Examination syllabus

1. Basic concepts of kinematics. Motion, mass point, reference system. Position vector, velocity, acceleration. Tangential and normal components of acceleration.
2. Description of motion in different coordinate systems: Cartesian, plane polar and cylindrical coordinate systems.
3. Kinematics of special types of motion. Rectilinear uniform motion, uniformly accelerated motion, projectile motion and circular motion.
4. Relative velocities. Fundamental concepts of particle dynamics. Mass and momentum. Newton's I. Law. Newton's II. Law (axiom of force). Force laws. Newton's III. Law (axiom of action-reaction).
5. Definition of instantaneous power, kinetic energy and work done by a force. Law of power, work-energy theorem.
6. Force field. Conservative forces. Introduction of potential energy. Connection between force and potential energy. Conservation of mechanical energy. Non-conservative forces.
7. Fundamental concepts of oscillations. Linear restoring force. Equation of motion of simple harmonic oscillation and solution of the differential equation. Potential energy of a simple harmonic oscillator. Energy considerations in case of simple harmonic motion.
8. Damped oscillations. Equation of motion of damped oscillation and solution of the differential equation in case of weak damping.
9. Forced oscillations. Equation of motion of forced oscillation and solution of the differential equation. Resonance.
10. Definition of statical momentum-, angular momentum-, and torque relative to point A. Relation between angular momentum and torque. Central forces. Definition of sector velocity. Connection between sector velocity and angular momentum.
11. The law of universal gravitation. Concept of gravitational mass. Gravitational potential energy. Gravitational field intensity, and potential. The motion of planets in gravitational field. Kepler's Laws.
12. Basic concepts of dynamics of system of particles. Centre of mass, external and internal forces. Equation of motion of the centre of mass. Angular momentum of a system, kinetic energy of a system.
13. System and environment. Thermodynamic variables. Extensive and intensive state variables. Thermal equilibrium. The zero-th. law of thermodynamics. Internal energy. Concept of work done by the environment. Concept of heat. The first law of thermodynamics.
14. Concept of temperature. The ideal gas temperature scale. The state equation of ideal gas. Ideal gas microscopic description. Assumptions of the kinetic theory. Calculation of pressure. Kinetic interpretation of temperature. Number of degrees of freedom. Principle of equipartition of energy
15. The application of the first law of thermodynamics for special transformations. Isochoric process, isobaric process, isothermal process and adiabatic process. Constant volume and constant pressure specific heats. Robert-Mayer equation.

16. Cyclic process. Heat engine, refrigerator. Reversible and irreversible processes. The Carnot cycle. The thermal efficiency.
17. Speed distribution of the molecules in gas. Most probable speed, average speed, root-mean square speed. Thermal expansion of solids.
18. Heat transfer. Heat conduction, the equation of linear conduction. Convection and radiation. Reversible and irreversible processes. The second law of thermodynamics. The efficiency of engines. Entropy and reversible processes. The mathematical form of the second law.