ROLL NO. _____

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

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **JUNE 2016** **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.**

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

a. Pure silicon at 0 K is
(A) Intrinsic semiconductor **(B)** Extrinsic semiconductor
(C) Metal **(D)** Insulator

b. In base SI units, tesla is expressed as
(A) $NA^{-1}m^{-1}$ **(B)** $kg\ s^{-2}\ A^{-1}$
(C) $kg\ m^{-2}s^{-2}A^{-1}$ **(D)** $NA^{-1}m^{-3}$

c. The $(1\ \bar{1}\ 1)$ plane is parallel to
(A) $(1\ 1\ 1)$ **(B)** $(\bar{1}\ 1\ \bar{1})$
(C) $(\bar{1}\ \bar{1}\ 1)$ **(D)** $(1\ 1\ \bar{1})$

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

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

f. Among the following elements, the one with largest diffusion coefficient in steel at 1000^{o} C is
(A) Mn **(B)** C
(C) Ni **(D)** W

g. The packing efficiency of a NaCl crystal (radius of Na^{+} = 0.98 Å, Cl^{-} = 1.81 Å) is
(A) 0.52 **(B)** 0.68
(C) 0.66 **(D)** 0.74

h. Aluminium is usually used for metallization of most ICs as it offers
(A) Relatively a good conductor
(B) High resistance
(C) Good mechanical bond with silicon
(D) Deposition of aluminium film using vacuum deposition

i. What is a varistor?
(A) a current-dependent diode
(B) a voltage-dependent diode
(C) a current-dependent resistor
(D) a voltage-dependent resistor

j. With gate open, the maximum anode current at which SCR is turned OFF from ON condition is called
(A) breakdown voltage **(B)** peak reverse voltage
(C) holding current **(D)** latching current

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

Q.2 a. Explain Bragg's law of X-ray Diffraction. **(8)**

b. Define Bond Energy, Bond Type and Bond Length in chemical bonding. How the bond length depends on atomic size? **(2+2+2+2)**

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

b. Distinguish between thermoplastics and thermosets, with the help of any three of their characteristics. What are the factors that influence the crystallinity of long chain polymers? **(6+2)**

Q.4 a. Explain resistivity and the factors that affect resistivity of conducting materials. **(8)**

b. Explain superconductivity and explain the effect of magnetic field & temperature on superconductors. **(8)**

Q.5 a. Derive Clausius- Mosotti relation. **(8)**

b. Explain ferroelectricity and piezoelectricity. **(8)**

Q.6 a. Explain the factors affecting permeability and hysteresis loss. **(8)**

b. (i) A transformer core is wound with a coil carrying an alternating 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 an area of 60000 units, when the axes are drawn in units of 10^{-4} Wb m^{-2} and 10^{2} A m^{-1}.
(ii) Write short note on Magnetostriction. **(4+4)**

Q.7 a. What are the different types of semiconductor? Explain with the help of energy band diagram. **(8)**

b. As the concentration of electrons in a semiconductor is changed by changing the impurity level, the conductivity also changes. Show that it passes through a minimum when $n_e = n_i \sqrt{\mu_h/\mu_e}$ and find the minimum value. Here n_i is the intrinsic concentration. **(8)**

Q.8 a. What is a PN junction? Draw and explain V-I Characteristics of a PN Junction diode. **(8)**

b. Explain the working of a tunnel diode. **(8)**

Q.9 a. Discuss epitaxial diffused junction diode and its application. **(8)**

b. Write short note on **(4+4)**
(i) Alloy Type Junction Diode
(ii) Grown Junction Diode