### Maintenance engineering and management

<table>
<thead>
<tr>
<th>Emnekode/Course code:</th>
<th>FX-MTOM-600</th>
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<tbody>
<tr>
<td>Emnenavn/Course name:</td>
<td>Maintenance engineering and management</td>
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<tr>
<td>Studiepoeng/Number of study points (ECTS):</td>
<td>10</td>
</tr>
<tr>
<td>Semester (høst/vår)/ Semester (autumn/spring):</td>
<td>Spring - Meeting based</td>
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<tr>
<td>Emnenivå/Course level:</td>
<td>Master</td>
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**Emnet er knyttet til studieprogram/Study programme:**
Experience based master in Technology and operations management

**Studenter på følgende studier har studierett på emnet/Only available to students in:**
Experience based master in Technology and operations management

**Absolutt forkunnskapskrav/Prerequisites:**
BSc in engineering

**Skal studenter som mangler forkunnskapskrav bli sperret av systemet for å få tilgang til å melde seg opp til eksamen/ Do you want the students lacking the necessary prerequisites to be excluded by the datastystem automatically?**
Yes

**Anbefalte forkunnskaper/Recommended prerequisites:**
Bachelor degree in Engineering.

**Innhold/Content:**
The goal of the course is to develop a basic understanding of central aspects, principles, methods and tools related to the management of operations and maintenance of advanced, complex and integrated machines, equipment, products, systems and to apply the knowledge in a practical industrial setting. The course will describe central factors and methods used to optimize activities in design and development, installation and commissioning, operations and maintenance, removal with respect to costs, profits, and acceptable risk level for health, safety and environment (HSE), as well as investments. Common operation and maintenance standards, maintenance engineering tools and techniques, as well as condition monitoring maintenance management will be presented and discussed. Furthermore, the course will cover predictive maintenance management and the basic principles and methods used in condition monitoring of rotating machinery, piping, pressure vessels and load bearing structures.

One or several project report shall be prepared with a theme in maintenance engineering management. The context will be on offshore technology (as for example oil and gas platforms or offshore wind farms).

**Arbeidsformer/Method of work:**
Lectures, mandatory projects. Participation in guest lectures. Lecture language is English.
Læringsutbytte/Learning outcome: After having taken this course the student should have the following knowledge, skills and general competence:

Kunnskap/Knowledge
- Understand how maintenance contribute as a business function and added value process and to identify trends in maintenance management
- Have a good understanding of standards, legislative requirements, definitions and terminology as well as various types of maintenance, goals, risks, and acceptance criteria
- Have a general knowledge and understanding of the design out/ design for maintenance philosophy.
- Have a general knowledge and understanding of Spare parts inventory and logistics problems
- Have a general knowledge and understanding of data and information management, CMMS
- Have an understanding of Reliability centered maintenance (RCM), Risk based maintenance (RBM) and Risk based inspections (RBI), as well as and ability to use these methods
- Have an understanding of Predictive maintenance and principles of condition monitoring
- Have a basic knowledge and understanding of the working principles of condition monitoring using vibration characteristics, process parameters, lubrication oil and wear particles as well as common non-destructive testing techniques

Ferdigheter/Skills
- Perform maintenance engineering analysis, establish coding and function hierarchy of equipment
- Perform Failure mode effects and criticality analysis, Fault tree analysis, Event tree analysis, etc.
- Perform a Life cycle cost analysis
- Perform a simple Spare parts needs assessment as well as inventory and logistics considerations

Generell kompetanse/General competence
- An ability to identify, formulate, and solve operations and maintenance problems
- An understanding of common methods, tools and analysis
- An ability to design a operations and maintenance management plan for a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- An ability to apply knowledge of mathematics, science, and engineering in development of operations and maintenance management plans and to use the techniques, skills, and modern tools necessary for operations and maintenance management practice.
- An ability to function in a multi-disciplinary team
- An ability to communicate effectively

Vilkår for å gå opp til eksamen / Obligatoriske arbeidskrav/ Requirements to sit for the exams/Required activities/courses:
The student needs to have a passing grade in the project
Vurderingsformer/ Forms of assessment:

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Weight</th>
<th>Duration</th>
<th>Tools</th>
<th>Grade</th>
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<tbody>
<tr>
<td>Project report</td>
<td>40%</td>
<td>All</td>
<td>A-F</td>
<td></td>
</tr>
<tr>
<td>Written exam</td>
<td>60%</td>
<td>3 hours</td>
<td>A-F</td>
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Skal FS eventuelt regne ut endelig karakter dersom vurderingsformen består av flere deler:
Do you want FS to calculate the final grade in a course if the exam consists of several parts:
The subject teacher decides the total grade

Litteratur/pensum/ Literature:
Compendium in Maintenance engineering and management, selected books and papers, including:

- Z-008 Criticality Analysis for maintenance purposes (Rev. 2, Nov. 2001), Norsok Standards. (download from www.standard.no/imaker.exe?id=244
- Kumar, U., (XXXX). Risk based maintenance strategies for mechanized and automated systems
- Faber, M.H., (XXXX). Risk-based inspection – The framework
- Malmholt, O. (XXXX). Maintenance objective, strategy, and organization, EUREKA Project, UTEK

Er emnet åpent for privatister/ Available for private candidates:
No

Studiepoengreduksjon mot andre emner/Reduction in points/Prohibitions:
None

Studentevaluering/ Student evaluation:
Standard forms and/or discussions

Ansvarlig fakultet og institutt/Faculty and department:
Faculty of science and technology, Department of mechanical and structural engineering and materials science

Emneansvarlig/andre fagpersoner på emnet/Responsible subject lecturer(s)/other responsible lecturers:
Subject responsible: Head of Department Professor Per Skjerpe and Professor Tore Markeset
Lecturers: Professor Tore Markeset, Associate Professor Knut Erik Bang