

Contents of the minor

Introduction	<p>For an asset to perform its required functionality, more is required than just the correct design and adequate daily operation. All systems are prone to some form of degradation and failure mechanism that will seriously impact reliability of the system over time. The immediate effect will be damage accumulation that has an impact on the expected asset life time. To maintain and improve asset reliability adequate maintenance is a key necessity.</p> <p>The objective of maintenance is therefore to reinstate the asset to a required level of reliability and availability. Maintenance activities need to be properly defined and (timely) executed to monitor and slow-down degradation and/or restore the asset to the designed condition. These maintenance activities shall be safe to execute and should also make effective use of the available resources such as budgets, time, people, information, spares and tools.</p> <p>The operational requirements and the availability of resources and technologies will change over the lifetime of the asset. This will enforce the need to continuously review and optimise asset performance, maintenance program and execution and to proactively assess the value of any new maintenance tool and technology.</p>
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<p>Learning objectives</p>	<p>The course consists of eight modules which are conducted fulltime within one semester (20 weeks) in Vlissingen. The first module will create a common understanding regarding maintenance, terminology and methodologies across the mixed group (backgrounds) of students.</p> <p>After the introduction module the following five modules will cover technical and engineering topics to better understand failure mechanisms, methods to detect degradation, repair options and the preparation, execution and optimisation of maintenance activities such as for spare parts.</p> <p>The other two key minor modules will provide you the opportunity to apply and explore the theory provided during the course in a more practical and real-life research project. Teamwork, research skills and project management are also required and will be further developed during this course as you will be working in a multi-disciplined project team.</p> <p>After completing this Minor you will be capable to identify degradation and equipment failures. You are able to judge and improve the current maintenance plan and to select the most appropriate maintenance action in order to realise the required equipment performance.</p>
<p>Additional information</p>	<p>The minor will not focus on one specific industry or asset type but will have a broad application area. All lecturers have different working backgrounds and will therefore offer a wide source of experience. Similarly the case studies used, any guest lecture and/or company visit can cover any of the five main industry areas: Aerospace, Process, Maritime, Energy and Infrastructure.</p> <p>You and your course participants will contribute towards the program with a good basic knowledge of the assets and operational requirements in your field of (prior) study. It is the mix of backgrounds in engineering studies and personal backgrounds which makes this team experience very valuable and interesting. Students are also encouraged to bring their own case examples and/or industry research projects.</p> <p>Professional positions within the industry and public service organizations that could be fulfilled with the knowledge gained in this course and supported by some years of working experience are for example: Maintenance Engineer in the process and energy industry, Maintenance Manager of a workshop/service provider, Superintendent for a shipping company. In these positions you will have to manage, i.e. identify, plan, execute and improve - maintenance activities on the assets of your business or your client's business.</p>

<p>Subjects for EMT 2019 EMT 2020 projects were:</p>	<p>3D printing spare parts for frigates DAMEN Maintenance excavator on board "Bravenes" VAN OORD Maintenance Krammer locks RWS Failure mechanism heat pumps DELTA ENERGY</p> <p>S 2000 M for spare parts DAMEN Maintenance aircompressors Vliegbasis Woensdrecht Reliability critical parts Hansweert locks RWS</p>

Assessments	See two tables below which combined represent the 30 ECTS minor.
Literature	<ul style="list-style-type: none"> • Tinga, T. (2013). Principles of Loads and Failure Mechanisms (English edition). Switzerland: Springer. • Lipschutz, S., & Lipson. M. (2011). Schaum’s Outlines of Probability (2 ed.). McGraw Hill. (used for EMT module 3 Failure Data - and module 7 Spare Parts Management) - ISBN 978-0-07-175561-0. • O’Connor, Patrick D. T. and Kleyner, Andre (2012). Practical Reliability Engineering (5 ed.). Wiley (EMT module 3: Failure Data Analysis). E-book.
Schedule	<p>The eight minor modules are split over two blocks of 10 weeks (module 1-4 and 5–8) and each block will have seven lecture weeks. During a standard lecture week three days will be used for the theoretical modules and lectures. One day will be spent fulltime on the group project, preferably at the company location. The fifth day is available to the student to do his self-study and prepare for his class or project tasks.</p> <p>The educational methods are mainly based on a guided self-discovery process. During modules 1 to 3 and 5 to 7 short case studies will be executed in which you apply the theory from the lectures in a simulated situation. By means of such challenges you will be forced to find solutions, explore further sources for information and will learn from the gained experiences.</p> <p>The project modules 4 and 8 will be much more focused around real life situations for which you and your team first will have to define the main research query and problem statement. From this statement you will have to find relevant theoretical models, approach sources and experts outside the course environment, check for possibly existing solutions and motivate the options available. You will have to consider the limitations in the business and operational context and develop your arguments for the best available solution and improvement.</p>

CU12202	Title: Equipment Maintenance Technology 1 (EMT 1)				EC's: 15	Mandatory: Yes	Language: English				
Requirements for registration: HBO-propedeuse and therefore successful completion of at least all first year courses of a technical bachelor program.											
Special conditions for credit allocations: Overall minimum score 5.5											
Course summary: In four different modules the basis for asset integrity and maintenance are covered. The theoretical modules on physics of failure and analysis of failure data are supported by a research project. For a real case and industrial project, the students will have to develop and present their research proposal.											
Test no.	Format <i>Oral (O), Written (W) or alternative assessment (A)</i>				Competences (HBO Engineering Profile 2016)	Weight	Minimum Score	Planning Regular	Exam Inspection	Planning Resit	Resit Inspect.
	O	W	A	Format							
1		x		Knowledge and skill test - Introduction EMT	Analysis (1a, 1b)	25	4.5	39	41	44	45
2		x		Knowledge and skill test – Physics of Failure	Realisation (3a)	25	4.5	42	43	44	45
3		x		Knowledge and skill test – Failure Data Analysis	Realisation (3c)	25	4.5	42	43	44	45
4			x	Group report - Research Proposal	Research (7a, 7b)	25	4.5	42	43	44	45

CU12203	Title: Equipment Maintenance Technology 2 (EMT 2)				EC's: 15	Mandatory: Yes	Language: English				
Requirements for registration: HBO-propedeuse and therefore successful completion of at least all first year courses of a technical bachelor program.											
Special conditions for credit allocations: Overall minimum score 5.5											
Course summary: In four different modules various advanced technologies in management and improvement of asset integrity and maintenance are explored. The theoretical modules on repair and maintenance technology, condition based maintenance and spare parts management are supported by a research project. The approved research proposal from CU12202 will be executed and will result in an well-defined advice for the project owner.											
Test no.	Format <i>Oral (O), Written (W) or alternative assessment (A)</i>				Competences (HBO Engineering Profile 2016)	Weight	Minimum Score	Planning Regular	Exam Inspection	Planning Resit	Resit Inspect.
	O	W	A	Format							
1		x		Knowledge and skill test - Repair and maintenance technology	Realisation (3a)	25	4.5	2	3	4	5
2		x		Knowledge and skill test - CBM and Inspection Technology	Control (4c)	25	4.5	2	3	4	5
3		x		Knowledge and skill test – Spare Parts Management	Control (4b)	25	4.5	2	3	4	5
4			x	Group report - Research Project Result	Research (7c, 7d, 7e)	25	4.5	2	3	4	5