AMIETE – ET (OLD SCHEME)

Code: AE04   **Subject: MATERIALS AND PROCESSES**
Time: 3 Hours   **Max. Marks: 100**

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.**
• **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.   Which one of the following material is Piezoelectric?

   (A) Pb_2Au **(B)** $BaTiO_3$
   (C) $MgAl_2O_4$ **(D)** $NiFe_2O_4$

b.   The magnetic susceptibility of a paramagnetic material is

   (A) Less than zero   **(B)** Less than one but positive
   (C) Greater than one   **(D)** Equals to zero

c.   A semiconductor is electrically neutral because

   (A) No majority carriers   **(B)** No minority carriers
   (C) No free carriers   **(D)** Equal positive & negative
   carriers

d.   The electrostatic nature of ionic bond makes it

   (A) Directional
   (B) Non-directional
   (C) Weak
   (D) Applicable to group IV elements.

e.   The miller indices are same for

(A) Perpendicular planes **(B)** Crystal planes
(C) Parallel planes **(D)** Three crystallographic axes

f. The relaxation times (τ) in a perfect dielectric is

(A) ∞ **(B)** 1
(C) $1 < \tau < \infty$ **(D)** 0

g. For small size, high frequency coils, the most common core material is

(A) Powdered iron **(B)** Air
(C) Ferrite **(D)** Steel

h. Magnetic recording tape is most commonly made from

(A) Ferric oxide **(B)** Silicon iron
(C) Small particles of iron **(D)** Alnico

i. Solder is an alloy of

(A) Copper and aluminium **(B)** Nickel, Copper and Zinc
(C) Tin and Lead **(D)** Silver, Copper and Lead

j. Which of the following material is the best conductor of electricity?

(A) Aluminium **(B)** Carbon
(C) Tungsten **(D)** Copper

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

Q.2 a. What are different types of atomic bonds observed in solid materials? Describe any two of them with suitable examples. **(8)**

b. What is atomic packing factor? Find the atomic packing factor for BCC and FCC structures. **(8)**

Q.3 a. What is point imperfection? Discuss various point defects. **(8)**

b. State and explain Gibb's phase rule. What is its importance? **(8)**

Q.4 a. Calculate the mobility and average time of collision of the electrons in copper. If the density of copper is 8.94 gm/ cm^3 , the resistivity is 1.73 $\times$ 10^{-8} Ω m and the atomic weight is 63.5. **(8)**

b. Give the chemical composition, properties and uses of Nichrome, Manganin and Constantan. **(8)**

Q.5 a. A potential difference of 2V is applied across the faces of a small germanium plate of area 1 cm^2, and of thickness 0.3 mm. Given, the concentration of free electrons in germanium is $2 \times 10^{19}/m^3$, mobilities of electron and holes are 0.36 m^2/V-sec and 0.17 m^2/V-sec respectively. Calculate the value of current produced. **(8)**

b. What is Hall effect? Derive the relation for Hall Voltage, charge density and mobility by assuming the presence of only one type of charge carrier. **(8)**

Q.6 a. What is piezoelectric effect? How is Quartz used for generating ultrasonic waves? Also write some uses of piezoelectric crystal. **(8)**

b. Write the properties and uses of mica, bakelite and polyvinyl chloride as insulating materials. **(8)**

Q.7 a. Differentiate between soft and hard magnetic materials with suitable examples and B-H plots. **(8)**

b. Calculate eddy current loss in w/kg in a specimen of alloy steel for maximum flux density of 1.1 wb/m^2 and frequency of 50 Hz, using 0.5 mm thick sheets. Take density and resistivity of alloy steel as

7800 kg/m^3 and 30×10^{-8} Ωm respectively. If hysteresis loss in each cycle is 380 watt $-sec/m^3$. Calculate total iron loss in $watt/kg$.   **(8)**

Q.8 a. Name the core process for production of Integrated circuits. Explain the process   of   ION IMPLANTATION.
   (8)

b. What is FORGING? Write the advantage and disadvantages of Hot Forging   and   Cold Forging.   **(8)**

Q.9 a. State   and   explain   Fick's   law   of diffusion.   **(6)**

b. Write   short   notes   on   the following: **(5+5)**

(i)   Objectives of heat treatment
(ii)   Domain   theory   of ferromagnetism