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Question Paper Code: 42003

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2018.

Second Semester

Civil Engineering

14UPH203 - MATERIALS SCIENCE

(Common to Mechanical Engineering)

(Regulation 2014)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions.

PART A - (10 x 1 = 10 Marks)

- The average time taken by a free electron between any two successive collisions is _____
(a) relaxation time (b) mean time (c) collision time (d) none of these
- Wiedemann-Franz law states that the ratio between thermal conductivity and electrical conductivity for all metals is
(a) directly proportional to pressure
(b) inversely proportional to volume
(c) inversely proportional to absolute temperature
(d) directly proportional to absolute temperature
- What kind of elements is doped in p-type semiconductors?
(a) trivalent (b) tetravalent (c) pentavalent (d) monovalent
- At 0K, a semiconductor acts as a
(a) Superconductor (b) good conductor
(c) insulator (d) p-type semiconductor

5. In the case of paramagnetic materials the spin magnetic moments of the adjacent atoms are aligned
- (a) parallel to each other (b) antiparallel to each other
(c) randomly (d) antiparallel but of unequal magnitude
6. At critical temperature T_c , the value of critical magnetic fields H_c will
- (a) zero (b) infinity (c) some non zero value (d) one
7. Frequency range of electronic polarization is _____
- (a) 10^{13} Hz (b) 10^2 Hz (c) 10^{15} Hz (d) 10^6 - 10^{10} Hz
8. The phenomena observed in ferroelectric material is
- (a) spontaneous magnetization (b) induced magnetization
(c) spontaneous polarization (d) induced polarization
9. Nitinol is a
- (a) conducting polymer (b) electrets
(c) shape memory alloy (d) thermo electric materials
10. Materials that takes their own shape only upon heating are referred as _____
- (a) Two way shape memory (b) One way shape memory
(c) Three way shape memory (d) none of these

PART - B (5 x 2 = 10 Marks)

11. Mention any four drawbacks of classical free electron theory of metals.
12. Define energy band gap.
13. Recall Meissner effect in superconductors.
14. Define dielectric constant.
15. Briefly explain shape memory effect.

PART - C (5 x 16 = 80 Marks)

16. (a) (i) Arrive at a mathematical expression for electrical and thermal conductivity of a conducting material. (10)
- (ii) What is Fermi distribution function? Discuss the effect of Fermi function with temperature. (6)

Or

- (b) Define density of states and derive an expression for carrier concentration in metals. (16)
17. (a) What is intrinsic semiconductor? Derive an expression for carrier concentration in an intrinsic semiconductor. (16)

Or

- (b) (i) What is Hall effect? Derive an expression for Hall coefficient? Describe arrangement for the measurement of Hall coefficient. (12)
- (ii) Write the applications of Hall effect. (4)
18. (a) (i) Explain domain theory of ferromagnetism. (12)
- (ii) Distinguish hard and soft magnetic materials. (4)

Or

- (b) (i) Classify the types of superconductors based on magnetization. (8)
- (ii) Discuss in detail the phenomena of superconductivity based on BCS theory. (8)
19. (a) (i) Explain different types of polarization mechanisms involved in dielectric Materials. (8)
- (ii) Analyze the dependence of polarization based on frequency and temperature of the dielectric material. (8)

Or

- (b) (i) Write brief notes on dielectric losses. (8)
- (ii) Discuss in detail various types of dielectric breakdown mechanisms. (8)

20. (a) What are shape memory alloys? Explain shape memory effect and pseudo elasticity. Discuss its various properties and applications. (16)

Or

- (b) (i) Briefly discuss how to improve the mechanical properties of commonly used engineering materials. (8)
- (ii) Differentiate fatigue and fracture in a material. (8)
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