



Date:

Registration number:

**ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU-27**  
**M.Sc. CHEMISTRY - IV SEMESTER**  
**SEMESTER EXAMINATION: APRIL 2022**  
**(Examination conducted in July 2022)**  
**CHDE0218 – CHEMISTRY OF MATERIALS**

**Time- 2½ hrs**

**Max Marks: 70**

**This question paper contains 2 printed pages and three parts**

**Part A**

**Answer any SIX of the following**

**[6x2=12]**

1. Mention any two applications of fullerenes.
2. Draw the band structure of a semiconductor in (i) bulk form (ii) nanoparticle form.
3. What is Meissner effect?
4. With a suitable diagram, explain Auger emission.
5. What are mesoporous solids? Give an example.
6. Differentiate between 2:1 and 1:1 clays.
7. List two top-down methods of synthesis of nanomaterials.
8. Give two differences between Weyl and Dirac semimetals.

**PART-B**

**Answer any FOUR of the following questions**

**[4x12=48]**

9. a) What are multiferroics? Explain why  $\text{BaTiO}_3$  is ferroelectric material while  $\text{BiFeO}_3$  is a multiferroic material.  
b) Explain polytypism in layered solids with suitable examples.  
c) What are layered chalcogenides? Give an example. (6+3+3)
10. a) What is Scherrer broadening in powder X-ray diffraction? What information can be obtained from this broadening?  
b) Explain briefly how pore volume and pore radius of material is determined.  
c) With suitable examples discuss how nanoparticles are synthesized by (i) spray pyrolysis (ii) hydrothermal method. (4+4+4)
11. a) With the help of a diagram explain the working of a scanning electron microscope (SEM).  
b) What is EDS? How is the thickness of the sample measured using EDS?  
c) What are the different regions of EELS spectrum? What information could be obtained from each region? (4+4+4)
12. a) What are metal organic framework (MOF) materials? Give the structure of one of the organic linkers used in the preparation of MOF.  
b) When  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  is subjected to thermogravimetric analysis (TGA), how many weight loss curves are obtained? Designate each weight loss to different chemical changes.

CHDE0218-A-22

- c) Explain synthesis of zeolites by hydrothermal method.  
d) Write a short note on GMR materials. (3+3+3+3)
13. a) Show, graphically, the variation of the following thermodynamic properties with temperature in superconductors: (i) entropy; (ii) specific heat. Also compare these thermodynamic properties with those of the metal in the normal state.  
b) What is ESCA? The ESCA spectrum of doubly oxidised cystine gives two peaks. What is the structure of cystine dioxide?  
c) Discuss the preparation and any two applications of polymer nanocomposites? (4+4+4)
14. a) Give any two methods of synthesis of MoS<sub>2</sub> two dimensional nanosheets.  
b) Differentiate between MCM-48 and MCM-41.  
c) Write a note on toxicity of nanomaterials. (4+4+4)

### PART-C

**Answer any TWO of the following questions**

**[2x5=10]**

15. a) Prove that there is no loss of momentum of electron in a Cooper pair.  
b) 4 nm, 6 nm and 10 nm particles of a semiconductor emit red, green and blue light on excitation. Match the particles with the emitted colours. (3+2)
16. a) Give reasons for the following.  
(i) Graphene VO<sub>2</sub> nanorods function better as a Li ion battery electrode than the VO<sub>2</sub> nanorods.  
(ii) ZnS coated CdSe core shell quantum dots are better suited for biological applications rather than plain CdSe quantum dots.  
b). Plan a synthesis protocol for a zeolite. What textural information can you obtain about the zeolite by using nitrogen adsorption-desorption isotherms? (3+2)
17. Match the following
- |                     |                     |
|---------------------|---------------------|
| Chalcogenides       | Hydrothermal method |
| Scotch tape method  | MoS <sub>2</sub>    |
| Quantum dots        | Graphene            |
| Capping agent       | CdSe nanoparticles  |
| Bottoms-up approach | Polyethylene glycol |
- (5)