



Program description

Master of Science in Technology and Safety in the High North

- Risk and reliability
- Automation
- Nautical science

120 credits Tromsø

The program description has been approved by the board of education at the Faculty of Science and Technology on 18.9.2019



Study programme name	Engelsk: Master of Science in Technology and Safety in the High North Bokmål: Master i Teknologi og sikkerhet i nordområdene/Sivilingeniør Nynorsk: Master i Teknologi og sikkerhet i nordområda/Sivilingeniør Disciplines: • Risk and reliability • Automation • Nautical Science
Degree obtained	Master of Science in Technology and Safety in the High North Master i Teknologi og sikkerhet i nordområdene / Sivilingeniør.
Target group	This is an interdisciplinary programme founded on engineering science. The programme is well suited for engineering students from automation, process and gas technology, nautical science and safety and environment. Applicants with equivalent education in technology and science, as e.g. mechanical engineers and maritime candidates, are also the target groups of this program.
Admission requirements, required prerequisite, recommended prerequisite knowledge	Admission to the Master program requires a relevant Bachelor's degree in engineering (180 credits), or similar education of not less than three years duration approved in accordance with the Norwegian Universities Act section 3-4. Relevant field of study may be automation, process and gas technology, nautical science, mechanical, processing, safety, civil engineering. Other fields of study may be considered upon individual assessment. Applicants must have a minimum grade average comparable to a Norwegian C (2.5) in the ECTS scale, see the UiT webpage for International admissions for more information on how the point average is calculated. The bachelor's degree must contain minimum 25 credits in mathematics, 5 credits in statistics and 7,5 credits in physics. Some of the courses in the bachelor programme have a certain amount of physics included and can be accepted. Applicants with education from non-Nordic countries must document English language proficiency. You will find more information on English language requirements on the UiT webpage for International admissions.
The study programme's Learning Outcome	The aim of the programme is to focus on the existing knowledge, issues, challenges, and theories of safety and technology with the focus on cold climate condition. After completing the programme, the candidate has the following learning outcomes:

Knowledge:

The candidate ...

- has a solid basis in engineering in general and advanced level of knowledge in one of the disciplines offered.
- has advanced knowledge about the scientific theory and methods of engineering, engineering challenges and solutions related to industrial activities especially in the Arctic.
- can apply their knowledge to new technological areas.
- can analyse academic problems of engineering based on the history, traditions and uniqueness of technology.

Risk and reliability

The candidate ...

- has a thorough knowledge and understanding of key theoretical and practical concepts and terminology in the area of technology and safety.
- has advance knowledge and understanding of the fundamental basis of risk and reliability engineering.
- has in-depth knowledge about scientific theory, methods and tools for managing and controlling complex technical systems and operations in different environmental condition.
- can apply their knowledge of risk and reliability to new technological areas.

Automation

The candidate ...

- has a thorough knowledge and understanding of key theoretical and practical concepts and terminology in automation technology.
- has knowledge of advanced theoretical and practical modelling and simulation tools for automation technology.
- has thorough knowledge of the theoretical foundation of advanced control techniques based on optimal control and state estimation.
- has knowledge of advanced concepts in selected optional topics.

Nautical Science

The candidate ...

- has a thorough knowledge and understanding of issues, theoretical concepts and regulatory framework of static and dynamic ship stability, both in intact and damaged ship hull conditions.
- has an overview of the principles in radio technology and advance knowledge in interference and noise in radio signals.
- has advance knowledge and understanding of limitations and design principles of maritime navigation, positioning (DP) and radio communication systems.
- has advance knowledge of marine operations in the ocean space with emphasis on how the environment is affecting the performance of operations.

Skills:

The candidate ...

- can analyse existing theories, methods and interpretations within technology and safety.
- can apply theoretical concepts and terminology of risk and reliability engineering in analysis of complex technical systems and operations in a harsh environment.
- can critically read and analyse miscellaneous sources of information, and use the information for structuring and formulating academic argumentation within the chosen field of study.
- can work independently with problem solving in their disciplines.
- can carry out an independent, limited research/development project under supervision and in accordance with applicable norms for research ethics.

Risk and reliability

The candidate ...

- can use of existing knowledge and theories of technology safety for analysing, planning and solving engineering related problems.
- can use risk and reliability theory for operation and maintenance management and engineering of technology.
- can model the impact of environment condition on the performance of technology and safety.
- can use the historical data and simulation in the process of decision making for improvement of the safety of engineering system.

