UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Fisica e Chimica - Emilio Segrè		
ACADEMIC YEAR	2018/2019		
MASTER'S DEGREE (MSC)	PHYSICS		
INTEGRATED COURSE	BIOSYSTEMS PHYSICS WITH LABORATORY		
CODE	19778		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	FIS/07		
HEAD PROFESSOR(S)	EMANUELE ANTONIO	Professore Associato	Univ. di PALERMO
OTHER PROFESSOR(S)	COTTONE GRAZIA	Professore Associato	Univ. di PALERMO
	EMANUELE ANTONIO	Professore Associato	Univ. di PALERMO
CREDITS	6		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	2		
TERM (SEMESTER)	1° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**COTTONE GRAZIA**		
	Monday 15:00 17:00 Studio 102 Dip. DIFC, viale delle Scienze, Ed. 18, primo piano		
	Wednesday 15:00 17:00 Studio 102 Dip. DIFC, viale delle Scienze, Ed. 18, primo piano		

DOCENTE: Prof. ANTONIO EMANUELE

PREREQUISITES	Prerequisites are fulfilled by attending subjects of the first year and specifically all activities of Statistical Physics and Spectroscopy with Laboratory
LEARNING OUTCOMES	Knowledge and understanding Students acquire the knowledge of protein structure, of protein interactions; Modeling and computer visualization of proteins; they become comfortable with the scientific method and its application to relevant biological systems; they acquire laboratory skills in biophysical laboratory. Applying knowledge and understanding Studente are able of applying scientific method to a variety of biophysical problems; they are capable to work in biophysical laboratories in the scientific area of industrial, healthcare, medical industry and also in activities related to environment, energy saving and cultural heritage. Making judgements Students are capable of doing, without guide, activities reported on the previous item by means of immersion in question, problems and discussions of biophysical research; they do laboratory work inside a group with minimal tutoring action to develop student independence in handling complex tasks. Communication skills Students acquire abilities of reporting results of biophysical research with competent wording also speaking with off-topic people. Students acquire abilities in writing complete scientific reports of their laboratory work done in cooperative (group) form. Lifelong learning skills Students have the ability of autonomously studying new scientific problems; they have the ability of resolve ordinary difficulties of biophysical laboratory.
ASSESSMENT METHODS	Assessment is done by oral evaluation done by a discussion of lecture topics and by preparation and discussion of a laboratory report. Laboratory report usually includes a brief theoretical introduction of the selected topic, a detailed description of experimental setup, a description of performed experiments, and data discussion and interpretation. Experiments and report are done by groups of usually three students to stimulate critical discussion of subject topics. Report drafting and editing should be done to evidence in a clear-cut style the fundamental grounds of the experimental work and its goals. In the discussion the student has to show and to defend the laboratory report. During the discussion of the topics and of the laboratory report the student's knowledge and his/her abilities of applying them are assessed. The use of appropriate scientific and technical language is also assessed. Final evaluation (out of 30, starting from 18) will be issued on the following grounds: a)basic knowledge of I modulo topics and of experimental techniques of the II modulo, sufficient awareness and independence during the discussion and the defense of experimental report, sufficient skills on scientific language (18-22); b)good knowledge of theoretical topics and of experimental techniques, good awareness and independence during the discussion and the defense of experimental report, good skills on scientific language (23-26); b)very good or excellent knowledge of theoretical topics and of experimental techniques, very good awareness and independence during the discussion and the defense of experimental report, excellent skills on scientific language (27-30 e lode);
TEACHING METHODS	The whole subject is scheduled on first semester of the second year and contains two subject: Biosystems physics and Laboratory of Biophysics. Students have to attend frontal teaching and laboratory activities (MANDATORY ATTENDANCE).

