

Attempt any two parts from the following: (6x2=12)

1) Write down the Maxwell's equations in free-space and prove that the velocity of plane electromagnetic wave in the vacuum is given by  $c = 1/(\mu_0 \epsilon_0)^{1/2}$ .

2) Derive an expression for the velocity of plane electromagnetic waves in a conducting medium. Deduce the expression for the depth of penetration.

3) What is Poynting Vector? A conductor of circular cross-section of radius 2 mm carries a current  $I_c = 2.5 \sin(5 \times 10^8 t) \mu A$ . What is the amplitude of the displacement current if  $\sigma = 35 \text{ Ms/m}$  and  $\epsilon_r = 1$ ?

Attempt any four parts from the following: (3.5x4=14)

1) What do you understand by intrinsic and extrinsic semiconductors? Derive an expression for the densities of free electrons and holes in an intrinsic semiconductor.

2) How are Cooper pairs formed? Explain the BCS theory of superconductivity and discuss the energy gap based on this theory.

3) Write short notes on any two of the followings:

- (i) Type I and Type II superconductors; (ii) Meissner effect
- (iii) Band theory of solids.

4) Find the temperature at which the number of electrons in the conduction band of a semiconductor increases by a factor of 10 over the number of electrons in it at room temperature. The band gap for semiconductor is 0.67 eV. (At room temperature  $kT \sim (1/40) \text{ eV}$ ).

5) How the carbon nano-tubes are produced? Discuss properties and uses of CNTs.

Printed pages: 2

(Paper code and roll No. to be filled in your answer book)

Paper code: KAS-201

Roll No. 1161157

B.Tech. (Main & COP)

Second Semester Theory Examination 20

Engineering Physics-II

Time: 2 Hours

Total

Note Attempt all questions. Draw diagrams if necessary.

1. Attempt any four parts of the following:

(a) Explain the term space lattice, translation vectors, cell in the description of crystal structure.

(b) Derive a relation between inter-planar distance and Lead is face-centered cubic with an atomic radius, Find the spacing of (i) (200) planes and (ii) (220) planes.

(c) Prove that the volume of unit cell of reciprocal lattice is inversely proportional to the volume of unit cell of crystal lattice.

(d) Determine the Miller indices of the cubic crystal which intersects the position coordinates  $(1, 1/4, 0)$ ,  $(1, 1/4)$  and all coordinate axes.

(e) Derive Bragg's Law for the diffraction of x-ray. Describe Bragg's X-ray spectrometer.

2. Attempt any two parts of the following:

(a) Derive Clausius-Mossotti Equation for non-polar molecules. Determine the percentage of ionic polarizability of  $\text{CaF}_2$  chloride. Crystal has the optical index of refraction 1.5 and 5.6 respectively.

(b) Describe Langevin's theory of dia-magnetism. Show that it is independent of temperature.

(c) Discuss polar and Non-polar molecules with example. Calculate the polarizability of  $\text{NH}_3$ , molecule is found experimentally measurement of dielectric constant as  $2.5 \times 10^{-39} \text{ C}^2 \text{ m}^{-1}$  and  $20 \times 10^{-39} \text{ C}^2 \text{ m}^{-1}$  at 400K. Calculate for each polarizability due to permanent dipole moment and deformation of the molecules.