ROLL NO. _____

Code: AE58/AE106 **Subject: MATERIALS & PROCESSES**

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **June 2018** **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. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q1. Choose the correct or the best alternative in the following: (2×10)

a. The atomic number of an atom is equal to
(A) atomic weight **(B)** number of protons
(C) atomic mass **(D)** mass number

b. The line energy of dislocation in BCC iron (a=2.87Å) is (shear modulus of Fe = 80 GN m^{-2})
(A) 2.47×10^{-12} J m^{-1} **(B)** 3.29×10^{-9} J m^{-1}
(C) 3.29×10^{-12} J m^{-1} **(D)** 2.47×10^{-9} J m^{-1}

c. High conductivity aluminium should not have
(A) solute atoms such as Cu, Ag and Au
(B) high dislocation density
(C) dissolved impurities
(D) All of these

d. The fastest diffusing species in Fe is
(A) W **(B)** Ni
(C) H **(D)** C

e. Energy gap in pure semiconductors at room temperature is
(A) 1 ev **(B)** 0 ev
(C) 6 ev **(D)** -2 ev

f. The correct order of coordination number in BCC, FCC and HCP unit cells is
(A) 12, 8, 6 **(B)** 6, 8, 12
(C) 12, 8, 24 **(D)** 8, 12, 12

g. Conductors are those material which have
(A) narrow conduction band **(B)** no conduction band
(C) broad conduction band **(D)** None of these

h. The unit of the diffusion coefficient D is
(A) m/s^2 **(B)** m^2/s
(C) $\frac{1}{m^2 - s}$ **(D)** $m^2 s$

i. At 0K, the probability of finding an electron at energy level E is unity, when
(A) $E \neq E_F$ **(B)** $E \leq E_F$
(C) $E > E_F$ **(D)** $E >> E_F$

j. The average distance between atoms along the body diagonal of the DC crystal is
(A) $a\sqrt{3}/4$ **(B)** $a\sqrt{3}/8$
(C) $a\sqrt{3}/2$ **(D)** $a\sqrt{3}$

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

Q.2 **a**. Explain secondary bonding and variation of bonding character and properties. **(8)**

b. Discuss Bragg's law of X-ray diffraction. **(8)**

Q.3 a. Calculate (i) the packing efficiency, and (ii) the density of diamond. Consider the mass of carbon atom is 1.992 x 10^{-26} kg and the lattice constant for diamond is 3.57Å at 300 K. **(4+4)**

b. Draw polymer structures for polyethylene, polyvinyl chloride, polypropylene, and polystyrene. **(8)**

Q.4 a. The diffusion coefficient for O^{-2} in Cr_2O_3 is $4x10^{-15}$ cm^2/s at 1150°C and $6x10^{-11}$ cm^2/s at 1715 °C. Calculate the activation energy and the diffusion constant D_0. **(8)**

b. What is resistivity of conducting materials? Discuss the various factors which affects the resistivity. **(8)**

Q.5 a. Explain breakdown of the solid, liquid & gaseous dielectrics. **(8)**

b. Explain the mechanism of polarization in dielectric materials and give the significance of term dielectric breakdown. **(8)**

Q.6 a. Differentiate between the characteristics of dia, para and ferro magnetism. Give an example of each type of material. Comment on the factors affecting permeability and Hysteresis loss. **(8)**

b. Qualitatively explain, the domain theory of ferromagnetic materials. Explain how are the domains formed and are affected by temperature changes? **(8)**

Q.7 a. Define hall-effect and derive the mathematical formulation for hall-coefficient. **(8)**

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

Q.8 a. Explain breakdown of depletion layer in semiconductors. **(8)**

b. Explain the following briefly: **(4+4)**
(i) NTC Thermistors (ii) Variable resistors

Q.9 a. Explain the Fabrication of Junction Transistor in detail. **(8)**

b. For an n- channel silicon FET with a =3 x 10^{-4} cm (effective channel width) and $N_D = 10^{15}$ electron /cm^3. Find:
(i) pinch of voltage (ii) the channel half width for $V_{GS} = 1/2V_P$ and $I_D = 0$. **(8)**