

**18P312**

(Pages: 2)

Name.....

Reg. No.....

**THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2019**

(Regular/Supplementary/Improvement)

(CUCSS - PG)

(Physics)

**CC15P PHY3 C11/CC17P PHY3 C11 - SOLID STATE PHYSICS**

(2015 Admission onwards)

Time: Three Hours

Maximum: 36 Weightage

**PART A**

Answer *all* questions. Each question carries 1 weightage.

1. Briefly explain the HCP structure.
2. What is Madelung interaction? Deduce the value of Madelung constant in a linear lattice.
3. What are the merits of Debye model over Einstein's model of specific heat capacity?
4. Explain Wiedeman-Franz law.
5. Write a brief note on Hall Effect.
6. Explain what is meant by Polarization Catastrophe.
7. What are spin waves?
8. Explain how Cooper pairs are formed in a super conductor.
9. Explain DC Josephson's effect.
10. Distinguish between Type I and Type II super conductors.
11. What is meant by order disorder type of ferroelectrics? Explain with examples.
12. Explain the physical significance of effective mass.

**(12 x 1 = 12 Weightage)**

**PART B**

Answer any *two* questions. Each question carries 6 weightage.

13. (a) Explain Bragg's law. Derive Bragg's law using reciprocal lattice concept.  
(b) Briefly explain Diamond structure and Sodium Chloride structure.
14. What is meant by Bloch function? Discuss the formation of allowed and forbidden energy band on the basis of Kronig-Penny model.
15. Derive Lorentz relation considering various types of electric fields related to an atom.
16. Derive the expression for specific heat using Debye model.

**(2 x 6 = 12 Weightage)**

### PART C

Answer any *four* questions. Each question carries 3 weightage.

17. A plane makes intercepts 1, 2 and 0.5  $\text{\AA}$  on the crystallographic axes on an orthorhombic crystal with  $a:b:c = 3:2:1$ . Determine the Miller indices of this plane.
18. The density of silver is  $10.5 \times 10^3 \text{ kg/m}^3$ . The atomic weight of silver is 107.9. Assuming that each silver atom provides one conduction electron, calculate the density of electrons. The conductivity of silver at  $20^\circ\text{C}$  is  $6.8 \times 10^7 \Omega^{-1}\text{m}^{-1}$ . Calculate the mobility of electrons in silver.
19. Obtain the expression for susceptibility of ferromagnetic material. Explain how saturation magnetization depends on temperature.
20. Diamond (atomic wt of Carbon 12) has Young's modulus of  $10^{12} \text{ Nm}^2$  and a density of  $3500 \text{ kg/m}^3$ . Ignoring crystalline anisotropy and difference between longitudinal and shear elastic module, calculate Debye temperature.
21. What is the frequency of electromagnetic waves radiated by a Josephson junction having voltage of 650 mV across its terminals?
22. The critical temperature of mercury with isotopic mass 199.5 is 4.185K. Calculate its critical temperature when its isotopic mass changes to 203.4

**(4 x 3 = 12 Weightage)**

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