

Printed Pages: 4

TAS - 101 / 201

(Following Paper ID and Roll No. to be filled in your Answer Book) PAPER ID: 9927 Roll No.

B. Tech.

(SEM. II) EXAMINATION, 2007-08

PHYSICS

Time: 3 Hours!

[Total Marks: 100

Note:

- Attempt all questions.
- Each question carries equal marks.
- (3) The physical constants are given at the end of the question paper.
- Attempt any four parts of the following: $5\times4=20$
 - (a) Show that the distance between any two points in two inertial frames is invariant under Galilean transformation
 - How fast would a rocket have to go relative to an (b) observer for its length to be contracted to 99% of its length.
 - Explain why a moving clock appears to go slow (c) to a stationary observer?
 - Show that for small velocities the relativistic (d) kinetic energy of a body reduces to the classical kinetic energy, which is less than the rest energy.
 - Show that the massless particles can exist only if (e) they move with the speed of light and their energy E and momentum p must have the relation, E = pc.
 - How much does a proton gain in mass when (f) 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 opposit sides is t₁ and t₂. If the number of fringes appearing with

wavelength $\lambda = 6000 A$ 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.

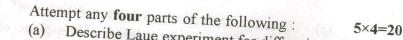
- What do you understand by resolving power of (e) an optical instrument? Explain Rayleigh criterian of resolution
- A telescope of aperture 3.0 cm is focussed on a window at 80 meter distance fitted with a wire mesh of spacing 2 mm. Will the telescope be able

to observe the mesh with $\lambda = 5500 \, \text{Å}$?

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°. 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?
- Attempt any two parts of the following: $10 \times 2 = 20$
 - (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 δ at the frequency 71.6MHz in aluminium. The permeability and conductivity for aluminium are $4\pi \times 10^{-7} N / Amp^2$ and 3.54×10^7 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.



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

Physical Constants:

Planck's constant $h = 6.63 \times 10^{-34} J.s$ Velocity of light in free space $C = 3 \times 10^8 m/s$ Electron 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 $m_e = 9.1 \times 10^{-31} kg$ Mass of proton = $1.67 \times 10^{-27} kg$.

- 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°. 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.

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