Master of Science in Mechanical Engineering

Materials Design and Processing for Industrial Engineering



Contacts





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Track description

Materials are the bases of industrial engineering, leading to revolutions not only of products and processes but of the entire society. The design of new materials for ever more performing applications is required. Moreover, sustainability is fundamental for the planet safeguarding. The study of recycling, zero-emission processes, and circular economy is the basis for new materials development.

Skills

Students will learn how to:

- design new materials and production processes;
- manage all aspects connected to the environmental impact;
- plan the innovative actions for the zero-emissions approach;
- discuss the business principles for successful application; (such as speed to market and economic factors).



CM2: Core Courses

Course Title

Energy Conversion Technologies

Dynamics of Mechanical Systems

Machine Design

Advanced Manufacturing Processes B

Design and Management of Production Systems

Advanced Materials for Industrial Engineering

YEAR	SEM	ECTS	ECTS GROUP
1	1	5	5
1	1	5	5
1	2	5	5
1	1	5	5
1	2	10	10
1	2	10	10

CM2: Track Specific Courses

Course Title

Materials Engineering, Recycling and Environmental Impact A

Innovation in Materials and Products Production A

Energy Efficiency and Decarbonization of Industrial Processes

Vision Based 3D Measurements

Control of Mechanical Systems

Non-Distructive Testing and Evaluation for Materials and Components

Design and Analysis of Experiments

Sustainable Materials for Innovative Processes

Solidification and Welding Metallurgy

Elective courses

(Lightweight Design of Mechanical Structures - Composite Structures, Modelling of Mechanical Behaviour of Materials, Additive Ma Repairing and Re-manufacturing Processes, Failure Analysis, Sicurezza Industriale e Ingegneria Forense, ...)

Lab course

(Robotic Manufacturing, Materials Selection and Life Cycle Analysis)



	YEAR	SEM	ECTS	ECTS GROUP
	1	2	10	10
	2	1	10	10
	1	1	5	
	1	1	5	
	1	2	5	
	1	1	5	10
	1	2	5	
	1	1	5	
	1	2	5	
nufacturing B,	2	1-2	5	20
	2	2	5	5

CM2: Master's Thesis

Design and characterization of new materials and alloys Recycle and reuse of materials and by-products Terminal Ballistic and Analysis of Gun Shot Residues



Feasibility, optimization and monitoring of AM processes

Advanced Materials for Industrial Engineering - 10 ECTS

- Relationship between the production route, the final and the properties under operating conditions
- Special Steels
- Non-ferrous alloys (Al, Mg, Cu, Ni, Ti)
- Composite materials
- Damage phenomena during service

Materials Engineering Recycling and Environmental Impact - 10 ECTS

- Metal production processes and plants
- Environmental impact and recycling techniques inside the perspective of the circular economy.
- Technological route design for the maximization of performance and to minimize the used resources and the emissions of greenhouse gases.
- Basis of Life Cycle Assessment.

Innovation in Materials and Products Production - 10 ECTS

- Innovations for the production of alloys and final products
- Continuous casting and semisolid innovative casting process for lightweight applications
- Metallurgical aspects of plastic deformation for smart microstructure design
- Innovations in coatings with nanostructured material
- Innovation and digitalization for cost and emission reduction: lean manufacturing and design thinking applied to materials
- Innovation founding

Solidification and welding metallurgy - 5 ECTS

- Principles of solidification
- Industrial welding processes for metals
- Metallurgical phenomena happening during welding solidification
- Solid state metallurgy of weld
- Fracture toughness of welded joints
- Lab experience

5.845

Sustainable materials for innovative processes - 5 ECTS

- Densification mechanisms and powder metallurgy: sintering and solidification of powders under high-density power beams.
- Solidification by direct deposition and cladding with powders and wires.
- Alloy design with sustainable raw material
- Prevention of processing defects in powder processes.

Rhenium 186.21 Osmium 190.23



Failure Analysis, Sicurezza Industriale e Ingegneria Forense - 5 ECTS

- Introduzione alla Failure Analysis: Case Histories
- Frattura duttile e frattura fragile, infragilimento
- Fenomeni di fatica: morfologia dei cedimenti per fatica
- I fenomeni di corrosione: morfologia dei fenomeni di corrosione. La protezione dalla corrosione
- Fenomeni di usura e danneggiamento delle superfici
- Sicurezza industriale e Ingegneria forense: aspetti tecnico-legali legati ai cedimento in esercizio
- Aspetti civili e penali della professione di ingegnere