**Registration No.:** | | | | | | | | | | |

**Total Number of Pages: 02** **Course: M.sc.I**

**Sub_Code: FCYC902**

**9th Semester Regular Examination: 2024-25**
**SUBJECT: Materials Chemistry**
**BRANCH(S): M.Sc.I(AC)**
**Time: 3 Hours**
**Max Marks: 70**
**Q.Code: R056**

**Answer Question No.1 (Part-I) which is compulsory, any five from rest (Part-II)**
**The figures in the right-hand margin indicate marks.**



## Part-I

**Q1** **Answer the following questions:** **(2 x 10)**

**a)** What do you understand by smart/intelligent materials? Give examples.

**b)** Why are ceramics used as insulators? Give examples of ceramics used as insulators.

**c)** Define Piezoelectric materials with suitable examples.

**d)** What are high-temperature superconductors? Give two examples.

**e)** With a neat sketch of the alignment of the atomic dipole with and without magnetic field, differentiate between diamagnetic and paramagnetic materials.

**f)** Differentiate between Ductile and brittle fracture using stress-strain diagram.

**g)** Differentiate insulators, conductors, and semiconductors using band diagram.

**h)** Write any two advantages of composite materials over other materials.

**i)** The average molecular weight of a sample of polyvinyl chloride is 20,050 g/mol. Calculate degree of polymerization.

**j)** Draw a leveled hysteresis curve for a ferromagnetic material.

## Part-II

**Long Answer Type Questions (Answer Any five)**

**Q2** **a)** Provide an overview of the classification of materials and their fundamental properties. **(5+5)**

**b)** What are nanomaterials? Write the important properties and applications of these materials.

**Q3** **a)** Discuss the sol-gel method of synthesis with a suitable example. **(5+5)**

**b)** What is the hydrothermal method? Give a brief description of this method mentioning the process conditions, types, and disadvantages.

**Q4** **a)** Write phase rule. Discuss the application of this rule to one component system. **(5+5)**

**b)** Give an overview of the technique used for the surface morphology.

**Q5** **a)** What is dielectric breakdown? Discuss the different types of dielectric breakdown. **(5+5)**

**b)** What are ferroelectric materials? Discuss different types of ferroelectric materials.

**Q6** **a)** Explain the origin of magnetic moments from an atomic view of matter. Give a comparison between dia, para, and ferromagnetic materials. **(5+5)**

**b)** What are ferrites? Write the important properties and applications of ferrites.

**Q7** **a)** Describe Hall effect. How you will determine the mobility of electrons in germanium knowing only the resistivity and Hall coefficient of it? **(5+5)**

**b)** An n-type semiconductor specimen has Hall coefficient $R_H = 3.66 \times 10^{-11}\ m^3A^{-1}\ s^{-1}$ the conductivity of the specimen is found to be $112 \times 10^7\ ohm^{-1}m^{-1}$. Calculate the charge carrier density $n_e$ and electron mobility at room temperature.

**Q8** **a)** Define the term polarization. Calculate the polarization produced in $BaTiO_3$ crystal if $Ti^{+4}$ ions at the body center shifts by $0.06^0$A, oxygen anions at side faces by $0.04^0$A and oxygen anions at top and bottom by $0.08^0$A, all in a direction opposite to the displacement of titanium ions. The lattice parameters are a = $4.03^0$A and b = c = $3.98^0$A. **(5+5)**

**b)** How is conductivity affected by mobility and concentration charge carriers? The electron and hole mobility for silicon are 0.14 and 0.048 $m^2$/V-s respectively at room temperature. If the hole concentration at this temperature is $1.33 \times 10^{16}\ m^{-3}$, calculate its conductivity at room temperature.