# Appendices to the Teaching and Examination Regulations for the Master's degree programme(s) in Mechanical Engineering (2023-2024)

# Appendix I Learning outcomes of the degree programme (Article 3.1)

After the completion of a 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.
1.4. Has a thorough understanding of:
   a. advanced instrumentation (For Advanced Instrumentation Track).
   b. smart processes, engineering materials and products (For Smart Factories Track).
   c. process design for energy systems (For Smart and Green Energy Systems 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/specializations of the degree programme (Article 3.6)

The degree programme has three tracks:

1. Advanced Instrumentation
2. Smart Factories, with two specializations:
    a. Materials for Mechanical Engineering
    b. Robotics, Mechatronics & Smart Systems
3. Smart and Green Energy Systems

# Appendix III Content of the degree programme (Article 3.8)

**Advanced Instrumentation Track:**

| **Course unit name** | **Course code** | **EC TS** | **Entry requirements** |
|---|---|---|---|
| Basic Detection Techniques | WMAS002-05 | 5 | |
| Introduction to Data Science | WMME027-05 | 5 | |
| Computational Solid Mechanics | WMME028-05 | 5 | |
| Advanced Instrumentation and Extreme Environments | WMME006-05 | 5 | |
| Analysis and Control of Smart Systems | WMIE015-05 | 5 | |
| Experimental Design | WMME012-05 | 5 | |
| Course in Business, Management and Society | Various | 5 | |
| Elective courses | | 25 | |
| Master Design Project Mechanical Engineering | WMME901-20 | 20 | Passed 45 ECTS of first year courses of the ME master programme |
| Master Research Project Mechanical Engineering | WMME902-40 | 40 | Passed 45 ECTS of first year courses of the ME master programme |

**Smart Factories Track:**

| Course unit name | Course code | ECTS | Entry requirements |
|---|---|---|---|
| Introduction to Data Science | WMME027-05 | 5 | |
| Robotics for IEM | WMIE005-05 | 5 | |
| Advanced Processing for Complex Materials | WMME007-05 | 5 | |
| Computational Solid Mechanics | WMME028-05 | 5 | |
| Analysis and Control of Smart Systems | WMIE015-05 | 5 | |
| Experimental Design | WMME012-05 | 5 | |
| Course in Business, Management and Society | Various | 5 | |
| Elective courses | | 25 | |
| Master Design Project Mechanical Engineering | WMME901-20 | 20 | Passed 45 ECTS of first year courses of the ME master programme |
| Master Research Project Mechanical Engineering | WMME902-40 | 40 | Passed 45 ECTS of first year courses of the ME master programme |

**Smart and Green Energy Systems Track:**

| Course unit name | Course code | ECTS | Entry requirements |
|---|---|---|---|
| Electrochemical Systems & Engineering | WMME029-05 | 5 | |
| Introduction to Data Science | WMME027-05 | 5 | |
| Computational Solid Mechanics | WMME028-05 | 5 | |
| Thermodynamics of Energy Conversion | WMME018-05 | 5 | |
| Advanced Process and Energy Technologies | WMCE012-05 | 5 | |
| Experimental Design | WMME012-05 | 5 | |
| Course in Business, Management and Society | Various | 5 | |
| Elective courses | | 25 | |
| Master Design Project Mechanical Engineering | WMME901-20 | 20 | Passed 45 ECTS of first year courses of the ME master programme |
| Master Research Project Mechanical Engineering | WMME902-40 | 40 | Passed 45 ECTS of first year courses of the ME master programme |

The assessment method of the courses can be found in the assessment plan of the degree programme and on ocasys.rug.nl.
The teaching method of the courses can be found on ocasys.rug.nl.

