Addressing fundamental questions and application challenges related to High-Tech Systems and Scientific Instrumentation with special emphasis on precision and the use of miniaturisation in Mechanical Engineering.

High-Tech Engineering (HTE)
The steady technology development of today pushes the performance of all kinds of equipment for electronics, health care, materials technology and many other fields to new extremes. To meet the new requirements, 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.
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 systems of mechanisms, sensors, actuators and control to perform complex tasks while interacting in a multiphysical environment, typically at high speed and high accuracy, at various length scales. Recent trends include distributed motion, as in compliant mechanisms, as well as distributed actuation and sensing, and control techniques based on fractional order calculus and reset strategies.

- **Engineering Dynamics (ED)** studies the time-dependent linear and non-linear motion of mechanical structures to engineer dynamical systems. Material properties, thermodynamic interactions and physical actuation forces are studied for enhanced performance of high-speed devices, using mathematical and experimental methods to elucidate and control their complex motions. Explore the ultimate limits of high-frequency nanoelectromechanical systems of atomic-scale dimensions.

- **Micro and Nano Engineering (MNE)** bridges the gap between the ultimate small and the macro world. Students learn to develop and optimise production and assembly processes and technologies which make use of phenomena at the nanometre level. The primary focus within the Micro and Nano Engineering group 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. It covers the foundations of mechanical engineering: the theoretical and experimental analysis of the statics and dynamics of structures and mechanical systems. Basic themes covered are Solid Mechanics, Dynamics, Computational Mechanics, Structural design and Optimization.

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**Curriculum High-Tech Engineering**

<table>
<thead>
<tr>
<th>First year (60 EC) *</th>
<th>ME Obligatory for all tracks (20 EC)**</th>
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<tbody>
<tr>
<td>Physics and Measurement for Mechanical Engineers (6 EC)</td>
<td>Control System Design (3 EC)</td>
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<tr>
<td>Heat Transfer (3 EC)</td>
<td>Nonlinear Mechanics (4 EC)</td>
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<tr>
<th>ME-HTE track Obligatory (25 EC)</th>
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<tbody>
<tr>
<td>Mechatronic System Design (4 EC)</td>
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<tr>
<td>Engineering Dynamics (4 EC)</td>
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<tr>
<td>Fundamentals of Mechanical Analysis (4 EC)</td>
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<tr>
<td>Intro lab PME (2 EC)</td>
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### Recommended Electives research areas* |

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<tr>
<th>EM</th>
<th>MSD</th>
<th>ED</th>
<th>MNE</th>
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<tbody>
<tr>
<td>Computational Methods (3 EC)</td>
<td>Predictive Modelling (3 EC)</td>
<td>Nonlinear Dynamics (4 EC)</td>
<td>Intro to Nanoscience and Technology (3 EC)</td>
</tr>
<tr>
<td>Functional Analysis (part of Intro lab PME)</td>
<td>Compliant Mechanisms (4 EC)</td>
<td>Experimental Dynamics (3 EC)</td>
<td>Micro- and Nanosystems for the life sciences (3 EC)</td>
</tr>
<tr>
<td>Other Electives</td>
<td></td>
<td>Intro to Nanoscience and Technology (3 EC)</td>
<td>(min) 14 EC (incl. recommended electives)</td>
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<th>Second year (60 EC) ***</th>
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<tr>
<td>Traineeship (optional) (15 EC)</td>
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* tentative, minor changes possible
** including a society oriented course
*** second year assignments can be joined in any combination
Graduation projects
The subjects of the graduation projects of some of the past students are listed below.

- Topology optimization of Dynamic structures
- Determination of critical loads for aeroplane wing optimisation
- 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
- Static balancing of reconfigurable mechanisms
- AFM Hollow Cantilevers Integrated with Actuating Systems
- Polymeric temperature micro sensor for wound monitoring
- A non-linear identification tool for extracting mechanical properties of graphene sheets
- High-resolution on-demand growth of nanodiamond and carbon nanotubes using femtopipette

Career prospects
The track prepares students to fulfill key positions in companies such as NXP, ADM, ASML, VDL, Airbus, Allseas, Siemens, SKF, BMW, MI Partners and Hittech or research institutes such as TNO and NLR. Many of these organizations are keen to hire our students to be future leaders or to join multidisciplinary teams working on mechanical innovations. Research oriented students with interest in teaching general basic aspects of Mechanical Engineering have also excellent perspectives for an academic career. Other opportunities include research at institutes or in the private sector and positions at engineering consultancy.

Student Association Taylor
The very active student association Taylor, aims to establish an active link between students and the department staff. By organizing various activities such as lectures and receptions, communication between MSc students and PhD researchers improves. Visits to industries are also organized. Aside from all these great activities the absolute highlight of the year is the annual “Taylor Trip”. During this international study trip companies are visited, whose core business align with the fundamentals and application fields of the track. Most activities will team up with the Opto-Mechatronics track as both belong to the department of Precision and Microsystems Engineering (PME).

