

Faculty of Engineering & Technology
First Semester B.E. (C.B.S.) Examination
ENGINEERING PHYSICS

Paper—II

Time : Two Hours]

[Maximum Marks : 40

INSTRUCTIONS TO CANDIDATES

- (1) All questions carry equal marks.
- (2) Solve **FOUR** questions as follows :
 - (i) Q. No. 1 OR Q. No. 2
 - (ii) Q. No. 3 OR Q. No. 4
 - (iii) Q. No. 5 OR Q. No. 6
 - (iv) Q. No. 7 OR Q. No. 8
- (3) Assume suitable data wherever necessary.
- (4) Use of non-programmable electronic calculator is permitted.

List of Constants

Planck's Constant "h" = 6.63×10^{-34} J.S

Velocity of Light "c" = 3×10^8 m/s

Charge on Electron "e" = 1.602×10^{-19} C

Mass of Electron "m" = 9.11×10^{-31} kg.

1. (a) Obtain an expression for change in wavelength of X-ray photon when it is scattered by an electron at rest. 4
- (b) What are the causes of existence of modified and un-modified components in Compton scattering ? 3
- (c) A photon of energy 1 MeV is scattered through 90° by a free electron. Calculate the change in energy of photon and electron after the interaction. 3

OR

2. (a) State the properties of matter waves. 2
- (b) Discuss in detail an experiment that confirms the existence of de-Broglie matter waves 4
- (c) What would be the de-Broglie wavelength associated with :
 - (i) 2000 kg car having a constant speed of 25 m/s
 - (ii) 80 kg scooter having a speed of 10 m/s.
 Give your conclusion. 4
3. (a) What is the Uncertainty Principle ? Is this principle the outcome of the wave description of a particle ? Describe diffraction of Electrons by Single Slit Experiment to prove its validity. 5
- (b) Show that the phase velocity of a de-Broglie wave is greater than the velocity of light, but group velocity is equal to velocity of the particle with which the wave is associated. 3
- (c) Calculate the minimum uncertainty in the velocity of an electron confined to a box of 10^{-8} m length. 2

OR

4. (a) A free particle of mass "m" is kept in a rectangular box of length "L". Considering one dimensional motion, obtain an expression of discrete energy of particle. Show that energy of particles are quantized. 5
- (b) State the properties of wave function " ψ ". 2
- (c) Calculate the lowest three permissible energies of an electron if it is bound by an infinite square well potential of width 2.5×10^{-10} m. 3
5. (a) Define atomic radius and packing fraction. Calculate the atomic radii and packing fractions for Body Centered and Face Centered Cubic Unit Cell. 4
- (b) What do you understand by Miller Indices of a crystal plane ? Obtain the relation between interplanar spacing and Miller indices of plane in Cubic Unit Cell. 3
- (c) For an FCC cubic crystal, the interplanar spacing of (110) plane is 2 Å. Calculate the atomic radius. 3

OR

6. (a) Calculate number of atoms per unit cell in Simple Cubic and Body Centered Cubic Unit Cell. Show that atomic density of BCC is double than SC-unit cell. 3
- (b) Derive Bragg's law for X-ray diffraction in crystals. State any one application of it. 4

(Contd.)

- (c) Bragg's Spectrometer is set for the first order reflection to be received by the detector at glancing angle 10° . Calculate the angle through which the detector is rotated to receive the second order reflection from the same face of crystal. 3
7. (a) Discuss energy band structures of conductors, insulators and semiconductors. Give a brief account of the general properties and characteristics of semiconductor. 3
- (b) What do you mean by intrinsic semiconductor? Obtain an expression for the intrinsic carrier concentration in an intrinsic semiconductor. 4
- (c) Find the resistance of an intrinsic germanium rod $1 \text{ cm} \times 1 \text{ mm} \times 1 \text{ mm}$ at 300 K
 For Ge, $n_i = 2.5 \times 10^{13} / \text{cm}^3$, $\mu_h = 3900 \text{ cm}^2/\text{V.S.}$,
 $\mu_e = 1900 \text{ cm}^2/\text{V.S.}$ 3

OR

8. (a) Draw neat and clean energy band diagrams of PN-junction in :
 (i) Unbiased condition
 (ii) Forward bias condition. 3
- (b) Explain the phenomenon of Hall effect and obtain an expression of Hall voltage developed in rectangular specimen of conductor at equilibrium. 4
- (c) The Hall coefficient of certain silicon specimen is found to be $-7.5 \times 10^{-5} \text{ m}^3/\text{c}$ at a certain temperature. If the conductivity is found to be 200 mho/m , calculate density of charge carriers and their mobility. 3