Mechanical Engineering
High-Tech Engineering

To meet the steadily increasing requirements in all high precision engineering application areas, traditional mechanical engineering is pushed to extremes in precision, miniaturisation and multi-domain integration both for the products of tomorrow and the equipment to make those products. This requires a science-based engineering approach based on thorough understanding of not only mechanics and dynamics but also aspects such as thermodynamics, mechatronics, optics and system miniaturisation and integration.

Course Programme
The purpose of the MSc Track in High-Tech Engineering (HTE) is to educate engineers in the technological knowledge and skills they need to design a new generation of both the products and the required equipment that will enable even greater achievements.

Starting from the fundamentals of physics and mechanics, students gain the insights and understanding they will need to push beyond the current limits. The programme includes analysis, design and implementation of solutions, using analytical models, computational methods and experimental work to reach new performance and understanding. With this focus on the ‘ultimate in mechanical engineering’ the program confronts students with the daunting conceptual and design challenges of developing (and utilising) tools for precision mechanical engineering. Although the emphasis is on high tech equipment and instrumentation, the same knowledge and methodology applies to energy systems, medical equipment, automotive and aerospace design and many other fields of mechanical engineering, enabling these future engineers to address the needs of our modern society.

Focus Area
Next to the HTE obligatory courses students choose a research focus in which they want to deepen their knowledge:
- Mechatronic System Design (MSD) aims at designing integrated, high accuracy systems of mechanisms, sensors, actuators and control.

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<tr>
<th>Degree</th>
<th>Master of Science in Mechanical Engineering</th>
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<tr>
<td>Starts</td>
<td>September</td>
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<tr>
<td>Credits</td>
<td>120 ECTS, 24 months</td>
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<td>Language</td>
<td>English</td>
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<td>Application deadline</td>
<td>April 1st: international students</td>
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<tr>
<td></td>
<td>July 1st: Dutch degree</td>
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<td>Scholarships</td>
<td>scholarships.tudelft.nl</td>
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to perform complex tasks while interacting in a multi-physical environment, with a focus on distributed actuation, sensing and control.

- **Opto-Mechatronics (OM)** deals with high-tech systems where optical units dominate the speed and precision of operation, such as lithography for semiconductor production and for 3D metal printing, but also extreme accuracy measurement systems. By nature, this is a multidisciplinary field integrating optics and mechatronic system design, resulting in smart and adaptive optical systems.

- **Engineering Dynamics (ED)** studies the time-dependent linear and non-linear motion of mechanical structures to engineer dynamical systems using both mathematical and experimental methods. Material properties, thermodynamic interactions and physical actuation forces are studied for enhanced performance of high-speed devices.

- **Micro and Nano Engineering (MNE)** bridges the gap between the ultimate small and the macro world. The primary focus is on the production and assembly of precise and small parts and products of micrometer and nanometre scale.

- **Engineering Mechanics (EM)** deals with physics of mechanics and its experimental, mathematical and numerical tools, design procedures and innovative designs. Basic themes covered are Solid Mechanics, Dynamics, Computational Mechanics, Structural design and Optimization.

### Graduation examples

The subjects of the graduation projects of some of the past students are listed below.

- Topology optimization of dynamic structures
- New finite element formulations for computational contact mechanics
- Design of an improved 6DOF positioning stage with nanometre stability for AFM measurements
- Development of distributed on demand supply for air conveyor systems
- Deformable gripper design using distributed actuators
- AFM hollow cantilevers integrated with actuating systems
- A non-linear identification tool for extracting mechanical properties of graphene sheets
- High-resolution on-demand growth of nanodiamond and carbon nanotubes using femtome