

# CC4 Bioinspired Engineering

## LEARNING OBJECTIVES

The Bio-inspired Engineering track aims to train mechanical engineers with interdisciplinary and multidisciplinary skills for ideating and designing innovative systems inspired by living organisms, sustainably utilizing available resources. These skills are essential and distinctive for addressing the significant technological and social challenges that the global population will face in the coming decades. Students in this program must take six cross-disciplinary core courses to prepare for a master's level mechanical engineering, followed by an introductory course that combines biology fundamentals for engineering with general principles of bio-inspired design. Subsequently, students can choose two courses from those characterizing the track, such as measurement tools for bionic systems, soft robotics, additive manufacturing, and bio-inspired structure design. Finally, they can select five elective courses from a broader pool to delve into topics of greater interest, ranging from materials to sustainability, from swarm intelligence to topological optimization.

## PRE- REQUISITES

Students opting for the Bio-inspired Engineering track are not required to have specific prerequisites. However, a solid foundation in engineering disciplines and an open mindset are recommended to prepare for designing radically innovative systems.



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## LEARNING OUTCOMES

A mechanical engineer focusing on Bio-inspired Engineering is a professional with a broad cultural background. Depending on the chosen courses in the curriculum, the graduate may have a highly multidisciplinary preparation extending beyond traditional mechanics or specialized skills in a specific bio-inspired engineering topic. In both cases, graduates from this program will possess advanced abilities in designing complex systems, problem-solving even in unexpected critical scenarios, developing unconventional solutions, and approaching sustainability in a way that surpasses current contradictions.

## JOB OPPORTUNITIES

Due to the versatility of the acquired skills, graduates from the Bio-inspired Engineering track can find employment in both the research and industrial sectors, spanning any production field and company size, where positions in design and innovation are present.

## PARTNER UNIVERSITIES

The topics covered in the Bio-inspired Engineering track are frontier research areas in various renowned universities and research centers, both in Italy and abroad. Specifically, there are collaborations with institutions such as Danmarks Tekniske Universitet (DTU, Denmark), Indian Institute of Science (IISc, India), Istituto Italiano di Tecnologia (IIT, Italy), Scuola Superiore di Studi Universitari e di Perfezionamento Sant'Anna (SSSA, Italy), Georgia Institute of Technology (Georgia Tech, USA), and James Madison University (JMU, USA).



# CC4 Bioinspired Engineering

## 1 YEAR COURSES 60 ECTS

### 40 ECTS

ECTS

<b>Energy Technologies for Efficient and Decarbonized Industry</b>	<b>10</b>
<b>Dynamics of Mechanical Systems</b>	<b>5</b>
<b>Advanced Machine Design</b>	<b>10</b>
<b>Advanced Manufacturing Processes B</b>	<b>5</b>
<b>Production Management</b>	<b>5</b>
<b>Advanced Materials for Mechanical Engineering</b>	<b>5</b>

### 10 ECTS

ECTS

<b>Systems Biology and Bio-Inspired Design</b>	<b>10</b>
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# CC4 Bioinspired Engineering

10 ECTS

	ECTS
Instrumentation and Measurements for Bionic Systems	5
Bio-inspired Robotics	5
Soft Robotics	5
Biomimetic Structure Design	5
Additive Manufacturing B	5

## 2 YEAR COURSES

40 ECTS + 20 ECTS Master's Thesis

5 ECTS

	ECTS
LAB - Bioinspired Robotics	5
LAB - Prototyping of Bioinspired Solutions	5

5 ECTS

	ECTS
Open Course	5

# CC4 Bioinspired Engineering

30 ECTS

ECTS

<b>Materials and Simulation Tools for Sustainable Processes</b>	<b>5</b>
<b>Introduction to Green and Sustainable Chemistry</b>	<b>5</b>
<b>Metamaterials and Metastructures</b>	<b>5</b>
<b>Swarm Intelligence</b>	<b>5</b>
<b>Modelling of Mechanical Behaviour of Materials</b>	<b>5</b>
<b>Topology Optimisation</b>	<b>5</b>
<b>Intellectual Property and Patents in Innovation</b>	<b>5</b>
<b>Creativity for Sustainable Design</b>	<b>5</b>
<b>Circular Industrial Systems</b>	<b>5</b>
<b>Smart Materials</b>	<b>5</b>
<b>Surface Treatment for Engineering Applications</b>	<b>5</b>
<b>Life Cycle Assessment of Materials and Processes</b>	<b>5</b>
<b>Microstructural Characterisation of Materials</b>	<b>5</b>
<b>Mechanics of Biological Structures</b>	<b>5</b>
<b>Strutture Bioartificiali e Biomimetiche</b>	<b>5</b>
<b>One (or more) of the above courses of 5 ECTS</b>	<b>5</b>

