Tracks in the Master's program Mechanical Engineering

The tracks in the Master ME are a further **optional** specialization level in the Master ME. Students choose selected courses form the ME core and Specialization course list to complete a track. The structure of a track is always the same as the regular ME master structure. Students can also choose to follow the regular ME program since it is **not** required to complete a track in order to complete the master ME

- 20 EC Core Courses
- 20 EC specialization courses
- 15 EC free electives
- 5 EC skills courses
- 15 EC internship
- 45 EC graduation project

After completion of a track Students have to indicate to the CSA whether they want to have the name of the track on the course list and if so, which track. It is not possible to have more than one track name on the course list.

On the following pages the core and specialization courses of all tracks are listed. Mandatory courses are indicated in red. For all tracks 4 core courses and 20 EC specialization courses have to be chosen, but core courses can also be selected as a specialization course. Recommended free electives will be published elsewhere, but for some tracks expected prior knowledge or homologation courses are listed.

Advanced Manufacturing across the Scales (AMS)

Coordinators: Diletta Giuntini and Regina Luttge

Core courses:

- Microfabrication Methods (4UM00) Q1 and Q4
- Advanced Engineering Mathematics (4BM00) Q1
- Advanced Computational Continuum Mechanics (4MM10) Q1
- Experimentation for Mechanical Engineering (4BM20) Q2
- Scientific Computing for Mechanical Engineering (4EM30) Q3
- Engineering Optimization (4DM20) Q3
- Fracture Mechanics – Theory and Application (4MM50) Q4

Specialization courses:

- Composite and Light-weight Materials (4MM00) Q1
- Structural performance of polymers and polymer composites (4LM60) Q1
- Multiscale Modelling for Polymer Mechanics (4LM30) Q2
- Heat and Flow in Microsystems (4EM40) Q2
- Computational and Experimental Micro-mechanics (4MM20) Q2
- Integrated System Design (4CM70) Q2
- Non-linear Control (4DM30) Q3
- Lab on a chip Microdevices (4UM10) Q3
- Soft Materials Processing (4LM20) Q3
- OptoMechatronics (4CM90) Q3
- Modelling and Control of Manufacturing Systems (4DM40) Q4
- Rheology (4LM50) Q4
- Optics for Mechanical Engineers Q4
- Advanced and Additive Manufacturing (4MM60) Q4

Computational Engineering (CE)

Coordinators: Idoia Cortes Garcia and Michael Abdel Malik

Core courses:

- Control Engineering (4CM00) Q1 and Q3 DSD
- Advanced Engineering Mathematics (4BM00) Q1
- Advanced Computational Continuum Mechanics (4MM10) Q1 CEM
- Interfacial Transport Phenomena in Engineering Flows (4BM60) Q2 TFE
- Multibody and Non-linear Dynamics (4DM10) Q2 DSD
- Scientific Computing for Mechanical Engineering (4EM30) Q3
- Engineering Optimization (4DM20) Q3
- Fracture Mechanics – Theory and Application (4MM50) Q3 CEM

Specialization courses:

- Structural Dynamics and Vibro-Acoustics (4DM00) Q1 DSD
- Composite and Light-weight Materials (4MM00) Q1 CEM
- Gas Dynamics (4EM10) Q2 TFE
- Multiscale Modelling for Polymer Mechanics (4LM30) Q2 CEM
- Heat and Flow in Microsystems (4EM40) Q2 TFE
- Modeling Combustion (4BM30) Q2 TFE
- Computational and Experimental Micro-mechanics (4MM20) Q2 CEM
- Optimal control and reinforcement learning (4SC000) Q2 DSD
- Physical and data-driven modelling (4CM40) Q3 DSD
- Advanced Discretization Techniques (4EM60) Q4
- Analysis and design of networked dynamical systems (4DM70) Q4 DSD
- Rheology (4LM50) Q4 CEM
- Advanced and Additive Manufacturing (4MM60) Q4 CEM
- Monte Carlo Simulations for Energy Application (4EM80) Q4 TFE

Of the non-mandatory courses listed above, 15 EC has to be from one division, CEM, DSD or TFE. This is the division in which also the graduation project will be carried out. It is recommended to take the other 5 EC from another division.

