The program of entrance tests in physics for applicants to the Master's degree of the Faculty of Physics of Moscow State University

I Mechanics

1. Kinematics of a material point.
2. Dynamics of the material point. Newton's laws.
3. Dynamics of the system of material points. Conservation laws.
4. Movement in a centrally symmetric field. Kepler's laws.
5. Lagrange function and Lagrange equations of the system of material points. Integrals of motion.
6. Dynamics of an absolutely rigid body. The inertia tensor.
7. Oscillations of systems with one and many degrees of freedom. Free and forced oscillations.
8. Canonical Hamilton equations.
9. Hamilton-Jacobi equation.

Literature

1. Matveev A. N., Mechanics and Theory of Relativity, Moscow, Vysshaya shkola Publ., 1986.
2. Landau L. D., Lifshits E. M., Mechanics, Moscow, Nauka Publ., 1988.
3. Landau L. D., Lifshits E. M., Hydrodynamics, Moscow, Nauka Publ., 1988.

II Molecular physics and statistical mechanics

1. Thermodynamic approach to description of molecular phenomena. Temperature.
2. The first law of thermodynamics. Cyclical processes.
3. The second law of thermodynamics.
4. Entropy of a thermodynamic system. Thermodynamic potentials.
5. Interaction of molecules. Perfect gas. Basic gas laws.
6. Velocity distribution of gas molecules. An ideal gas in an external potential field.
7. Canonical distributions.
8. Ideal Bose and Fermi gas. Equilibrium radiation.
9. Heat capacity of solids. Debye and Einstein models.
10. Fluctuation theory. Brownian motion.
11. Real gases. The Van der Waals equation.
12. First-and second-order phase transitions.

Literature

1. Matveev A. N. Molecular Physics, Moscow, Vysshaya shkola Publ., 1987.
2. Landau L.D., Lifshits E.M. Statistical Physics, part 1. M., Nauka, 1976.

III Electrodynamics and optics

1. Electrostatic field. Coulomb's law. The Gauss theorem.
2. Static magnetic field. The Biot-Savard-Laplace law. Electromagnetic induction.
3. Maxwell's equation in vacuum. Scalar and vector potentials.
4. The energy of the electromagnetic field. Poynting vector.
5. Radiation of electromagnetic waves in the electric dipole approximation.
6. Maxwell's equations in the medium. Material equations. Permittivity and refractive index.
7. Dielectrics, magnets, conductors, superconductors and their electromagnetic properties.
8. Fundamentals of the special theory of relativity. Lorentz transformations.
9. Light interference. Temporal and spatial coherence. Interferometers.
10. Diffraction of light. Fresnel and Fraunhofer approximations. Spectral devices.

11. Radiation of light by atoms and molecules. Width of the radiation line.
13. Spontaneous and forced transitions. Lasers.
14. Light dispersion and absorption. Reflection and refraction at the boundaries of two media. Light scattering. The Rayleigh formula.
15. Laws of the photoelectric effect. The Stefan-Boltzmann law.

Literature

1. Matveev A. N., Electricity and Magnetism, Moscow, Vysshaya shkola Publ., 1983
2. Tamm I. E., Fundamentals of the theory of electricity, Moscow: Nauka, 1976.
3. Landau L. D., Lifshits E. M., Field Theory, Moscow, Nauka Publ., 1973.
4. Akhmanov S. A., Nikitin S. Yu., Physical Optics, Clarendon Press, 1997.

III Physics of the atomic nucleus and particles

1. Basic characteristics of atomic nuclei. Quantum characteristics of nuclear states.
2. Radioactivity.
3. Nuclear fission and synthesis. Nuclear power. Reactors.
4. Models of atomic nuclei.
5. Gamma radiation of nuclei. The Mossbauer effect.
6. Nuclear forces and their properties.
7. Elementary particles and their interactions. Antiparticles.
8. Strong interaction. Quark structure of hadrons.
9. Weak interaction and related processes. Neutrinos.

Literature

1. Mukhin K. N. Experimental Nuclear Physics, vol. 1, 2. Moscow, Energoatomizdat, 1993.
2. Frauenfelder G., Henley E. Subatomic Physics, Moscow, Mir Publ., 1979.

V Atomic physics and quantum mechanics

1. Experimental facts underlying quantum theory. Wave and corpuscular properties of matter.
2. The Boron hydrogen atom.
3. Basic postulates of quantum mechanics. The wave function.
4. The uncertainty principle.
5. Description of the evolution of quantum mechanical systems. The Schrodinger equation. Stationary states.
6. Linear quantum harmonic oscillator.
7. Passage of particles through a potential barrier. Tunnel effect.
8. Angular momentum. Adding up moments.
9. Traffic in the center field. The hydrogen atom: wave functions and energy levels.
10. Stationary perturbation theory in the absence and presence of degeneracy. Zeeman and Stark effects.
11. Systems of identical particles. Bosons and fermions. The Pauli principle.
12. Theory of elastic scattering. Born approximation.

Literature

1. Landau L. D., Lifshits E. M., Quantum Mechanics, Moscow, Fizmatgiz Publ., 1974.
2. Davydov A. S., Quantum Mechanics, Moscow, Fizmatgiz Publ., 1973.
3. Sokolov A. A., Ternov I. M., Zhukovsky V. Ch., Quantum Mechanics, Moscow, Nauka Publ., 1979.