**ST. JOSEPH’S COLLEGE (AUTONOMOUS), BANGALORE-27**

**M.Sc. CHEMISTRY: IV SEMESTER**

**SEMESTER EXAMINATION-APRIL2018**

**CH 0415: Solid State Chemistry**

**Time: 2½ Hours Max Marks:70**

*This question paper contains* ***2 pages*** *and* ***3 parts***

**PART-A**

Answer any ***SIX***of the following questions: **6 x 2 = 12**

1. Why is the point group 233 written as 23?
2. Give any two features of YBa2Cu3O7that are responsible for its superconductivity.
3. What is structure factor? How Is it related to the intensity of x-radiation?(Give the mathematical equation)
4. Identify the lattice type and the crystal system present in the space group F432?
5. Plot the results of zone theory in the ‘repeat zone’ representation.
6. Give any two applications of piezoelectric crystals.
7. Substantiate the statement, “Neutron diffraction can complement X-ray diffraction”.
8. Draw the unit cell of K2NiF4.

**PART-B**

Answer any ***FOUR***of the following questions: **4 x 12 = 48**

1. a) Write the mathematical function for the representation of the ground state Cooper

pairs of electrons. How does Cooper’s model explain the phenomenon of electron

 pairing in superconductors?

 b) Show that 41 and 43 screw axes form an enantiomorphous pair using pictorialrepresentations?(Use motif 7) (6 + 6)

10.a) What is reciprocal lattice? Derive Bragg’s law by constructing Ewald’s sphere of

 reflection.

b) Calculate the number of reflections for the tungsten crystal using MoKα

radiation (λ= 0.711Å). The volume of the unit cell is 1600 (Å)3. (8 + 4)

11. a) Derive the equation cos ψ= N/2, where ψ is the angle of rotation

 and N is an integer, and verify whether the order of axis n=1, 2, 3, 4, 5

 and 6 is possible for a perfect crystalline substance.

 b) Give all the point groups belonging to orthorhombic system and draw their

 stereographic projections. (6 + 6)

1. a)Show that the structure factor Fhkl vanishes for the space group Pc(c glide perpendicular to b axis with hol for l = odd

b) Explain (i) stacking faults and (ii) turbostratic disorder.

c) Write a note on order-disorder transitions. (4 + 5 + 3)

13. a) Discuss the applications of semiconductors based on their optical properties.

 b) What is ferroelectricity? Explain how structural changes accompany ferroelectric transitions taking BaTiO3 as example. (6 + 6)

14. a) Plot resistivity against temperature for a typical metal. Explain why such a curve is observed.

 b) Explain the origin of weak paramagnetism in almost all metals.

 c) What are Ruddledsen-Popper phases? Describe their structure in relation to perovskite structure. (4 +3 + 5)

**PART-C**

Answer any ***TWO*** of the following questions: **2 x 5= 10**

1. Using Euler’s Formula check whether the combination of rotation axes(i) 622 and (ii) 642 is allowed or not. Justify your answer by calculating the interaxial angles.
2. a) What space group information can be got from the following systematic absences?
3. The crystal system is monoclinic and the lattice is primitive. All the reflections are observed except from oko plane for k = odd.
4. The crystal system is monoclinic and all the reflections are observed except from hkl planes where (h+k) = odd.

b) Identify the type of stoichiometric defects in the following cases.

 (i) Density of defective crystal is less than that of defect-free crystal.

 (ii) Burger vector is parallel to the direction of dislocation. (3 + 2)

17. a) Identify the nature of contact (ohmic/rectifying) in the following cases.

(i) metal (A) – metal (B) junction; φA>φB

 (ii) metal (M) – p-type semiconductor (S) junction; φM>φS

b) Calculate the difference in energy between the Fermi level and the top of the valence band for an intrinsic semiconductor whose UV-visible absorption onset is 350 nm. (3 + 2)

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