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B. Tech.

(Semester-II) Theory Examination 2017 - 18

ENGINEERING PHYSICS-II

Time:3 Hours *Total Marks:70*

Note: Attempt all Sections. If require any missing data then choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 7 = 14**

a. Define unit cell and primitive cell.
b. Find out the packing factor for a Simple Cubic structure.
c. What is ionic polarization in dielectrics?
d. What is the origin of magnetization in magnetic materials?
e. What is the difference between conduction current and displacement current?
f. What do you mean by intrinsic and extrinsic semiconductors?
g. Explain effect of temperature on electrical resistivity of superconducting materials.

SECTION B

2. Attempt any *three* parts of the following: **7 x 3 = 21**

a. Derive an expression for Compton shift. Explain the presence of unmodified radiation in Compton scattering.
b. Explain ferroelectricity and piezoelectricity. Give some applications of ferroelectric and piezoelectric materials.
c. Derive the electromagnetic wave equations in free space. Prove that the electromagnetic waves propagate with speed of light in free space.
d. Show that the Fermi level of an intrinsic semiconductor lies half way between conduction band and valance band. What will be position of Fermi level in n-type semiconductor? Explain with suitable diagram.
e. What are carbon nanotubes? Discuss arm chair, zigzag and chiral single walled carbon nanotubes

SECTION C

3. Attempt any *one* part of the following: **7 x 1 = 7**

(a) Show that in a cubic lattice the distance between successive planes of indices (h k l) is given by $d_{hkl} = \frac{a}{\sqrt{h^2+k^2+l^2}}$, where 'a' is lattice constant. A substance with FCC lattice has density 6250-kg/m^3 and molecular weight 60.2.Calculate the lattice constant. Given, Avogadro's number is 6.02 x 10^{23} per gm molecule.

(b) What is Laue's spot in X-ray diffraction? Explain how Bragg's law explained formation of Laue's spot? Calculate the longest wavelength that can be analyzed by a crystal of spacing 2.82 Å in the second order.

4. **Attempt any *one* part of the following:** **7 x 1 = 7**

(a) Explain dielectric loss. Deduce an expression for dielectric loss and sketch the loss spectrum for a polar material.

(b) Distinguish diamagnetic, paramagnetic and ferromagnetic substances. A material has 10 turns per cm of wire wound uniformly upon it which carries a current of 2.0 ampere. The flux density in the material is 1.0 Weber/m^2.Calculate the magnetization of material($\mu_0 = 4\pi \times 10^{-7}$weber/amp-meter).

5. **Attempt any *one* part of the following:** **7 x 1 = 7**

(a) Derive Maxwell's equations in differential form. Give physical significance of each equation.

(b) Prove that electromagnetic waves are transverse in nature. If the magnitude of $\boldsymbol{E}$ in a plane electromagnetic wave is 377 V/m, determine the magnitude of $\boldsymbol{H}$ in free space.

6. **Attempt any *one* part of the following:** **7 x 1 = 7**

(a) Find out the probability of occupancy of an energy level by an electron if (i) $E < E_F$ and (ii) $E > E_F$, where E_F is Fermi energy. Calculate the probability of occupancy of energy level by an electron at 300K which is lying 0.015eV below Fermi-level.

(b) Deduce an expression for the concentration of electrons in conduction band of an intrinsic semiconductor. A semiconductor rod of 10 mm length and 1 mm^2 cross-section has been doped with a total of 5×10^{13} donor atoms at room temperature. Calculate the electron and hole densities if the intrinsic carrier density in semiconductor is 2.4×10^{19} m^{-3}.

7. **Attempt any *one* part of the following:** **7 x 1 = 7**

(a) Discuss Meissner effect. Show that perfect diamagnetism and zero resistivity are two independent and essential properties of the superconductor.

(b) Explain superconductivity on the basis of BCS theory. Determine critical current and current density, which can flow through a long thin superconducting wire of diameter 2 mm if critical field for the material is $1.2\text{x}10^4$ A/m.