

CSM : 15

PHYSICS PAPER - I

Time Allowed : 3 hours

Full Marks : 100

Marks for each question is indicated against it.

Attempt any 5 (five) questions taking not more than 3 (three) questions from each Part.

PART A

1. (a) Establish the differential equation of motion under a central force and deduce the solution for attractive inverse square force field. (4+6=10)
(b) State and prove Kepler's laws of a planetary motion. (1+3+3+3=10)
2. (a) Distinguish between elastic and inelastic collision. Show that in one dimensional elastic collision of two particles of equal mass the particles simply interchange their velocities after collision. (4+6=10)
(b) Find the moment of Inertia of a solid sphere of radius 20cm and density $6 \times 10^3 \text{Kg/m}^3$ about one of its tangential axes. (6)
(c) State Euler's theorem. (4)
3. (a) Derive Lorentz space and time transformation equations. Show that these equations reduce to Galilean transformation for $v \ll c$. (8+2=10)
(b) On the basis of Lorentz transformation, discuss the time dilation according to special theory of relativity. Explain the terms proper and improper time. (4+2=6)
(c) A 1m long rod is moving along its length with a velocity of $0.6c$. Calculate its length as it appears to (i) an observer on the earth (ii) moving with the rod itself. (2+2=4)
4. (a) What are Micro and Macro states? (4)
(b) Using the necessary assumption derive Bose-Einstein distribution Function. (16)

PART B

5. (a) Define damped harmonic oscillations. Write the differential equation for a damped harmonic oscillator and solve it. Plot a displacement time graph for all the three special cases of the solution. **(2+1+5+2=10)**
- (b) Deduce the wave equation for transverse waves in a string and find its solution. **(6+4=10)**
6. (a) Discuss the production and detection of plane and circularly polarised light. **(4+4=8)**
- (b) What is optical activity? Discuss its origin. List the factors on which the rotation of the plane of polarisation depends and define specific rotation. **(2+4+2+1=9)**
- (c) What is a quarter wave plate? **(3)**
7. (a) What are Self and Mutual inductances? Derive an expression for the coefficient of self induction for an inductor of N turns, length l and the relative permittivity of the intervening medium to be μ_r . **(4+6=10)**
- (b) Give the characteristics of Ferromagnetic substances. Explain the terms hysteresis, retentivity and coercivity with the help of a hysteresis loop. **(4+3+3=10)**
8. (a) What are normal and anomalous dispersion? **(6)**
- (b) Deduce Planck's radiation law and hence obtain Rayleigh-Jeane's Law as one of its limiting case. **(10+4=14)**

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