Code: AE58   **Subject: MATERIALS & PROCESSES**

AMIETE – ET

Time: 3 Hours   **DECEMBER 2012**   **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.
- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions, selecting at least TWO questions from each part, each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1   **Choose the correct or the best alternative in the following:**   **(2×10)**

   a. In which of the following mixed ionic-covalent bonds exists.

   (A) high strength materials   **(B)** semiconductors
   (C) heat insulators   **(D)** none of these

   b. At high temperatures, the mean free path and collision time of an electron in a metal are inversely proportional to

   (A) T^2 **(B)** T
   (C) T^3 **(D)** independent of temperature

   c. In photoelectric effect the number of electrons emitted is proportional to

   (A) work function of cathode   **(B)** velocity of incident beam
   (C) frequency of incident beam   **(D)** intensity of incident beam

   d. Minerals and ceramics are

   (A) biological materials   **(B)** inorganic materials
   (C) plastics   **(D)** organic materials

   e. When FCC iron and BCC iron coexist in equilibrium, the degrees of freedom are

   (A) 1   **(B)** 2
   (C) 3   **(D)** 0

   f. As compared to substitutional diffusion, Interstitial diffusion is much

   (A) slower   **(B)** sometimes faster
   (C) faster   **(D)** depends on certain conditions

g. The number of double bonds required in the monomer for cross-linking is

    (A) 2   **(B)** 3
    (C) 4   **(D)** 1

h. The temperature at which a metal becomes superconductor is called

    (A) Curie Temperature   **(B)** Debye Temperature
    (C) Critical Temperature   **(D)** Neel Temperature

i. Which one of the following material does not have permanent magnetic dipoles?

    (A) ferromagnetic   **(B)** Both **(A)** & **(C)**
    (C) paramagnetic   **(D)** diamagnetic

j. The depletion region of a junction diode is formed

    (A) During the manufacturing process
    (B) When forward bias is applied to it
    (C) When the temperature of the junction is reduced
    (D) Under reverse bias

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Explain Ionization Potential, Electron Affinity and Electronegativity in brief with the help of two examples of each. **(4)**

    b. Name the type of bonding present in brass, rubber, BaS and Nylon. **(4)**

    c. Explain the Powder Method and also give its advantages. **(8)**

Q.3 a. What are the essential conditions for polymerization process? What do you understand by cross – linking? **(8)**

    b. Explain Frenkel defect and Schottky defect? **(8)**

Q.4 a. Explain the method of determination of diffusion coefficient (D) using a diffusion couple. **(8)**

    b. What are type-I and type-II superconducting materials? Why type-II materials are preferred for applications of superconductivity? **(8)**

Q.5 a. Let a material having a dielectric constant of 6.0 is positioned within the region between the plates of a parallel plate capacitor having an area of 6.45×10^{-4} m^2 and a plate separation of 2×10^{-3} m. If a potential of 10 V is applied across the capacitor, compute the capacitance, magnitude of charge stored on each plate, the dielectric displacement and the polarization (P). **(8)**

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b. What is the importance of dielectric materials? Give examples of any two important dielectric materials with their properties. **(8)**

Q.6 a. What do you understand by the term Magnetization? Name and explain the three classes in which the magnetic materials are grouped. **(8)**

b. Give four examples of soft and hard magnetic materials each along with their compositions. **(8)**

Q.7 a. Calculate the Hall voltage for an aluminium specimen that is 15 mm thick for a current of 25 Amp when a magnetic field of 0.6 tesla is imposed in a direction perpendicular to the current. If the electrical conductivity and electron mobility for aluminium are given as $3.8 \times 10^7 (\Omega\text{-m})^{-1}$ and 0.0012 m^2/V-s, respectively. **(8)**

b. Show that on doping with a pentavalent impurity of concentration of 1 ppm, the electrical conductivity of Ge increases significantly if Ge at room temperature (=300 K) has electron mobility (μ_e) and hole mobility (μ_p) equal to 0.38 and 0.18 respectively. Given that the for Ge $n_i = 7.2 \times 10^{19} / m^3$ and $N_d = 4.42 \times 10^{28}$. **(8)**

Q.8 a. What are Relays? Briefly discuss Dry Reed Relay and Ferreed Relay. **(8)**

b. Differentiate between a Zener breakdown and an Avalanche breakdown. **(8)**

Q.9 a. Write short note on the following:

(i) Epitaxial diffused junction diode.
(ii) Transfer characteristics of JFET.
(iii) Zone-refining
(iv) Czochralski method of growing single crystal. **(16)**