



General physics competition program for engineering students PHYSICS I

Mechanics

Material point mechanics

Basic concepts (space, time, mass); Reference systems, Galilean transformations; Kinematics of rectilinear movement; One dimensional Kinematics; Kinematics of circular motion; Kinematics of arbitrary curvilinear movement (polar, spherical coordinates); Movement in non-inertial reference systems - centrifugal and Coriolis accelerations; Force and impulse; The principles of Galilei-Newton mechanics; applications; Galileo's principle of relativity; Moment of force and kinetic moment; conservation laws; Mechanical work and mechanical energy; conservative and dissipative forces; the law of conservation of energy; mechanical energy dissipation;

Oscillations

Harmonic/Anharmonic/Forced/Forced with resistance force; Resonance Representation of oscillations (vectorial and complex); Fourier analysis; Composition of oscillations (2 parallel oscillations and 2 perpendicular oscillations); Coupled oscillations – the problem of small oscillations;

Rigid body mechanics

Mass centre, momentum, angular momentum, the moment of inertia, the energy of rotation, the law of motion for the rotation of a rigid body; Rigid body – oscillatory movement, physical pendulum; The rigid body in rotation - gyroscopic movement; equilibrium conditions

Mechanical waves in elastic media; Acoustics.

Waves - fundamentals; One-dimensional wave equation (longitudinal and transversal); The general solution of waves equation; Two-dimensional waves in elastic media; Harmonic waves; timeless wave equation; Waves in 3 dimensions (special cases: spherical waves and plane waves);

II. Thermal Phenomena

Fundamental laws and principles of the thermodynamics of reversible processes.

Thermodynamic system, state definition, state parameters, thermodynamic processes, thermodynamic equilibrium, absolute temperature;

Laws of thermodynamics;

First law of thermodynamics (thermal and caloric coefficients, internal energy, work, heat); the second law of thermodynamics (Carnot cycle, entropy, irreversible processes); the fundamental relationship of



thermodynamics, thermal and caloric, equations; open systems, chemical equilibrium; phase transitions; the third law of thermodynamics (Applications, The Nernst and Planck formulas; consequences; Absolute negative temperatures)

III. The physical basis of electromagnetism.

Charge and electric current

Basic principles, the law of conservation of charge, electrostatic field (in vacuum and substance); dielectric polarization, conductors in the electric field – characteristic quantities; Direct and alternating electric current; basic electrical circuits.

Magnetic field in vacuum and substances

Characteristic quantities; movement of electric charges in electric and magnetic field, Maxwell's equations: fundamental experiments, differential form and integral form; material laws in electromagnetism; energy density and energy transport (Poynting vector) in the electromagnetic field;

Electromagnetic waves

The spectrum of electromagnetic waves; Properties of electromagnetic waves

REFERENCES:

1. Course grades of university courses taught at technical universities
2. Physics problems given at the county, national and international school Olympiads