Code: DE54/DE104   **Subject: ENGINEERING MATERIALS**

DipIETE – ET (Current & New Scheme)

Time: 3 Hours   **JUNE 2017**   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:**   (2x10)

a. Fermi Level is
   (**A**) An average value of all available energy levels
   (**B**) The highest occupied energy level at absolute zero of temperature
   (**C**) An energy level at the top of a valence band
   (**D**) The largest available energy level

b. Polarisation in a dielectric is
   (**A**) Free charge per unit volume of the dielectric
   (**B**) Bound charge per unit volume of the dielectric
   (**C**) Bound charge per unit area of the dielectric
   (**D**) Free charge per unit area of the dielectric

c. If dielectric losses are zero then
   (**A**) Current leads the voltage by 90^0
   (**B**) Current lags the voltage by 90^0
   (**C**) Displacement current is in phase with applied voltage
   (**D**) Conduction current is in quadrature with applied voltage

d. The permeability of iron can be increased by
   (**A**) Alloying with cobalt   (**B**) Purifying it
   (**C**) Introducing carbon in it   (**D**) Alloying with nickel

e. Which statement is correct?
   (**A**) An insulator has a wide forbidden energy gap
   (**B**) In an insulator the valence band is completely filled with electrons and conduction band is completely empty
   (**C**) The upper band in an insulator contributes to electrical conductivity since no electrons are present to act as carriers
   (**D**) It is impossible for any electron in the filled valence band of an insulator to be accelerated by an electric field

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f. Thermistors are
   (A) Linear resistances   (B) Non-linear resistances
   (C) Linear inductances   (D) Non-linear inductances

g. The dielectric in electrolytic capacitor is
   (A) Aluminium oxide   (B) Aluminium hydroxide
   (C) Nitrogen oxide   (D) Nitrogen dioxide

h. Which statement is correct for FET
   (A) These cannot be directly connected coupled
   (B) Their performance is affected by ambient temperature changes
   (C) These have low input impedance
   (D) These have extremely high input impedance of the range 10^6 to 10^{16} Ω

i. The amount of energy possessed by a monatomic gas molecule for each
   direction of motion Cartesian is
   (A) (3/2) KT   (B) (1/2)KT
   (C) $2KT^2$ (D) (1/3)KT

j. The Hall voltage across an impurity semiconductor crystal can be increased
   by increasing the
   (A) current flowing through crystal (B) thickness of crystal
   (C) width of crystal   (D) temperature

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

Q.2 a. The resistivity of pure copper is 1.56 µΩ-cm an alloy of copper containing1
        atomic percent nickel has a resistivity of 2.81 µΩ-cm. An alloy of copper
        containing 3 atomic percent silver has a resistivity of 1.98 µΩ-cm. What is the
        resistivity of an alloy containing 2 atomic percent nickel and 2 atomic percent
        silver?   **(6)**

        b. Derive the equation of motion of an electron.   **(6)**

        c. Explain the effect of temperature on electrical conductivity of metals.   **(4)**

Q.3 a. Explain that if number of atoms per unit volume is kept constant the dielectric
        constant of monoatomic gases is independent of temperature for normal
        operating temperatures.   **(8)**

        b. Derive the Clausius-Mossotti relation.   **(8)**

Q.4 a. With the help of circuit diagram explain what you understand by dielectric
        loss?   **(6)**

        b. Write the dielectric properties of polymeric system.   **(4)**

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c. What is piezoelectricity? Explain the phenomenon of piezoelectricity. Name any two materials that exhibit piezoelectric properties. **(6)**

Q.5 a. Briefly explain the classification of magnetic materials. **(6)**

b. What is magnetostriction? Draw curves showing magnetostriction coefficient λ for iron, nickel and cobalt in three directions of single crystals. **(6)**

c. Explain factors affecting permeability and hysteresis loss. **(4)**

Q.6 a. With the help of suitable diagrams explain the energy bands in solids. **(8)**

b. Four microgram of antimony are thoroughly mixed in molten form with 100 gms of pure germanium and antimony atoms substitute for germanium atoms uniformly throughout the solid material. Find: **(8)**
(i) The density of antimony atoms
(ii) The density of donated electrons
(iii) The conductivity if electron mobility is $3600 \, cm^2$/volts-sec for the carriers
(iv) The total resistance of a bar of such n-type material 2 cm long, 0.012 x 0.012 cm in cross-section. Given density of Ge = 5.46 gm/cm^3. Atomic weight of Sb = 121.76

Q.7 a. Explain the tunnelling effect of tunnel diode. **(8)**

b. Write short notes on the following: **(8)**
(i) Thermistors
(ii) Varistors

Q.8 a. With the help of diagrams explain the various types of carbon-composition resistors. **(6)**

b. A rolled paper capacitor of value 0.04 µF is to be constructed using two strips of aluminium of width 4 cm and wax impregnated paper of thickness 0.04 mm and relative permittivity 3. What length of foil strip will be necessary? **(4)**

c. What are the various functions of relay? Explain briefly. **(6)**

Q.9 a. What are the different techniques of fabrication of junction transistors? Explain each of them with the help of diagrams where ever necessary. **(8)**

b. Explain the transfer characteristics of JFET. Also write its merit and demerits.
(8)