements can be found in the local degree policy of KTH, see http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/examina/1.27227

Appendix 1 - Course list
Appendix 2 - Programme syllabus descriptions

Appendix 1: Course list

Master's Programme, Naval Architecture, 120 credits (TMRSM), Programme syllabus for studies starting in autumn 2010

General courses

Year 1

Mandatory courses (27.0 Credits)

Course code	Course name	Credits	Edu. level
SD2411	Lightweight Structures and FEM	8.0 hp	Second cycle
SD2707	Marine Innovation	5.0 hp	Second cycle
SD2708	Hull Structural Design	6.0 hp	Second cycle
SD2710	Initial Ship Design For students who has not done Degree project, first level, in Naval Architecture	8.0 hp	Second cycle

Optional courses

Course code	Course name	Credits	Edu. level
SD2702	Naval Design 10 cr are studied during the second term and 10 cr during the third term.	20.0 hp	Second cycle
SD2706	Sailing for Performance	6.0 hp	Second cycle

Conditionally elective courses

Course code	Course name	Credits	Edu. level
EH2010	Management of Technology	7.5 hp	Second cycle
FSD3705	High-speed Craft Structural Design	6.0 hp	Third cycle
ME1000	Industrial Management	6.0 hp	First cycle
ME1032	Economics of Industrial and Technical Transformation	6.0 hp	First cycle

ME2034	Management of New Technology and Industrial Creativity	6.0 hp	Second cycle
ME2036	Industrial Dynamics, Advanced Course	6.0 hp	Second cycle
ME2057	Human Factors Engineering	6.0 hp	Second cycle
ME2800	Ideation - Creating a Business Idea	7.5 hp	Second cycle
MJ2611	Introduction Industrial Ecology	6.0 hp	Second cycle
MJ2652	Environmental Effects from Technical Systems and Processes	6.0 hp	Second cycle
MJ2663	Environmental Management	6.0 hp	Second cycle
MJ2680	Environmental Systems Analysis	6.0 hp	Second cycle
MJ2691	Technology and Sustainable Development	6.0 hp	Second cycle
MJ2693	Sustainable Development in Theory and Practice	6.0 hp	Second cycle
SD2130	Signal Analysis	8.0 hp	Second cycle
SD2140	Vibro Acoustics	8.0 hp	Second cycle
SD2150	Experimental Structure Dynamics, Project Course	9.0 hp	Second cycle
SD2155	Flow Acoustics	6.0 hp	Second cycle
SD2175	Numerical Methods for Acoustics and Vibration	9.0 hp	Second cycle
SD2413	Fibre Composites - Analysis and Design	6.0 hp	Second cycle
SD2414	Fibre Composites - Materials and Manufacturing	6.0 hp	Second cycle
SD2416	Structural Optimisation and Sandwich Design	6.0 hp	Second cycle
SE2123	Testing Techniques in Solid Mechanics	6.0 hp	Second cycle
SG2211	Vehicle Aerodynamics	6.0 hp	Second cycle
SG2212	Computational Fluid Dynamics	7.5 hp	Second cycle
SG2214	Fluid Mechanics	7.5 hp	Second cycle
SG2218	Turbulence	7.5 hp	Second cycle
SG2224	Applied Computational Fluid Dynamics	5.0 hp	Second cycle

Supplementary information

Compulsory courses + tracks-courses + conditionally elective courses 75 cr.

Among the conditionally elective courses there are two which is given by Stockholms University: Oceanography and Meteorology.

Year 2

Mandatory courses (15.5 Credits)

Course code	Course name	Credits	Edu. level
AK2036	Theory and Methodology of Science with Applications (Natural and Technological Science)	7.5 hp	Second cycle
SD2703	Marine Dynamics	8.0 hp	Second cycle

Optional courses

Course code	Course name	Credits	Edu. level
SD2702	Naval Design 10 cr are studied during the second term and 10 cr during the third term.	20.0 hp	Second cycle
SD2706	Sailing for Performance	6.0 hp	Second cycle

Supplementary information

Compulsory courses + tracks-courses 75 cr.

Track, Lightweight Structures (MRSA)

Year 1

Conditionally elective courses

Course code	Course name	Credits	Edu. level
SD2413	Fibre Composites - Analysis and Design	6.0 hp	Second cycle
SD2414	Fibre Composites - Materials and Manufacturing	6.0 hp	Second cycle
SD2416	Structural Optimisation and Sandwich Design	6.0 hp	Second cycle
SE1025	FEM for Engineering Applications Given in English in per 1 and in Swedish in per 3	6.0 hp	First cycle

Track, Fluid Mechanics (MRSB)

Year 1

Conditionally elective courses

Course code	Course name	Credits	Edu. level
SG2212	Computational Fluid Dynamics	7.5 hp	Second cycle
SG2214	Fluid Mechanics	7.5 hp	Second cycle
SG2224	Applied Computational Fluid Dynamics	5.0 hp	Second cycle

Track, Sound and Vibrations (MRSC)

Year 1

Conditionally elective courses

Course code	Course name	Credits	Edu. level
SD2130	Signal Analysis	8.0 hp	Second cycle
SD2150	Experimental Structure Dynamics, Project Course	9.0 hp	Second cycle
SD2175	Numerical Methods for Acoustics and Vibration	9.0 hp	Second cycle