**Courses in Business, Management and Society**

| Course unit name | Course code | ECTS |
|---|---|---|
| Technology Based Entrepreneurship | WMIE006-05 | 5 |
| Global Change | WMEE008-05 | 5 |
| Sustainable Industrial Practice | WMIE027-05 | 5 |

**Joint project options for obtaining a master's degree in a closely related programme:**

| Course unit name | Course code | ECTS | Entry requirements |
|---|---|---|---|
| Master Research Project IEM-ME* | WMIE903-55 | 55 | - Passed 45 ECTS of first year courses of both the IEM and ME master programmes;<br>- Passed Research Methodology (IEM). |
| Master Design Project IEM** | WMIE901-25 | 25 | - Passed 45 ECTS of first year courses of both the IEM and ME master programmes;<br>- Passed Research Methodology (IEM). |
| Master's Research Project ME-EES*** | WMEE909-50 | 50 | - Passed 45 ECTS of first year courses of the ME master programme |

* The joint Master Research Project IEM-ME is available only to students enrolled in both the ME and IEM master programmes. This joint project replaces, and cannot be combined with, the regular Research Projects in both programmes.
** The IEM Design Project is available to students enrolled in both the ME and IEM master programmes. This project may substitute, or be followed in addition to, the Master Design Project ME.
*** The joint Master Research Project ME-EES is available only to students enrolled in both the ME and EES master programmes. This joint project replaces, and cannot be combined with, the regular ME Research Projects. For the entry requirements of EES, check the EES TER appendices.

# Appendix IV Electives (Article 3.9.1)

**Electives for Advanced Instrumentation Track**

| Course unit name | Course code | ECTS |
|---|---|---|
| Bio-Signal Processing for Human Machine Interaction | WMBE026-05 | 5 |
| Multibody and Nonlinear Dynamics | WMME009-05 | 5 |
| Robotics for IEM | WMIE005-05 | 5 |
| Scientific Visualization | WMCS018-05 | 5 |
| Space Mission Technology (for ME) | WMAS025-05 | 5 |
| Advanced Detection Techniques | WMME005-05 | 5 |
| Finite Element Methods and Applications | WMMA051-05 | 5 |
| Fitting Dynamical Models to Data | WMIE007-05 | 5 |
| MEMS, NEMS and Nanofabrication | WMIE010-05 | 5 |
| Microfluidics | WMME020-05 | 5 |
| Multiscale Contact Mechanics and Tribology | WMIE011-05 | 5 |
| Surface Engineering and Coating Technology | WMIE013-05 | 5 |
| Advanced Vibration | WMME030-05 | 5 |
| Applied Optics | WMME010-05 | 5 |
| Engineering Design Integration | WMIE029-05 | 5 |
| Modeling and Control of Complex Nonlinear Engineering Systems | WMMA020-05 | 5 |
| Product Design by the Finite Element Method | WMIE003-05 | 5 |
| Data-Driven Optimization | WMME011-05 | 5 |
| Medical Imaging Instrumentation | WMME014-05 | 5 |
| Opto-Mechatronics | WMME015-05 | 5 |
| Systems Engineering | WMIE021-05 | 5 |

**Electives for Smart Factories Track**

Each specialization has its own set of specialization specific electives. 15 ECTS (out of 25 ECTS) of electives needs to be chosen from the list of electives from one specialization. The remaining 10 ECTS can be chosen from any of the electives within the track.

Electives for the specialization Materials for Mechanical Engineering

| Course unit name | Course code | ECTS |
|---|---|---|
| Multibody and Non-Linear Dynamics | WMME009-05 | 5 |
| Finite Element Methods and Applications | WMMA051-05 | 5 |
| Multiscale Contact Mechanics and Tribology | WMIE011-05 | 5 |
| Surface Engineering and Coating Technology | WMIE013-05 | 5 |
| Advanced Polymer Processing | WMCE006-05 | 5 |
| Advanced Vibration | WMME030-05 | 5 |
| Smart Materials for Engineering | WMME021-05 | 5 |
| Composites and Metamaterials | WMME031-05 | 5 |
| Fracture of Materials | WMME023-05 | 5 |

