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15PHY12/22

First/Second Semester B.E. Degree Examination, Dec.2019/Jan.2020 Engineering Physics

Time: 3 hrs.

Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. Physical Constants: Velocity of light, $C = 3 \times 10^8$ m/S,

Planck's constant $h = 6.625 \times 10^{-34}$ JS;

Mass of electron $m_e = 9.11 \times 10^{-31}$ kg,

Boltzmann constant $K = 1.38 \times 10^{-23}$ J/K,

Avagadro number, $N_A = 6.02 \times 10^{26}$ /Kmole,

Charge of electron $e = 1.6 \times 10^{-19}$ C

Module-1

- 1 a. Explain briefly the Planck's radiation law and reduce it to Wien's law and Rayleigh-Jeans law. (06 Marks)
- b. Using time - independent Schrodinger's wave equation for a particle in one dimensional potential well of infinite height, obtain an expression for normalization of wave function. (06 Marks)
- c. An electron is bound in one dimensional well of width 0.5 \AA but of infinite height. Find the energy value in eV for the ground state and first two excited state. (04 Marks)

OR

- 2 a. What is Phase velocity and group velocity? Obtain the relation between phase velocity and group velocity. (06 Marks)
- b. What is Wave function ' Ψ '? Give its properties and physical significance. (06 Marks)
- c. Calculate the de - Broglie wavelength associated with an electron whose kinetic energy is 150 eV. (04 Marks)

Module-2

- 3 a. Derive an expression for electrical conductivity based on quantum free electron theory. (06 Marks)
- b. What is Meissner effect? Distinguish between type I and type II superconductor. (06 Marks)
- c. Calculate the Fermi velocity and mean free path for the conduction electrons in silver, given that its Fermi energy is 5.5eV, and the relaxation time for electrons is 3.83×10^{-14} s. (04 Marks)

OR

- 4 a. What is Superconductivity? Explain BCS theory of super conductivity. (06 Marks)
- b. Explain how quantum free electron theory succeeded in overcoming the drawbacks of classical free electron theory. (06 Marks)
- c. Calculate the drift velocity of the electron in the presence of an applied electric field of strength 50V/m, whose mobility in a conductor is $5 \times 10^{-3} \text{ m}^2 \text{ V}^{-1} \text{ S}^{-1}$. (04 Marks)

Module-3

- 5 a. Explain the construction and working of CO₂ laser with the help of energy level diagram. (08 Marks)



- b. Obtain an expression for Numerical aperture in an optical fibre. (04 Marks)
c. The angle of acceptance of an optical fibre is 38° when kept in air. Find the angle of acceptance when it is in a medium of Refractive index 1.33. (04 Marks)

OR

- 6 a. Derive an expression for energy density of radiation in terms of Einstein's A and B coefficients. (06 Marks)
b. Explain three types of optical fibres with a neat diagram. (06 Marks)
c. Find the ratio of population of two energy levels of the wavelength of light emitted at 340K is 6340 \AA . (04 Marks)

Module-4

- 7 a. Define Unit cell. Describe briefly the seven crystal systems with neat diagram. (08 Marks)
b. Derive Bragg's law for X-ray diffractions by crystals. (04 Marks)
c. Draw the following planes in a cubic unit cell : (100), (110), (112) and (121). (04 Marks)

OR

- 8 a. Define Packing factor. Calculate the packing factor for sc, bcc and fcc structures. (07 Marks)
b. Describe the crystal structure of Diamond. (05 Marks)
c. The interplanar spacing in a crystal is 1 \AA and the glancing angle is 30° . Calculate the wavelength of the X-rays for first order Bragg reflection. (04 Marks)

Module-5

- 9 a. Define Mach Number. Distinguish between ultrasonics and supersonic waves. (04 Marks)
b. What is carbon nanotube. Write down any four properties and four applications of carbon nanotube. (06 Marks)
c. Explain the Sol-Gel and ball milling methods of synthesis of nano materials. (06 Marks)

OR

- 10 a. What is Shock wave? Write down the applications of shock wave. (04 Marks)
b. Describe the construction and working of Reddy's shock tube. (06 Marks)
c. Explain with principle, working of Scanning Electron microscope. (06 Marks)
