

Online entrance examination questions

Master's degree program in Nanophotonics and Metamaterials

1. Charge conservation law. Coulomb's law. Electric field. Superposition principle. Continuous charge distribution model. The electric field distribution of uniformly charged ring and string.
2. Polarization of electromagnetic waves under reflection and refraction. Fresnel equations. Electromagnetic surface waves. Applications of Fresnel equations: Brewster's law. Phase relations for electromagnetic waves at the interface of two media.
3. Electric flux. Divergence theorem (Gauss's flux theorem) for the electric field vector. Application of Divergence theorem for point charge and infinite plane.
4. Dispersion of light. Frequency dispersion and spatial dispersion. Electronic theory of frequency dispersion. Dependence of the permittivity on frequency.
5. Electric dipole. Electric field and electrostatic potential of a point dipole. Electric dipole in external electric field (force, torque, potential energy).
6. Nonlinear polarization of medium. Nonlinear optical phenomena (harmonic generation, frequency summation and subtraction, self-focusing, stimulated scattering).
7. Concept of electric capacity. Examples of capacitors with different geometrical configuration. Capacity of a parallel-plate capacitor.
8. Electromagnetic wave propagation along dielectric waveguides.
9. Magnetic field. Magnetic field of a current-carrying conductor. Biot–Savart law.
10. Planar optical waveguides. Waveguide modes.