PG Even Semester Examination, May 2025

PHYSICS

(4th Semester)

Course No.: PHYCC-653C

(Condensed Matter Physics-II)

Full Marks: 70

Pass Marks: 28

Time: 3 hours

The figures in the right margin indicate full marks for the question.
Answer any five questions selecting one from each unit.

UNIT-I

1. (a) Derive the Boltzman Transport Equation and hence obtain an expression for the viscosity for a gas having Maxwellian velocity distribution. 3+7=10

   (b) What are the thermoelectric powers? What is the relation between the Seebeck and Peltier coefficients? 4

2. Set up the classical theory for thermal conductivity K of a metal and hence discuss Wiedmann-Franz law. Show that the Lorentz number obtained on the basis of quantum theory is equal to $[\pi^2/3][k/e]^2$, where symbols have their usual meanings. 8+2+4=14

UNIT-II

3. (a) What do you mean by the Density Functional Theory (DFT)? What are the

Turn Over

two Hohenberg Kohn Theorems? Prove the theorems. 2+6=8

(b) Write short notes on any two of the following : 3x2=6

(i) Self-consistent field (SFC) process

(ii) Exchange correlation energy

(iii) Augmented plane wave (APW) and Linearized Augmentd plane wave (LAPW) method.

4. How do the energy bands form in solids? Discuss the theory of Tight-Binding Approximation and apply it to calculate the energy bands for three viz. SC, BCC and FCC Bravais lattices. 2+9+3=14

UNIT-III

5. (a) Derive the expression for Cole-Cole plot of a dielectric. What are the significances of Cole-Cole plot. 6+2=8

(b) What is the phenomenon of Ferroelectricity? Explain briefly the polarization catastrophe or Ferroelectric catastrophe. 2+4=6

6. (a) What is meant by a local field in a solid dielectric? Obtain Claussius-Mossotti relation in dielectrics subject to static fields. 1+9=10

(b) Calculate the dielectric constant of a solid dielectric whose density is 3 x 10^{28} atoms/m^3 and electric polarizability is 10^{-40} Fm^2. 4

UNIT-IV

7. Discuss the variation of spontaneous magnetisation with temperature for ferromagnetic materials. Explain in detail the Quantum Theory of Ferromagnetism and derive Curie-Weiss law for their susceptibility. 4+10=14

8. What is antiferromagnetism? Describe the two sub-lattice model to explain antiferro magnetism. How does this model account for the difference between the Neel temperature and the Curie-Weiss temperature? 2+8+4=14

UNIT-V

9. (a) Explain the Mossbauer effect. What are the Natural and Doppler broadenings?

(b) Describe an experimental setup and discuss the results of chemical application of Mossbauer effect. 7+7=14

10. Write briefly on : 7x2=14

(i) Isomer Shift

(ii) Quadrupole Splitting

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