UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Fisica e Chimica - Emilio Segrè		
ACADEMIC YEAR	2022/2023		
MASTER'S DEGREE (MSC)	PHYSICS		
INTEGRATED COURSE	BIOPHOTONICS WITH LABORATORY		
CODE	22663		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	FIS/07		
HEAD PROFESSOR(S)	VETRI VALERIA	Professore Ordinario	Univ. di PALERMO
OTHER PROFESSOR(S)	SANCATALDO GIUSEPPE VETRI VALERIA	Ricercatore a tempo determinato Professore Ordinario	Univ. di PALERMO Univ. di PALERMO
CREDITS	6		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	2		
TERM (SEMESTER)	1° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**SANCATALDO GIUSEPPE** Monday 11:00 13:00 Edificio 18 viale delle scienze **VETRI VALERIA** Monday 15:00 17:00 Viale delle Scienze Edificio 18		

DOCENTE: Prof.ssa VALERIA VETRI

PREREQUISITES	Required preliminary knowledge is obtained by attending the first year lectures with particular focus to Statistical Physics and Laboratory Spectroscopy courses
LEARNING OUTCOMES	Knowledge and understanding Students acquire: knowledge on biosystems, their structure, organization and interactions; a familiarity with the scientific method of investigation and with its application to biological systems of physical interest; laboratory skills in the field of biophysics. Ability to apply knowledge and understanding: Students are able to apply the scientific method to a broad spectrum of biophysical problems; are able to operate in biophysics laboratories both in the field of scientific research and in the field of scientific support for industrial, medical, health and environmental, energy saving and cultural heritage activities. Autonomy of judgment Students are able to carry out, with good independence, the activities indicated in the previous point, through a continuous exposure to questions, discussions and problems related to research in biophysics. The laboratory tests, aimed at group work and the drafting of written reports, are carried out in minimum driving conditions to ensure a high degree of ability in managing complex situations. Communication skills Students acquire the ability to discuss the results of biophysical studies with language suitable language also to a non-expert audience. Students acquire the ability to write complete scientific reports on laboratory activities also carried out in a collaborative form (group activities). Learning skills The lessons and laboratory activity carried out allows to acquire: the ability to independently analise a new scientific problem; the ability to look for new sources of information and references ; the ability to face and solve the ordinary problems during laboratory activities in the biophysical field
ASSESSMENT METHODS	The final exam consists of an exam-interview on topics covered during the lessons and in the preparation and subsequent discussion of a report on the activity carried out by the student in the laboratory. The laboratory report must contain a brief theoretical introduction to the topic, a detailed description of the experimental set-ups used, a description of the experiments carried out and finally a discussion on the data obtained and their interpretation. The drafting of a report is aimed at producing a document that identifies and clearly states the fundamental elements of the experimental activity and the goals. During the interview and discussion of the laboratory report, the candidate's knowledge and ability to apply it are assessed. This test also allows to evaluate the possession of suitable scientific language and ability of make a clear and direct scientific discussion . The final evaluation, graded on a scale of 30, will be formulated on the basis of the following conditions: a) basic knowledge of the topics and experimental techniques covered by the two modules, sufficient degree of awareness and autonomy in the discussion and defense of the report on laboratory activity, sufficient level of scientific language and communication skills (18-22); b) good knowledge of the topics and experimental techniques covered by the two modules, a fair degree of awareness and autonomy in the discussion and defense of the report on the laboratory activity, good level of scientific language and communication skills (23-26); c) in-depth knowledge of the topics and experimental techniques covered by the two modules, a good degree of awareness and autonomy in the discussion and defense of the report on the laboratory activity, excellent level of scientific language and communication skills (27-30 cum laude);
TEACHING METHODS	The didactic activities of the two modules will take place in succession. Teaching activity includes both face to face lessons and laboratory activities (with MANDATORY ATTENDANCE) which will be carried out by students organized in small groups. During the lectures (and in any case before the final exam) students are required to submit written reports on the experiences carried out in the laboratory. These reports, if submitted in suitable time, are discussed during the semester in order to guide the student in learning advanced methods of data analysis and in the interpretation of scientific data.

