

Registration Number:

Date & Session:



**ST JOSEPH'S UNIVERSITY, BENGALURU -27**  
**M.Sc. Chemistry – 4<sup>th</sup> SEMESTER**  
**SEMESTER EXAMINATION: APRIL 2024**  
(Examination conducted in February 2024)  
**CHDE 0223: CHEMISTRY OF MATERIALS**  
**(For current batch students only)**

**Time: 2 Hours**

**Max Marks: 50**

**This paper contains 2 printed pages and 3 parts.**

**PART-A**

Answer any **EIGHT** of the following questions

**8x2=16**

1. What is a nanocomposite? Give an example.
2. List two ways by which nanoparticles can enter the human body?
3. What is EXAFS? Give two applications of it.
4. Give two differences between cationic and anionic clays.
5. Explain the principle of atomic force microscopy (AFM).
6. Show the band structure of a semiconductor in (i) bulk form (ii) nanoparticle.
7. Give two differences between type 1 and type 2 multiferroics.
8. Illustrate polytypism with a suitable example.
9. Compare entropy and free energy in normal state and superconducting state.
10. What are zero-D nanomaterials? Give an example.

**PART-B**

Answer any **TWO** of the following questions

**2x12=24**

11. a. What are polymer matrix nanocomposites? Describe its synthesis with an example.  
b. Discuss any two methods to prepare graphene. Mention their advantages and disadvantages of the methods.  
c. Explain with an example, the applications of nanomaterials in (i) environmental amelioration (ii) biomedical applications. (4+4+4)
12. a. What are the unique properties of nanomaterials? How are they classified based on their size?  
b. Give two differences and two similarities between TEM and SEM.  
c. How do low temperature and high temperature superconductors differ with respect to critical temperature and critical magnetic fields?  
d. Give four postulates of BCS theory of low temperature superconductors. (3+3+3+3)

13. a. What are conducting polymers? Give two examples.  
b. Discuss the structure and synthesis of zeolites. Give two examples for zeotypes.  
c. (i) Differentiate between MCM-41 and MCM-48.  
(ii) What is the metal ion used in MOF-5? Give the structures of two linkers used in MOF. (4+4+4)

### PART-C

Answer any **TWO** of the following questions

**2x5=10**

14. a. What is the role of the specified nanomaterial in the following composites? Give reasons.  
(i). Carbon onions in  $\text{LiCoO}_2$ - carbon onion composite batteries.  
(ii). Carbon nanotubes in  $\text{CNT-Al}_2\text{O}_3$  composite as a hybrid reinforcement material.  
b. At  $0^\circ\text{C}$  and 1 atmosphere pressure, the volume of nitrogen gas required to cover a sample of opal, assuming Langmuir monolayer adsorption, is found to be  $120\text{ cm}^3\text{ g}^{-1}$  of the opal. Calculate the surface area per gram of opal. Given that the area occupied by a nitrogen molecule is  $0.161(\text{nm})^2$ . (2+3)
15. Two nanomaterials X and Y, when characterized by X-ray diffraction, showed two broad indistinguishable peaks at  $2\theta$  around  $\sim 25.5^\circ$  and  $43.5^\circ$  with a lot of noise. Raman spectroscopy measurement of both X and Y showed two bands around  $1300\text{cm}^{-1}$  and  $1500\text{cm}^{-1}$  respectively. However, the ratio of the Raman intensity of the two bands was very high for X compared to Y. Identify X and Y and justify your answers.
16. a. Auger spectrum of sulphur in  $\text{Na}_2\text{S}_2\text{O}_3$  is recorded. How many peaks would it exhibit? Give reason.  
b. How would you identify  $\text{CH}_3\text{CHO}$  and  $\text{CH}_3\text{COOH}$  using ESCA C(1s) spectra? (3+2)