

Survey to subject of analytical mechanics for third year of physics

CHAPTER (1): Fundamental Concepts

Vectors

The Scalar Product – The Vector Product – An Example of the Cross Product: Moment of a Force – Triple Products – Change of Coordinate System: The Transformation Matrix – Derivative of a Vector – Position Vector of a Particle: Velocity and Acceleration in Rectangular Coordinates – Velocity and Acceleration in Plane Polar Coordinates – Velocity and Acceleration in Cylindrical and Spherical Coordinates.

CHAPTER (2): Newtonian Mechanics: Rectilinear Motion of a Particle

Newton's Law of Motion – Rectilinear Motion: Uniform Acceleration Under a Constant Force – Forces that Depend on Position: The Concepts of Kinetic and Potential Energy – Velocity-Dependent Forces: Fluid Resistance and Terminal Velocity.

CHAPTER (4): General Motion of a Particle in Three Dimensions

General Principles – The Potential Energy Function in Three-Dimensional Motion: The Del Operator – Forces of the Separable Type: Projectile Motion – The Harmonic Oscillator in Two and Three Dimensions – Constrained Motion of a Particle.

CHAPTER (5): Gravitation and Central Forces

Gravitational Force between a Uniform Sphere and a Particle – Kepler's Laws of Planetary Motion – Kepler's Second Law: Equal Areas – Kepler's First Law: The Law of Ellipses – Kepler's Third Law: The Harmonic Law – Potential Energy in a Gravitational Field: Gravitational Potential – Potential Energy in a General Central Field – Energy Equation of an Orbit in a Central Field – Orbital Energies in an Inverse-Square Field – Limits of the Radial Motion: Effective Potential – Nearly Circular Orbits in Central Fields: Stability – Apsides and Apsidal Angles for Nearly Circular Orbits

CHAPTER (6): Dynamics of Systems of Particles

Center of Mass and Linear Momentum of a System – Angular Momentum and Kinetic Energy of a System – Motion of Two Interacting Bodies: The Reduced Mass – Collisions – Oblique Collisions and Scattering: Comparison of Laboratory and Center of Mass Coordinates – Motion of a Body with Variable Mass: Rocket Motion

CHAPTER (7): Mechanics of Rigid Bodies: Planar Motion

Center of Mass of a Rigid Body – Rotation of a Rigid Body about a Fixed Axis: Moment of Inertia – Calculation of the Moment of Inertia

CHAPTER (8): Motion of Rigid Bodies in Three Dimensions-Lagrange equations-Hamilton equations

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Rotation of a Rigid Body about an Arbitrary Axis: Moments and Products of Inertia—Angular Momentum and Kinetic Energy – Principal Axes of a Rigid Body – Euler's Equations of Motion of a Rigid Body

CHAPTER (9): Lagrangian Mechanics

Generalized Coordinates – Calculating Kinetic and Potential Energies in Terms of Generalized Coordinates: An Example – Lagrange's Equations of Motion for Conservative Systems – Some Applications of Lagrange's Equations – The Hamiltonian Function: Hamilton's Equations

CHAPTER (10): Dynamics of Oscillating Systems

Potential Energy and Equilibrium: Stability – Oscillation of a System with One Degree of Freedom about a Position of Stable Equilibrium