B. Sc. DEGREE END SEMESTER EXAMINATION : MARCH 2023
SEMESTER 6 : PHYSICS
COURSE : **19U6CRPHY12** : SOLID STATE PHYSICS
(For Regular - 2020 Admission and Supplementary - 2019 Admission)

Time : Three Hours   Max. Marks: 60

PART A
Answer any 8 (2 marks each)

1. Write down the expression for electrical conductivity of an intrinsic semiconductor. Explain the terms.
2. State Bloch theorem and What are bloch functions.
3. Explain the variation of susceptibility with temperature for antiferromagnetic materials.
4. What do you mean by a free electron gas model?
5. What are majority carriers and minority carriers?
6. Define the Curie-Weiss law. Discuss its application for ferromagnetic materials.
7. Distinguish between mono crystalline and polycrystalline substances?
8. Show that when a superconductor is placed in an external magnetic field, the field must penetrate up to a certain depth inside the superconductor. Hence define the penetration depth.
9. What are Bravias lattices?
10. Explain the concept of reciprocal lattice?

(2 x 8 = 16)

PART B
Answer any 6 (4 marks each)

11. An iron rod of 0.5 cm^2 area of cross section is subjected to a magnetising field of 1200 Am^{-1}. If the susceptibility of iron is 599, calculate (i) the permeability (ii) magnetic induction B in the specimen and (iii) magnetic flux produced
12. The dielectric constant of a medium is 4. The electric field in the dielectric is10^6 Vm^{-1} Calculate the electric displacement vector and polarization.
13. What is meant by Fermi energy? Discuss the temperature effects on the free electron Fermi gas?
14. A Josephson junction is known to radiate an electro-magnetic wave of frequency 0.24x 10^{12} Hz. What is the dc voltage applied across the junction?
15. Analyse the conduction mechanism for n-type and p-type semiconductors.
16. Discuss the origin of energy bands in solids based on Kronig-Penney model?
17. Find the Miller indices of a plane that makes intercepts of 2 Å, 3 Å and 4 Å on the axes of an orthorhombic crystal with a: b: c=4: 3: 2?
18. The first order spectrum of a beam of X-rays diffracted by a silicon crystal corresponds to an angle of 30. The distance between the corresponding parallel planes is 3 A^O. Calculate the wavelength of X-rays used?

(4 x 6 = 24)

PART C
Answer any 2 (10 marks each)

19. Derive an expression for the binding energy of an ionic crystal. Obtain an expression for the Madelung constant. Evaluate the Madelung constant for a linear ionic crystal.

20. Explain the representation of crystal planes. Briefly explain the procedure to obtain the Miller indices of a plane?

21. Desrcibe Hall Effect in metals. Prove that Hall voltage is proportional to current density. Explain Hall Coefficient.

22. Explain how and why are the ferromagnetic domains formed? Draw a typical B-H loop and describe the different magnetisation processes, which lead to the formation of a B-H loop. What are the advantages and disadvantages of having a B-H loop in a material?

(10 x 2 = 20)