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

AMIETE – ET (NEW SCHEME)

Time: 3 Hours   **DECEMBER 2011**   Max. Marks: 100

NOTE: There are 9 Questions in all.

- **Please write your Roll No. at the space provided on each page immediately after receiving the Question Paper.**
- **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. 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. If the radius of anion is r_a and of cation is r_c, the bond length is

(A) $(r_a + r_c)$ **(B)** $\sqrt{3}(r_a + r_c)$

(C) $\dfrac{\sqrt{3}}{2}(r_a + r_c)$ **(D)** $r_a - r_c$

b. The packing efficiency of NaCℓ crystal is

(A) 0.52   **(B)** 0.66
(C) 0.68   **(D)** 0.74

c. Which of the following elements, has largest diffusion coefficient in steel

(A) Mn   **(B)** W
(C) Ni   **(D)** C

d. The Fermi level of copper is 7ev. The maximum velocity of free electrons at $O^\circ K$ is

(A) $1570\,\text{Km/s}$ **(B)** $1110\,\text{Km/s}$
(C) $860\,\text{Km/s}$ **(D)** $0\,\text{Km/s}$

e. Pure silicon at $O^\circ K$ is an

(A) instrinsic semiconductor   **(B)** metal
(C) extrinsic semiconductor   **(D)** insulator

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f. The transition from the ferromagnetic to the paramagnetic is named as

(A) Curie   **(B)** Curie-Weiss
(C) Neel   **(D)** Debye

g. Ionic polarization

(A) decreases with temperature
(B) increases with temperature
(C) may increase or decrease with temperature
(D) is independent of temperature

h. Which of the following diode is used as variable capacitor in tunned circuits

(A) Zener diode   **(B)** Varactor diode
(C) tunnel diode   **(D)** p-n junction diode

i. Non polarised electrolytic capacitors are used in

(A) DC circuits   **(B)** AC circuits
(C) Both **(A)** & **(B)**   **(D)** None of the above

j. JFET is

(A) Unipolar device   **(B)** Bipolar device
(C) Nonpolar device   **(D)** P-N junction diode

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

Q.2 a. What is unit cell? Derive the effective number of lattice points in the unit cell of the three cubic space lattices.   **(8)**

b. Compare Ionic, Covalent and metallic bonds based on their formation and properties with suitable examples.   **(8)**

Q.3 a. Calculate packing efficiency and density of diamond.   **(8)**

b. Explain different types of crystalline imperfections.   **(8)**

Q.4 a. Discuss the following applications of Fick's second law:
(i)   Corrosion resistance of Duralumin
(ii) Carburization of steel.   **(4+4)**

b. The resistivity of pure copper is $1.56 \times 10^{-6} \, \Omega - cm$. An alloy of copper containing 1 atomic percent Nickel has a resistivity of $2.81 \times 10^{-6} \, \Omega - cm$. An alloy of copper containing 3 atomic percent silver has resistivity of $1.98 \times 10^{-6} \, \Omega - cm$. What is the resistivity of an alloy containing 2 atomic percent nickel and 2 atomic percent silver? **(8)**

Q.5 a. What is permanent dipole moment? Show how the presence of permanent dipole contributes to the dielectric constant. Discuss the temperature dependence of dielectric constant. **(8)**

b. Explain breakdown mechanism in dielectric materials. **(8)**

Q.6 a. A transformer core is wound with a coil carrying an AC current at a frequency of 50 Hz. Assuming the magnetization to be uniform throughout the core volume of 0.01 m^3, calculate the hysteresis loss. The hysteresis loop has area of 60,000 units, when the axes are drawn in units of 10^{-4} Tesla and $100 \, A/m^2$. **(8)**

b. What is Ferromagnetism? Discuss Ferromagnetism below and above curie temperature. What are Ferromagnetic domains? **(8)**

Q.7 a. Classify conductors, semiconductors and insulators based on energy band diagram. **(8)**

b. 4 micrograms of antimony are thoroughly mixed in molten form with 100 gm germanium find
(i) the density of antimony atoms.
(ii) density of donated electrons.
(iii) conductivity if $\mu e = 3600 \, cm^2/v - s$.
Assume density of $Ge = 5.46 \, gm/cm^3$ and weight of $Sb = 121.76$. **(8)**

Q.8 a. Explain construction and draw V-I characteristic of SCR. Discuss its working based on two transistor model. **(8)**

b. Discuss characteristics and applications of the following:-
(i) Thermistors
(ii) Non symmetrical varistors. **(8)**

Q.9 a. Discuss various methods used in fabrication of semiconductor junction. **(8)**

b. Compare BJT and JFET based on construction, working and applications. **(8)**