Energy Conversion and Storage (ECS)

Coordinators: Noud Maes and Maja Rücker

Core courses:

- Advanced Engineering Mathematics (4BM00) Q1
- Experimentation for Mechanical Engineering (4BM20) Q2
- Sustainable Energy Sources (4EM70) Q2
- Interfacial Transport Phenomena in Engineering Flows (4BM60) Q2
- Scientific Computing for Mechanical Engineering (4EM30) Q3
- Engineering Optimization (4DM20) Q3

Specialization courses:

- Introduction to Computational Fluid Dynamics (4RM00) Q1
- Gas Dynamics (4EM10) Q2
- Heat and Flow in Microsystems (4EM40) Q2
- Microscale modeling of heat storage materials (4SE20ONL) Q2
- Modeling Combustion (4BM30) Q2
- Thermal Energy Storage (4EM50) Q3 2.5 EC
- Thermal energy storage and demand (4SE30ONL) Q3
- Hydraulic Turbomachines (4BM10) Q3
- Energy Geoscience (4BM50) Q3 2.5 EC
- Optical Diagnostics for Combustion and Fluid Flow (4BM40) Q4
- Clean Engines and Future Fuels (4AT020) Q4
- Energy transition – the path towards net zero (4CBLM00) interim

Only one of the two courses 4EM40 and 4SE20ONL can be selected. Only one of the two courses 4EM50 and 4SE30ONL can be selected.

Engineering Fluid Mechanics (EFM)

Coordinators: Nick Jaensson and Clemens Verhoosel

Core courses:

- Advanced Engineering Mathematics (4BM00) Q1
- Advanced Computational Continuum Mechanics (4MM10) Q1
- Interfacial Transport Phenomena in Engineering Flows (4BM60) Q2
- Experimentation for Mechanical Engineering (4BM20) Q2
- Scientific Computing for Mechanical Engineering (4EM30) Q3

Specialization courses:

- Introduction to Computational Fluid Dynamics (4RM00) Q1
- Gas Dynamics (4EM10) Q2
- Modeling Combustion (4BM30) Q2
- Heat and Flow in Microsystems (4EM40) Q2
- Lab on a chip Microdevices (4UM10) Q3
- Hydraulic Turbomachines (4BM10) Q3
- Physical and data-driven modelling (4CM40) Q3
- Optical Diagnostics for Combustion and Fluid Flow (4BM40) Q4
- Advanced Discretization Techniques (4EM60) Q4
- Rheology (4LM50) Q4

Engineering Solid Mechanics (ESM)

Coordinators: Markus Hütter and Ron Peerlings

Core courses:

- Advanced Engineering Mathematics (4BM00) Q1
- Advanced Computational Continuum Mechanics (4MM10) Q1
- Experimentation for Mechanical Engineering (4BM20) Q2
- Scientific Computing for Mechanical Engineering (4EM30) Q3
- Engineering Optimization (4DM20) Q3
- Fracture Mechanics – Theory and Application (4MM50) Q4

Specialization courses:

- Composite and Light-weight Materials (4MM00) Q1
- Structural performance of polymers and polymer composites (4LM60) Q1
- Multiscale Modelling for Polymer Mechanics (4LM30) Q2
- Computational and Experimental Micro-mechanics (4MM20) Q2
- Advanced Discretization Techniques (4EM60) Q4
- Advanced and Additive Manufacturing (4MM60) Q4

The graduation project should have a significant component or challenge of Solid Mechanics.