Track, Management (MRSD)

Year 1

Conditionally elective courses

Course code	Course name	Credits	Edu. level
EH2010	Management of Technology	7.5 hp	Second cycle
ME1000	Industrial Management	6.0 hp	First cycle
ME2053	Logistics & Supply Chain Management *	6.0 hp	Second cycle
ME2054	Purchasing & Supply Chain Management *	6.0 hp	Second cycle

Supplementary information

One of ME2053 and ME2054 has to be studied

Track, Sustainable Development (MRSE)

Year 1

Conditionally elective courses

Course code	Course name	Credits	Edu. level
MJ2663	Environmental Management	6.0 hp	Second cycle
MJ2670	Risk Management	6.0 hp	Second cycle
MJ2691	Technology and Sustainable Development	6.0 hp	Second cycle

Appendix 2: Specialisations

Master's Programme, Naval Architecture, 120 credits (TMRSM), Programme syllabus for studies starting in autumn 2010

Track, Lightweight Structures (MRSA)

Marine vessels are in general lightweight structures built as stiffened shells in hierarchical arrangement. The dominating material in shipbuilding is still conventional steel but it is likely that the use of composite materials will increase, for example to decrease weight and thereby increase the ships energy efficiency. Internationally leading research is conducted at KTH Lightweight Structures which has supported the Swedish industry to apply fibre reinforced composite and sandwich material concepts in large vessels. A significant example is the 70 metre all carbon fibre Visby class corvette. Students studying naval architecture at KTH have the opportunity to combine fundamental principles of naval architecture with knowledge about modern materials and related design principles and manufacturing methods.

Contact person for the profile Lightweight Structures is Dan Zenkert, danz@kth.se, 08-7906435.

Track, Fluid Mechanics (MRSB)

Since ships and other naval systems operate in water a good understanding of fluid dynamics is crucial for any naval architect when studying e.g. seakeeping, resistance, propulsion and appendages. This profile is intended to give fundamental understanding as well as working skills in uncompressible fluid mechanics which is the basis for the flow around naval systems. In the courses, the governing set of partial differential equations, the Navier-Stokes equations, are derived, dissected, simplified and solved. The characteristics of boundary layers are investigated. The profile also includes modules concerning modern computational tools (CFD) for solving for the flow patterns in more complex situations. The fundamental mathematical principles of CFD is covered as well as hands-on projects where modelling and solving of real problems are done.

Contact person for the profile Fluid Mechanics is Erik Lindborg, erikl@mech.kth.se, 08-7906801.

Track, Sound and Vibrations (MRSC)

Issues related to sound and vibrations are numerous in ship design. For example in passenger ships, both acoustic and vibration criteria are increasingly important as demands for comfort increases. There are many sources of vibration in ships. The major sources are the engine and fluctuating pressure pulses and cavitation from the propeller which hits the hull. Many other systems and appliances also cause sound and vibration such as ventilation installations, external waves hitting the ship and various pumps. The profile in Sound & Vibration treats the topic from many aspects ranging from analytical understanding of the

phenomena, numerical methods of modelling and solving complex dynamic problems as well as experimental investigations by modal analysis. An engineer with this profile will be able to work with both details regarding generation as well as propagation and reduction of sound and vibration in complex structures.

Contact person for the profile Sound & Vibration is Hans Bodén, hansbod@kth.se, 08-7904962.

Track, Management (MRSD)

As an Engineer in the Naval Architecture field, your work will not only include purely technical activities. It is also important to understand the way businesses are made and the way the industry changes. Managerial issues will almost always be intertwined with the technical tasks that you have to face. In the profile Management, you will learn how to deal with the interface between marine technology, shipping, management, and industry development. This profile focuses on the problems in industries of this kind, how the companies produce different types of products and services that are important in the field, and how this type of companies, often project-based and cooperating with suppliers and customers, can be managed. The profile aims at providing in-depth knowledge of the financial, organizational and management aspects of a company in the maritime field. Emphasis is on the ability to manage and control projects in these contexts, the connection between business strategy and the management, and the risks and opportunities associated with globalization with respect to the industry. It gives a good foundation for an employment as a manager for companies and projects within the industry as well as a general knowledge about these roles in other types of industries. It also prepares for starting and managing a smaller company in the field, e.g. a consulting firm in the Naval Architecture field.

Contact person for the profile Management is Håkan Kullvén, hakan.kullven@indek.kth.se, 08-7906052.

Track, Sustainable Development (MRSE)

Shipping is, and will continue to be, one very important driving force in the development of most parts of the world and will therefore also be a part of development of new technologies to reach a sustainable global usage of the limited resources of the earth. The profile in sustainable development is based on the concept of Industrial Ecology with focus on the understanding of interactions between technical, economical, social and ecological systems and processes, a very important aspect for shipping, on global, national and company level. The profile will lead to understanding of the concepts of sustainable development from an environmental, social and economical viewpoint as well as the ecological prerequisites .The profile studies will include strategies for sustainable development and the role of technology, ecosystems’ long-term sustainability, material and energy flows within industry and society, tools and methods to work with sustainable development in industry and society with an emphasis on systems analysis methods.

Contact person for the profile Sustainable Development is Nils Brandt, nilsb@kth.se, 08-7908059.