

**SEM I**  
**(CBSGS)**  
**MAY 2019**

Time: 2 hours

Marks: 60

1. Question number 1 is compulsory
2. Attempt any three from remaining
3. Figure to right indicates marks
4. Assume necessary data

Q1 attempt **any 5** from following

15

1. Explain the steps to calculate the Miller indices of a plane.
2. Calculate the distance between two carbon atoms of a basis of the diamond structure, if the lattice constant of structure is  $5 \text{ \AA}$ .
3. Draw the diagrams to show the variation of fermi level with temperature for n-type and p-type semiconductors.
4. Define reverberation of time. State the factors on which it depends upon.
5. Calculate the number of turns required to produce a flux of  $10^{-3} \text{ Wb}$  around an iron ring of  $5 \text{ cm}^2$  cross section and 20 mm mean diameter having an air gap of 2 mm wide across it. The relative permeability of iron is 1000.
6. Two parallel plate capacitors having equal and opposite charges are separated by a dielectric slab of thickness 2 cm. If the electric field inside is  $10^6 \text{ V}$  and dielectric constant is 3, calculate the polarization and displacement density.
7. Explain the statement "crystal acts as three dimensional grating with X-rays".

Q.2) **a.** Explain Hall effect & its significance. A bar of n type Ge of size  $0.010 \text{ m} \times 0.001 \text{ m}$  is mounted in a magnetic field of  $2 \times 10^{-1} \text{ T}$ . The electron density in the bar is  $7 \times 10^{21} / \text{m}^3$ . If one millivolt is applied across the long ends of the bar, determine the current through the bar and the voltage between Hall electrodes placed across the short dimensions of the bar. Assume  $\mu_e = 0.39 \text{ m}^2 / \text{vs}$ .

8

**b.** Explain various point defects in crystals. Estimate the number of Frenkel defects per  $\text{mm}^3$  in AgCl if energy of formation of frenkel defects is 1.5 eV at  $700^0 \text{ K}$ . The molecular weight of AgCl is 0.143 kg/mol and specific density is 5.56.

7

Q.3) **a.** Draw the unit cell of HCP. Derive the number of atoms/unit cell, the c/a ratio and the void space percentage.

8

b. With a neat labelled diagram explain the principle, construction and working of a piezoelectric oscillator. 7

Q.4) a. For an intrinsic semiconductor show that the Fermi level lies in the centre of the forbidden energy gap. 5

b. Calculate the energy loss per minute in the core (of mass 40 Kg) of a transformer, if area of the hysteresis loop is 1900 erg/cc. Frequency is 100 cycles/sec and density of the material of the core is 7.5 gm/cc

c. Derive the relation between polarization, dielectric susceptibility and dielectric constant. 5

Q. 5) a. Explain the determination of the crystal structure using Bragg's spectrometer. 5

b. If a gas contains  $1.2 \times 10^{27}$  atoms/m<sup>3</sup> and radius of atom is 0.53 Å, then calculate electronic polarizability and dielectric constant. Find the capacitance of a parallel plate capacitor having this gas inside with plate area 1cm<sup>2</sup> and plate separation 0.12 cm. 5

c. Define Ligancy and critical radius ratio in case of ionic solid. Write the conditions for stability of ionic crystals in 3-D. 5

Q.6) a. Two ships are anchored at certain distance between them. An ultrasonic signal of 50 KHz is sent from one ship to another via 2 routes. First through water and second through atmosphere. The difference between the time intervals for receiving the signals at the other ship is 2 seconds. If the velocity of sound in atmosphere and seawater are 348 m/s and 1392 m/s respectively, find the distance between the ships. Also find the time taken by the signal to travel through water. 5

b. Explain principle, construction & working of a solar cell. 5

c. Distinguish between diamagnetic, paramagnetic & ferromagnetic materials. 5

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[Time: 2 Hours]

[ Marks: 60]

Please check whether you have got the right question paper.

N.B: 1. Questions No 1 is compulsory.

2. Attempt any three questions from remaining five questions.

3. Figure to the right indicates full marks.

4. Atomic weights : Ca=40, C=12, O=16, H=1, Mg=24

S =32, Cl=35.5, Na=23.

**Q.1** Attempt any five from the following.

15

- Differentiate between temporary and permanent hardness.
- Define lubricant and give its functions.
- What are plasticizer? Give its functions.
- Define Gibbs Phase rule. State the number of phases and component in the following equation.  $\text{NH}_4\text{Cl}_{(s)} \rightleftharpoons \text{NH}_{3(g)} + \text{HCl}_{(g)}$
- What are nanomaterials? Write the applications of fullerenes.
- What are thermoplastic polymer? Name any two thermoplastic polymer.
- 20 ml of sewage water is refluxed with 0.1 N  $\text{K}_2\text{Cr}_2\text{O}_7$  in presence of  $\text{H}_2\text{SO}_4$  &  $\text{Ag}_2\text{SO}_4$ . The unreacted dichromate required 5ml of 0.1 N FAS solution. Blank titration consumed 15ml of 0.1 N FAS solution. Calculate COD of effluent

**Q.2** a) Calculate the amount of time (90% pure) and soda (100% pure) required for softening one million liters of water containing following impurities in ppm: **06**

$\text{CaSO}_4=136$ ,  $\text{H}_2\text{SO}_4=49$ ,  $\text{MgCl}_2=95$ ,  $\text{MgSO}_4= 60$ ,  $\text{SiO}_2= 50$ .

b) With the help of phase diagram explain one component system. **05**

c) What is SWCNT and MWCNT? Explain laser method for the production of CNT. **04**

**Q.3** a) Define lubrication. Discuss the mechanism of thick film lubrication with neat diagram. **06**

b) What is meant by fabrication of Plastic? Describe a molding method suitable for thermoplastic resins. **05**

c) State the limitations of phase rule. **04**

- Q.4** a) Give the preparation, properties and uses of (**any two**) **06**  
 (i) PMMA (ii) Kevlar (iii) Buna-s
- b) Write a note on : **05**  
 (i) Reverse osmosis (ii) Disinfection of water by Ozone
- c) Find the acid value of a vegetable oil. whose 10ml required 4ml of 0.01 N KOH during titration (density of oil = 0.92 gm/ml) **04**
- Q.5** a) What is cement? Name the raw materials necessary for the manufacturing of port land cement. Draw the diagram of the rotary kiln and write the chemical reactions with temperature, during the burning process. **06**
- b) Write note on : **05**  
 i) Role of polymers in medicine & surgery  
 ii) Glass Transition temp
- c) An exhausted zeolite sufferer was regenerated by 150 liters of Nacl solution having a strength of 150gm/L of Nacl. If the hardness of water is 500 ppm, calculate total volume of water that is softened by the softener **04**
- Q.6** a) Explain activated sludge process with the help of flow sheer diagram. And write the main objectives of sewage treatment. **06**
- b) What is valucnigation? Explain giving proper reaction. Write advantages of vulcanized rubber. **05**
- c) Define & give the significance of following properties of lubricant. **04**  
 i. Flash point & fire Point  
 ii. Cloud point & pour Point

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