



Printed Pages : 4

TAS - 101 / 201

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

PAPER ID : 9927

Roll No.

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### B. Tech.

(SEM. II) EXAMINATION, 2007-08

### PHYSICS

Time : 3 Hours]

[Total Marks : 100

- Note :**
- (1) Attempt all questions.
  - (2) Each question carries equal marks.
  - (3) The physical constants are given at the end of the question paper.

1 Attempt any **four** parts of the following :  $5 \times 4 = 20$

- (a) Show that the distance between any two points in two inertial frames is invariant under Galilean transformation.
- (b) How fast would a rocket have to go relative to an observer for its length to be contracted to 99% of its length.
- (c) Explain why a moving clock appears to go slow to a stationary observer ?
- (d) Show that for small velocities the relativistic kinetic energy of a body reduces to the classical kinetic energy, which is less than the rest energy.
- (e) Show that the massless particles can exist only if they move with the speed of light and their energy  $E$  and momentum  $p$  must have the relation,  $E = pc$ .
- (f) How much does a proton gain in mass when accelerated to a kinetic energy of 500 MeV.

2 Attempt any **four** parts of the following :  $5 \times 4 = 20$

- (a) State the essential conditions for observing the phenomenon of interference of light.
- (b) Discuss the effect of introducing a thin plate of mica in the path of one of the interfering beams in a biprism experiment.
- (c) A square piece of cellophane film with index of refraction 1.5 has a wedge shaped section so that its thickness at two opposite sides is  $t_1$  and  $t_2$ . If the number of fringes appearing with wavelength  $\lambda = 6000 \text{ \AA}$  is 10, calculate the difference  $(t_2 - t_1)$ .
- (d) In Fraunhofer diffraction at single slit. Show that the intensity of first subsidiary maximum is about 4.5% of that of the principal maximum.
- (e) What do you understand by resolving power of an optical instrument ? Explain Rayleigh criterion of resolution.
- (f) A telescope of aperture 3.0 cm is focussed on a window at 80 meter distance fitted with a wire mesh of spacing 2 mm. Will the telescope be able to observe the mesh with  $\lambda = 5500 \text{ \AA}$  ?

3 Attempt any **two** parts of the following:  $10 \times 2 = 20$

- (a) Explain the phenomenon of double refraction in calcite crystal. Describe the construction, working and use of a Nicol Prism.
- (b) (i) Discuss the phenomenon of rotation of the plane of polarisation of light by optically active material.

- (ii) Determine the specific rotation of the given sample of the sugar solution if the plane of polarisation is turned through  $13.2^\circ$ . The length of the tube containing 10% sugar solution is 20 cm.
- (c) Explain spontaneous and stimulated emission of radiation. How stimulated emission takes place with the exchange of energy between Helium and Neon atoms ?

4 Attempt any **two** parts of the following : **10×2=20**

- (a) What is Poynting vector ? Discuss the work-energy theorem for the flow of energy in an electromagnetic field.
- (b) (i) Prove that the electromagnetic waves are transverse in nature.
- (ii) Calculate the depth of penetration  $\delta$  at the frequency 71.6MHz in aluminium. The permeability and conductivity for aluminium are  $4\pi \times 10^{-7} \text{ N/Amp}^2$  and  $3.54 \times 10^7$  Siemen/m respectively.
- (c) (i) Prove that the magnetic moment due to orbiting of an electron can be expressed in terms of Bohr magneton.
- (ii) An iron rod 20cm long 1cm in diameter and of permeability 1000 is placed inside a solenoid wound uniformly with 600 turns/m. If the current of 0.5amp is passed through solenoid, find the magnetic moment of the rod.

5 Attempt any **four** parts of the following : **5×4=20**

- (a) Describe Laue experiment for diffraction of x-rays.
- (b) An x-rays photon is found to have its wavelength doubled on being scattered through  $90^\circ$ . Find the wavelength and energy of the incident photon.
- (c) Calculate de-Broglie wavelength associated with a proton moving with a velocity equal to  $\frac{1}{20}$ th of the velocity of light.
- (d) An electron has speed of 600m/s with an accuracy of 0.005%. Calculate the certainty with which we can locate the position of the electron.
- (e) Derive time dependent Scrodinger wave equation.
- (f) Find the expression for the energy level of a particle in one dimensional box.

### Physical Constants :

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

Velocity of light in free space  $C = 3 \times 10^8 \text{ m/s}$

Electron charge  $e = 1.6 \times 10^{-19} \text{ C}$

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

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

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

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