Date:
Registration number:

ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU-27
M.Sc. Analytical Chemistry- III SEMESTER
SEMESTER EXAMINATION: OCTOBER 2021
(Examination conducted in January-March 2021)

CH 9418 – SOLID STATE CHEMISTRY

Time- 2 ½ hr **Max Marks-70**

This question paper contains **TWO** printed pages and **THREE** parts.

Part A

Answer any SIX questions **6 x 2 = 12**

1. Draw the plot of resistivity vs temperature for i) a metal ii) a semiconductor.
2. Write the general representation of a screw axis. What are the values of translation components of the screw axis with respect to 3-fold rotation.
3. What is limiting sphere? What is its significance?
4. Write any two differences between electron diffraction and X-ray diffraction.
5. Explain anti-ferromagnetic ordering in solids.
6. Write two limitations of precipitation synthesis.
7. Explain F-centre with an example.
8. Draw the unit cell of K_2NiF_4 and indicate the positions of K, Ni and F.

Part B

Answer any FOUR questions **4 x 12 = 48**

9. a) Write all the point groups obtained by the combination of three proper rotation axes at a point. Draw the stereographic projections for any two of the point groups obtained by this combination.
   b) Explain the following with pictorial representation, using motif '7'
   i) 2_1 screw axis ii) 'b' glide (6+6)
10. a) Show that the five roto-reflection and roto-inversion axes are equivalent in pairs with the help of stereographic projections.
    b) Discuss the construction of Ewald's sphere and derive Braggs' diffraction condition in terms of reciprocal lattice vector. (6+6)
11. a) The 2θ values for diffraction peaks in powder patterns of a cubic system are given below. Index the pattern.

Peak No.	1	2	3	4	5	6
2θ (deg)	44..41	64.59	81.77	98.26	115.34	135.47

b) What is phase problem in crystallography? How is it solved by heavy atom method?

c) Neutron diffraction and X-ray diffraction are complementary to each other. Explain.

(5+4+3)

12.a) Discuss Kronig-Penney treatment of electron in periodic potential and show how 'allowed' and 'forbidden' zones of energy emerge.

b) Explain how a p-n junction is constructed. Describe the mechanism of current flow in a forward biased and a reverse biased p-n junction. (6+6)

13. a) Explain i) edge dislocation ii) grain boundaries

b) What is first order phase transition? Explain the variation of entropy with respect to temperature for a first order phase transition with the help of a diagram.

c) Write a note on crystal structure of garnets. (5+ 4+3)

14. a) Write a note on the following methods of solid state synthesis

i) *chimie douce* synthesis ii) combustion synthesis iii) sol-gel synthesis

b) Explain Hall effect. How would you determine the nature of the majority charge carrier and its mobility through the measurement of Hall coefficient, R? (6+6)

Part C

Answer any TWO questions **2 x 5 = 10**

15. a) The point group 233 is written as 23. Justify.

b) Given unlimited supply of $Zn(NO_3)_2$, $Al(NO_3)_3$, urea and water, design any two methods to synthesize $ZnAl_2O_4$. (3+2)

16. Gallium arsenide crystallises in one of the cubic lattice structures. In the unit cell the atoms take the following positions

Ga 000, ½½ 0, ½0½, 0½½

As ¼¼¼ ¾¾¼ ¾¼¾ ¼¾¾

Identify the cubic lattice and arrive at structure factor for gallium arsenide for general (hkl). Which reflections will be systematically suppressed?

17. a) Show that in a Ge crystal doped with 1ppm of As, the major charge carriers are electrons. E_g of Ge = 0.72 eV. The As states are 0.012 eV below the bottom of the conduction band and the Fermi level is 0.16 eV below the bottom of the conduction band at 25^o C.

b) A material shows increase in magnetic susceptibility when heated up to a temperature T and decreases exponentially after this temperature. Plot the hysteresis curve of this material. (3+2)

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