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| **Register No:** |

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

M.Sc. CHEMISTRY: I V SEMESTER

**SEMESTER EXAMINATION: January 2020**

**CHDE 0218- CHEMISTRY OF MATERIALS**

Note : (i) The question paper has **two printed pages** and **three parts**. All parts are compulsory.

(ii) Answer any **SIX** out of eight questions from part – A, Any **FOUR** out of six questions from part – B, and any **TWO** out of three questions from part – C.

Time : 2 ½ hrs Max .Marks : 70

**PART A** **6 x 2 = 12**

1. What is electron diffraction?
2. Two poytypes of a ABO3 perovskite are 3C and 2 H. How are they different?
3. What are the constituents of Metal Organic Frameworks (MOFs)? Give an example.
4. Explain Meissner effect.
5. What are conducting polymers? Give an example.
6. Show the band structure of a semiconductor (i) in bulk form; (ii) as nanoparticle.
7. What are the roles of capping agents in nanomaterials chemistry?
8. What is a supercapacitor? How is it different from a capacitor and a battery?

**PART B** **4 x 12 = 48**

1. (a) Compare the three imaging modes of Atomic Force Microscopy (AFM) .

(b) What are the three characteristic peaks of Electron Energy Loss Spectroscopy

(EELS)? What information is obtained from each one of these peaks?

(c) Give the principle of Energy Dispersive X- ray Spectroscopy (EDS).

(d) With the help of a diagram explain the working of TEM. (3+3+3+3)

1. (a) How are zeolites prepared by hydrothermal process? Give the structural difference between MCM 41 and MCM 48.

(b) What are intercalation compounds? Explain using a suitable example.

(c) Why are cationic clays called so? Explain the structures of 2:1 and 1:1 clays.

(d) What are inverse opals? How are they synthesized? (3+ 3+3+3)

1. (a) With the help of a diagram explain auger emission.

(b) Discuss BCS theory of superconductors.

(c) What is EXAFS? Why is it atom specific?

(d) Differentiate between DSC and DTA. (3+3+3+3)

1. (a) With the help of suitable band structure diagrams explain

(i) topological insulators; (ii) Weyl semimetals.

(b) What are ceramic nanocomposites? Give any two examples and their applications

(c) Write a note on GMR materials. (4+4+4)

1. (a) Discuss the following methods of nanomaterial synthesis taking suitable examples

(i) spray pyrolysis; (ii) chemical exfoliation.

(b) Discuss the applications of nanomaterials in (i) photocatalysis; (ii) medicine; (iii) biological studies. (4 + 8)

14. (a) What is graphene? Give any two methods of its large scale synthesis. List any four

applications of graphene.

(b) Write a note on cytotoxicity of nanomaterials.

(c) Describe any two methods employed in the synthesis of thin films. (5+3+4)

**PART C**  **2 x 5 = 10**

1. (a) Prove that there is no loss of momentum of electron in a Cooper pair.

(b) Bragg angles for a cubic solid occur at θ= 19.0, 22.5, 33.0,39.0 and 41.5° in powder x- ray diffraction when recorded using CuKα radiation (λ = 1.5408 A°). Calculate the unit cell parameters of the solid. (2+3)

1. (a) The specific surface area of a microporous silica sample was found to be 423 m2/g. Calculate the volume of liquid nitrogen required to fill the pores in I g of this sample.

(Avagadro Number = 6.022 X10 23 , Molar volume = 22.414dm3mol-1)

(b) Sample A of CdS nanoparticles has the following distribution of diameters. 5 nm - 5 particles, 6 nm - 8 particles; 10 nm - 7 particles. Sample B of CdS nanoparticles is monodisperse with all particles having a diameter of 8 nm. What would be the approximate crystallite size arrived at from PXRD of these samples? How would the UV-Vis spectra of these samples look like? . (3+2)

17. Design a suitable synthesis each for the following.

(i) Fe-Pt alloy nanoparticles from the metal carbonyls

(ii) CdS nanoparticle intercalated WS2

(iii) CuO nanoparticles starting from copper nitrate

(iv) Clay- PVC nanocomposites

(v) Large quantities of MoS2 nanosheets

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