

2026

ELECTRONICS — HONOURS

Paper : DSCC-7

(Applied Physics)

Full Marks : 75

The figures in the margin indicate full marks.

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

Group – A

1. Answer **any ten** questions :

2×10

- (a) What is meant by a primitive unit cell?
- (b) Define coordination number of a crystal structure.
- (c) What are Miller indices used for?
- (d) Distinguish between ionic bond and covalent bond.
- (e) State de Broglie's hypothesis.
- (f) What is meant by probability density in quantum mechanics?
- (g) Define an operator in quantum mechanics with one example.
- (h) What is meant by density of states?
- (i) State any two characteristics of Bose-Einstein statistics.
- (j) What is Hermitian Operator in Quantum Mechanics?
- (k) What is an intrinsic semiconductor?
- (l) Define magnetic susceptibility.

Group – B

Answer **any three** questions.

- 2. Explain the concept of lattice and basis. Show how a crystal structure is generated from them. 5
- 3. Discuss the wave-particle duality of matter and explain its significance in modern physics. 5
- 4. Explain the concept of effective mass of an electron in a crystal lattice. How does it vary with the wave vector $\vec{k}$? 3+2

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5. Discuss the origin of electrical resistivity in metals according to the free-electron model. 5
6. Explain intrinsic and extrinsic semiconductors with suitable energy band diagrams. 5

Group – C

Answer *any four* questions.

7. (a) Derive the packing fraction for a body centered cubic crystal structure.
(b) Explain the concept of reciprocal lattice. Write down Bragg's equation for a direct lattice as well as a reciprocal lattice. 4+(2+2)+2
8. Discuss Wien's radiation law and Rayleigh-Jeans law. Mention their limitations. Explain how Planck's radiation law reduces to the above two laws under limiting conditions. (3+2)+5
9. (a) Describe Heisenberg's uncertainty principle and discuss its physical significance.
(b) Obtain the energy eigenvalues of a particle confined in a one-dimensional infinite potential well. (3+2)+5
10. (a) What is Kronig-Penny model? Explain how it leads to the formation of energy bands in solids.
(b) Compare Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distribution functions. (2+4)+4
11. (a) Explain the Meissner Effect in super-conductivity. Differentiate between type-I and type-II super-conductors.
(b) Define Fermi Level. Write the expression for concentration of carriers in an intrinsic semiconductor explaining each term. (3+3)+(2+2)
12. (a) What do you mean by polarization in dielectric materials? Discuss the different types of polarization in such materials.
(b) Classify magnetic materials into diamagnetic, paramagnetic, ferromagnetic and antiferromagnetic substances with examples. (2+4)+4
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