UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Fisica e Chimica - Emilio Segrè
ACADEMIC YEAR	2024/2025
MASTER'S DEGREE (MSC)	PHYSICS
SUBJECT	BIOPHYSICS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50337-Sperimentale applicativo
CODE	22022
SCIENTIFIC SECTOR(S)	FIS/07
HEAD PROFESSOR(S)	COTTONE GRAZIA Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
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.ssa GRAZIA COTTONE

PREREQUISITES	The prerequisite for profitably attending the course and achieving the goals it seeks is the knowledge of chemistry, classical and quantum physics, and statistical mechanics.
LEARNING OUTCOMES	Knowledge and understanding: acquisition of knowledge of physics of biosystems and of the main theoretical/ experimental metodologies for the study of the structure, function and dynamics of biological macromolecules. Apply knowledge and understanding: application of the scientific method to a wide range of biophysical problems. Making judgments: development of critical analysis of the textbooks proposed for studying research cases and applications. Being able to remark the importance and highlight the consequences of the analyzed scientific studies. Communication skills: development of the ability to present orally ideas, problems and solutions. Ability to highlight the achievements of biophysical studies with a proper language. Learning skills: ability to deepen the concepts presented during the course, through the study of different textbooks. Ability to update the knowledge via the consultation of scientific publications in the field.
ASSESSMENT METHODS	The final exam consists of an oral test, an examination - interview about the topics covered in the course. This test allows to evaluate, in addition to the knowledge of the candidate and his ability to apply them, even the scientific language skills and the ability of a clear and direct presentation. Grades are on a scale of 30. The final assessment, properly graded, will be made on the basis of these conditions: a) the student has poor basic knowledge of the main topics of the course, very little or no ability to independently apply the knowledge gained (rating: insufficient); b) the student has a minimum basic knowledge of the main topics of the course, very little ability to independently apply the knowledge gained (rating: 18-21 out of 30); c) the student does not have full mastery of the subjects studied, but he/she has the knowledge, satisfactory language skills, sufficient ability to independently apply the knowledge gained (rating: 21-23 out of 30); d) the student has basic knowledge of the topics studied, fair language skills, sufficient ability to independently apply the knowledge to the solution of the proposed problems (rating: 23-25 out of 30); d) the student has good mastery of the subjects, good ability in analysing the presented phenomena, full language skills (rating: 26-29 out of 30) ; e) the student has thorough and widespread knowledge of the topics studied, excellent ability in analysing the presented phenomena, excellent language skills (rating: 30-30L out of 30). Compensatory tools and dispensatory measures will be guaranteed by the Disability and Neurodiversity Center - University of Palermo (Ce.N.Dis.) to students with disabilities and neurodiversity, based on specific needs and in implementation of current legislation.
EDUCATIONAL OBJECTIVES	The purpose of the course is to introduce students to the study of biological soft matter via physical models, methods and methodologies with particular focus on soluble and membrane proteins. Educational objectives are: the acquisition of theoretical knowledge of physics phenomena in biological matter and of basic spectroscopic techniques particularly useful for the study of structural and dynamic properties of biosystems; the application to a selection of topics of current interest in Biophysics, with the aim to show how physical methods can provide essential tools in understanding biological phenomena, allowing to have a more complete vision of them. .
TEACHING METHODS	The teaching activity is developed through lectures in the classroom (48 Hours).
SUGGESTED BIBLIOGRAPHY	Protein physics: a course of lectures, A. V. Finkelstein, O. B. Ptitsyn, II Edizione 2016, ISBN 978-0-12-809676-5 Basic textbook Introduction to protein structure, C Branden, J. Tooze, II Edizione 2013, ISBN 978-0-8153-2305-1 Basic textbook

	Scientific papers on biophysical topics

SYLLABUS

Hrs	Frontal teaching
1	Introduction to the course. Biophysics and relative fields of inquiry. Textbooks.
8	STRUCTURE OF PROTEINS: Chemical and physical properties of the aminoacids. pH and pK. Isoelectric point. Primary and secondary structure. Energy potential and barriers for backbone dihedrals. Super-secondary motifs. Tertiary structure. Globin family. Quaternary structure. Classification of proteins based on structure and function. Conjugated protein and prosthetic groups. Heme proteins. Fibrous proteins.
6	Function in protein models. Membrane proteins bacteriorhodopsin and the photocycle; ligand gated ion channel and the ion permeation; photosyntetic reactin center.
4	Determination of protein three-dimensional structure via X-Ray and cryo-EM techniques. The Protein Data Bank. The file pdb.
8	INTERACTIONS IN PROTEINS. Non covalent interactions: salt bridges, electrostatic forces, van der Waals forces, Lennard-Jones potential, disulfide bridges. Hydrogen bond. Hydrophobic effect. Introduction to protein folding. Anfinsen experiment. Levinthal paradox. Funneling. Dill model and other models.Thermal and chemical denaturation, stopped-flow measurements, calorimetric studies of thermal denaturation, cold denaturation and stability curve. Specific heat in the unfolded state and molecular models.
4	UV-visible spectroscopy. Absorption, the Lambert-Beer law. Spectra in vacuum and in solvent: the roto-vibrational structure. Elecronic transitions in: organic chromophores, peptidic bond, side chains, prostetic groups, metals, aminoacids, nucleic acids. Conformational changes via UV-visible measurements. Solvent effects on UV-visible spectra: batochromic, ipsochromic, iper and ipo chromic shift. pH effects on UV-visible spectra.
4	Emission: Fluorescence, intensity of fluorescent radiation. Solvent, temperature and pH effects on fluorescence. Fluorescent probes, markers, relevance in biophysics, fluorescent aromatic aminoacids, immunofluorescence. Phosphorescence.Jablonsky diagram.Quantum yeld of fluorecence and phosphoresences.
1	FRET: Principles and applications.
4	Infrared spectroscopy. Molecular vibrations. Diatomic homo and heteronuclear molecules. Poliatomic molecules. Effects on IR absorption frequency. IR Specroscopy in polipeptides and proteins. Amide bands.Amid I for the determination of secondary structure content: alpha helix and beta sheet. Spectra of proteins in native and denatured state. Nucleic acids spectra.
6	An introduction to computational biophysical. Theoretical/computational models for studying biological process with computers.
2	Introduction to the software "Visual Molecular Dynamics (VMD)" for visualization, measurements and data analysis of simulations of biological macromolecules.