FDITE113 Methods in modern biophysics

(P. Maróti, L. Nagy)

Description:

The aim of the course is to provide our advanced knowledge about the (bio-)physical relevance of constitution and function of biological systems at any level (infra or supra individual) of the biological organization. Topics will be chosen to discuss the structural and functional relationships of important life processes, to provide most important research questions and methods and directions of possible practical importances. Connections to other disciplines (inter and multidisciplinary approaches) will be provided. Selected topics are given as follows.

Topics:

Biomechanics

- Statics, kinematics and dynamics in biological systems; relevance in biological evolution, healthcare and sports
- Flow of fluids (applications of fundamental physical processes (lows) of ideal and viscous fluids in biological systems)
- Transport processes in biological systems (micro and macro transport; (passive, facilitated and active) transport across the membranes)
- Deformation, elasticity, viscoelasticity; biomechanics of muscle function

Bioelectricity

- Membrane potential (origin of the membrane potential, experimental methods to measure it)
- Resting and action potential
- Electric activity of organs, potential on the surface of the body

Thermodynamics

- Applications (validity) of the main principles of thermodynamics in biological system; chemical potential
- *Non*-linear thermodynamics (biological examples)

Heat flow in the living systems and between the body and the environment

Optical absorption and fluorescence spectroscopy

Spectrum of the electromagnetic wave

Molecular bases of optical spectroscopy

Experimental spectroscopy

Optical spectroscopy of biological systems (molecular bases, applicability of Beer-Lambert's law)

Lasers

Radiation and biological systems

Ionizing and non-ionizing radiations and the living systems (origin and properties of the radiations and their effects on biological systems, applications)

Nuclear radiation (types and properties of the radiations)

Applications in biology with special attention to medicine

Dosimetry

Physical bases of sensing (vision and hearing)

General phenomena of sensing

Biophysical bases of light perception (evolution and biophysics of vision (optical, cellular and molecular phenomena))

Biophysical bases of hearing (special biophysical characteristics of sound, sensing sound)

Modern biophysical methods in basic and applied research

(Selected topics can fit flexibly to the profession and interests of students.)

Recommended literature:

S. Damjanovich, J. Fidy and Szöllősi (eds): Medical physics. Medicina, 2009)

P. Davidovits: Physics in Biology and Medicine. Academic Press, 2013