TM253192S

Reg. No : 31/10/25

Name :

MASTER'S DEGREE (C.S.S) EXAMINATION, OCTOBER 2025

2024 ADMISSIONS REGULAR

SEMESTER III - ELECTIVE COURSE

PH3E01TM20 - Solid State Physics for Materials

Time : 3 Hours

Maximum Weight : 30

Part A

I. Answer any Eight questions. Each question carries 1 weight **(8x1=8)**

1. Compare Schottky and Frenkel imperfections with one example each.
2. Write notes on Burgers vector in the case of edge and screw dislocations. [CO1,Remember]
3. Explain the concept of a slip plane and a slip direction. Why are certain planes and directions more likely to be slip systems in a given crystal structure?
4. What are the roles of attractive and repulsive forces in the formation of solids?
5. Even though the Madelung constant is a function of crystal structure, the Madelung potential of ionic crystals is independent of crystal structure. Why?
6. Explain the condition for obtaining the frequencies of the longitudinal modes of oscillation.
7. Obtain the expressions for dielectric function of an electron gas.
8. Discuss the condition under which a metastable phase could be found in a binary diffusion couple.
9. Give an account on phase, components and variables of a system.
10. Mention any five applications of Fick's law with a brief decsription of each. [CO4,Remember]

Part B

II. Answer any Six questions. Each question carries 2 weight **(6x2=12)**

11. A cube of copper of 10 mm x 10 mm x 10 mm is sheared at a rate of 10 mm per min. Estimate in order of magnitude the minimum number of dislocations in motion in this cube at a given instant. Assume a dislocation velocity of 1 km/s. [CO1,Apply]
12. An fcc crystal has a CRSS of 0.7 MN/m^2. What tensile stress must be applied along the [100] direction of the crystal to initiate plastic deformation? [CO1,Apply]
13. What is the potential energy of CsCl at equilibrium if the separation between the Cs and Cl atoms is 35 nm. Given, A=1.79 and n = 11.5.
14. Describe the metallic bonding process in an aggregate of copper atoms.
15. Show that increase in exchange energy due to the excitation of the spin is $6JS^2$.
16. Derive LST relation. Explain its importance?
17. If Q = 2 eV, and Do = 8 x 10^{-5} m^2/s, then determine the ratio of diffusivities at 100°C and 105°C. [CO4,Apply]
18. Discuss the role of phase diagram in zone refining of materials.

Part C

III. Answer any Two questions. Each question carries 5 weight **(2x5=10)**

19. Write an essay on point imperfections highlighting the features of imperfections arising due to deviation from stoichiometry. Discuss the enthalpy of formation of point imperfections. [CO1,Understand]
20. Discuss the nature of ionic bonding. Elaborate the procedure in Born Haber cycle.

21. Derive the dispersion relation for Magnons.

22. Outline the detailed theory of diffusion. Solve the equations in the spacial cases of diffusion through a plane surface, through a hollow cylinder and through a spherical shell. [CO4,Understand]