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

PAPER ID : 9913 Roll No. | | | | | | | | | | |

B.Tech.

FIRST SEMESTER EXAMINATION, 2006-07

PHYSICS

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt ALL questions.*

(ii) All questions carry equal marks.

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

(iv) Be precise in your answer.

1. Attempt ***any four*** parts of the following : **(5x4=20)**

(a) Show that the space-time interval between two events remains invarient under Lorentz-transformations.

(b) Show that a circle $x^2 + y^2 = a^2$ in a frame S appears to be an ellipse in the frame S′ which is moving relative to frame S with velocity v along x-axis.

(c) Verify the statement that no material particle can attain a velocity larger than the velocity of light c.

(d) A clock measures the proper time. With what velocity it should travel relative to an observer so that it appears to go slow by 30 seconds in a day.

(e) Calculate the rest mass, relativistic mass and momentum of a photon having energy 5 eV.

(f) A train whose length is 150 m when at rest, has to pass through a tunnel of length 125 m. The train is moving with uniform speed of 2.4×10^8 m/s towards the tunnel. Find the length of train and that of tunnel as observed by an observer at the tunnel.

2. Attempt *any two* parts of the following : **(10x2=20)**

(a) Discuss the formation of interference fringes due to a wedge shaped thin film seen by normally reflected sodium light and obtain an expression for the fringe width.

(b) What is meant by diffraction of light ? Describe the feature of a single slit Fraunhofer's diffraction pattern.

(c) (i) A diffraction-grating is just able to resolve two lines of wavelengths 5140.34 Å and 5140.85 Å in the first order. Will it resolve the lines 8037.2 Å and 8037.5 Å in second order ?

(ii) Newton's ring are formed in reflected light of wavelength 6000 Å with a liquid between the plane and curved surfaces. If the diameter of the 6th bright ring is 3.1 mm and the radius of curvature of the curved surface is 100 cm. Find the refractive index of liquid.

3. Attempt *any two* parts of the following : **(10x2=20)**

(a) Explain the phenomena of double refraction in a calcite crystal. Give the construction and theory of (i) quarter wave plate and (ii) half wave plate.

(b) (i) Differentiate between spontaneous emission and stimulated emission.

(ii) Explain the meaning of population inversion.

(c) (i) Calculate the energy and momentum of a photon of a laser beam of wavelength 6328 Å

(ii) Calculate the specific rotation of sugar solution from the following data :

Length of the tube = 22 cm, Volume of solution = 88 c.c., Amount of sugar in solution = 6 gm, Angle of rotation = 9°54′.

4. Attempt *any two* parts of the following : **(10x2=20)**

(a) Deduce the equation for the propagation of the plane electromagnetic wave in free space. Show that the electric and magnetic vectors are normal to each other as well as to the direction of the propagation of the wave.

(b) (i) Deduce Poynting theorem for the flow of energy in an electromagnetic field.

(ii) Show that the diamagnetic susceptibility is negative and is independent of temperature.

(c) (i) If the earth receives 2 cal min^{-1} cm^{-2} solar energy, what are the amplitudes of electric and magnetic fields of radiations.

(ii) What is hysteresis curve ? Explain residual magnetism, coercive force and hysteresis loss.

5. Attempt *any four* parts of the following : **(5x4=20)**

(a) Calculate the de Broglie wavelength of neutron of energy 12.8 MeV.

(b) Explain the Heisenberg's uncertainty principle.

(c) Using uncertainty principle, find the binding energy of an electron in an atom.

(d) The energy of a linear harmonic oscillator in its third excited state is 0.1 eV. Calculate the frequency of vibration.

(e) When x-rays of energy 100 KeV strikes a target, they are scattered at an angle 30°. Find the energy of recoiled electrons.

(f) A particle of mass m is represented by the wave function $\psi_1 = A_n \sin n\pi\frac{x}{a}$ in the range $0 \le x \le a$ and $\psi = 0$ elsewhere. Find the normalised form of the wave function.

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
Rest mass of electron	$m_e = 9.1 \times 10^{-31}$ kg
Electronic charge	$e = 1.6 \times 10^{-19}$ C
Permittivity of free space	$G_o = 8.85 \times 10^{-12}$ F/m
Permeability of free space	$\mu_o = 4\pi \times 10^{-7}$ H/m
Mass of neutron	$m_n = 1.67 \times 10^{-27}$ kg

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