	<u>Automation</u> <i>The candidate ...</i> • can use of existing knowledge and theories in automation technology for advanced analysis, planning and solving of automation related problems. • can use advanced theory and practical tools to optimization-based controllers for real advanced processes with multiple inputs and/or multiple outputs. • can implement integrated solutions. <u>Nautical Science</u> <i>The candidate ...</i> • can carry out and make use of existing knowledge and theories of dynamic stability with reference to intact and damage hull conditions. • can analysis how external forces influence the integrity of seagoing vessels. • can propose and evaluate solutions for planning of effective operations. General competence: <i>The candidate ...</i> • can critically read, cite, analyse and understand scientific literature. • can independently communicate scientific information clearly and precisely, both written and oral forms for both general public and specialists in the field. • can apply his/her knowledge and skills in new areas, for solving advanced working tasks and in contribution to innovation and entrepreneurship. • can reflect on their professional practice, work in groups, manage report writing, presentation, and function in a multi-disciplinary team.
Academic content and description of the study program	The programme (120 credits) is a 2 years full-time study at the Department of Technology and Safety of UiT The Arctic University of Norway in Tromsø. The programme gives a comprehensive understanding of aspects and challenges related engineering science and technology in a vulnerable and harsh environment. Special

attention is given to technical and operational solutions, as well as safety related issues.

Important concepts, issues and theories in innovation and entrepreneurship will also be addressed through different courses. The students develop their thinking in innovative way on current issues related to technology and safety through participation in projects and assignments.

The following courses are compulsory courses for all disciplines of the master programme:

- TEK-3002: Risk and reliability engineering, 10 ECTS
- TEK-3006: Cold climate engineering, 10 ECTS
- TEK-3004: Project paper, 10 ECTS
- TEK-3901: Master thesis in technology, 30 ECTS

The two first of these courses gives the candidate an overall understanding of Arctic engineering knowledge. Knowledge of how to operate in harsh climate with Polar Low pressure systems, icing conditions and in dark winter season are given with connection to on- and offshore installations.

The Master's programme offer the following three disciplines :

Risk and reliability

Compulsory courses:

- STA-2001: Stochastic processes
- SVF-3206: Safety management and accident investigation
- TEK-3018: Advanced techniques for risk and reliability

Focus:

Knowledge and skills in risk and reliability theory for complex systems, and advanced use of modelling, software and expert judgement. Insight in methods and tools for managing and controlling risk and safety for technological systems.

Automation

Compulsory courses:

- FYS-2006: Signal processing
- TEK-3013: Optimization and control

Focus:

Knowledge and skills in handling of measurement data to design analyse and/or control advanced processes. Implementation of integrated automation solutions.

Nautical Science

Compulsory courses:

- TEK-3011: Ship stability
- TEK-3010: Marine operations
- TEK-3014: Navigation systems

Focus:

Knowledge and skills in theory and regulation regarding ship stability in normal and challenging operation. Hydrodynamics and environmental criteria for marine operations, and the use of advanced navigation systems in modern ships.

Updated subject descriptions for the program are available online.

Table: program structure

Discipline: Risk and reliability			
1. semester	TEK-3002 Risk and Reliability Engineering, 10 ECTS	STA-2001 Stochastic Processes 10 ECTS	SVF- 3206 Safety Management and Accident investigation
2. semester	TEK-3018 Advanced Techniques for Risk and Reliability Analysis 10 ECTS	TEK-3006 Cold Climate Engineering, 10 ECTS	Optional course, 10 ECTS
3. semester	TEK-3004 Project paper, 10 ECTS	Optional course, 10 ECTS	Optional course, 10 ECTS
4. semester	TEK-3901 Master thesis in engineering, 30 ECTS		
Generally recommended optional courses for the discipline of Risk and reliability:			
Autumn Courses:			
- SVF-3207 Resilience			
- TEK-3003: Specialization subject in technology			
- TEK-3017: Applied Optimal Estimation in Engineering Systems			
- TEK-3601: Machine Vision			
- MAT-3200: Mathematical methods			

	Spring Courses - TEK-2005: Operation and Maintenance Management. - TEK-3015: Multi physics simulations - SVF-3204: Risikovurdering og - styring/Risk assessment and management - AT-327: Arctic Offshore Engineering			
	Discipline: Nautical Science			
	1. semester	TEK-3002 Risk and Reliability Engineering, 10 ECTS	TEK-3011 Ship Stability 10 ECTS	TEK-3014 Navigation Systems 10 ECTS
	2. semester	TEK-3006 Cold Climate Engineering, 10 ECTS	TEK-3010 Marine Operations 10 ECTS	Optional course, 10 ECTS
	3. semester	TEK-3004 Project paper, 10 ECTS	Optional course 10 ECTS	Optional course, 10 ECTS
	4. semester	TEK-3901 Master thesis in engineering 30 ECTS		
	Generally recommended optional courses for the discipline of Nautical Science:			
	Autumn Courses - TEK-3017: Applied Optimal Estimation in Engineering Systems - SVF-3206: Safety Management and Accident investigation - TEK-3601: Machine Vision - FYS-2021: Machine Learning - TEK-3003: Specialization subject in technology			
	Spring Courses - TEK-2005: Operation and Maintenance Management. - TEK-3015: Multi physics simulations - TEK-3018: Advanced Techniques for Risk and Reliability Analysis - AT-327: Arctic Offshore Engineering - AT-332: Physical Environmental Loads on Arctic Coastal and Offshore Structures - SVF-3204: Risikovurdering og - styring/Risk assessment and management			

