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Uni. Roll No. …….

Program/ Course: B.Tech. (Sem. 1/2)

Name of Subject: Physics

Subject Code: BSC-18101

Paper ID: 15925

Time Allowed: 03 Hours **Max. Marks: 60**

NOTE:

1) **Parts A** and B are **compulsory**
2) **Part-C** has Two Questions Q8 and Q9. Both are compulsory, but with internal choice
3) Any missing data may be assumed appropriately
4) Use of scientific calculator is allowed

Part – A [Marks: 02 each]

Q1.

a) Define polarization of light. Enumerate various types of polarization.
b) Explain spiking in Ruby laser.
c) How can we increase the conductivity of intrinsic semiconductors?
d) Differentiate damped and undamped oscillations.
e) Explain factors responsible for change in properties when we change from bulk to nanoscale.
f) What is dispersion relation? Give its mathematical expression and discuss various cases of dispersion.

Part – B [Marks: 04 each]

Q2. Write short notes on (i) Magnetic Anisotropy (ii) Magnetostriction.

Q3. Differentiate intrinsic and extrinsic semiconductors. Discuss the position of Fermi level in both cases.

Q4. Derive the differential equation for harmonic oscillator. Also show that total energy of the harmonic oscillator is constant at any instant of time.

Q5. The electric potential in a certain region of space is given by $V(x,y,z) = 20x^2+10y+5z^3$. Find the electric field intensity vector? Check the field thus obtained is (i) uniform (ii) solenoidal.

Q6. Wave function of a particle in 1-D box of length L is given as

$$\Psi(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{n\pi x}{L}\right) ; \text{n} = \text{integer}$$

Show that this wave function satisfies 1-D time independent Schrodinger equation. Given that $E = \frac{n^2\pi^2\hbar^2}{2mL^2}$ and U = 0.

Q7. Derive London equations of superconductivity. Hence explain Meissner effect and flux penetration using the same.

Part – C **[Marks: 12 each]**

Q8. (i) Show that electromagnetic waves are transverse in nature.

(ii) A beam of plane electromagnetic waves is travelling in vacuum in an arbitrary direction. The magnitude of electric field component of the wave changes according to the relation $E = E_0 Sin(\omega t - \vec{k}\cdot\vec{r})$, where $E_0 = 15\times10^{-5} NC^{-1}$, $\vec{k}$ is propagation vector, $\vec{r}$ is a vector along the direction of propagation and ω is angular frequency of the electromagnetic wave. This beam is incident at an angle of 60° on a small surface having area $5\times10^{-6} m^2$. Find the amount of energy received by the surface in 3milliseconds.

OR

(i) Discuss the working of He-Ne laser and CO_2 laser using well labeled diagrams?

(ii) Define acceptance angle and numerical aperture. Find their mathematical expressions. A step index fibre having length 2km is found to have n_1=1.55 and n_2=1.50. Find acceptance angle and numerical aperture of the fiber. If the radius of the core is 15 μm and the wavelength of the carrier is 850 nm, then check whether the fiber is SMF or MMF.

Q9. (i) Discuss the formation of wave packet. Define phase velocity and group velocity and show that group velocity is always equal to the particle velocity.

(ii) Find points of maximum probability for particle moving in 1-D box of width L present in first excited state.

(iii) Define Hooke's law for a three dimensional body and give its utility in daily life.

OR

(i) What are ferrimagnetic substances, ferromagnetic substances and ferrites? Give some important applications of ferrites.

(ii) Discuss in detail applications and risks involved in the use of nanomaterials.

(iii) If the critical magnetic field for a superconductor at 0K is $10^4 A/m$ and the radius of wire is 3mm, then find the value of critical current for superconductor at 0K (Assume that there is no external magnetic field).

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