Materials for High-Tech Systems Design (MHS)

Coordinators: Lambèrt van Breemen and Joris Remmers

Core courses:

- Advanced Engineering Mathematics (4BM00) Q1
- Advanced Computational Continuum Mechanics (4MM10) Q1
- Experimentation for Mechanical Engineering (4BM20) Q2
- Scientific Computing for Mechanical Engineering (4EM30) Q3
- Engineering Optimization (4DM20) Q3
- Applications of Design Principles (4CM50) Q4

Specialization courses:

- Composite and Light-weight Materials (4MM00) Q1
- Structural performance of polymers and polymer composites (4LM60) Q1
- Multiscale Modelling for Polymer Mechanics (4LM30) Q2
- Computational and Experimental Micro-mechanics (4MM20) Q2
- Rheology (4LM50) Q4
- Advanced and Additive Manufacturing (4MM60) Q4

The graduation project should have a significant component or challenge of Mechanics in Design, High-Tech Applications or Systems Engineering.

Mechatronic Systems Design (MSD)

Coordinators: Ines Lopez Arteaga and Maarten Streinbuch

Core courses:

- Control Engineering (4CM00) Q1 and Q3
- Multibody and Non-linear Dynamics (4DM10) Q2
- Experimentation for Mechanical Engineering (4BM20) Q2
- Scientific Computing for Mechanical Engineering (4EM30) Q3
- Engineering Optimization (4DM20) Q3
- Applications of Design Principles (4CM50) Q4

Specialization courses:

- Structural Dynamics and Vibro-Acoustics (4DM00) Q1
- System Theory for Control (4CM10) Q1
- Integrated System Design (4CM70) Q2
- Advanced Motion Control (4CM60) Q2
- Optimal control and reinforcement learning (4SC000) Q2
- Technical Optics Q2
- Non-linear Control (4DM30) Q3
- Supervisory Control of cyber-physical systems (4SCXX) Q3
- Physical and data-driven modelling (4CM40) Q3
- OptoMechatronics (4CM90) Q3
- Modelling and Control of Manufacturing Systems (4DM40) Q4
- Hybrid Systems and Control (4CM20) Q4
- Optics for Mechanical Engineers Q4
- Advanced and Additive Manufacturing (4MM60) Q4

The bachelor course Design Principles (elective course after the curriculum revision) is a prerequisite for the MSD master track withing DSD. If you do not have this course in your ME bachelor program, you must include it as a homologation course in your master course list (note that for homologation purposes at most 15 ECs bachelor level 3 courses may be selected).

Robotics (Rob)

Coordinators: René van de Molengraft and Alessandro Saccon

Core courses:

- Control Engineering (4CM00) Q1 and Q3
- Multibody and Non-linear Dynamics (4DM10) Q2
- Experimentation for Mechanical Engineering (4BM20) Q2
- Scientific Computing for Mechanical Engineering (4EM30) Q3
- Engineering Optimization (4DM20) Q3
- Applications of Design Principles (4CM50) Q4

Specialization courses:

- System Theory for Control (4CM10) Q1
- Optimal control and reinforcement learning (4SC000) Q2
- Non-linear Control (4DM30) Q3
- Supervisory Control of cyber-physical systems (4SCXX) Q3
- Physical and data-driven modelling (4CM40) Q3
- Modelling and Control of Manufacturing Systems (4DM40) Q4
- Analysis and design of networked dynamical systems (4DM70) Q4
- Hybrid Systems and Control (4CM20) Q4

The following list shows for all core courses in which track they can be chosen as a core course:

- Advanced Engineering Mathematics: AMS, CE, ECS, EFM, ESM, MHS
- Control Engineering: CE, MSD, Rob
- Microfabrication Methods: AMS
- Interfacial Transport Phenomena in Engineering Flows: CE, ECS, EFM
- Advanced Computational Continuum Mechanics: AMS, CE, EFM, ESM, MHS
- Multibody and Non-linear Dynamics: CE, MSD, Rob
- Sustainable Energy Sources: ECS
- Experimentation for Mechanical Engineering: AMS, ECS, EFM, ESM, MHS, MSD, Rob
- Scientific Computing for Mechanical Engineering: AMS, CE, ECS, EFM, ESM, MHS, MSD, Rob
- Engineering Optimization: AMS, CE, ECS, ESM, MHS, MSD, Rob
- Fracture Mechanics – Theory and Application: AMS, CE, ESM
- Applications of Design Principles: MHS, MSD, Rob