10908

Printed Pages—5 **TAS—201**

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

**PAPER ID : 9927** **Roll No.** | | | | | | | | | | |

**B.Tech.**

(SEM II) EVEN SEMESTER THEORY EXAMINATION, 2009-2010

# PHYSICS

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

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

*(ii)* *All questions carry **equal** marks.*

*(iii)* *In case of numerical problems assume data wherever not provided.*

*(iv)* *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

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

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

Mass of neutron $= m_n = 1.67 \times 10^{-27}$ kg

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

Permeability of free space $= M_0 = 4\pi \times 10^{-7}$ H/m

1. Attempt any **four parts** of the following : **(4x5=20)**

(a) Show that space-time interval $x^2+y^2+z^2-c^2t^2$ is invariant under Lorentz transformations.

(b) Show that, when an object moves with velocity $v(v \to c)$, relative to a fixed frame, its measured length appears to be contracted in the direction of its motion by a factor $\sqrt{1-v^2/c^2}$.

(c) Show that clock moving with velocity $v$ relative to an observer appears to him go slow by a factor of $\sqrt{1-v^2/c^2}$, than at rest relative to him.

(d) Show that relativistic kinetic energy of a particle is given by

$$K=(m-m_0)c^2=m_0c^2\left[\left(1-v^2/c^2\right)^{-1/2}-1\right]$$

and hence calculate the work done to increase the speed of electron of rest energy 0.5 MeV from 0.6 c to 0.8 c.

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

2. Attempt **any two** parts of the following : **(2x10=20)**

(a) (i) Explain conditions of interference for optical waves and differentiate between interference due to division of wave front and division of amplitude giving one example of each.





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(ii) Explain, what are coherent sources ? How two coherent sources are produced ? Explain coherence length, spatial coherence and temporal coherence.

(b) (i) Describe the Newton's ring method to determine the wavelength of sodium light. What will happen to fringes if air film between the plano-convex lens and glass plate is filled with a liquid of refractive index M. Explain.

(ii) A film of refractive index M is illuminated by white light at an angle of incidence $i$. In reflected light two consecutive bright fringes of wavelength $\lambda_1$ and $\lambda_2$ are found over lapping. Obtain expression for thickness of film.

(c) (i) Explain phenomenon of diffraction and distinguish Fresnel and Fraunhoffer diffraction. Obtain intensities of diffraction pattern in Fraunhoffer diffraction due to a single slit.

(ii) Explain Rayleigh criteria for limit of resolution. Obtain expression for resolving power of a grating. Can $D_1$ and $D_2$ lines of Na light be resolved (For $\lambda_{D1}=5890A^0$, $\lambda_{D2}=5896A^0$) in second order. Number of lines in grating of 2.0 cm wide 4500.

3. Attempt **any two** parts of the following : **(2x10=20)**

(a) (i) Explain the terms 'absorption', 'spontaneous' and 'stimulated' emission of radiation. Obtain a relation between transition probabilities of spontaneous and stimulated emission.

(ii) Explain the construction and working principle of Ruby laser.

(b) (i) Write differences between unpolarised and polarised light and define plane of vibration and plane of polarisation.

(ii) How can you produce polarised light by reflection ? Explain Brewster's law. By using Brewster's law prove that when an ordinary light is incident on the transparent substance at the polarising angle, the reflected and refracted rays are at right angle to each other.

(c) (i) Find the thickness of a quarter wave plate for the wavelength of light of 589 nm and $M_0 = 1.55$, $M_e = 1.54$.

(ii) Calculate the energy and momentum of a photon of a laser beam of wavelength 6328 $A^0$.

4. Attempt **any two** parts of the following : **(2x10=20)**

(a) (i) Derive electromagnetic wave equations in conducting medium.

(ii) Obtain the electromagnetic wave equations, using Maxwell's equation, in an isotropic dielectric medium and show that the speed of wave is less than its speed in vacuum.

(b) State Ampere's law in differential and integral forms. Discuss the modification made by Maxwell's taking displacement current in consideration. Explain the displacement current and its implications.

(c) (i) Discuss diamagnetic, paramagnetic, ferromagnetic, antiferromagnetic and ferrimagnetic substances by citing one example of each.

(ii) Define hysteresis and find out hysteresis loss with the help of B-H curve.

5. Attempt **any four** parts of the following : **(4x5=20)**

(a) State Heisenberg's uncertainty principle. Use this to show that electron cannot reside in an atomic nucleus.

(b) Calculate the smallest possible uncertainty in position of an electron moving with velocity $v = 3 \times 10^7$ m/second.

(c) Describe Bragg's law and Bragg's spectrometer.

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

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

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