ROLL NO. _____

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

AMIETE – ET

Time: 3 Hours **JUNE 2013** **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. 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)** $(1\ 1\ \bar{1})$

b. A cation vacancy and an anion vacancy in a crystal of type AB is called

(A) Schottky defect **(B)** Frenkel defect
(C) Pair of vacancies **(D)** None of these

c. At 0K, the probability of finding an electron at energy level E is unity, when

(A) $E << E_F$ **(B)** $E \leq E_F$
(C) $E > E_F$ **(D)** $E >> E_F$

d. With the increase in temperature, the orientation polarization in general

(A) increases **(B)** decreases
(C) is constant **(D)** None of these

e. The temperature of the antiferromagnetic-to-paramagnetic transition is called

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

f. As compared to Si, the electron mobility in GaAs is

(A) slower **(B)** same
(C) faster **(D)** None of these

g. The function of an oxide layer during IC fabrication is

(A) to mask against diffusion or ion-implant
(B) to insulate the surface electrically
(C) to produce a chemically stable surface
(D) all of these

h. For ideal Si P-N junction diode the forward cut-off voltage is

(A) 0.7 Volt **(B)** 0.3 Volt
(C) Zero Volt **(D)** ∞ Volt

i. As per Bragg's law

(A) $\lambda = 2d \sin\theta$ **(B)** $\lambda = d \sin\theta$
(C) $n\lambda = \frac{d}{2}\sin\theta$ **(D)** $\lambda = 2d \cos\theta$

j. Thermal expansion of materials arises from

(A) strong bonds **(B)** thermal vibrations
(C) weak bonds **(D)** asymmetry of potential energy curve

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

Q.2 a. Calculate the frequency & the wavelength of the radiation emitted, when an electron falls from the 2s level to the 1s level of the hydrogen atom. **(8)**

(energy of electron in hydrogen atom for 2s, $E = 2.18 \times 10^{-18}$ J and for 1s, $E = 5.44 \times 10^{-19}$ J)

b. There is no end centered tetragonal lattice in the Bravais list, but there is an end-centred orthorhombic lattice. Explain why this is so. **(8)**

Q.3 a. Calculate $\frac{c}{a}$ ratio for an ideally close packed HCP crystal. **(8)**

b. What is a Burger Vector? Discuss the steps used to determine Burger Vector of dislocation. **(8)**

Q.4 a. Explain the following:

(i) Pipe diffusion (ii) Lattice diffusion **(4+4)**

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

Q.5 a. Explain the effect of dielectric on the behaviour of a capacitor. **(8)**

b. Explain the following:
(i) Ferro-electricity (ii) Piezoelectricity **(4+4)**

Q.6 a. Explain the following:
(i) Origin of permanent magnetic dipoles
(ii) Magnetic Resonance **(4+4)**

b. The saturation of magnetization of BCC iron is 1750 kA/m. Calculate the net magnetic moment per iron atom in the crystal. **(8)**

Q.7 a. The resistivity of pure silicon at room temperature is 3000 ohm-m. Calculate the intrinsic carrier density. **(4)**

b. Explain the following:

(i) Types of semiconductors
(ii) Hall effect
(iii) Thermal conductivity of semiconductors **(4+4+4)**

Q.8 a. Draw V-I characteristic of a P-N junction diode and explain the zener & avalanche breakdown. **(8)**

b. Write applications of the following:
(i) Resistors
(ii) Paper capacitors
(iii) Air cored coils
(iv) Ferreed Relays **(8)**

Q.9 Explain the following:

(i) Alloyed junction process.
(ii) Operation of JFET with high drain voltages. **(2×8)**