1 Electromagnetic waves, the electromagnetic spectrum. Light as a wave and its characteristics: diffraction, interference, polarization. The dual nature of light. Matter waves
2 Blackbody radiation. The photoelectric effect: experimental findings and their explanation. The Einstein equation
3 Rutherford’s experiment, the Rutherford model of the atom. Bohr’s model: Bohr’s postulates, the Franck-Hertz experiment
4 The quantum-mechanical model of the atom, wave function. Heisenberg’s uncertainty relationship. Physical meaning of quantum numbers. The Stern-Gerlach and Einstein-de Haas experiments
6 Properties and spectrum of X-rays. Components and function of an X-ray tube. Types of X-rays and the mechanisms of their generation
7 X-ray diffraction. Principles of the method, interference, the reason of using X-rays, Laue equations. Fields of applications
8 Structure and models of the atomic nucleus. Properties of nuclear force, binding energy. Mass defect. The liquid drop and shell model of the nucleus
9 Radioactivity. The radioactive decay law. Average lifetime, half life, decay constant. Real activity vs measured count rate
10 Types of radioactive radiations, their properties and interactions with matter. Applications of radioactive isotopes
12 Types of thermodynamic systems. Intensive and extensive quantities. The 0th and 1st law of thermodynamics
13 The 2nd law of thermodynamics. Entropy. Thermodynamic probability, the statistical interpretation of entropy
14 Thermodynamic potentials: internal energy, enthalpy, free energy, Gibbs-free energy. Change of thermodynamic potentials during equilibration processes. Chemical potential
15 Diffusion. Fick’s 1st law. Diffusion coefficient. The Einstein-Stokes formula. Fick’s 1st law. Diffusion through the cell membrane: passive, active and facilitated diffusion
16 Osmosis. Van’t Hoff’s law. Osmotic pressure and its significance
17 Types of fluid flow. Reynolds number. Viscosity. Laws of fluid flow: continuity equation, Bernoulli’s law, the Hagen-Poiseuille law, Stokes’ law
18 Structure and characteristics of the circulatory system. Determination of the cardiac output, the Frank-Starling law. The work of the heart
19 Levels of protein structure. Theory of protein folding: Anfinsen’s experiment, Levinthal’s paradox, the folding funnel model
21 Sensory receptors. Phases of the action potential. Changes of ion fluxes corresponding to the different phases

23 Sound and its characteristics. The decibel scale. Structure and function of the ear. Békésy’s theory. Molecular basis of hair cell function

24 The cytoskeletal system. Types, polymerization, characteristics and mechanical properties of cytoskeletal filaments. Associated proteins


26 Structure of cross-striated muscle. Structure of muscle, the sarcomere and its building elements. Contractile proteins

27 Mechanical properties of muscle. Passive and active muscle function. Length dependence of the force. Velocity dependence of the force and power of muscle

28 Molecular basis of muscle function and regulation. The sliding filament model. Types of regulation. Muscle regulatory proteins and their characteristics. The role of calcium in regulation

Biophysics 1 – practical exam questions
2015/2016

Room 1
1 Direct Current measurements
2 Alternating Current measurements
3 Electrical conductance
4 Refractometry
5 Spectroscopy and spectrophotometry
6 Polarimetry
7 Viscosity of fluids
8 Surface tension
9 Adsorption and swelling
10 Centrifugation
11 Electrophoresis

Room 2
1 The Geiger-Müller counter
2 Radioactive half-life
3 Gamma-absorption and spectrometry
4 Absorption of beta-radiation, dead time
5 Scintigraphy
6 Optics. Illumination
7 Absorption photometry
8 Blood pressure. Electrocardiography
9 Ultrasound
10 Temperature measurement
11 Audiometry