

Faculty of Medicine, Masaryk University, Brno

Syllabus of the subject-matter required for the Admission Examination

## PHYSICS

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The students should understand the following physical principles and concepts, as well as, apply them in simple examples and calculations. Knowledge of basic SI units is also unavoidable.

### A) Basic concepts

Fundamental and derived SI units, standard prefixes of units (multiples and submultiples), vectors, scalars, addition of vectors.

### B) Mechanics of a particle and rigid body

Uniform rectilinear motion, uniformly accelerated motion (particle position, velocity and acceleration calculation), free fall, Newton laws of motion, force, momentum, impulse of a force, weight, density, torque, static and kinetic friction, uniform circular motion (frequency, angular frequency, centripetal acceleration), work, power, efficiency, kinetic energy, potential energy of a body in field of gravity, elasticity (normal stress, linear strain, Hooke's law, modulus of elasticity), Newton principle of universal gravitation (understanding the formula, gravitational acceleration, potential of the gravitational field).

### C) Wave motion and sound

Basic concepts (period, frequency, phase velocity), instantaneous displacement of an oscillating body, its velocity and acceleration, travelling and standing waves, transverse and longitudinal waves, destructive and constructive interference, intensity of wave motion (radiation), oscillating mass on a spring, oscillating pendulum, audible sound and ultrasound, intensity and level of sound intensity.

### D) Mechanics of fluids

Ideal or perfect liquid, pressure (Pascal principle, hydrostatic pressure, units, hydraulic press), Archimedes principle, force of buoyancy, viscosity, laminar and turbulent flow, equation of continuity, Bernoulli's equation, surface tension, capillary elevation and depression, pressure in the bubble (Laplace's formula).

### E) Principles of thermodynamics

Basic concepts (thermodynamic systems, states and processes), reversible and irreversible processes, thermodynamics (Kelvin) temperature, ideal gas law (state equation of ideal gas), universal gas constant, pV-diagrams, equations for isothermal, isosteric, isobaric and adiabatic process, thermal expansion and contraction of solids, heat, heat capacity, specific heat capacity, 1<sup>st</sup> law of thermodynamics, equation of thermal conductivity, latent heats, 2<sup>nd</sup> law of thermodynamics (working cycle of the Carnot ideal engine), absolute and relative air humidity.

### F) Theory of electricity

Electric charge, conductors, Coulomb's law, dielectric constant, electric field intensity, potential and potential difference (voltage), electrical capacity of a parallel-plate capacitor, capacitors in parallel and in series, electric current, Ohm's law, resistivity, conductivity, temperature coefficient of resistance, Kirchhoff's laws, resistors in parallel and in series, electrical power and heating effect, thermoelectric phenomenon, Faraday's law of electrolysis, Faraday's constant, N-type and P-type semiconductors, properties of P-N junction, principle of a transistor.

### G) Magnetism and electromagnetism

Force acting between two magnetic poles, magnetic permeability, magnetic flux and flux density, magnetic force, magnetic field due to a straight wire or coil, magnetic force exerted on a conductor passed by current, Fleming's rule, magnetic force between two parallel conductors, definition of ampere in SI, magnetic deflection of a moving electron, electromagnetic induction, Lenz's law, voltage induced in straight wire, self-inductance of a coil, alternating current, effective values of current and voltage, electric power of alternating current, impedance (capacitance, inductance), AC transformer.

#### H) Optics

Basic properties of light and optical media, speed of light, reflection and refraction of light (Snell's law, critical angle), lenses, so-called lens-maker's equation, sign convention, dioptric power, converging and diverging lens, lens equation, linear magnification, mirror (imaging equation and magnification), basic optical properties of human eye, microscope and its magnification, light spectrum, interference of light, polarised light, photometry (luminous intensity, luminous flux, illumination).

#### I) Theory of relativity

Dilation of time, contraction of length, relativistic addition of velocities, relativistic mass, energy and mass equivalence principle.

#### J) Quantum, atomic and nuclear physics

Unit "electron volt", mole, Avogadro's constant, excitation of atoms, de Broglie matter waves, principal quantum number, orbital quantum number, magnetic quantum number, Pauli's exclusion principle, emission and absorption light spectra, principle of X-ray tube, photoelectric effect, Compton scattering, structure of atom nucleus, nuclides, isotopes, nuclear binding energy, principle of a nuclear reactor, alpha-decay, beta-decay, gamma-decay, neutron radiation, fission of heavy nuclei, law of radiation decay, Becquerel, Geiger-Mueller counter.

#### Recommended literature:

Mornstein, Vojtěch. *An Overview of Physics*. Brno : Masaryk University, Medical Faculty, 2010. 80 p. ISBN 978-80-210-5192-8.