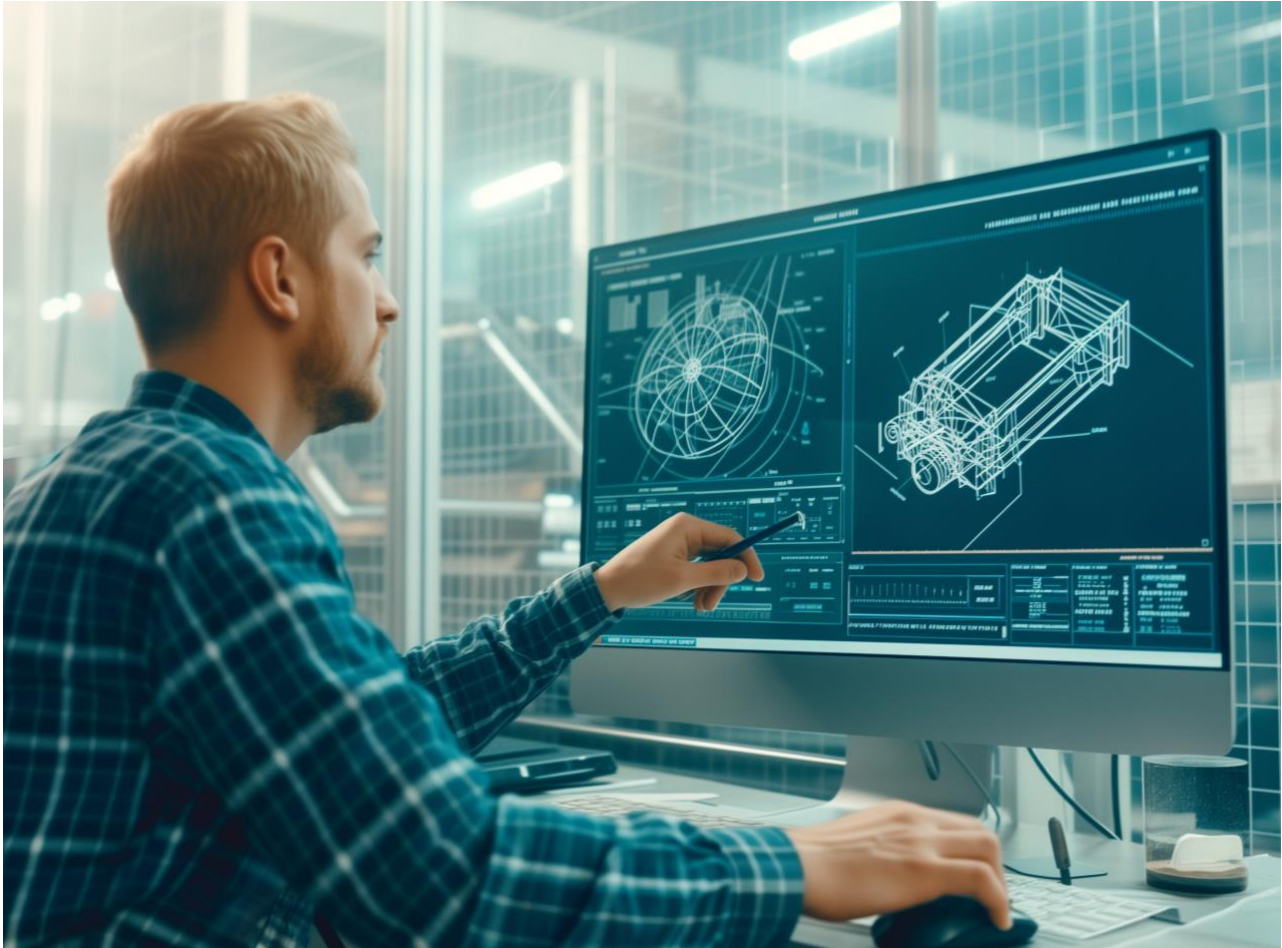# MECHANICAL ENGINEERING FOR PRODUCT INNOVATION



The Master's Degree in Mechanical Engineering for Product Innovation is a modern Mechanical Engineering Program, focusing on key areas of mechanical innovation, such as innovative materials (metal alloys, polymers, composites, nanomaterials), the latest mechanical design methodologies and simulations (static, fatigue, dynamic, thermal, aerodynamics) and the most advanced manufacturing processes and logistics systems. The Master program offers both theoretical courses and high level applied or research-oriented teachings within a framework of industrial competitiveness and sustainability, providing students with advanced knowledge and skills to model, design, and manufacture the products, processes, and industrial systems of the future.

