

2021

ELECTRONICS — HONOURS

Paper : CC-3

(Applied Physics)

Full Marks : 50

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Answer **question no. 1** and **any four** questions from the rest.

1. Answer **any ten** questions :

1×10

(a) In primitive unit cell, lattice share per unit cell is

(i) 1

(ii) 2

(iii) 4

(iv) 6.

(b) Ionic solids are

(i) very soft material.

(ii) very good electrical conductor.

(iii) very high melting point material.

(iv) very low melting point material.

(c) Hydrogen bond is a

(i) primary bond

(ii) secondary bond

(iii) very strong bond

(iv) None of these.

(d) Atomic packing factor for FCC structure is

(i) 0.50

(ii) 0.74

(iii) 0.68

(iv) 0.25.

(e) Coordination number for the BCC crystal structure is

(i) 4

(ii) 6

(iii) 8

(iv) 12.

(f) Silicon has

(i) Simple Cubic structure (SC)

(ii) Body Centre Cubic structure (BCC)

(iii) Face Centre Cubic structure (FCC)

(iv) Diamond Cubic structure (DC).

Please Turn Over

- (g) Miller-Bravais indices $\{hkl\}$ is useful for indexing
- (i) Cubic crystal
 - (ii) Hexagonal crystal
 - (iii) Monoclinic crystal
 - (iv) Tetragonal crystal.
- (h) Concept of matter wave was suggested by?
- (i) Heisenberg
 - (ii) Schrodinger
 - (iii) Einstein
 - (iv) De Broglie.
- (i) The square of the magnitude of the wave function is called
- (i) Current density
 - (ii) Probability density
 - (iii) Charge density
 - (iv) Volume density.
- (j) Glass is a
- (i) Tough material
 - (ii) Ductile material
 - (iii) Hard material
 - (iv) All of these.
- (k) Which of the following statement(s) are true?
- (i) Particles following FD statistics are distinguishable.
 - (ii) Particles following FD statistics are indistinguishable.
 - (iii) Particles following MB statistics are distinguishable.
 - (iv) Particles following BE statistics are indistinguishable.
- (l) Metal has
- (i) Zero band gap value.
 - (ii) Band gap value $> 6\text{eV}$.
 - (iii) Band gap value between 0.25 eV to 2.5 eV .
 - (iv) Band gap value between 3 eV to 5 eV .

2. (a) Name different crystal systems for three dimensional lattice.
(b) What is inter-planar spacing?
(c) Why x-ray is used for the determination crystal structure?
(d) What is reciprocal lattice?

3+2+3+2

3. (a) State Hook's law. Show a stress-strain diagram and find out Young's modulus from the diagram.
(b) What is plastic deformation?
(c) What is heat capacity?
(d) Briefly explain why metals are typically better thermal conductors than ceramic materials.

(1+1+1)+2+2+3

4. (a) Calculate the Compton wavelength of an electron and find the maximum wavelength change in the Compton effect.
- (b) Show that the wave velocity of the De Broglie wave is a function of the wavelength even in free space, while the group velocity equal to the particle velocity.
- (c) Compare phase velocity and group velocity. 4+4+2
5. (a) What is wave vector?
- (b) Write down the time-independent Schrodinger equation for a particle in a one dimensional potential box with rigid boundaries.
- (c) Show that :
- (i) $[x, p_x] = i\hbar\psi$
- (ii) $[p_x, p_y] = 0$. 2+4+4
6. (a) What is thermodynamical probability?
- (b) What is Bose condensation?
- (c) How does Fermi energy vary with temperature?
- (d) Derive Rayleigh Jeans law from Plank's radiation law. 2+2+3+3
7. (a) State and explain Matheissen's rule related to the resistivity of metals.
- (b) Show the resistivity versus temperature plot for metals.
- (c) What are holes?
- (d) From E-K diagram, show that effective mass of hole is higher than the effective mass of electron. 3+1+2+4
8. (a) Define magnetic susceptibility and permeability. How can one classify magnetic materials on the basis of these properties?
- (b) What is Curie point? Why magnetic behaviour of magnetic substances decreases with increasing temperature? – Explain.
- (c) Draw the B-H curve for a ferromagnetic material and identify the retentivity and coercive field on the curve. 4+3+3
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