C2/116

Please check that this question paper contains 09 questions and 02 printed pages within first ten minutes.

[Total No. of Questions: 09] [Total No. of Pages: 02]

Uni. Roll No. .....

30/11/2019 (M)

Program: B.Tech. (Batch 2018 onward)
Semester: 1st /2nd
Name of Subject: Physics
Subject Code: BSC-101
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

Part – A **[Marks: 02 each]**

Q1.

a) Write Maxwell's equations in differential form.
b) What is the need to achieve population inversion ?
c) Differentiate between undamped oscillator and damped oscillator.
d) Write short note on extrinsic semiconductors.
e) Why the quantum number n=0 is not possible for particle moving in one dimensional box?
f) What are the conditions for a material to be superconductor?

Part – B **[Marks: 04 each]**

Q2. Deduce London equations and define London penetration depth.

Q3. Define acceptance angle and derive mathematical expression for the same.

Q4. Find the constants a,b and c such that the vector field

$\vec{F} = (x+2y+az)\,\hat{i} + (bx-3y-2)\,\hat{j} + (4x+cy+2z)\,\hat{k}$ is **irrotational**.

Q5. A damped oscillator is subjected to a damping force proportional to its velocity. Set up the differential equation of the oscillation. Discuss the case of critically damped motion.

P.T.O.

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Q6. Apply time independent Schrondinger equation to study the motion of a particle confined in a one dimensional box of length L. Hence find energy eigen values associated with the motion.

Q7. Drive an expression for Fermi energy in intrinsic semiconductor. What is the effect of temperature on Fermi level in an intrinsic semiconductor.

Part – C **[Marks: 12 each]**

Q8. (i) Derive mathematical relationship amongst Einstein coefficients and discuss the results thus obtained. Also find the ratio of rate of spontaneous emission to rate of stimulated emission at 300K corresponding to emission of green light photon with λ = 550 nm.

(ii) A manufacturer wishes to make a silica core, step index fiber with V= 75 and numerical aperture NA=0.30 to be used at 820nm. If n_1=1.458, what should the core size and cladding index be? Also find the value of critical angle and acceptance angle of the given fiber.

OR

(i) Deduce em wave equation for free space and prove that the electromagnetic waves are transverse in nature.

(ii) In an electric field the electric potential is given by $V(x,y,z) = (4x^2 + 3y^2 + 9z^2)^{-1/2}$. Calculate the electric field at point (1,1,1).

Q9. (i) Distinguish between the phase velocity and group velocity. Derive dispersion relation and discuss various cases possible.

(ii)Find the probability that a particle in a box L wide can be found between 0.45Land 0.55L for the ground and first excited states.

(iii) What do you understand by free oscillations and forced oscillations?

OR

(i) State and explain Meissner effect using London equations.

(ii) Write some important applications and risks of nanomaterials.

(iii) Penetration depth for a sample at 6K and 7K is 41.2nm and 180.3nm respectively. Calculate its transition temperature and the penetration depth at 0K .

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