# Study program

In order to guarantee a strong background in the area of Mechanical Engineering, mandatory teachings are offered in the fields of Mechanics of Materials, Innovative Metallic Alloys, Advanced Thermodynamics, Dynamics and Vibrations, Product and Process Engineering, Assembly Systems and Logistics, Product Development and Innovation.

The Program is completed with four different tracks, each with properly focused teachings:

- Advanced Mechanical Design
- Smart Digital Manufacturing
- Sustainable Materials and Design
- Multiphysics Simulation

The Master's degree programme culminates with an industrial internship (6 ECTS) and a thesis demonstrating mastery of the subject matter, autonomous working capabilities, and strong communication skills.
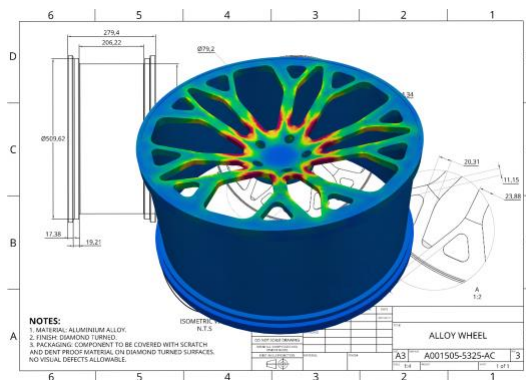


# List of Courses

## Compulsory Courses (for all Tracks)

| Year | Semester | Teaching | ECTS |
|------|----------|----------|------|
| I | 1 | Mechanics of Materials and Structures | 9 |
| I | 1 | Advanced Thermodynamics | 9 |
| I | 1 | Metallic alloys for product innovation | 9 |
| I | 2 | Dynamics and Vibrations | 9 |
| II | 1 | Product and manufacturing engineering | 9 |
| II | 1 | Assembly Sistems and Logistics | 9 |
| II | 1 | Product Develoment and Innovation | 9 |

# Track "Advanced Mechanical Design"

This track is focused on the latest mechanical design and simulation methodologies (static, fatigue, dynamic), including those necessary to effectively design advanced mechanical components with innovative materials such as composites, nanocomposites and polymers, also taking advantage of numerical tools.
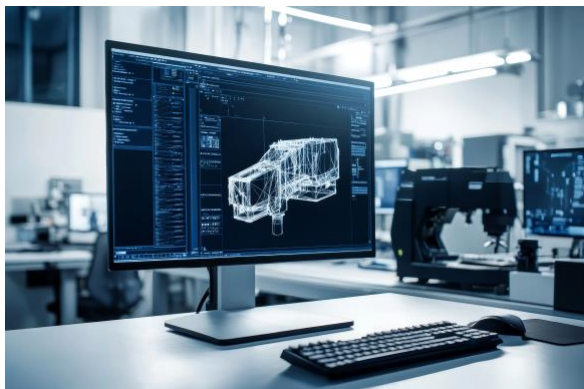
## Compulsory Courses for the Track

| Year | Semester | Teaching | ECTS |
|------|----------|----------|------|
| I | 2 | Lightweight design with composites | 6 |
| I | 2 | Finite Elements for structural design | 6 |
| I | 2 | Design of automatic machines | 6 |
| I | 2 | Applied Aerodynamics * | 6 |
| II | 1 | Advanced Design with polymers and polymeric composites* | 6 |

* One course to be chosen from these two

## Elective Courses for the Track

| Year | Semester | Teaching | ECTS |
|------|----------|----------|------|
| II | 1 | Advanced Methods for Geometric Modeling | 6 |
| II | 1 | Digital twins for automation | 6 |
| I | 2 | Multibody system dynamics and simulation | 6 |

# Track "Smart Digital Manufacturing"

This track is focused the knowledge related to the engineering design of advanced and automated manufacturing systems, including the design of automatic machines, maintenance management policies, advanced manufacturing technologies, digital twins for automation and collaborative robots.