MODULE
BIOPHYSICS LABORATORY

Prof. ANTONIO EMANUELE

SUGGESTED BIBLIOGRAPHY

Manuali di uso e manutenzione della strumentazione (bilancia analitica, pH-metro, termostato, termometro con sonda Pt-100, centrifuga).
Charles S. Johnson and Don A. Gabriel, Laser Light Scattering, Dover Classics of Science & Mathematics, Dover Publications Inc.
Testi di approfondimento
B. Berne and R. Pecora, Dynamic Light Scattering, Dover Publications Inc.
Charles R. Cantor and Paul R. Schimmel Biophysical Chemistry: Techniques for the Study of Biological Structure and Function Pt. 2, W.H.Freeman & Co Ltd

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

EDUCATIONAL OBJECTIVES OF THE MODULE

The subject is devoted to provide the knowledge and skills needed to do typical jobs of biophysical laboratory including spectroscopical determination of concentration of protein in aqueous solution. It also provide the basics of scattering techniques.

SYLLABUS

Hrs	Frontal teaching
8	Tools and techniques of a biophysical laboratory: analitic scale, pH-meters, bottles and sample holders, small tools. Sample preparation, dilution, filtration, ultrafiltration, centrifugation. Temperature measurements. Temperature control systems. Liquid cromatography. Concentration determination of a protein solution.

Hrs	Workshops
16	Preparation of buffer solutions and protein solutions. Concentration determination of a protein solution.
16	Static and dynamic light scattering: basic instrumentation and measurements of hydrodynamic radius of nanoparticles solutions.

MODULE
PHYSICS OF BIOSYSTEMS

Prof.ssa GRAZIA COTTONE

SUGGESTED BIBLIOGRAPHY

Introduction to protein structure, C Branden, J. Tooze
Protein physics: a course of lectures, A. V. Finkelstein, O. B. Ptitsyn

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

EDUCATIONAL OBJECTIVES OF THE MODULE

The purpose of the course is to introduce students to the study of biological matter via physical methods and methodologies with particular reference to the structure of soluble and membrane proteins and to molecular interactions.
Educational objectives are: the acquisition of knowledge of physics phenomena in biological matter and of experimental techniques particularly useful for the study of structural propertiesof biosystems and of the molecular interactions, with the aim to show how physical methods can provide essential tools in understanding biological systems, allowing to have a more complete vision of them.

SYLLABUS

Hrs	Frontal teaching
8	Primary structure: aminoacids, pH, pK, isoelectric point, sequence alignments. Peptidic bond, the backbone, Ramachandran angles, other dihedrals, dihedral potentials and energy barriers. Secondary structure: helix alpha, 3-10 helix, pi helix, helix dipole moment, parallel and antiparallel beta sheet, turns, hairpin, random loops. Tertiary structure: structural motifs, supersecondary structure, topology diagrams, alpha, beta and mixed alpha-beta tipology, four helix bundle, globin fold, hemeproteins. Quaternary structure: dimeric, trimeric, ...,virus proteins. Protein classification: based on structure, based on fuction, conjugate proteins, prosthetic groups; alpha and beta fibrous proteins. Membrane proteins: porine, G-coupled, bacteriorodhopsin and its photocycle, ion channels voltage and ligand gated, reaction center.
2	Determination of protein structure: X-ray diffration; monodimensional and bidimensional NMR.
6	Modeling and visualization of proteins in the computer lab
8	Space-time scales of motion in biomolecules; time and free energy: the Arrhenius Law. Interactions in proteins: non covalent interactions, van der Waals, Lennard-Jones potential, electrostatic interactions, salt bridges, hydrogen bond, hydrophobic effect, hydrophobic interactions. Protein folding: folding and denaturation, folding and primary structure, the Anfinsen experiment, the Levinthal paradox, cooperative processes, Dill funnel, other models. Chemical and thermal denaturation, calorimetry, calorimetric studies of thermal denaturation, temperature and entalpy of denaturation, pH effects, cold denaturation, heat capacity at constant pressure in the unfolded states and molecular models; chaperonines.