MODULE
INTRODUCTION TO BIOPHOTONICS AND WET LAB

Prof. GIUSEPPE SANCATALDO

SUGGESTED BIBLIOGRAPHY

TESTO BASE (BASIC TEXTBOOK)
Serdyuk, Zaccai, Zaccai, Methods in Molecular Biophysics, Ed. Cambridge University Press. 1st or 2nd edition, ISBN 9781107056374
TESTO DI APPROFONDIMENTO (SUPPLEMENTARY TEXTBOOK)
Van Holde, Principles of Physical Biochemistry, Ed. Pearson, 2nd edition, ISBN 9780132017442

AMBIT	20901-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	51
COURSE ACTIVITY (Hrs)	24

EDUCATIONAL OBJECTIVES OF THE MODULE

The aim of the module is to introduce the student to the study of biological matter using basic physics methods and methodologies, with particular attention to the structure, organization and interaction of biosystems. Educational objectives are: the acquisition of knowledge of physical phenomena in biological matter and of experimental techniques particularly useful for the study of the structural properties of biosystems and molecular interactions. The course also aims to provide the knowledge and skills necessary for carrying out a "wet" laboratory activity in the biophysical field and for the applications of biophotonics.

SYLLABUS

Hrs	Frontal teaching
4	Course introduction, exam evaluation methods. Biosystems. Structure and function of proteins and DNA. Cell and tissue organization. Biomimetic compartments.
6	Biophotonics. Radiation-biological matter interaction. Absorption, diffusion and luminescence of biological systems. Light sources. Optical sensors and biosensors.
6	General equipment and techniques of Biological Physics laboratory. Samples preparation: dilution, filtration and analysis of molecular properties using biophysical investigations. Measurement of the concentration of a protein solution.

Hrs	Workshops
16	Preparation of buffer solutions, preparation of solutions of proteins and fluorescent molecules. Measurement of the concentration of proteins in solution. Classical experiments for structure-property-morphology characterization.

MODULE
LAB OF BIOPHOTONICS

Prof.ssa VALERIA VETRI

SUGGESTED BIBLIOGRAPHY

TESTO BASE (BASIC TEXTBOOK)
Pawley J.B., “Handbook of Biological Confocal Microscopy”, Third edition, Plenum Press, 2006. ISBN: 978-0-387-45524-2

TESTO DI APPROFONDIMENTO (SUPPLEMENTARY TEXTBOOK)
Lakowicz J.R. "Principles of Fluorescence Spectroscopy" Springer ISBN 978-0-387-46312-4

AMBIT	20901-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	35
COURSE ACTIVITY (Hrs)	40

EDUCATIONAL OBJECTIVES OF THE MODULE

This part aims at providing the student with concepts related to advanced experimental techniques with applications to biophysics and nanotechnologies. These concepts form the basis for the development of experimental analyzes in related fields. The goal is to develop the abilities in the design and conduct of advanced fluorescence microscopy experiments through the use of FLIM (time-resolved fluorescence microscopy (ns)) experiments that highlight the structure-property-function correlation of the samples under analysis. The fundamentals of analysis and interpretation of the data obtained from advanced fluorescence microscopy will be provided.

SYLLABUS

Hrs	Frontal teaching
4	Biosystems characterized by high conformational heterogeneity: theory, experimental analysis and characterization.
6	Fluorescence and fluorescent probes. Fluorescence and confocal microscopy. Optical sectioning and three-dimensional imaging. Spectroscopic analysis in 4D (x, y, z, t).
6	Nanosecond Time Resolved Fluorescence Microscopy (FLIM). Analysis of nano- and bio-systems and of the molecular interactions involved. Theory, experimental development and optimization and data analysis.

Hrs	Workshops
12	Characterization of the structure-property relationship of bionanosystems. Development of one experiment (on a selected topic in student-teacher agreement) on topics related to biophysics and nanotechnologies: bionanosystems and their molecular dynamics / interaction will be analyzed using confocal fluorescence microscopy and FLIM. Data analysis by standard fit and phasor approach of fluorescence life times.