COURSE DESCRIPTION – ACADEMIC YEAR 2025/2026

Course title	**Introduction to bioengineering**
Course code	42802
Scientific sector	IBIO-01/A
Degree	Master in Smart Technologies for Sports and Health (LM-32)
Semester	1 and 2
Year	1
Credits	12
Modular	Yes

Total lecturing hours	72
Total lab hours	48
Attendance	Preferrable. Non-attending students should contact the lecturer at the start of the course to agree on the modalities of the independent study
Prerequisites	Basics competences of physics.
Course page	Teams, OLE

Specific educational objectives	The course belongs to the type "altre attività". **MODULE 1: Bioengineering** Basic knowledge of the elements of bioengineering: biological tissues, biomaterials, implants and organs, life support system technologies, biological signals, biomedical instrumentation. **MODULE 2: Biosignal processing** Basic knowledge of biological signal processing, including peripheral physiological signals, EMG, eye and body tracking and brain signals, as well as knowledge of the operation and design of brain-body-computer interfaces.

Module 1	**Bioengineering**
Module code	42802A
Module scientific sector	IBIO-01/A
Credits	6
Lecturing hours	36
Lab hours	24
Lecturer	Prof. XXX
Contact	XXX.XXX@unibz.it
Scientific sector of lecturer	IBIO-01/A Bioengineering
Teaching language	English
Office hours	After consultation and agreement with lecturers
Lecturing assistant (if any)	-
Contact LA	-
Office hours LA	-
List of topics	• Fundamentals of biosystems and their environment; • Biological tissues: characterization and properties; • Biomaterials: overview, modelling, engineering, and characterization; • Biological signals: sources, classification;

	• Strategies for biosignal acquisition and biofeedback actuation (wearables, implants, smart pills, smart textiles); • Biosignal instrumentation: classification, regulation, and security.
Teaching format	Frontal lectures, homeworks, exercises, and laboratories.

Module 2	**Biosignal processing**
Module code	42802B
Module scientific sector	IBIO-01/A
Credits	6
Lecturing hours	36
Lab hours	24
Lecturer	Prof. XXX
Contact	XXX.XXX@unibz.it
Scientific sector of lecturer	IBIO-01/A Bioengineering
Teaching language	English
Office hours	After consultation and agreement with lecturers
Lecturing assistant (if any)	-
Contact LA	-
Office hours LA	-
List of topics	• Brain and body signals; • Processing of peripheral physiological signals (ECG, respiratory rate, skin conductance); • Processing of EMG signals; • Processing of eye and body tracking signals; • Processing of brain signals (electroencephalography, MEG, ECoG); • Brain and body computer interfaces.
Teaching format	Frontal lectures, homeworks, exercises, and laboratories.

Learning outcomes	**Knowledge and understanding** • Knowledge and understanding of biotechnological methods and technologies with a focus on biological tissues, biomaterials, implants and organs, life support system technologies, biological signals and biomedical instruments; • Knowledge and understanding of biosignal processing methods, with a focus on biosignal processing, including peripheral physiological signals, EMG, eye and body tracking and brain signals, as well as knowledge of the operation and design of brain-body-computer interfaces. **Applying knowledge and understanding** • Application of biotechnological methods and technologies to the design of smart smart systems for sport and health; • Application of biosignal processing methods and tools in the design of smart intelligent systems for sport and health; **Making judgments** • Ability to plan and re-plan the work of a technical project and to complete it within specified deadlines and objectives;

	• Ability to work independently and autonomously in small and large projects and with structural responsibilities. **Communication skills** • Ability to present the contents of a scientific and technical report within a given timeframe; • Ability to organize and write technical documentation; • Ability to develop and present technical content in English; • Ability to interact and collaborate with peers or professionals in the context of a project; • Ability to synthesize knowledge acquired through reading and studying scientific and technical documentation; preparation of reports and presentations. **Learning skills:** • Ability to independently expand on knowledge acquired during study by reading and understanding scientific and technical documentation in English; • Ability to expand knowledge, including incomplete knowledge, in the area of problem solving, taking into account the primary objective of the project.
Assessment	Final exam: the exam covers the topics addressed in MODULE 1 and MODULE 2 and consists of two parts: ● MODULE 1 (50% of the final exam): Oral exam and project work. The mark for each part of the exam is 18-30, or insufficient. The oral exam comprises verification questions, and open questions to test knowledge application skills. It counts for 50% of the total mark. The project consists of a project and verifies whether the student is able to apply the concepts taught or presented in the course to solve concrete problems. It is assessed through a final presentation, a demo, and a project report and can be carried out either individually or in a group of 2 students. It is discussed during the oral exam, and it counts for 50% of the total mark. ● MODULE 2 (50% of the final exam): Oral exam and project work. The mark for each part of the exam is 18-30, or insufficient. The oral exam comprises verification questions, and open questions to test knowledge application skills. It counts for 50% of the total mark. The project consists of a project and verifies whether the student is able to apply the concepts taught or presented in the course to solve concrete problems. It is assessed through a final presentation, a

	demo, and a project report and can be carried out either individually or in a group of 2 students. It is discussed during the oral exam, and it counts for 50% of the total mark.
Assessment language	English
Assessment Typology	Monocratic
Evaluation criteria and criteria for awarding marks	• MODULE 1: The final mark is computed as the weighted average of the oral exam and the project. The exam is considered passed when both marks are valid, i.e., in the range 18-30. Otherwise, the individual valid marks (if any) are kept for all 3 regular exam sessions, until all other parts are completed with a valid mark. After the 3 regular exam sessions, all marks become invalid. Relevant for the oral exam: clarity of answers; ability to recall principles and methods, and deep understanding about the course topics presented in the lectures; skills in applying knowledge to solve exercises about the course topics; skills in critical thinking. Relevant for the project: skill in applying knowledge in a practical setting; ability to summarize in own words; ability to develop correct solutions for complex problems; ability to write a quality report; ability in presentation; ability to work in teams. Non-attending students have the same evaluation criteria and requirements for passing the exam as attending students. • MODULE 2: The final mark is computed as the weighted average of the oral exam and the project. The exam is considered passed when both marks are valid, i.e., in the range 18-30. Otherwise, the individual valid marks (if any) are kept for all 3 regular exam sessions, until also all other parts are completed with a valid mark. After the 3 regular exam sessions, all marks become invalid. Relevant for the oral exam: clarity of answers; ability to recall principles and methods, and deep understanding about the course topics presented in the lectures; skills in applying knowledge to solve exercises about the course topics; skills in critical thinking. Relevant for the project: skill in applying knowledge in a practical setting; ability to summarize in own words; ability to develop correct solutions for complex problems; ability to write a quality report; ability in presentation; ability to work in teams. Non-attending students have the same evaluation criteria and requirements for passing the exam as attending students.

Required readings	• MODULE 1: All the required reading material will be provided during the course and will be available in electronic format. Copy of the slides will be available as well. • MODULE 2: All the required reading material will be provided during the course and will be available in electronic format. Copy of the slides will be available as well.
Supplementary readings	• MODULE 1: All the required supplementary reading material will be provided during the course. • MODULE 2: Suresh R. Devasahayam, Signals and Systems in Biomedical Engineering: Physiological Systems Modeling and Signal Processing, Springer, 2019. Pasquale Arpaia, Antonio Esposito, Ludovica Gargiulo, and Nicola Moccaldi, Wearable Brain-Computer Interfaces, Prototyping EEG-based Instruments for Monitoring and Control, CRC Press, 2023.
Software used	• MODULE 1: All the required software material will be provided during the course. • MODULE 2: All the required software material will be provided during the course.