Appendix I Learning outcomes of the degree programme (art. 1.3)

After the completion of master's degree programme in Mechanical Engineering, the graduate is expected to attain the following learning outcomes.

On knowledge and understanding
The graduate**:**

1.1 has knowledge of the underlying concepts of mechanical engineering, including the necessary physics, mathematics and computer science, at a level that permits admission to a higher level post-graduate programme
1.2 is familiar with the quantitative character of mechanical engineering and with the relevant research methods
1.3 has operational knowledge and design skills in the field of mechanical engineering
1.4A has a thorough understanding of advanced instrumentation (For Advanced Instrumentation Track)
1.4B has a thorough understanding of smart processes and products (For Smart Factories Track)
1.4C has a thorough understanding of process design (For Process Design for Energy Systems Track)
1.4D has a thorough understanding of engineering materials (For Materials for Mechanical Engineering Track)
1.5 has knowledge in the field of business and management

On the synthesis and application of knowledge and understanding
The graduate:

2.1 is able to carry out research in order to understand phenomena that are usable in developing mechanical engineering applications
2.2 is able to analyse a (new) complex applied problem, and develop a structured and well-planned approach to search for a solution
2.3 is able to apply his/her mechanical engineering knowledge and skills in his/her own and related subject areas
2.4 is able to seek new applications for mechanical engineering concepts
2.5 is able to use advanced instrumentation and/or advanced programming tools
2.6 is able to apply mechanical engineering concepts in an industrial environment or in an international mechanical engineering research environment
2.7 is able to collaborate in a (multi-disciplinary) international research and design team

On reasoning and judgement
The graduate:

3.1 is able to obtain relevant information using modern information channels, and interprets this information critically for specific use in mechanical engineering research
3.2 judges his/her and others' actions within a scientific context, taking societal and ethical aspects into account
3.3 is able to draw conclusions on the basis of limited or incomplete information, and realizes and formulates the limitations of such conclusions

On communication skills
The graduate:

4.1 is able to communicate clearly, verbally and in writing, on his/her subject and relevant applications, at different levels understandable to experts and non-experts using relevant communication tools

On learning skills
The graduate:

5.1 is able to address issues inside as well as outside his/her main subject area, therefore and thereby gaining new knowledge and skills

5.2 is able to familiarize him/herself with recent advances in science and engineering and use them in mechanical engineering applications

Appendix II Tracks of the degree programme (art. 2.2)

The degree programme has two tracks:

- Advanced Instrumentation
- Smart Factories
- Process Design for Energy Systems
- Materials for Mechanical Engineering

Appendix III Content of the degree programme (art. 2.3)

Advanced Instrumentation Track:

Course unit	ECTS	Practical	Entry requirements
Analysis and Control of Smart Systems	5		
Basic Detection Techniques	5		
Computational Mechanics	5		
Experimental Design	5		
Introduction to Data Science	5		
Advanced Instrumentation and Extreme Environments	5		
Course in Business, Management and Society	5		
Elective courses	25		
Master Design Project Mechanical Engineering	20	X	Passed 45 ECTS of the master degree programme courses
Master Research Project Mechanical Engineering	40	X	Passed 45 ECTS of the master degree programme courses

Smart Factories Track:

Course unit	ECTS	Practical	Entry requirements
Advanced Processing for Complex Materials	5		
Analysis and Control of Smart Systems	5		
Computational Mechanics	5		
Experimental Design	5		
Introduction to Data Science	5		
Robotics for IEM	5		
Course in Business, Management and Society	5		
Elective courses	25		
Master Design Project Mechanical Engineering	20	X	Passed 45 ECTS of the master degree programme courses
Master Research Project Mechanical Engineering	40	X	Passed 45 ECTS of the master degree programme courses

Process Design for Energy Systems Track:

Course unit	ECTS	Practical	Entry requirements
Advanced Process and Energy Technologies	5		
Analysis and Control of Smart Systems	5		
Thermodynamics of Energy Conversion	5		
Computational Mechanics	5		
Experimental Design	5		
Introduction to Data Science	5		
Course in Business, Management and Society	5		
Elective courses	25		
Master Design Project Mechanical Engineering	20	X	Passed 45 ECTS of the master degree programme courses
Master Research Project Mechanical Engineering	40	X	Passed 45 ECTS of the master degree programme courses

Materials for Mechanical Engineering Track:

Course unit	ECTS	Practical	Entry requirements
Computational Mechanics	5		
Smart materials for Engineering	5		
Experimental Design	5		
Introduction to Data Science	5		
Micromechanics	5		
Surface Engineering and Coating Technology	5		
Course in Business, Management and Society	5		
Elective courses	25		
Master Design Project Mechanical Engineering	20	X	Passed 45 ECTS of the master degree programme courses
Master Research Project Mechanical Engineering	40	X	Passed 45 ECTS of the master degree programme courses

The assessment method of the courses can be found in the assessment plan of the degree programme and on the Ocasys database, see
https://www.rug.nl/ocasys/fwn/vak/showpos?opleiding=6068

Courses in Business, Management and Society

Course Unit	ECTS	Practical	Entry requirements
Global Change	5		
Strategic Management of Information Technology	5		
Sustainability for Engineers	5		
Technology Based Entrepreneurship	5		