Electives for the specialization Robotics, Mechatronics & Smart Systems

| **Course unit name** | **Course code** | **ECTS** |
|---|---|---|
| Bio-Signal Processing for Human Machine Interaction | WMBE026-05 | 5 |
| Multibody and Non-Linear Dynamics | WMME009-05 | 5 |
| Fitting Dynamical Models to Data | WMIE007-05 | 5 |
| MEMS, NEMS and Nanofabrication | WMIE010-05 | 5 |
| Advanced Vibration | WMME030-05 | 5 |
| Robotics for AI | WMAI011-05 | 5 |
| Modeling and Control of Complex Nonlinear Engineering Systems | WMMA020-05 | 5 |
| Smart Materials for Engineering | WMME021-05 | 5 |
| Data-Driven Optimization | WMME011-05 | 5 |
| Opto-Mechatronics | WMME015-05 | 5 |
| Systems Engineering | WMIE021-05 | 5 |

General track electives (not specialization related)

| **Course unit name** | **Course code** | **ECTS** |
|---|---|---|
| Basic Detection Techniques | WMAS002-05 | 5 |
| Scientific Visualisation | WMCS018-05 | 5 |
| Microfluidics | WMME020-05 | 5 |
| Engineering Design Integration | WMIE029-05 | 5 |
| Product Design by the Finite Element Method | WMIE003-05 | 5 |
| Polymer Physics | WMCH025-05 | 5 |

**Electives for Smart and Green Energy Systems Track**

| Course unit name | Course code | ECTS |
|---|---|---|
| Bio-based Products | WMCE001-05 | 5 |
| Interfacial Engineering | WMCE003-05 | 5 |
| Multibody and Non-Linear Dynamics | WMME009-05 | 5 |
| Finite Element Methods and Applications | WMMA051-05 | 5 |
| Microfluidics | WMME020-05 | 5 |
| Photovoltaics Science and Energy | WMCH011-05 | 5 |
| Surface Engineering and Coating Technology | WMIE013-05 | 5 |
| Advanced Vibration | WMME030-05 | 5 |
| Advanced Polymer Processing | WMCE006-05 | 5 |
| Analysis and Control of Smart Systems | WMIE015-05 | 5 |
| Engineering Design Integration | WMIE029-05 | 5 |
| Hydrogen, Fuels and Electrolysers | WMME019-05 | 5 |
| Modeling and Control of Complex Nonlinear Engineering Systems | WMMA020-05 | 5 |
| Processes, Energy and Materials Modelling | WMEE016-05 | 5 |
| Sustainable Electric Energy Storage | WMCH029-05 | 5 |
| Capita Selecta in Ocean Energy | WMME033-05 | 5 |
| Fracture of Materials | WMME023-05 | 5 |
| Fuel Cell Systems | WMEE015-05 | 5 |
| Systems Engineering | WMIE021-05 | 5 |

The assessment method of the courses can be found in the assessment plan of the degree programme and on ocasys.rug.nl.
The teaching methods and entry requirements of the courses can be found on ocasys.rug.nl.

# Appendix V Entry requirements and compulsory order of examinations (Article 4.4)

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

# Appendix VI Admission to the degree programme (Articles 2.1A1+2.1B.1)

Holders of the following Bachelor's degrees from research universities in the Netherlands will be admitted to the Master's degree programme:

1. BSc Mechanical Engineering
2. 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:

1. BSc Industrial Engineering and Management, Production Technology and Logistics specialization including the Mechanical Engineering specialisation package.

# Appendix VII Transitional provisions (Article 7.1)

The transitional arrangement is an arrangement that students can use if they wish to replace a course that is part of their Teaching and Examination Regulations, but either no longer exists or has been changed to a different course in a later set of Teaching and Examination Regulations. In some cases, an arrangement can consist of multiple courses. If a transition is not in the list of transitional arrangements, students will need permission of the Board of Examiners first.

| **Discontinued course units** | | | | **Substitute course units** | | | | |
|---|---|---|---|---|---|---|---|---|
| *Course unit code* | *Course unit name* | *EC TS* | *Final exam period* | *Course unit code* | *Course unit name* | *EC TS* | *Explanation* | *Equivalent Yes/No* |
| | | | | | | | | |

# Appendix VIII Additional requirements open degree programmes (Article 5.6)

**Open degree programme**

In exceptional circumstances, students wishing to pursue an open degree programme may file a request with the Board of Examiners. The Board of Examiners will evaluate whether the proposed curriculum meets the learning outcomes of the degree programme and can determine further conditions in their Rules and Regulations.