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| MINOR COURSE- MN1A | Mechanics | (Theory Credit -03) (Total Marks=60+15) |
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Course Objective:

The objective of this course is to introduce students to fundamental concepts in mechanics, including vector analysis, differential equations, laws of motion, energy and momentum conservation, rotational dynamics, gravitation, oscillations, elasticity, fluid motion, and special relativity. The course aims to build a solid foundation in classical mechanics and provide students with the mathematical tools needed to analyze physical systems. By the end of the course, students will be able to apply these concepts to solve problems in a variety of contexts and gain insight into both macroscopic and relativistic phenomena.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. **Understand the concept of vector algebra** and use scalar and vector products in solving problems related to forces, motion, and other physical quantities.
2. **Solve first and second-order ordinary differential equations**, particularly in the context of mechanical systems, and apply these solutions to model the behavior of physical systems.
3. **Understand and apply Newton's Laws of motion** to analyze the dynamics of particles and systems, including concepts such as the center of mass and conservation of momentum.
4. **Utilize the work-energy theorem** to solve problems involving conservative and non-conservative forces, and understand the principles of energy conservation and rocket motion.
5. **Analyze rotational motion**, including angular velocity, angular momentum, torque, and moment of inertia for simple bodies, and apply the concept of angular momentum conservation.
6. **Apply Newton's law of gravitation** to understand motion in central force fields, including the derivation of Kepler's laws, satellite motion, and the concept of weightlessness.
7. **Examine oscillatory motion**, including simple harmonic motion (SHM), damped and forced oscillations, and understand resonance and real-world applications of these phenomena.
8. **Understand the fundamentals of elasticity and fluid motion**, including the behavior of materials under stress (elasticity) and fluid dynamics, with applications to Poiseuille's equation for capillary flow.
9. **Grasp the principles of special relativity**, including Lorentz transformations, time dilation, length contraction, mass-energy equivalence, and the relativistic Doppler effect, and apply these concepts to relativistic kinematics and energy-momentum transformations.

Course Contents:

Vectors (03 HRS): Vector algebra, scalar and vector products, derivatives of a vector with respect to a parameter.

Ordinary Differential Equations (04 HRS): 1st order homogeneous differential equations, 2nd order homogeneous differential equations with constant coefficients.

Laws of Motion (03 HRS): Frames of reference, Newton's Laws of motion, dynamics of a system of particles, center of mass.

Momentum and Energy (04 HRS): Conservation of momentum, work-energy theorem, conservative and non-conservative forces, conservation of energy, motion of rockets.

Rotational Motion (04 HRS): Angular velocity and angular momentum, torque, conservation of angular momentum, moment of inertia for simple bodies.

Gravitation (06 HRS): Newton's law of gravitation, motion of a particle in a central force field (motion in a plane, angular momentum conservation, areal velocity constant), Kepler's laws, satellite motion, geosynchronous orbits, weightlessness.

Oscillations (08 HRS): Simple harmonic motion (SHM): Energy considerations, time-averaged values. Damped oscillations: Equation of motion, solutions, and physical interpretation. Forced oscillations: Transient and steady states, resonance, quality factor. Real-world examples of resonance.

Elasticity and Fluid Motion (05 HRS): Elastic constants and relations, twisting torque on a cylinder or wire, Poiseuille's equation for capillary flow.

Special Theory of Relativity (08 HRS): Michelson-Morley experiment and its implications. Postulates of special relativity. Lorentz transformations, length contraction, time dilation, relativistic addition of velocities, mass-energy equivalence. Relativistic Doppler effect and kinematics. Energy-momentum transformation.

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G. R. Fowles and G. L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol.I, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
8. Concept of Physics, H C Verma
9. Properties of matter D S Mathur
10. Mechanics & Electrodynamics, by Brijlal & Subramaniam.
11. Theory and Problems of Theoretical Mechanics, Murray R. Spiegel, 1977, McGraw Hill Education

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| MINOR COURSE- MN1A | Mechanics | (Practical Credit-01) (Total Marks=25) |
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1. To determine the height of a building using a Sextant.
2. To study the Motion of Spring and calculate (a) Spring constant (b) g (c) Modulus of rigidity.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine g and velocity for a freely falling body using Digital Timing Technique
5. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Young's Modulus of a Wire by Optical Lever Method.
7. To determine the elastic Constants of a wire by Searle's method.
8. To determine the value of g using Bar Pendulum.
9. To determine the value of g using Kater's Pendulum.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Edn, 2011, Kitab Mahal
4. Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.