FA4 Mechatronics and Robotics

LEARNING OBJECTIVES

The Mechatronics and Robotics track is specifically designed to equip mechanical engineering students with a comprehensive set of interdisciplinary skills spanning from applied mathematics to electrical and electronic engineering and automation engineering.
Students in this track will engage in a course that emphasizes the most commonly utilized actuators in engineering applications. Furthermore, they will delve into control theory, covering classical approaches and modern techniques. The curriculum also offers an applied mathematics course, allowing students to enhance their proficiency in nonlinear dynamics, partial differential equations, model order reduction methods, optimizing algorithms, or topological optimization methods.
In addition, students benefit from a broad array of elective courses, ranging from electronics to advanced controls and from robotic systems to mechatronic applications and state-of-the-art sensors. This diverse selection enables students to specialize in specific areas of interest within the expansive realm of mechatronics and robotics.

PRE-REQUISITES

While no specific prerequisites are required for students opting for the Mechatronics and Robotics track, a strong foundation in fundamental skills, particularly mathematics, and physics, is highly recommended. Additionally, possessing a profound understanding of mechanical system dynamics would be advantageous. Moreover, cultivating a curious mindset, driven to tackle and resolve complex, interdisciplinary, and multidisciplinary problems, is indispensable for thriving in this field.

FA4 Mechatronics and Robotics

LEARNING OUTCOMES

Students in the Mechatronics and Robotics track will gain a profound grasp of engineering principles, theories, and concepts encompassing mechanical, electrical, electronic, and computer engineering. They will develop advanced proficiency in designing, analyzing, implementing, and integrating complex and innovative applications that rely on their comprehensive understanding of system dynamics, sensors, actuators, signal processing, and feedback control. Moreover, students will acquire the problem-solving competencies to tackle real-world challenges bolstered by their teamwork and project management skills that facilitate effective collaboration within multidisciplinary teams.

MINORS

The Mechatronics and Robotics track allows students to pursue two specialized minors. The first minor centres on mechatronics, encompassing various applications such as electric and autonomous vehicles, smart farming practices, and MEMS sensors. The second minor focuses specifically on robotics, covering diverse areas, including industrial, collaborative, bio-inspired, and micro and nano-scale robotics. These minors add depth and specialization to the track, allowing students to develop expertise in their chosen area of interest.

FA4 Mechatronics and Robotics

JOB OPPORTUNITIES

The interdisciplinary nature of the Mechatronics and Robotics track opens up a wide range of career opportunities for students. Graduates can pursue employment in companies involved in developing and producing systems and products that necessitate a combination of mechanical components, sensors, drive systems, and control systems. In essence, the demand for mechanical engineers with mechatronics and robotics expertise extends to almost any industry imaginable, making this skillset highly sought after in the job market, from manufacturing and automotive to aerospace, healthcare, and beyond. This offers abundant avenues for professional growth and development.

PARTNER UNIVERSITIES

There are countless collaborations with the most prestigious international universities. By way of example, the universities where Mechatronics and Robotics students went to complete their thesis in the last year are the following: Xi'an Jiaotong University (XJTU, China), Korea Advanced Institute of Science and Technology (KAIST, Corea), Sungkyunkwan University (SKKU, Corea), Aalto University (Aalto, Finland), Otto-von-Guericke-Universität Magdeburg (OvGU, Germany), Rheinisch-Westfälische Technische Hochschule Aachen (RWTH Aachen, Germany), Technische Universität München (TUM, Germany), Keio University (Keio, Japan), Tokyo Denki University (Japan), Universidad del País Vasco (UPV, Spain), Chalmers Tekniska Högskola (Chalmers, Sweden), École Polytechnique Fédérale de Lausanne (EPFL, Switzerland), Eidgenössische Technische Hochschule Zürich (ETH Zurich, Switzerland), Technische Universiteit Delft (TU Delft, The Netherlands), Technische Universiteit Eindhoven (TUe, The Netherlands), California Institute of Technology (Caltech, USA), University of California, Davis (UC Davis, USA), and Virginia Tech (VT, USA).

FA4 Mechatronics and Robotics

1 YEAR COURSES

60 ECTS

45 ECTS

	ECTS
Data Analysis for Mechanical System Identification	10
Actuating Devices for Mechanical Systems	5
Advanced Dynamics of Mechanical Systems	10
Advanced Machine Design	10
Advanced Manufacturing Processes B	5
Smart Materials	5

10 ECTS

	ECTS
Methods and Technologies for Feedback Control Systems	10

FA4 Mechatronics and Robotics

5 ECTS

	ECTS
Nonlinear Dynamics and Chaos	5
Topology Optimisation	5
Nonlinear Optimization	5
Model Order Reduction Techniques	5
Numerical Analysis for Partial Differential Equations B	5

FA4 Mechatronics and Robotics

2 YEAR COURSES

40 ECTS + 20 ECTS Master's Thesis

10 ECTS

	ECTS
Mechatronic Systems A	10

5 ECTS

	ECTS
LAB - Noise, Vibration and Harshness Testing	5
LAB - Bioinspired Robotics	5
LAB - Innovative Applications of Industrial Robotics	5
LAB - Mechatronics	5
LAB - Metamaterials and Metastructures	5
LAB - Robotic Manufacturing	5
LAB - Haptics and Multisensory Interaction in Virtual and Augmented Reality	5

5 ECTS

	ECTS
Open Couse	5

FA4 Mechatronics and Robotics

20 ECTS

	ECTS
Machine Learning for Mechanical Systems	5
Swarm Intelligence	5
Nonlinear Control	5
Robust Control	5
Algorithmic Game Theory	5
Bio-inspired Robotics	5
Industrial Robotics	5
Micro and Nano Robotics	5
Soft Robotics	5
Collaborative Robotics	5
Sustainable Mobility Behavior and Policies	5
Autonomous Vehicles	5
Smart Farming	5
Hybrid and Electric Vehicles	5
Vehicle Dynamics and Control B	5

FA4 Mechatronics and Robotics

	ECTS
Mechanics and Design of Micro Electro Mechanical Systems - Sensors	5
Wind Turbine and Wind Farm Modelling and Control B	5
Edge-Device Based Measurements and Industry Internet of Things	5
Vision Based 3D Measurements	5
Functional Mechanical Design	5
Metamaterials and Metastructures	5
Smart Structures and Devices	5
Fundamentals of Electronics - Analog	5
Fundamentals of Electronics - Digital*	5
Sicurezza Elettrica	5
Electrical Drives for Industry and Transport Applications	5
Communication Technologies for Industrial and Vehicle Engineering	5
Failure Analysis, Sicurezza Industriale e Ingegneria Forense	5
Creativity for Sustainable Design	5

FA4 Mechatronics and Robotics

	ECTS
Extended Reality for Creativity in Design	5
Energy Conversion Technologies	5
Noise and Vibration Engineering	5
Reliable and Resilent Design of Mechanical Systems	5
Product Digital Twin	5
XR Applications for Engineering	5
Additive Manufacturing B	5
Digital Machining B	5
Digital Twins of Production Systems B	5
Digital Manufacturing	5
Smart Maintenance Management	5
Intellectual Property and Patents in Innovation	5
Applied Project Management **	5
Industrial Project Management A	5
Production Management	5
High-Tech Startups: Creating and Scaling Up	5
One (or more) of the above courses of 5 ECTS	5