MEDICAL BIOTECHNOLOGY AND NANOBIOTECHNOLOGY (LM49)

(Lecce - Università degli Studi)

Teaching BIOPHYSICS

GenCod A004556

Owner professor Tiziano VERRI

Teaching in italian BIOPHYSICS

Teaching BIOPHYSICS

SSD code BIO/09

Reference course MEDICAL BIOTECHNOLOGY AND

Course type Laurea Magistrale

Credits 6.0

Teaching hours Front activity hours: 50.0

For enrolled in 2018/2019

Taught in 2019/2020

Course year 2

Language ENGLISH

Curriculum NANOBIOTECNOLOGICO

Location Lecce

Semester First Semester

Exam type Oral

Assessment

Course timetable
https://easyroom.unisalento.it/Orario

BRIEF COURSE DESCRIPTION

This course deals with the basic theoretical physics underlying biological phenomena, with emphasis on those occurring at the membrane level. From the broad axiom that in biological systems *'a barrier separates two-compartments'* it focuses on the processes that allow a particle (ion, small molecule, protein, nanoparticle, ...) to cross the membrane and on how it does interact with water (solvent) and soluble components (solutes) in each compartment. It also focuses on those biophysical phenomena that make a membrane *'active'*, i.e. that allow a biological membrane to produce and transmit a signal from a compartment to the other and/or along the barrier. In this respect, it explores the molecular foundations of biophysics, the thermodynamics of non-equilibrium systems and membrane transport, with emphasis on nerve impulses, and membrane transduction, with emphasis on membrane receptor-based processes.
The course begins with an overview of molecular biophysics and the concept of molecular recognition, followed by a discussion of the interaction between molecules, the primary process that determines membrane transport and reception, and the importance of intercellular interactions in the existence and development of multicellular organisms.
The student is also introduced to the stability conditions of a steady-state, the concept of entropy for an open system, the thermodynamics of the sodium-potassium pump, ionic equilibrium between sodium- and potassium-rich solutions separated by an active membrane, the conformational properties of membranes, and the general phenomenological theory of active, facilitated and passive transport and the role of the carriers and channels.
The structure-function relationships that allow channels and carriers, on one side, and receptors, on the other, to operate efficaciously in the membrane are discussed on the basis of the most recent structural data available in protein databanks.
This course is a valuable resource for biologists and biotechnologists, physicists and biophysicists, graduate and postgraduate students having basic knowledge of physics, and anyone acquainted with biological membranes and proteins.

REQUIREMENTS

No formal prerequisites are required with respect to other courses. However, basic knowledge of general physics, physical chemistry and general physiology is recommended.

COURSE AIMS

Course outline and aims

This course aims at providing students with an in-depth knowledge of the current view of membrane biophysics, the role as a barrier played by the membrane and the roles played by channels, carriers and receptors in the membrane physiology. The course also aims at highlighting the spatial organization of membrane proteins, their structures and how their major structural elements make them work efficiently. Major methodological approaches to membrane biophysics including their powers and limitations will be also discussed.

Learning outcomes

Knowledge to be attained:
Molecular foundations of biophysics

- the subject matter of molecular biophysics
- molecular recognition
- molecule-molecule interaction
- reception
- intercellular interactions

The thermodynamics of non-equilibrium systems

- the dissipation function
- the coupling of chemical reactions
- the steady-state of a linear system
- the coupling of chemical reactions with diffusion processes
- processes remote from equilibrium
- entropy
- entropy and information in biology

Membrane transport

- cell membranes
- the thermodynamics of passive membrane transport
- the thermodynamics of active membrane transport
- the thermodynamic model of the sodium-potassium pump
- the model theory of passive membrane transport
- the model theory of active membrane transport
- the structure of membranes
- the conformational properties of membranes
- induced ion transport

Nerve impulses

- axons and nerve impulses
- propagation of the nerve impulse
- generation of the impulse
- activation and inactivation of sodium conductivity
- synaptic transmission

Abilities to be attained:

- Methods, protocols and equations to study membrane biophysics and membrane protein

functioning

- Protein databank querying and consulting

TEACHING METHODOLOGY	Learning methods consist of formal lectures and integrative lectures held using slides and hypertext links to specific Web sites (5 credits= 40 hours), followed by practical laboratory classes (1 credit = 10 hours). Outside these activities, the students are expected to read assigned papers from the scientific literature.
ASSESSMENT TYPE	Oral examination. It is aimed at ascertaining, in proportion: - The level of theoretical knowledge through the presentation of the program topics (50%) - The level of practical abilities through description of methods and methodologies (20%) - The ability to apply theoretical knowledge and practical skills to solve simple problems (30%)
REFERENCE TEXT BOOKS	Cell Physiology Source Book 4th Edition. Essentials of Membrane Biophysics. Editors: Nicholas Sperelakis. Hardcover ISBN: 9780123877383. eBook ISBN: 9780123877574. Imprint: Academic Press. Published Date: 28th December 2011