A   Reg. No. : ☐☐☐☐☐☐☐☐☐☐☐☐

Question Paper Code: 52003

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

Second Semester

Mechanical Engineering

15UPH203–MATERIAL SCIENCE

(Common to Chemical Engineering)

(Regulation 2015)

Duration: Three hours   Maximum: 100 marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. At $T = 0$ K, the energy levels located above Fermi energy E_F are   CO1- R

    (a) partially filled   (b) vacant   (c) filled   (d) none of these

2. In dielectric, the polarization is   CO1- R

    (a) linear function of the applied electric field

    (b) square function of the applied electric field

    (c) exponential function of the applied electric field

    (d) independent of electric field

3. Conductivity of a semiconductor increases with   CO2- R

    (a) increase in temperature   (b) decrease in temperature

    (c) constant temperature   (d) increase in band gap

4. Acceptor type impurities are the   CO2- R

    (a) trivalent atoms   (b) tetravalent atoms   (c) pentavalent atoms   (d) divalent atoms

5. Water is a _____ substance.   CO3- R

    (a) paramagnetic   (b) ferromagnetic   (c) antiferromagnetic   (d) diamagnetic

6. The Cooper pair is   CO3- R

   (a) two electrons moving in the same direction   (b) two electrons with resultant spin zero

   (c) two electrons connected through a phonon   (d) two electrons connected like a boson

7. Metallic glasses are   CO4- R

   (a) crystalline   (b) soft   (c) amorphous   (d) biomaterials

8. When particle size is reduced from micro to nano, porosity is   CO4- R

   (a) increased   (b) decreased   (c) same   (d) exponentially increased

9. Cracks are   CO5- R

   (a) volume defects   (b) point defects   (c) surface defects   (d) line defects

10. The entropy S for a reversible process is   CO5- R

   (a) constant   (b) zero   (c) positive   (d) negative

PART – B (5 x 2= 10 Marks)

11. State Wiedemann Franz law.   CO1- R

12. What do you mean by Fermi level?   CO2- R

13. Mention any two applications of a superconductor.   CO3- R

14. How are carbon nanotubes (CNT) formed?   CO4- R

15. What is meant by imperfections in a crystal?   CO5- R

PART – C (5 x 16= 80 Marks)

16. (a) Calculate electrical conductivity of a metal with relaxation time 10^{-14} second and density of electrons 6×10^{28} m^{-3} by obtaining an expression for electrical conductivity for metals on the basis of classical free electron theory.   CO1- App   ((16)

Or

   (b) (i) Obtain an expression for the internal field experienced by an atom in a one dimensional array of atoms subjected to an external field and deduce Clausius – Mosotti equation.   CO1- App   (12)

      (ii) Using the above Clausius Mosotti equation , calculate the dielectric constant of the material for a solid elemental dielectric with density 3×10^{28} atoms / m^3 having electronic polarisability 2×10^{-40} Fm^2.   CO1- App   (4)

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17. (a) (i) Why does the conductivity of a semiconductor change with impurity content? Specify two elements that you would add to pure silicon to make it an extrinsic semiconductor of the n-type and the p type. CO2- Ana (8)

(ii) What are the differences between intrinsic and extrinsic semiconductors? CO2- Ana (8)

Or

(b) (i) Obtain the expression of Hall coefficient in terms of current density and electronic charge by defining Hall effect. CO2- Ana (12)

(ii) How will you identify whether the given semiconductor is a p-type or n-type semiconductor? CO2- Ana (4)

18. (a) (i) Classify magnetic materials based on their spin and explain them. CO3- Ana (8)

(ii) Distinguish between hard and soft magnetic materials. CO3- Ana (8)

Or

(b) (i) Distinguish between Type I and Type II super conductors. CO3- Ana (8)

(ii) Show that superconductors are perfect diamagnet. CO3- Ana (8)

19. (a) (i) What are metallic glasses? How are they prepared? CO4- U (10)

(ii) Explain any two properties and applications of metallic glasses. CO4- U (6)

Or

(b) Compare the properties of nanomaterials synthesized by PVD and CVD method by explaining any one method in detail. CO4 Ana (16)

20. (a) What is creep? Discuss the factors affecting creep. CO5- U (16)

Or

(b) State the First and Second law of thermodynamics. Discuss Carnot cycle of a heat engine working between two temperatures T_1 and T_2 assuming $T_1 > T_2$. (T_1 is the temperature of the source and T_2 is the temperature of the sink). CO5- U (16)

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