PG Even Semester Examination, May 2025

PHYSICS

(4th Semester)

Course No.: PHY-404B

(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 thermoelectronic power? 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. 8+6=14

UNIT-II

3. How do the energy bands form in solids? Discuss the theory of Tight-Binding Approximation and apply it to calculate the energy bands gaps in SC and BCC cubic crystals. 2+9+3=14

4. (a) What do you mean by the Density Functional Theory (DFT)? What are the two Hohenberg Kohn Theorems? Prove the theorems. 2+6=8

(b) Describe the augmented plane wave (APW) method to calculate band structure. 4

UNIT-III

5. What is meant by a local field in a solid dielectric? Obtain Claussius-Mossotti relation in dielectrics subject to static fields. 4+10=14

6. (a) Discuss the frequency dependence of dipolar polarizability. Obtain Debye's equations that exhibit dispersion. 4+3=7

(b) What is the phenomenon of Ferro-electricity? Explain briefly the polarization catastrophe. 3+4=7

UNIT-IV

7. Gve an account for the quantum theory of paramagnetism and discuss the low and high temperature cases. 10+4=14

8. Explain the origin of diamagnetism in materials. Obtain an expression for diamagnetic susceptibility using Langevin's classical theory. What is the significance of negative susceptibility? 2+10+2=14

UNIT-V

9. (a) What is optical conductivity? Discuss briefly the effect of trapping mechanism on decay time.

(b) What are the colour centres? Discuss a process for generation of colour centre in alkali halides. 7+7=14

10. What is luminescence? Describe the different mechanism of luminescence in the details. How does luminescence efficiency depend on the concentration of the atomic activators? 2+8+4=14

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