Code : 221201

2013

PHYSICS

Time : 3 hours | *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

1. Answer any *seven* questions : 2×7=14

(a) What do you understand by electromagnetic waves?

(b) What is Ampere's circuital law?

(c) Can two electric bulbs (each 50 W) with point-like filament of the same material and lying close to each other produce interference?

(d) Why can optical diffraction grating not be employed to study the diffraction of X-rays?

(e) Why can light waves be polarized, while sound waves cannot be polarized?

  (Turn Over)

(f) What is the phenomenon of double refraction?

(g) What is the physical significance of $E^2 = p^2c^2 + m_0^2c^4$?

(h) Why do we not observe the effect of time-dilation in everyday phenomenon?

(i) What do you mean by matter waves? What is the aim of Davisson-Germer experiment?

(j) A nucleon is to a nucleus of diameter 5×10^{-4} m. Calculate the minimum uncertainty in the momentum of the nucleon.

2. Prove that normal component of $\vec{D}$ and tangential component of $\vec{E}$ are continuous across the boundary of three dielectrics having no charge at the boundary. Establish the relation between $\vec{D}$ and $\vec{E}$, where terms have their usual meanings. 14

3. Give the theory of Fraunhofer diffraction pattern produced by a single slit. When the grating element is less than the twice of the wavelength of light used, the first-order spectrum will be visible in a grating. Prove it. 14

4. Discuss Brewster's law and Malus law of polarization of light. Explain the phenomena of double refraction of light in crystals. 14

5. *(a)* Derive the standard Lorentz transformation equations on the basis of postulates of special theory of relativity.

(b) If photons have no mass, then how do photons have momentum? 14

6. *(a)* Why is a metastable level between stable energy levels necessary for laser emission?

(b) Why is a system with four allowed energy levels more suitable than a three-level system for laser action?

(c) Why is optical feedback necessary in a laser device? How is it achieved? 14

7. *(a)* What is Compton effect?

(b) Calculate the Compton wavelength for an electron.

(c) Why does the unmodified line appear in Compton scattering?

(d) Prove that Compton shift is independent on the nature of the scatter. 14

8. *(a)* Deduce the time-dependent Schrödinger wave equation for a free particle and a particle under an external force field.

(b) Write down Schrödinger equation for one-dimensional motion of a free particle in a one-dimensional potential box. Find its eigenfunction and eigenvalue. 14

9. Write short notes on any *two* of the following : 7×2=14

(a) Optical resonator

(b) Probability density

(c) Magnetooptic effect

(d) Failure of Galilean transformation

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