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Printed Pages : 7 TAS – 101/201

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 9913/9927 Roll No.

B. Tech. (Sem. I & II)

SPECIAL CARRYOVER EXAMINATION, 2006-07

PHYSICS

Time : 3 Hours] *[Total Marks : 100*

Notes : *(i) Attempt **all** questions.*

(ii) Marks carried by the questions are shown against it.

(iii) The physical constants are given at the end of the question paper.

1 Attempt any **four** of the following : **5×4**

(a) Using the postulates of special theory of relativity, deduce the Lorentz transformation equations.

(b) Calculate the percentage contraction in the length of rod in a frame of reference, moving with velocity 0.8 c in a direction at an angle of 30^o with its length.

(c) A stone is dropped from an aeroplane moving with a constant horizontal velocity. What will be the path (i) as observed by the pilot (ii) as observed by a man standing on the earth ? If both are different then explain why ?

(d) If frame S' is moving with velocity $v\hat{i}$ with respect to frame S, and the component of velocity in frame S' are $u'_x = c\cos\phi$ and $u'_y = c\sin\phi$ then prove that for the frame S, $u_x^2 + u_y^2 = c^2$.

(e) A spaceship moving away from the earth with velocity 0.5 c fires a rocket whose velocity relative to the space is 0.5 c. Calculate the velocity of the rocket as observed from the earth in following two cases :

(i) away from the earth

(ii) towards the earth

(f) Is there any condition at which the Lorentz transformation reduces to Galilian transformation ? Explain it by taking suitable example.

2 Attempt any **four** of the following : **5×4**

(a) In a biprism experiment the micrometer reading for zero order and tenth order fringes are 1.25 mm and 2.37 mm respectively when light of $\lambda = 5.90 \times 10^{-5}$ cm. is used. Now what will be the position of zero order and tenth order fringes if λ is changed to 7.50×10^{-5} cm.

(b) Find the expression for the fringe width in case of wedged-straped thin film.

(c) Explain what happens when :

(i) Glass plate is replaced by plane mirror in Newton's ring experiment

(ii) Thickness of wedged-straped thin film becomes very large.

(iii) A sheet of mica is introduced in the path of one of the interfering wave in Fresnel's biprism experiment.

(d) What is advantage of oil immersion objective in microscope ? Derive the expression for the resolving power of microscope.

(e) A diffraction grating is just able to resolve two lines of $\lambda = 5140.34\ A°$ and $5140.85\ A°$ in the first order. Will it resolve the lines $8037.20\ A°$ and $8037.50\ A°$ in the second order ?

(f) (i) What are the difference between interference and diffraction ?

(ii) A light of wavelength **5500** $A°$ falls normally on a slit of width 22.0×10^{-5} cm. Calculate the angular position of the first two minima on either side of the central maxima.

3 Attempt any **four** of the following : **5×4**

(a) What is quarter wave plate ? Describe its method of construction and use. Deduce its thickness for a given wavelength in terms of refractive indices.

(b) Plane polarized light is incident on a plate of quartz cut with faces parallel to optic axis calculate :

(i) the ratio of intensities of extraordinary and ordinary light if the vibrations in the incident light make an angle of 30^{o} with the crystal.

(ii) the least thickness of the plate for which extraordinary and ordinary beams on emergence recombine to form plane polarised light. (Given $\lambda = 6000\ A°$, $\mu_0 = 1.5442$, $\mu_E = 1.5532$)

(c) Define the plane of polarization. Give Fresnel's explanation of the rotation of polarization.

(d) (i) Define the specific rotation

(ii) On introducing a polarimeter tube of 25 cm. long containing a sugar solution of unknown strength it is found that the plane of polarization is rotated through 10^{o}. Find the strength of the solution in gm/cm^3. Given specific rotation of sugar solution 60^{o} per decimeter per unit concentration.

(e) (i) Comment on the statement, "Polarization requires that the vibrations are transverse."

(ii) Can sound waves be polarised ? Give reasons for your answer.

(f) Find the ratio of population of the two states in a He-Ne laser that produces light of wavelength 6328 A^{o} at $27^{o}C$. (Given that k (Boltzman constant) is 8.61×10^{-5} eV/K)

4 Attempt any **two** of the following : **10×2**

(a) (i) Explain the concept of displacement current. Write four Maxwell's equations and explain their physical significance.

(ii) What do you mean by continuity equation and deduce an expression for this equation ?

(b) (i) The relative permittivity of distilled water is 81. Calculate refractive index and velocity of light in it.

(ii) A plane electromagnetic wave propagating along the X-direction has a wavelength 5.0 mm. The electric field is in the γ-direction and its maximum magnitude is 38 V/m. Write the equation of the electric and magnetic fields as a function of x and t.

(c) (i) Prove that the energy dissipated per cc. of the magnetisation is μ_0 times the area of M - H (or I-H) curve.

(ii) Calculate the hourly loss of energy in the iron core of a transformer, the hysterisis loop of which is equivalent in area to 3000 ergs/cm^3. Given frequency 50 cycles/sec, density of iron 7.5 gm/cc and weight of the core 12 kg.

5 Attempt any **two** of the following : **10×2**

(a) Discuss quantum mechanically the problem of linear harmonic oscillator and obtain its eigen values. Also write significance of zero point energy.

(b) What is Compton effect ? Derive an expression for Compton shift, $\Delta\lambda = \frac{h}{m_o c}(1 - \cos\theta)$ where the symbols are having their usual meanings.

(c) (i) A set of lattice planes reflects X-rays of wavelength 1.32 A^o at a glancing angle of 9^o 30'. Calculate the possible spacing of this set of planes for different order of reflections. (Given that sin 9^o 30' = 0.1650)

(ii) Compute the energy difference between the ground state and the first excited state for an electron in a one-dimensional rigid box of length 10^{-8} cm.

PHYSICAL CONSTANTS

Planck's constant $h = 6.63 \times 10^{-34}$ J.s.

Velocity of light in free space $c = 3 \times 10^8$ m/s

Electronic charge $e = 1.6 \times 10^{-19}$ c

Permittivity of free space $\epsilon_0 = 8.85 \times 10^{-12}$ F/m

Permeability of free space $\mu_0 = 4\pi \times 10^{-7}$ H/m

Rest mass of electron $m_e = 9.1 \times 10^{-31}$ kg.