

6/PHY-350 Syllabus-2023

2026

(May-June)

FYUP : 6th Semester Examination

PHYSICS

(Solid-State Physics)

(PHY-350)

Marks : 75

Time : 3 hours

The figures in the margin indicate full marks for the questions.

Answer *any ten* questions.

1. Discuss the various symmetry elements associated with a crystal. Explain point group and space group symmetry. $6+1\frac{1}{2}=7\frac{1}{2}$
2. What are Bravais lattices? Describe briefly the seven crystal systems in three-dimension mentioning their characteristic features. Give examples of simple cubic, face-centred cubic and body-centred cubic crystals. $1+5+1\frac{1}{2}=7\frac{1}{2}$
3. (a) What are lattice planes? How are they represented in terms of miller indices? Sketch (111) plane in a cubic crystal. $1+2+1\frac{1}{2}=4\frac{1}{2}$

(2)

- (b) Copper has f.c.c. structure and its atomic radius is $1.278 \text{ \AA}$. Calculate its density if the atomic weight of copper is 63.5. 3
4. (a) Calculate the interplanar spacing for a (3 2 1) plane in a simple cubic lattice whose lattice constant is $4.2 \times 10^{-8} \text{ cm}$. 3
- (b) What is a reciprocal lattice? Show that reciprocal lattice of a b.c.c. lattice is an f.c.c. lattice. $1\frac{1}{2} + 3 = 4\frac{1}{2}$
5. Explain why X-rays are diffracted by crystal. Derive Laue's condition for X-ray diffraction. Show that Bragg's law is the special case of it. $2 + 4\frac{1}{2} + 1 = 7\frac{1}{2}$
6. (a) A monochromatic X-ray of wavelength $1.75 \text{ \AA}$ is incident on a crystal. If the first-order diffraction occurs at 30° , calculate the interatomic spacing. $3\frac{1}{2}$
- (b) What is structure factor in X-rays diffraction? Obtain the structure factor of a b.c.c. lattice. $1 + 3 = 4$
7. Discuss the lattice vibrations of a lattice with two atoms per unit cell. Show that the atoms in optical branch move in opposite direction, while in acoustical branch they move in the same direction. $7\frac{1}{2}$

(3)

8. Derive Debye's formula for the specific heat of solids. What are the assumptions and achievements of the theory? $7\frac{1}{2}$
9. (a) Obtain the expression for the electrical conductivity of a metal using Drude model. 5
- (b) Explain Wiedemann-Franz law using Drude model. $2\frac{1}{2}$
10. Show that the electronic heat capacity of a metal is proportional to its temperature. $7\frac{1}{2}$
11. (a) Calculate the Fermi energy of sodium whose density is 0.534 g/cc and atomic weight 23 amu. Given the mass of the electron is $9.1 \times 10^{-28} \text{ g}$ and Planck constant is $1.054 \times 10^{-27} \text{ erg-s}$. 3
- (b) Discuss Bloch theorem. $4\frac{1}{2}$
12. Derive the expression for the concentration of intrinsic charge carriers in semiconductor. $7\frac{1}{2}$
13. Define magnetic susceptibility. Using Langevin's theory of diamagnetism, find the expression for diamagnetic susceptibility. $1 + 6\frac{1}{2} = 7\frac{1}{2}$

14. (a) Discuss domains and spontaneous magnetization in ferromagnetic substances. $2+2=4$
- (b) Explain anti-ferromagnetism. Give examples of anti-ferromagnetic material. $2\frac{1}{2}+1=3\frac{1}{2}$
15. (a) Explain the characteristic features of a superconductor. $3\frac{1}{2}$
- (b) Discuss the differences between Type I and Type II superconductors. 4
16. (a) What are Cooper pairs? $2\frac{1}{2}$
- (b) Discuss the BCS theory of superconductor. 5

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