

**The entrance examination syllabus for application to the Master of Physics degree
at the Faculty of Physics of Lomonosov Moscow State University
Shenzhen MSU-BIT University**

A. Mechanics

- Kinematics of a material point: radius-vector, point position, velocity, acceleration. Movement along the circle.
- The Fundamental Equation of Dynamics. Three Newton's laws.
- Momentum. Kinetic and potential energy. Laws of Conservation of Energy, Momentum, and Angular Momentum
- Dynamics of a solid body. The inertia tensor. Steiner's theorem.
- Elastic deformations of a solid body. Strain, stress, Young's modulus, Poisson's ratio.
- Mechanical oscillations. Harmonic motion. Damping factor, eigenfrequency, resonance. Quality factor. The mathematical pendulum, spring pendulum. Amplitude-frequency and phase-frequency characteristics.

B. Thermodynamics and Molecular Physics

- Thermodynamic description of molecular phenomena. Temperature. Ideal gas model. The state equation of an ideal gas. Processes in ideal gases: isothermal, isobaric, isochoric, adiabatic.
- The Maxwell distribution. The most probable, average, and RMS velocities of gas molecules.
- Boltzmann distribution. Distribution of gas molecules in the gravity field. The barometric formula. Collision of molecules in a gas: the collision frequency and the mean free path. The equipartition theorem.
- The first law of thermodynamics. The heat capacity. The heat capacity of an ideal gas. The relationship of the heat capacity of a gas with the number of degrees of freedom of molecules. The Mayer equation. The polytropic process. Cyclic processes. Carnot cycle. The efficiency.
- The Second Law of Thermodynamics. Entropy.
- Real gases. The Van der Waals equation.

C. Electrodynamics

- Electrostatics. Coulomb's law. Gauss theorem. Electric field, potential, energy of the field. The electric field of a point charge. The superposition principle. The connection between potential and electric field. Electric dipole.
- Conductors and dielectrics in an electric field. Electric induction, polarization. Dielectric permittivity and susceptibility.
- Electric current and current density. Electrical voltage. Electrical resistance. Ohm's law. The Joule-Lenz law.
- Magnetostatics. Biot-Savart Law. Electromagnetic induction. Magnetism. Magnetization. Magnetic permeability and susceptibility.
- Electric circuits. Kirchhoff's rules. Electromagnetic oscillations. RC, LC, RLC circuits. Damping factor, quality factor. Circuit energy.
- Maxwell's equations in matter. Wave equation. Poynting vector. Energy.

D. Optics

- Geometric optics. Thin and thick lens formulas. Convex and concave lenses. Real and virtual image. Magnification. Lens power.
- Interference of light. Young's double slit experiment. Temporal and spatial coherence. The Michelson interferometer. Fabry–Pérot interferometer. Coherence time. Coherence length.
- Diffraction of light. Fresnel and Fraunhofer diffraction. The Huygens–Fresnel principle. Beam diffraction divergence.
- Reflection and refraction of light. Fresnel formulas. Brewster's angle. Total internal reflection. Refractive index. Absorption. Scattering. Dispersion.
- Polarization of light. Anisotropic media. Polarization ellipse. Polarizers and waveplates.
- Thermal radiation. Quantum nature of light. Planck's law. The Stefan–Boltzmann law. The Rayleigh–Jeans law. The Wien's displacement law.