My projects in the first year involved the design and prototyping of a tremolo part for an electric guitar based on compliant mechanisms, the optimization of the frame for a quadcopter and the design of a MEMS tribometer, which is being produced and is going to be used for measuring friction at the micro scale. For my graduation project I have been working on the design of a micro energy harvester to power a hearing aid system for children.

One of the most unique aspects for me is the departments community. The enthusiasm of the professors, the dedication of the students and the feeling of being on the cutting edge of science and engineering are giving the PME department its characteristic atmosphere that revolves around fun and performance. Additionally, the numerous activities hosted by the study association Taylor, including the study trip at the end of the year, promote the building of a close group of colleagues and lasting friendships.

I have pulled all-nighters struggling over an assignment, ordered pizza on the platform with my project group while working late, and celebrated the results of my efforts with free drinks during the receptions. If you are the kind of person that is intrigued by a challenge and is prepared to work hard for it, you will not regret choosing this track. For me, it has given me the opportunity to develop myself both as an engineer and as a person, and this opportunity will be there for you too.

I chose this track because I was looking for a challenging program that would educate me in solving the toughest engineering problems out there. The complex challenges of the high-tech industry are reflected in this track, making this easily one of the hardest mechanical engineering programs offered. When choosing this challenge be prepared to get thrown in the deep, time and time again. That being said, being part of this elite group of engineering students has been one of the best experiences in my life.

The program features hard core mechanical engineering. Starting from basic physical principles and fundamental mechanics you are introduced into the world of micro- and nanotechnology. For the applications of this knowledge a wide variety of projects is offered.

Thijs Blad (The Netherlands)

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Thijs Blad (The Netherlands)
Admission requirements and application procedure

**Dutch BSc degree**

In most cases, if you hold a BSc degree and the Master’s programme is closely related to your Bachelor’s programme, you will be admitted directly into the programme. However, if the Master’s programme does not follow directly from your undergraduate programme, you will be required to take additional courses in what is called a bridging programme. This may be a standard programme, or it may be tailored to your specific situation.

To see which Master’s programmes are open to you on completion of your Bachelor’s degree Dutch university, go to www.doorstroommatrix.nl.

Application goes through Studielink: tudelft.studielink.nl

**Dutch HBO degree**

An HBO Bachelor’s degree does not qualify you for direct admission to a TU Delft Master’s degree programme. To start a Master’s degree programme, you will first need to complete a supplementary programme in order to bring your knowledge to the required level. You can do this during your HBO programme by completing a bridging minor or by means of a bridging programme after securing your HBO diploma.

Entrance requirements for mathematics and English (some exceptions) apply for both the bridging minor and the bridging programme. See www.hbodoorstroom.tudelft.nl for detailed information.

Application goes through Studielink: tudelft.studielink.nl

**International applicants**

To be considered for admission to a MSc Programme you’ll need to meet TU Delft’s general admission requirements.

1. A BSc degree (or a proof that you have nearly completed a BSc programme) in a field closely related to the MSc programme.
2. A BSc Cumulative Grade Point Average (CGPA) of at least 75% of the scale maximum.
3. Proof of English language proficiency:
   - TOEFL with a minimum score of 21 for each section and an overall band score of at least 90 (internet-based test). Please note that we only accept the TOEFL internet-based test.
   - IELTS (academic version) with a minimum score 6.0 for each section and an overall Band score of at least 6.5.
   - or proof that you have passed the University of Cambridge ‘Certificate in Advanced English’ with a minimum grade B or the University of Cambridge ‘Certificate of Proficiency in English’.

For international students, the application period starts in October and closes on 1 April. To start an MSc application, fill in the online application and pay the refundable application fee of €100. Then send hard copies of the application documents to TU Delft’s International Office. Please note that you should apply early when you want to be considered for a scholarship as well!

For more information about the application procedure and studying at TU Delft in general, go to: www.admissions.tudelft.nl.

International Week

At the start of the academic year an Introduction Week is organized. You will be presented with introductions to the staff and the research of the groups, and get introductions to the main courses. At the end of the week you will be challenged to propose a preliminary study program. Hands-on assignments, communal lunches, drinks, a BBQ and the additional games & sports day on Friday are all aimed to build the HTE community.

There is also an introduction programme specifically for international students. The Central International Office, the Faculties and Dutch and international students from TU Delft, welcome the new international students to TU Delft with a special introductory programme. All new MSc students are required to take part in this introduction programme. This programme consists of an online preparation before arrival and an intensive introduction on Campus at TU Delft during the last weeks of August.

Further information

Please visit the webpage for all details, complete requirements, deadlines and contact information:
www.me.msc.tudelft.nl

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Further information for international applicants

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W: www.studyabroad.3me.tudelft.nl

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