

<b>NEW SCHEME</b>
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**First/Second Semester B.E Degree Examination, February/March 2005**

**Common to all Branches  
Engineering Physics**

Time: 3 hrs.]

[Max.Marks : 100

**Note:** 1. Answer any FIVE full questions.

2. Value of Constants :

$$\text{Electron mass } m = 9.11 \times 10^{-31} \text{ kg}$$

$$\text{Electron charge } e = 1.6 \times 10^{-19} \text{ C}$$

$$\text{Velocity of light } c = 3 \times 10^8 \text{ m/s;}$$

$$\text{Planck's constant } h = 6.625 \times 10^{-34} \text{ J.S}$$

1. (a) Explain only the conclusions drawn in photoelectric effect and Davison Germer experiment leading to de-Broglie hypothesis.
- (b) Obtain an expression for de-Broglie wavelength using the group velocity concept.
- (c) Show that a free electron cannot exist in a nucleus of an atom.
- (d) An electron is confined to a box of length  $10^{-8} \text{ m}$ . Calculate the minimum uncertainty in its velocity and comment on the result. (5+7+4+4 Marks)
2. (a) What is the wave function? Give its physical significance and properties.
- (b) A wave function is given by  $\Psi = A \sin(n\pi x/L)$  for a motion of the particle in a zero potential well of breadth  $L$ . Calculate the value of  $A$ , where  $x$  is the position of the particle along  $L$ .
- (c) Describe how cooper pairs are formed. What is the importance of cooper pairs in superconductivity?
- (d) Give a brief account of high temperature superconductors. (5+5+6+4 Marks)
3. (a) Bring out the salient features of Drude-Lorentz theory.
- (b) Obtain an expression for density of states of energy levels.
- (c) Show that if the probability of occupancy is  $x$  at an energy level  $\Delta E$  below the Fermi level, then  $x$  is also probability of non occupancy at an energy level  $\Delta E$  above the Fermi level. (5+10+5 Marks)
4. (a) What is dielectric loss? Derive an expression for dielectric loss and discuss the frequency dependence of dielectric loss.
- (b) A parallel plate capacitor has an area of  $3 \times 10^{-3} \text{ m}^2$  and the plates are separated by a distance of 1mm. If a material with dielectric constant of 3.5 is introduced between the plates, determine the capacitance of the capacitor and electric field that must be applied for a charge of 20nC to be stored on each plate.
- (c) Discuss the properties of soft and hard magnetic materials. Also mention two important applications of each. (7+5+8 Marks)

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5. (a) Deduce expression for radiant energy density in terms of Einstein's coefficients and discuss the need for population inversion.
- (b) Explain the construction and working of He-Ne gas LASER with energy level diagram.
- (c) Write a note on Holography. (7+8+5 Marks)
6. (a) Discuss the advantages and disadvantages of optical fiber communication system over conventional communication system.
- (b) The numerical aperture of an optical fiber is 0.2 when surrounded by air. Determine the refractive index of its core given the refractive index of cladding as 1.59. Also find the acceptance angle when it is in a medium of refractive index 1.33.
- (c) Describe the construction and working of a Bragg's X-ray spectrometer and explain how it is used for determination of inter-planar spacing in a crystal. (6+4+10 Marks)
7. (a) Discuss Bravais lattice and crystal systems with the help of illustration.
- (b) Explain the importance of Miller indices of direction and planes in crystallography.
- (c) Calculate the coordination number and packing factor for SC, BCC and FCC structures.
- (d) A current of 5mA flows in an X-ray tube operating under a potential of 10 kV. Calculate the rate at which the electron are bombarding the target and the maximum speed they could attain. (6+4+6+4 Marks)
8. (a) Discuss nano-technology system giving at least one application in detail.
- (b) What are the advantages and disadvantages of composite materials?
- (c) Explain the term MEMS. Give a brief account of Smart materials. (7+5+8 Marks)

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