Appendix IV Electives (art. 2.4)

Electives for Advanced Instrumentation Track

Course unit	ECTS	Practical	Entry requirements
Advanced Detection Techniques	5		
Applied Optics	5		
Characterisation of Materials	5		
Fitting Dynamical Models to Data	5		
Medical Imaging Instrumentation	5		
Modelling and Control of Complex Nonlinear Engineering Systems	5		
Multibody and Nonlinear Dynamics	5		
Multiscale Contact Mechanics and Tribology	5		
Opto-Mechatronics	5		
Product Design by the Finite Element Method	5		
Robotics for IEM	5		
Scientific Visualisation	5		
Space Mission Technology	5		
Structure at Macro, Meso and Nano Scale	5		
Surface Engineering and Coating Technology	5		
Systems Engineering	5		
MEMS, NEMS and Nanofabrication	5		
Finite Element Methods for Fluid Dynamics	5		
Microfluidics	5		

Electives for Smart Factories Track

Course unit	ECTS	Practical	Entry requirements
Advanced Detection Techniques	5		
Advanced Polymer Processing	5		
Finite element modelling for advanced processing	5		
Basic Detection Techniques	5		
Characterisation of Materials	5		
Data-driven optimization	5		
Fitting Dynamical Models to Data to Data	5		
Modelling and Control of Complex Nonlinear Engineering Systems	5		
Multibody and Nonlinear Dynamics	5		
Multiscale Contact Mechanics and Tribology	5		
Opto-Mechatronics	5		
Polymer Physics	5		
Product Design by the Finite Element Method	5		
Robotics for AI	5		
Scientific Visualisation	5		
Structure at Macro, Meso and Nano Scale	5		
Surface Engineering and Coating Technology	5		
Systems Engineering	5		
MEMS, NEMS and Nanofabrication	5		

Convex Optimization	5		
Finite Element Methods for Fluid Dynamics	5		

Electives for Process Design for Energy Systems Track

Course unit	ECTS	Practical	Entry requirements
Advanced Powder Technologies	5		
Advanced Reactor Technologies	5		
Multibody and Nonlinear Dynamics	5		
Surface Engineering and Coating Technology	5		
Product design by the Finite Element Method	5		
Interfacial Engineering	5		
Hydrogen, Fuels and Electrolysers	5		
Fuel Cell Systems	5		
Finite element modelling for advanced processing	5		
Processes, Energy and Materials	5		
High- and Low-Temperature Fuel Cells	5		
Finite Element Methods for Fluid Dynamics	5		
Smart Materials for Engineering	5		
Microfluidics	5		
MEMS, NEMS and Nanofabriaction	5		
CFD for engineers	5		
Compressible flows	5		

Electives for Materials for Mechanical Engineering Track

Course unit	ECTS	Practical	Entry requirements
Advanced Processing for Complex Materials	5		
Characterisation of Materials	5		
Fracture of Materials	5		
Multibody and Non-Linear Dynamics	5		
Multiscale Contact Mechanics and Tribology	5		
Polymer Physics	5		
Product Design by the Finite Element Method	5		
Structure at Macro, Meso and Nano Scale	5		
Systems Engineering	5		
Computational Physics	5		
Interfacial Engineering	5		
MEMS, NEMS and Nanofabrication	5		
Finite Element Methods for Fluid Dynamics	5		
CFD for engineers	5		
Finite element modelling for advanced processing	5		

The assessment method of the courses can be found in the assessment plan of the degree programme and on the Ocasys database, see
https://www.rug.nl/ocasys/fwn/vak/showpos?opleiding=6068

Appendix V Entry requirements and compulsory order of examinations (art. 3.4)

For students admitted to the programme only one entry requirement for individual modules is defined:

- A student is allowed to start with either the Design- or the Research project if at least 45 ECTS of the first year have been passed.

Appendix VI Admission to the degree programme and different specializations (art. 5.1.1 + art. 5.2)

Holders of the following Bachelor's degrees from Universities in the Netherlands will be admitted to the Master's degree programme:
- BSc Mechanical Engineering
- BSc Aerospace Engineering

Holders of the following Bachelor's degrees from the University of Groningen are considered to have sufficient knowledge and skills and will be admitted to the Master's degree programme in Mechanical Engineering on that basis:

* BSc Applied Physics:

Requirements:
1. Computer Aided Design and Manufacturing

* BSc Physics

Requirements:
1. Computer Aided Design and Manufacturing
2. Mechanics for IEM
3. Control Engineering

* BSc Astronomy, minor Instrumentation and Informatics

Requirements:
1. Computer Aided Design and Manufacturing

* BSc Applied Mathematics

Requirements:
1. Computer Aided Design and Manufacturing

* BSc Industrial Engineering and Management

Requirements:
1. Computer Aided Design and Manufacturing
2. Mechanics for IEM
3. Control Engineering

Appendix VII Extra effort for obtaining a master's degree in a closely related programme (art. 3.17)

Not applicable.

Appendix VIII Application deadlines for admission (art. 5.6.1)

See basic Teaching and Examination Regulations 2020-2021 Master's degree programmes.

Decision deadlines(art. 5.6.3)

See basic Teaching and Examination Regulations 2020-2021 Master's degree programmes.