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Total No. of Questions – 08

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B.E. I Semester Examination

BE-I/11(A)

229878

Engineering Physics

Course Code : BSC-102

Time Allowed: Three Hours *Maximum Marks – 100*

Note: Attempt five questions in all, selecting at least two questions from each section. Each question carries 20 marks. Use of Scientific Calculator is allowed.

SECTION – A

1. (a) State Maxwell's equations for an electromagnetic wave in free space and obtain the wave-equations for it. Prove the relation $\vec{E} = C\vec{B}$. 12

(b) Prove the relations: 8

(i) $\nabla.\vec{E} = S/\varepsilon_0$ ρ/ε_0

(ii) $\nabla.\vec{B} = 0$

2. (a) Explain the De-Broglie concept of matter waves. Discuss what is meant by wave-packet, phase and group velocities. Show that the group velocity of the waves associated with a particle is equivalent to the velocity of the particle. 12

(b) Calculate the (i) Speed and (ii) De-Broglie wavelength of an electron moving with kinetic energy of 120 eV. 8

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3. (a) Explain what is meant by Damped Oscillations. Deduce the differential equation of a damped harmonic Oscillator and find its solution. Discuss in detail the cases of critical damping and overdamping. 12

(b) A quartz crystal of thickness 0.001 m is vibrating at resonance. Calculate the fundamental frequency. Given Young's modulus for Quartz $= 7.9 \times 10^{10}$ N m^{-2} and density of quartz $= 2650$ kg m^{-3}. 8

4. (a) Define gradient of a scalar function ϕ. Show that gradient of a scalar function at any point is a vector representing the greatest rate of change of the scalar function at that point and is always perpendicular to the level surface. 12

(b) A 10 eV electron is incident on a barrier of height 20eV. What is the probability that the electron will tunnel through the barrier if its width is (i) 0.5 nm and (ii) 0.10 nm. 8

SECTION – B

5. (a) Differentiate between intrinsic and extrinsic semiconductors. Describe n-type and p-type semiconductors. Derive an expression for the electron concentration in an intrinsic semi conductor. 12

(b) An n-type germanium sample is 2 mm wide and 0.2 mm thick. A current of 10 mA is passed through the sample (x-direction) and a field of 0.1 Wb/m^2 is directed perpendicular to the current flow (Z-direction). The developed Hall voltage is 1.0 mV. Calculate the Hall coefficient and number of electrons/m^3. 8

(a) Describe and explain the formation of Newton's Rings in

reflected monochromatic light. Prove that in reflected light (i) diameters of bright rings are proportional to the square roots of odd natural numbers and (ii) the diameters of dark rings are proportional to the square roots of natural numbers. 12

(b) Light of wavelength 5×10^{-5} cm is incident normally on a plane transmission grating of width 3 cm and 15000 lines. Find the angle of diffraction in first order. 8

7. (a) State and explain Stimulated absorption, spontaneous emission and stimulated emission. Discuss Einstein's Co-efficients and derive a relation between them. 12

(b) In a laser, the energy difference between the two laser levels is 0.117 eV. Determine the frequency and wavelength of the radiation. 8

8. (a) Explain what is meant by Fermi Level. Prove that fermi level in an intrinsic semiconductor lies midway in the forbidden band i.e. $E_f = E_c + E_v/2$. 10

(b) Give the theory of a plane transmission grating and show how it can be used to determine the wavelength of light. 10

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$d \sin\theta = n\lambda$

$\theta = \frac{n\lambda}{d}$