	Discipline: Automation			
	1. semester	TEK-3002 Risk and reliability engineering 10 ECTS	FYS-2006 Signal Processing 10 ECTS	Optional course, 10 ECTS
	2. semester	TEK-3006 Cold climate Engineering 10 ECTS	TEK-3013 Optimization and Control 10 ECTS	Optional course 10 ECTS
	3. semester	TEK-3004 Project paper 10 ECTS	Optional course 10 ECTS	Optional course 10 ECTS
	4. semester	TEK-3901 Master thesis in engineering 30 ECTS		
	Generally recommended optional courses for the discipline of Automation: Autumn Courses - FYS-2010: Digital image processing - TEK-3601: Machine Vision - TEK-3600 Embedded systems - MAT-3200: Mathematical methods - TEK-3017: Applied Optimal Estimation in Engineering Systems - TEK-3003: Specialization subject in technology Spring Courses - TEK-2005: Operation and maintenance management - TEK-3018: Advanced Techniques for Risk and Reliability Analysis - TEK-3015: Multi physics Simulations.			
Learning activities, examination and assessment	The teaching is based on relevant research within engineering, safety and technology, as well as professional development work and experience related to operations in the high north. The learning activities are adapted to candidates with different bachelor degrees within engineering and technology. This provides both an additional knowledge within their disciplines and a more general understanding of safety and technology in the high north. The study program uses a variety of teaching methods, and includes lectures, projects, student presentations, teamwork and mandatory assignments. These methods will help students to take an active role in the learning process by writing tasks and project reports in order to achieve the total learning outcome of the study programme. It is emphasized that learning activities will contribute to professional development of students and their skills for collaboration, communication and practical problem solving through working in groups. The study program provides knowledge about scientific			

	theories and methods, and the project paper and master thesis are designed for individual research work. Lectures are organised either as blocks or regularly, on a weekly basis. In some courses, seminars may be arranged. Some courses may include compulsory lectures, exercises, excursion and approval of exercises/fieldwork or semester reports. This will be stated in the course descriptions. Assessment methods will vary between written exam, home exam, group assignments, project submission and oral exam. In some cases, the assessment will be a combination of different assessment methods. For a more detailed description of the assessment forms, see subject descriptions. Professional achievements are assessed either with letter marks or passed / failed. If no assessment is required, "completed / non-completed" can be used.
The study programme's relevance	The programme qualifies for various positions in private or public sector that require competence in safety and technology. Relevant occupations include jobs in e.g. the oil and gas industry, maritime industry and public administration. Research, education, and further study on Ph.D. level are other options.
Work scope	In order to reach the learning goals, students must expect to work 37.5 hours a week with the studies. The learning activities will consist of lectures, seminars, group work, semester assignments, exercises, exams and self-study. It will be required both to work independently and in groups. Learning activities are based on relevant research and professional development work. For learning activities associated with individual subjects, see subject descriptions.
For master's theses/independent work in master's degrees	In the fourth semester, the students will carry out a mandatory, independent and individual master's thesis, equivalent to 30 ECTS. The students should choose an in-depth study within their field of study from their Bachelor degree, or base the thesis on one or more of the topics included in the programme, e.g. maritime operations and preparedness, reliability engineering or operation and maintenance. The Dept. will provide a supervisor for the students. The master thesis is assessed with letters A-F.
Language of instruction and examination	This is an English master programme, where both the study plan and course curriculum are in English. Lectures and examination will be in English. Exercises, assignments and reports are to be made in English. All formal information regarding the study programme is given in English.
Internationalisation	The study programme is well suited for international students. Courses are based on research fields that are well known internationally, and students will be introduced to current research topics and projects by the scientific staff or international guest lectures.

Student exchange	Students are encouraged to participate in exchange programmes abroad, and the department offers assistance for students who will participate in exchange programmes. Recommended exchange institutions are: • Politecnico di Milano, Italy • University of Tasmania, Australia • Tokyo University of Marine Science and Technology, Japan High North universities are also of special interest, and students can apply for other exchange programmes. It is possible to take part of the study in other Norwegian universities for example at the University Centre of Svalbard (UNIS). The exchange courses will substitute the courses in relevant semester of the programme and will be included in the diploma. Student exchange may be carried out in the 3rd semester.
Administrative responsibility and academic responsibility	The Department of Technology and Safety is administratively responsible for the program. The Program Board Master of Science in Technology and safety at the Department of Technology and safety has professional responsibility.
Quality assurance	The study program is evaluated annually according to the UiT evaluation system. The evaluation takes place in meetings between students and employees. It can also include an anonymous questionnaire.
Other regulations	Complementary regulations for two-year master's degree (120 credits) at the Faculty of Science and Technology Vilkår for bruk av tilleggsbetegnelsen Sivilingeniør (siv.ing.) approved by The Norwegian Association of Higher Education Institutions spring 2016.

