(b) What are color centres? How F centres can be produced in an ionic crystal and what are the properties of these centres? What are F′ centres?   1+2+2+2 = 7

UNIT - V

9. (a) When a substance is called liquid crystal? Describe the composition of these materials.
                                                  2+2 = 4

(b) Describe the structures of cholesteric mesophases. Name two distinct types of nematic mesophase crystals? How are they differentiated?   4+2+4 = 10

10. (a) When a substance can be called nanomaterial? Classify nanomaterials according to their physical composition? What are the Top-down and bottom-up approaches for the synthesis of nanomaterials?   1+3+2 = 6

(b) Write notes on any two of the following:
                                                  4+4 = 8
   i)   Chemical vapour deposition
   ii) Laser ablation
   iii) X-ray diffraction technique

★★★

PHYSICS

3rd Semester

Course No. : PHYCC - 304B

(Condensed Matter Physics - I)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

(Answer any five questions, taking one from each unit)

UNIT - I

1. (a) Derive expressions for velocities of longitudinal and transverse elastic waves propagating in the [110] direction.   10

(b) Show that the deformed coordinate axes are not orthogonal.   4

2. (a) Describe elastic stiffness and elastic compliance constants. Further, show that for a cubic crystal, there are only three independent elastic stiffness constants.   10

(b) Derive an expression for dilation.   4

UNIT - II

3. (a) Explain the failure of the Einstein Theory of Specific heat of solids?   2

   (b) How Debye's theory explain the failure of Einstein theory of specific heat? Derive the Debye's expression for the specific heat of a solid.   2+10=12

4. (a) Assuming the inter-particle interaction having cubic and quartic terms, what are the possible scattering process of phonons? Explain the Normal and Umklapp processes?   3+4=7

   (b) What is Thermoluminescence? Explain in detail the mechanism of the phenomenon of Thermoluminescence?   2+5=7

UNIT - III

5. (a) What is the basis or assumptions of Drude-Lorentz free electron theory? Discuss the limitations of free electron theory?   2+2=4

   (b) Explain the Ohm's law and find the expression for electrical conductivity on the basis of Drude-Lorentz free electron theory.   5+5=10

6. (a) How Sommerfield model explains the failure of classical free electron theory? Show that the available electron states between E and E+dE

for a cubical metal specimen of side L (volume V) as,

$$Z(E)dE = \frac{V}{2\pi^2}\left(\frac{2m}{\Box^2}\right)^{\frac{3}{2}} E^{\frac{1}{2}}dE \qquad 2+5=7$$

   (b) What is the significance of the Fermi-Dirac distribution? Discuss the effect of temperature on the Fermi-Dirac distribution function?   2+5=7

UNIT - IV

7. (a) What do you mean by lattice defects? Classify lattice defects in different categories according to their nature. What are the effects of these defects on the properties of the crystal?   1+2+2 = 5

   (b) What is meant by slip in dislocation? How dislocation line and Burger vector is defined? What is the difference between edge and screw dislocation?   1+2+1 = 4

   (c) Find the equilibrium concentration of vacancies in case of Frenkel defect at temperature T.   5

8. (a) What is meant by diffusion in solids? Explain in short the mechanisms through which the diffusion takes place? Find the frequency of jumping of atoms in a crystal at temperature T undergoing vacancy motion.   1+3+3 = 7