Code : 221101

B.Tech 1st Semester Exam., 2014

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) Derive the relativistic kinetic energy of a particle of rest mass m_0 moving with velocity v.

(b) A quarter wave plate is designed for 6000 Å. Find phase retardation for 4500 Å if change in refractive index is negligible.

(c) What is the de Broglie wavelength associated with electrons made to move from rest under a potential difference of 500 volts?

(d) Show that population inversion is not possible by direct excitation from a lower to higher level.

(e) What is the amount of work done in accelerating a body from rest to 0·6 c ?

(f) Why is diffraction of sound more evident than light waves in our daily life?

(g) What are the differences of temporal coherence and spatial coherence?

(h) What do you mean by solenoidal and irrotational vectors?

(i) Why should the wave function be normalized to 1?

(j) Explain the meaning of quantum mechanical tunnelling. Mention two examples where this phenomenon is observed.

2. Write down Maxwell's field equations, explaining the terms used. Show that in vaccum both electric and magnetic vectors obey wave equation. Assuming a plane wave solution, show that magnetic field is always orthogonal to the electric field. 14

3. (a) What do you mean by diffraction of light? Can X-ray produce diffraction of light? 4

(b) Derive the expression of intensity at a point for Fraunhofer diffraction due to double slit. Draw the intensity distribution curve and explain it. 10

4. (a) State Malus' law and prove it. 4

(b) Discuss Nicol prism as polarizer and analyzer. 4

(c) How are unpolarized, plane polarized, circularly polarized and elliptically polarized light distinguished? 6

5. (a) Explain three-level and four-level laser schemes. 3

(b) Can we have two-level laser? Justify your answer. 3

(c) Explain the working principle and construction of a ruby laser. 8

6. (a) What are inertial frames of reference? Discuss the basic postulates of a special theory of relativity. Mention some of the consequences of special theory of relativity. 8

(b) Derive Lorentz transformation equations on the basis of postulates of special theory of relativity. 6

7. (a) Obtain the expression for stationary energy levels for particle of mass m which is free to move in a region of zero potential between two rigid walls at $x = 0$ and $x = 1$. Are the energy levels degenerate? 9

(b) Prove that the wave function $\psi(x, t) = A\cos(kx - \omega t)$ does not satisfy the time-dependent Schrödinger equation for a free particle. 5

8. (a) State Wien's radiation formula and give its limitations. 4

(b) State clearly explaining all the terms Planck's law, Rayleigh-Jeans law and Wien's displacement law for radiation. Find out the two limits at which the Planck's formula reduces to the other two. 10

9. Write short notes on the following : 7+7=14

(a) Scalar and vector potentials

(b) Quantum confinement effects in nano-materials

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