

Final exam topics Physics BSc 2020

(for those who started their studies **in** 2017 autumn **or after** 2017 autumn)

1. Fundamentals of mechanics

Coordinates, velocity, acceleration. Newton's axioms. Motion equation for special motions. Momentum, angular momentum, energy. Work and power.

2. Fundamentals of electrodynamics

The fundamental equations of electrodynamics: Maxwell's equations in differential and integral form. The laws of induction. Continuity equation, charge conservation. Laws of stationary currents.

3. Extensive and intensive thermodynamic quantities

Empirical temperature, equation of state for an ideal gas. Heat expansion. Classification of state variables. The laws of thermodynamics. Entropy. Heat engines, refrigerators

4. Fundamental concepts of nuclear physics

The characteristic features of the nucleus (mass, density, binding energy, spin), models of the atomic nucleus. Radioactivity, fission and fusion of nuclei. Nuclear reactor, nuclear power plant.

5. Vibrations

Harmonic, anharmonic, damped oscillations, driven oscillators, resonance, the relevant differential equations, examples in mechanics, and electrodynamics (springs, pendulums, RLC circuits)

6. Waves

The wave equation. The wave function for plane and spherical waves, Dispersion. Standing waves, The Doppler effect.

7. Electrostatics, magnetostatics

The fundamental equations of electrostatics. The work of the electric force, electrostatic potential. Capacitors, capacity. Characteristics of static magnetic fields, forces in static magnetic fields. The magnetic field of an infinitely long straight wire.

8. Fundamentals of special relativity

Postulates of special relativity. Measuring the length of moving objects, length contraction. Time dilation, the proper time, the twin paradox. Moving particles' clock. Addition of velocities. Relativistic momentum and energy.

9. Fundamentals of quantum mechanics

Observable quantities and operators. The meaning of the wave function. Canonical commutation relation. Measurement in quantum mechanics. Expected value and standard deviation, uncertainty principle. Time-dependent and time-independent Schrödinger equation, stationary states.

10. The atom and the light

Dual nature of light: light as electromagnetic wave, photoelectric effect, Compton scattering. Atomic models: the Bohr model, the atomic model of quantum mechanics. The structure of Mendeleev's periodic table.

11. Optics

The speed of light. Fermat principle. Reflection and refraction. Imaging of mirrors and lenses. Projectors, microscopes, telescopes. The human eye. Diffraction on one slit and on gratings.