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

M. Sc. CHEMISTRY: IV SEMESTER

**Special Supplementary Examination, JUNE 2019**

**CH DE 0517: Material Chemistry**

Supplementary candidates only.

Attach the question paper with the answer booklet

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

All parts are compulsory.

Time: 2½ hrs Max .Marks: 70

**Part A**

**Answer any six. 2 x 6 = 12 marks**

1. Name a surfactant used in the preparation of MCM. Give any one application of MCM.
2. When an IR spectrum of alumina was recorded peaks due to hydroxyl groups were observed at wavenumbers 3800, 3690 and 3590 cm-1. How do you account for it?
3. Give any two differences between SEM and TEM.
4. What is tip convolution in atomic force microscopy?
5. What are 1D nanomaterials? Give two examples.
6. Briefly describe spray pyrolysis method for the synthesis of nanomaterials.
7. What are the advantages of nanocomposites?
8. Write the anodic and cathodic reactions in a direct methanol fuel cell.

**Part B**

**Answer any four. 4 x 12 = 48 marks**

1. a) Explain gelation and crystallization methods of preparation of catalytic materials with one example for each method.

b) Give chemical equations for grafting of molybdate species on alumina surface.

c) Draw the C(1s) X-ray photoelectron spectrum of ethyl trifluroacetate (CF3COOC2H5) and assign the peaks. **(6 + 3 + 3)**

1. a) Discuss the structure of any one zeolite. Give two applications of mordenite?

b) Discuss the top-down synthesis of graphene from graphite intercalation compounds.

c) What are polyoxometallates? Give any two of their applications. Write the names and molecular formulae of two heteropoly acids.  **(4 + 4 + 4)**

1. a) Give three biological applications of nanoparticles.

b) What is the importance of surface modification?

c) How are pore volume and pore radius of a material determined?

d) Give the structures of four linkers used in metal organic framework (MOFs). Give two applications of MOFs. **(3 + 3 + 3 + 3)**

12. a) Discuss La Mer principle with the help of a diagram.

b) What is chemical exfoliation of layered solids? What are its advantages and limitations?

c) What are the roles of capping agents in the synthesis of nanoparticles? **(4 + 5 + 3)**

13. a) What are the usual methods by which thin films can be prepared? Explain any one of these methods.

b) What are ceramic matrix nanocomposites? How are they prepared? Give any two specific applications of such composites.

c) How are polymer–inorganic nanocomposites prepared? Give any two applications of these composites. **(4 + 4 + 4)**

14. a) Discuss the use of graphene (or reduced graphene oxide) as a component in the nanohydrids for (i) supercapacitors and (ii) lithium ion batteries.

b) Nanomaterials are increasingly used as catalysts in photocatalytic hydrogen evolution reaction. Why?

c) Write a note on cytotoxicity of nanoparticles. **(4 + 4 + 4)**

**Part C**

**Answer any two 2 x 5 = 10 marks**

15. a) Identify the role of the specified component in the following nanocomposites:

(i) NiO in Fe3O4 - NiO composite for data storage application.

(ii) CdS in TiO2-CdS composite for photochemical dye degradation.

b) Match the following

**A B**

Pt nanowire easy exfoliation

Fe-Pt alloy nanoparticles surface plasmon resonance

CdSe nanoparticles chirality

MoS2 nanosheets superparamagnetism

SWCNT QD-LED TV

Graphite Oxide IT or 2H **(2 + 3)**

1. a) Plan a synthesis protocol for the following:

(i) gamma-Fe2O3 nanoparticles soluble in hexane.

(ii) LDH nanosheets soluble in water.

b) Account for the fact that KLIILIII - LIILIII auger spectrum for Na2S2O3 gives two lines for 1D2 state of sulphur. **(3 + 2)**

1. At 0°C and 1 atm pressure, the volume of nitrogen gas required to cover the surface of a sample of anatase (TiO2), assuming Langmuir monolayer adsorption, is found to be 110 cm3g-1. Calculate the surface area per gram of TiO2, given that the area occupied by a nitrogen molecule is 0.161 (nm)2.

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CH DE0517-B-18