COURSE OF STUDY *Physics (LM-17)*

ACADEMIC YEAR *2023-2024*

ACADEMIC SUBJECT *Electronic bio-sensors*

General information	
Year of the course	2nd
Academic calendar (starting and ending date)	1st semester: September - December 2023
Credits (CFU/ECTS):	3
SSD	CHIM/01
Language	English
Mode of attendance	Compulsory

Professor/ Lecturer	
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Department and address	Department of Chemistry, Floor 0, Office n. 7
Virtual room	------
Office Hours (and modalities: e.g., by appointment, on line, etc.)	Office hours upon appointment

Work schedule			
Hours			
Total	Lectures	Hands-on (laboratory, workshops, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
75	16	15	44
CFU/ECTS			
3	2	1	

Learning Objectives	*Electronic bio-sensors is a lecture course designed to provide MSc Students with an advanced knowledge on the development of novel biosensing platforms. Particularly, the course will focus on: (1) Physics of organic thin-film transistors, (2) Physical and chemical properties of electrolyte-gated devices, (3) Electrochemical biosensors (potentiometric and amperometric), (4) Enzyme-based Boolean Logic Gates and Mathematical Modelling of Enzyme-based Amperometric Biosensors (5) Machine learning based data analysis.*
Course prerequisites	*Solid State Physics, Semiconductor Structures, Laboratory of Digital Device, computational Physics*

Teaching strategy	*Lectures with projected slides, lab activity followed by data analysis. It is extremely important to use the material projected during the lectures. The course will be held in class.*
Expected learning outcomes in terms of	The course Electronic bio-sensors will supply the student with knowledge about electronic bio-sensors accounting for theoretical and practical skills.
Knowledge and understanding on:	o The course Electronic bio-sensors will supply the student with knowledge about electronic bio-sensors accounting for theoretical and practical skills.

Applying knowledge and understanding on:	o Ability to discuss on the development of novel electronic bio-sensors, data analysis and modelling.
Soft skills	● *Making informed judgments and choices* Ability to develop an electronic bio-sensor. ● *Communicating knowledge and understanding* Ability to write lab reports; Ability to discuss the knowledge acquired about the different topics both during the oral exam. Use the appropriate terminology. ● *Capacities to continue learning* o Compare data obtained by using different sensors.
Syllabus	
Content knowledge	***Biosensors: Theory and Applications (1 CFU, 8 hours):*** *Physics of organic thin-film transistors. Physical and chemical properties of electrolyte-gated devices. Electrochemical biosensors (potentiometric and amperometric). Single molecule biosensors working at the physical limit. Analytical figures of merit of biosensors.* ***Modelling of Enzymes-based Amperometric Biosensors (1 CFU, 8 hours):*** *Enzyme-based Boolean Logic Gates and Mathematical Modelling of Enzyme-based Amperometric Biosensors.* ***Data analysis (1 CFU, 15 hours):*** *Machine learning based data analysis. Lab activity.*
Texts and readings	*Some course materials will be provided as electronic (pdf) files. Particularly the following electronic books (RECOMMENDED, not REQUIRED) will be available for the students:* 1. *E. Katz. Enzyme-Based Computing Systems. Wiley-VCH Verlag GmbH & Co. KGaA. ISBN: 9783527345700.* 2. *Fondamenta per la Chimica Analitica (pubblicato, con il patrocinio di SISNIR, con ISBN: 9788890406461*
Notes, additional materials	*All slides and additional material will be supplied as complementary study material.*
Repository	*OneDrive, GoogleDrive*

Assessment	
Assessment methods	*Oral Exam*
Assessment criteria	● *Knowledge and understanding* Evaluation at the oral exam with questions about the different topics encountered during the course. Correct terminology. Knowledge of equations. ● *Applying knowledge and understanding* Evaluation of lab activity. Knowledge of equations and their application to practical cases. ● *Autonomy of judgment* Auto-evaluation through the interactive questions at the end of each lecture. Additional explanations and clarifications will be given during office hours. ● *Communicating knowledge and understanding* Ability to discuss about a specific topic with the correct terminology, with a critic evaluation of the analytical methods discussed during the class. ● *Capacities to continue learning* Ability to compare results obtained with complex analytical approaches.
Final exam and grading criteria	Evaluation of the answers on the different topics encountered during the course. Correct terminology. Knowledge of equations.
Further information	
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