2023
M.Sc.
Third Semester
DISCIPLINE SPECIFIC ELECTIVE – 01
PHYSICS
Course Code: MPHD 3.11(A)
(Condensed Matter Physics - II)

Total Mark: 70   *Pass Mark: 28*
Time: 3 hours

Answer <u>five</u> *questions, taking* <u>one</u> *from each unit.*

UNIT–I

1. What are different classes of lattice imperfections? Calculate the energy required for the formation of Schottky defects in an ionic crystals.

   $5+9=14$

2. Describe with suitable diagram the edge dislocation and screw dislocation. Find out an expression for dislocation density of a crystal.

   $6+8=14$

UNIT–II

3. Explain the various properties and important applications of superconducting materials. The critical field of niobium is 1×10^5 A/m at 8 K and 2×10^5 A/m at 0 K. Calculate the transition temperature of the element. $12+2=14$

4. What is SQUID? Explain its working and mention some of its application. Calculate the critical current of a wire of lead having a diameter 1 mm at 4 K. The critical temperature for lead at 7.18 K and $H_c(0) = 6.5\times10^4$ A/m. $2+10+2=14$

UNIT–III

5. What are nanomaterials? Write a note on nano wires mentioning its properties and application. Calculate the exciton Bohr radius of gallium arsenide (GaAs). Given that $m_e = 0.067\ m_0$, $m_h = 0.45\ m_0$ and $\varepsilon = 12.4$.   4+8+2=14

6. Define carbon nanotube. Discuss the physical structures and applications of carbon nanotubes.   2+12=14

UNIT–IV

7. Define top down and bottom up approach. Write an essay on lithographic techniques of fabrication. Explain UV-V is spectroscopy for characterization of nanomaterials.   4+5+5=14

8. Explain the working and advantages of atomic force microscope (AFM) with a neat sketch. Explain why X-ray is used for crystal structure characterization.   12+2=14

UNIT–V

9. Write a note on the following:
   (i) Molecular and nano electronics   8
   (ii) Nano medicine and drug delivery system   6

10. Explain photocatalytic hydrophilic surfaces? Discuss the mechanism of photocatalytic hydrophilic surfaces for self-cleaning application with a neat diagram.   4+10=14

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