**Code: A-04 Subject: MATERIALS AND PROCESSES**

**Time: 3 Hours Max. Marks: 100**

**NOTE: There are 11 Questions in all.**

      **Question 1 is compulsory and carries 16 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.**

      **Answer any THREE Questions each from Part I and Part II. Each of these questions carries 14 marks.**

      **Any required data not explicitly given, may be suitably assumed and stated.**

**Q.1 Choose the correct or best alternative in the following: (2x8)**

a.       The atomic diameter of an FCC crystal having lattice parameter a is

**(A)**. **(B)**.

**(C)**. **(D)**.

b. A pair of one cation and one anion missing in a crystal of the type AB is called

**(A)**  Schottky defect. **(B)** Frenkel defect.

**(C)** Pair of vacancies. **(D)** None of these.

c. The maximum number of co-existing phases in a C-component system is

**(A)**    C P + 2. **(B)**P(C 1).

**(C)**F C +2.**(D)**C + 2.

d. The Fermi level is

**(A)**    an average value of all available energy levels.

**(B)**    the highest occupied energy level at .

**(C)**    an energy level at the top of the valence band.

**(D)**    the largest available energy level.

e. Pure silicon at zero K is an

**(A)**     intrinsic semiconductor. **(B)** extrinsic semiconductor.

**(C)** metal. **(D)** insulator.

f. The dielectric strength of a material is the highest

**(A)**     current which can pass through it.

**(B)**     voltage that can be applied to it.

**(C)**     field (voltage per meter thickness) that can be with-stood by it.

**(D)**    current density that can be transmitted by it.

g. Hard magnetic material is characterised by

**(A)**     high coercive force and low residual magnetic induction.

**(B)**     low coercive force and high residual magnetic induction.

**(C)**     high coercive force and magnetic induction.

**(D)**    only low coercive force.

h. Fine grain sizes are obtained by

**(A)**     slow cooling. **(B)**increasing nucleation rate.

**(C)** decreasing growth rate. **(D)** fast cooling.

**PART I**

**Answer any THREE Questions. Each question carries 14 marks.**

**Q.2** a. Explain with suitable examples the ionic, covalent and metallic bonds. Explain Madelung constant? **(6 + 2)**

b. What are Miller indices? What are their significances? Draw a (110) and a plane inside a cubic unit cell. **(2 + 4)**

**Q.3** a. Illustrate the point, line and surface imperfections found in solid materials with suitable sketches. Does the Burgers vector change with the size of the Burgers circuit? Explain. **(6 + 3)**

b. Find the maximum radius of the interstitial sphere that can just fit into the void between the body centred atoms of bcc structure. **(5)**

**Q.4** a. Explain with suitable diagrams the atomic model of diffusion. What is Einsteins relation? **(6 + 2)**

b. What are the total variables and degrees of freedom of a system of two components, when the number of phases is one, two, three etc.? **(6)**

**Q.5** a. Derive an expression for the electrical conductivity of a metal on the basis of free electron theory. Explain why nichrome and not copper is used as a heating element. **(6 + 4)**

b. The Fermi level for potassium is 2.1ev. Calculate the velocity of the electrons at the Fermi level. **(4)**

**Q.6**a.What is an energy band? Why does the Fermi level in an intrinsic semiconductor lies in the middle of the energy gap? **(2 + 6)**

b. Distinguish between doping and alloying. Which of the two should be resorted to for changing the mechanical properties and why? **(6)**

**PART II**

**Answer any THREE Questions. Each question carries 14 marks.**

**Q.7** a. Show that the electronic polarizability is proportional to the volume of the atom. What is the effect of temperature on the polarization of ferroelectric material? **(5 + 3)**

b. What is dielectric strength? Discuss the reasons for dielectric break down. **(3 + 3)**

**Q.8** a. Explain domain theory of ferromagnetism. **(6)**

b. Draw a typical hysteresis loop for a ferromagnetic material. Show which part is reversible and which is not. What procedure would you recommend for making the material required for magnetic memories? **(4 + 4)**

**Q.9** a. What are the functions of oxide layer in a high quality IC? Explain. **(6)**

b. Differentiate ion implantation and metallization processes in the fabrication of ICs. **(8)**

**Q.10**a. Explain with sketch the process of forging. **(7)**

b. What are the objectives of annealing? Explain annealing and spheroidising processes. **(4 + 3)**

**Q.11**a. What are the properties and applications of bakelite and transformer oil? **(6)**

b. Compare and differentiate the properties of common semi-conducting materials and common dielectric materials. **(8)**