## Compulsory Courses for the Track

| Year | Semester | Teaching | ECTS |
|------|----------|----------|------|
| I | 2 | Design of automatic machines | 6 |
| I | 2 | Maintenance Management | 6 |
| I | 2 | Quality and Metrology in Manufacturing | 6 |
| I | 2 | Multibody system dynamics and simulation* | 6 |
| II | 1 | Additive manufacturing* | 6 |

\* One course to be chosen from these two

## Elective Courses for the Track

| Year | Semester | Teaching | ECTS |
|------|----------|----------|------|
| II | 1 | Digital twins for automation | 6 |
| I | 2 | Simulation of metallurgical processes | 6 |
| I | 2 | Energy management in industry | 6 |

# Track "Sustainable Materials and Design"

This track is focused on industrial and product sustainability, such as material selection for sustainable design, material technology and recycling, green design, lightweight design, energy management in industry and circular economy.
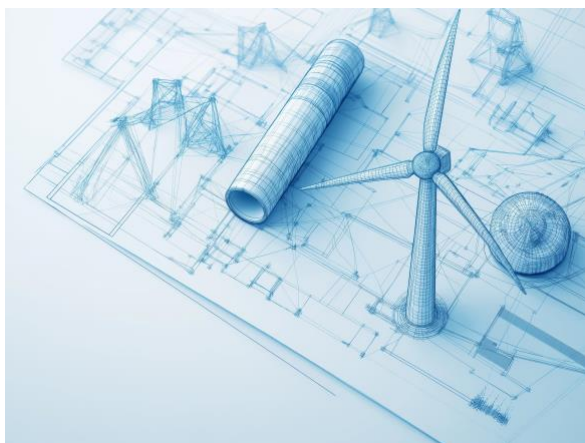
## Compulsory Courses for the Track

| Year | Semester | Teaching | ECTS |
|------|----------|----------|------|
| I | 2 | Energy management in industry | 6 |
| I | 2 | Lightweight design with composites | 6 |
| I | 2 | Selection criteria of metallic alloys | 6 |
| I | 2 | Maintenance Management* | 6 |
| II | 1 | Additive manufacturing* | 6 |

\* One course to be chosen from these two

## Elective Courses for the Track

| Year | Semester | Teaching | ECTS |
|------|----------|----------|------|
| II | 1 | Advanced Design with polymers and polymeric composites | 6 |
| I | 2 | Polymers Technology and Recycling | 6 |
| I | 2 | Urban Mining and Circular Economy | 6 |

# Track "Multiphysics Simulation"

This track is focused on advanced numerical simulation of innovative products in several fields of mechanical engineering, such as geometrical modelling, structural analyses, dynamic behaviour, process simulation, thermofluid dynamics, aerodynamics.
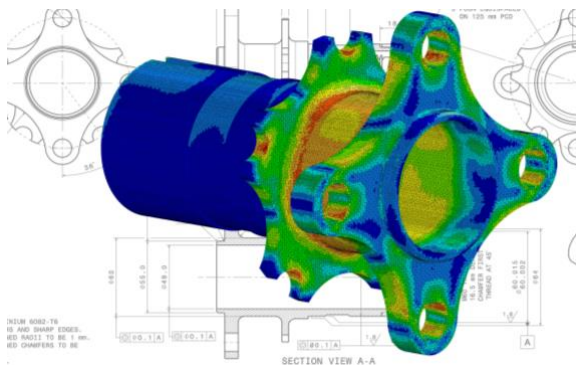



## Compulsory Courses for the Track

| Year | Semester | Teaching | ECTS |
|------|----------|----------|------|
| I | 2 | Multibody system dynamics and simulation | 6 |
| I | 2 | Finite Elements for structural design | 6 |
| I | 2 | Simulation of metallurgical processes | 6 |
| I | 2 | Applied Aerodynamics* | 6 |
| II | 1 | Advanced Methods for Geometric Modeling* | 6 |

\* One course to be chosen from these two

## Elective Courses for the Track

| Year | Semester | Teaching | ECTS |
|------|----------|----------|------|
| II | 1 | Numerical Thermo-Fluid Dynamics | 6 |
| I | 2 | Maintenance Management | 6 |
| I | 2 | Digital twins for automation | 6 |