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Printed Pages – 5

TAS – 101

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

PAPER ID : 9913 **Roll No.**

B.Tech.

FIRST SEMESTER EXAMINATION, 2005-2006

PHYSICS

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt **ALL** questions.*

(ii) Marks of each question are shown against it.

(iii) Be precise in your answer.

Physical constants :

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

Velocity of light $c = 3 \times 10^{8}$ *m/s.*

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

Mass of proton $m_p = 1.67 \times 10^{-27}$ *kg.*

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

(a) State the fundamental postulates of special theory of relativity and hence derive Lorentz transformation equations.

(b) Derive an expression for time dilation and give an example to show that time dilation is a real effect.

(c) A particle of rest mass m_o moves with speed $C/\sqrt{2}$. Calculate its mass, momentum, total energy and kinetic energy.

(d) Derive Einstein's mass-energy relation, $E = mc^2$. Give some evidence to prove its validity.

(e) Find the speed of an electron of kinetic energy 0.1 MeV according to classical and relativistic mechanics.

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

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

(a) (i) Describe and explain the formation of Newton's rings in reflected monochromatic light. Explain why Newton's rings are circular ?

(ii) Show that the diameter Dn of the n^{th} Newton's ring, when two surfaces of radii R_1 and R_2 are placed in contact, is given by the relation $\frac{1}{R_1} \pm \frac{1}{R_2} = \frac{4n\lambda}{Dn^2}$.

(b) (i) What do you understand by missing orders spectrum ? What particular spectra would be absent if the width of transparencies and opacities of the grating are equal.

(ii) What other spectral lines in the visible range 4000Å to 7000 Å will coincide with the fifth order line of 6000 Å in a grating spectrum ?

(c) Define resolving power and dispersive power of a grating. Derive an expression for the resolving power of a plane transmission grating.

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

(a) Explain the spontaneous and stimulated emission of radiation. Discuss the construction and working of a Ruby laser.

(b) (i) Describe and explain the phenomena of optical rotation. Show that $\theta = \frac{\pi d}{\lambda}(\mu_L - \mu_R)$, where symbols have their usual meaning.

(ii) A certain length of 5% solution causes the optical rotation of 20°. How much length of 10% solution of the same substance will cause 35° rotation.

(c) Describe the construction and working of a biquartz polarimeter. How will you use it to determine the specific rotation of an optically active substance ?

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

(a) State and explain Apere's circuital law. Use it to find the magnetic field induction $\vec{B}$ at a point within a current carrying (i) long solenoid (ii) tortoid.

(b) (i) Explain the concept of displacement current and show how it led to the modification of Ampere's law.

(ii) Show that the wave equation for electric field $\vec{E}$ is given by $\nabla^2\vec{E} = \mu_\circ\epsilon_\circ \frac{\partial^2\vec{E}}{\partial t^2}$.

(c) (i) What is Hysteresis Curve ? Explain residual magnetism and coercive force.

(ii) An iron rod 0.2 m long, 10 mm in diameter and of permeability 100 is placed inside a long solenoid wound with 300 turns/meter. If a current of 0.5 ampere is passed through the solenoid, find the magnetic moment of the rod.

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

(a) Discuss Compton effect and derive the expression for compton shift.

(b) Derive Bragg's law for the diffraction of X-rays by crystals. Describe Bragg's X-ray spectrometer.

(c) Calculate 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.

(d) Derive time-dependent Schrödinger wave equation.

(e) Calculate the uncertainty in the velocity of an electron which is confined in a 10A° box.

(f) Determine the velocity and kinetic energy of a neutron having de-Broglie wavelength 1.0 A° (mass of neutron is 1.67×10^{-27}kg)

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