

Course name: Physics with elements of biophysics (USOS Code: B-B.2004Eng)

ECTS: 6

No. of hours: 60 (20 lectures + 40 classes)

Course coordinator: Dr hab. Maria Stolarz

Prerequisites: General knowledge in physics and biology at high school level

Course description: PHYSICS AND BIOPHYSICS Physical phenomenon, physical quantity, unit of measurement, measurement, measurement errors, scientific notation of numbers, scale, order of magnitude, sub-multiple and multiple units, vector and scalar physical quantities, physical law, examples of physical laws, characteristics of living organisms. PHYSICAL QUANTITIES AND UNITS OF MEASUREMENT Basic physical quantities: time, length, mass, current intensity, temperature, luminous intensity, amount of matter. Derived physical quantities: force, energy, work, power, heat. Base and derived units of measurement. Types of environmental stimuli. BASIC INTERACTIONS AND RADIOACTIVITY Basic interactions: strong, electromagnetic, weak, gravitational. Radioactivity, the law of radioactive decay, isotopes, C14 dating, alpha, beta and gamma radiation, radioactive elements. STRUCTURE OF THE ATOM Hydrogen atom, electron shells and orbitals, electron configurations, photon, absorption and emission spectra, ion, ionization energy, bioelements. ELECTROMAGNETIC RADIATION Radiation sources, ranges of electromagnetic radiation, light, photometry, microwaves, radio waves, functional magnetic resonance, X-rays, computed tomography, X-ray diffraction, ultraviolet, infrared radiation, fluorescence, phosphorescence, laser, photon flux density, radiation energy, wavelength and frequency, filter. STATES OF MATTER AND WATER Gas, liquid, solid, hydrogen, potassium, sodium, calcium, magnesium, ATP, glucose, water, hydrogen bonds, cohesive and adhesive forces, surface tension, capillary phenomena, amphiphilic compounds, monolayer, Wilhelmy method, surface pressure, isotherm of monomolecular film. ELECTROPHYSIOLOGY Electric charge, Coulomb's law, electric field, electric potential and voltage, electric current, conductors, insulators, Ohm's law, cell membrane resistance, open vacuole method, resting and action potential, nerve impulse, excitability threshold, refractory period, chronaxia, rheobases, all-or-nothing law. BIOLOGICAL MEMBRANES Cell membrane structure, phospholipids, surface and integral proteins, sugars, fluid mosaic model, asymmetry, semi-permeability, selectivity, permeability, diffusion, osmosis, electrochemical gradient, Nernst equilibrium potential, passive and active membrane transport, ion channels, symport, antiport, cell membrane functions.

Recommended literature: Davidovits P., Physics in Biology and Medicine, 2008; Dillon P.F. Biophysics. A Physiological Approach, 2012; Dill K.A., Bromberg S., Molecular Driving Forces, 2011; Sperelakis N. (ed.), Cell Physiology Source Book: Essentials of Membrane Biophysics 2011.