B.Sc. (Physics)
Paper –I: Mechanics and Waves and Oscillations
Part – A: Mechanics

Unit – I

1. **Vector Analysis (10):**

   Scalar and vector fields, gradient of a scalar field and its physical significance. Divergence and curl of a vector field and related problems. Vector integration, line, surface and volume integrals. Stokes, Gauss and Greens theorems- simple applications.

2. **Newton's Laws and motion under central force (14)**

   Laws of motion, mass and force, motion under force dependant upon position, velocity, time and their combinations, motion of variable mass system, motion of a rocket, multi-stage rocket, conservation of energy and momentum.
   Central forces – definition and examples, conservative nature of central forces, force as a negative gradient of potential energy, gravitational potential and gravitational field, centre of mass of many body system, two body problem, equation of motion under a central force, motion under inverse square law, derivation of Kepler's laws, Coriolis force and its expressions.

3. **Collisions (6)**

   Collisions in two and three dimensions, center of mass and Lab frames, concept of impact parameter, differential scattering cross-section, Rutherford scattering.

Unit – II

4. **Mechanics of rigid bodies(10)**

   Definition of Rigid body, rotational kinematic relations, equation of motion for a rotating body, angular momentum and inertial tensor. Eulers equation, torque free motion of a symmetric top. Symmetric top and precessional motion, Gyroscope and navigation precession of the equinoxes

5. **Mechanics of continuous media(10)**

   Stress and strain relation, Elastic constants of isotropic solids, Uniform and non uniform strains with examples, Poisson's ratio and expression for Poisson's ratio in terms of y, n, k.

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Fluid motion and its equilibrium properties, basic concepts leading to equation of continuity.

6. Special theory of relativity (10)

Galilean relativity, absolute frames, Michelson-Morley experiment, Postulates of special theory of relativity. Lorentz transformation, time dilation, length contraction, addition of velocities, position and velocity as four vectors, four momentum, mass-energy relation.

PART – B: WAVES AND OSCILLATIONS

Unit – III

7. Fundamentals of vibrations (16)

Simple harmonic oscillator, and solution of the differential equation– Physical characteristics of SHM, torsion pendulum, - measurements of rigidity modulus , compound pendulum, measurement of 'g',
Damped harmonic oscillator, solution of the differential equation of damped oscillator. Energy considerations, comparison with undamped harmonic oscillator, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance, velocity resonance.

8. Superposition of Harmonic motions(8)

Addition of two simple harmonic motions with different frequencies and phases, addition of many simple harmonic motions, combination of two mutually perpendicular simple harmonic vibrations of same frequency and different frequencies, Lissajous figures

9. Fourier analysis of complex vibrations(6)

Fourier theorem and evaluation of the Fourier coefficients, analysis of periodic functions-square, triangular, saw-tooth functions. Fourier energy theorem.

Unit – IV

10 Transverse and Longitudinal waves(12)

Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string

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clamped at both ends, overtones, energy transport, transverse impedance. Reflection and transmission of waves.

Longitudinal waves in air, solution of a differential equation, reflection and transmission of acoustic waves, Mach number.

11. Vibrations of bars(12)

Longitudinal vibrations in bars- wave equation and its general solution. Special cases (i) bar fixed at both ends ii) bar fixed at the mid point iii) bar free at both ends iv) bar fixed at one end. Transverse vibrations in a bar-wave equation and its general solution. Boundary conditions, clamped free bar, free-free bar, bar supported at both ends, Tuning fork.

12. Ultrasonics (6)

Ultrasonics, properties of ultrasonic waves, production of ultrasonics by piezoelectric and magnetostriction methods, detection of ultrasonics, determination of wavelength of ultrasonic waves. Velocity of ultrasonics in liquids by Sear's method. Applications of ultrasonic waves.

NOTE: Problems should be solved at the end of every chapter of all units.

Textbooks

1. Berkeley Physics Course. Vol.1, **Mechanics** by C. Kittel, W. Knight, M.A. Ruderman - *Tata-McGraw hill Company Edition 2008.*
2. **Fundamentals of Physics**. Halliday/Resnick/Walker *Wiley India Edition 2007.*
3. **Waves and Oscillations**. S. Badami, V. Balasubramanian and K. Rama Reddy *Orient Longman.*
4. **First Year Physics** - *Telugu Academy.*
5. **Mechanics of Particles, Waves and Oscillations**. Anwar Kamal, *New Age International.*
6. **College Physics-I**. T. Bhimasankaram and G. Prasad. *Himalaya Publishing House.*
7. **Introduction to Physics for Scientists and Engineers**. F.J. Ruche. *McGraw Hill.*
8. **Waves and Oscillations**. N. Subramaniyam and Brijlal *Vikas Publishing House Private Limited.*

Reference Books

1. **Fundamentals of Physics** by Alan Giambattista et al *Tata-McGraw Hill Company* Edition, 2008.

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2. **University Physics** by Young and Freeman, *Pearson Education, Edition 2005.*
3. **Sears and Zemansky's University Physics** by Hugh D. Young, Roger A. Freedman *Pearson Education Eleventh Edition.*
4. **An introduction to Mechanics** by Daniel Kleppner & Robert Kolenkow. *The McGraw Hill Companies.*
5. **Mechanics**. Hans & Puri. *TMH Publications.*
6. **Engineering Physics**. R.K. Gaur & S.L. Gupta. *Dhanpat Rai Publications.*

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Practical Paper – I
FIRST YEAR PRACTICALS

1. Determination of 'g' and 'k' using compound pendulum
2. Damping of an oscillating disc using logarithmic decrement in Air and Water.
3. Calculate Moment of Inertia using Bifilar suspension.
4. Calculate Y and n using oscillations of a mass under different combination of springs.
5. 'Y' by uniform Bending (or) Non-uniform Bending.
6. Verification of Laws of a stretched string (Three Laws).
7. Moment of Inertia of a fly wheel.
8. Measurement of errors –simple Pendulum.
9. Determination of frequency of a Bar/tuning fork-Melde's experiment.
10. 'n' by torsion Pendulum.
11. Observation of Lissajous figures using CRO.
12. Study of flow of liquids through capillaries.
13. Determination of Surface Tension of a liquid using capillary rise.
14. Study of Viscosity of a highly viscous fluid using searl's viscometer.
15. Volume Resonator –determination of frequency of a tuning fork.

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