

Master's degree program in Physics and Technology of Nanostructures

List of entrance examination questions

1. Electromagnetic field. Physical essence of Maxwell's equations.
2. Wave equation. Properties of an electromagnetic wave.
3. Field energy of an electromagnetic wave. Poynting vector.
4. Polarization states of a plain harmonic wave. Elliptical polarization, circular polarization, linear polarization. Polarizer types.
5. Malus's law. Natural light.
6. Harmonic oscillator radiation. Harmonic spherical wave and its properties.
7. Basic photometric quantities (luminous flux, luminous intensity, luminance, luminous emittance, illuminance), and their measurement units.
8. Coherence of light. Spatial and temporal coherence.
9. Interference of light: basic correlations and properties of the interference field. Types of interference fringes.
10. Interference pattern visibility. Temporal and spatial coherence.
11. Multibeam interference. Airy function. Fabry–Pérot interferometer.
12. Diffraction of light. Huygens–Fresnel principle. Zone plate.
13. Fresnel-Kirchhoff diffraction integrals. Fresnel diffraction. Fraunhofer diffraction.
14. Holography. Hologram as an element of ideal optical system. Applications of holography.
15. Electromagnetic-wave deflection and refraction at the interface of two dielectric media. Fresnel equations. Electromagnetic surface waves.
16. Brewster's Law. Phase relationships at the interface of two media.
17. Radiation propagation in optically anisotropic media. Wave normal ellipsoid и radial ellipsoid.
18. Optical dispersion. Frequency dispersion and spatial dispersion. Electronic theory of frequency dispersion.
19. Light scattering in turbid media. Molecular scattering in gases.
20. Optical activity. Elementary theory of the rotation of polarization plane.
21. Nonlinear polarization of media. Nonlinear optical phenomena (harmonic generation, frequency summation and subtraction, self-focusing, stimulated scattering).
22. Holography. Recording and reconstruction of a holographic image. Applications of holography.
23. Operational principles of an optical laser. Active laser medium.
24. Aberrations of optical systems.
25. Resolving power of a microscope. Electron microscope.
26. Doppler effects in optics.
27. Speed of light. Methods of determining the speed of light.
28. Light dispersion and absorption.
29. Zeeman effect. Anomalous Zeeman effect.
30. Photoelectric effect. Inner photoelectric effect.