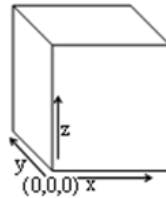


PART A

[40 MARKS]

1) Draw the following planes and directions for a simple cubic system (draw separate unit cells for each case. Do not draw all the directions and planes in one unit cell. Consider the axis and origin of the unit cell as shown in the unit cell (Figure) given below): [2 x 4=8]

Directions: [210], [244]
 Planes: (202), (212)



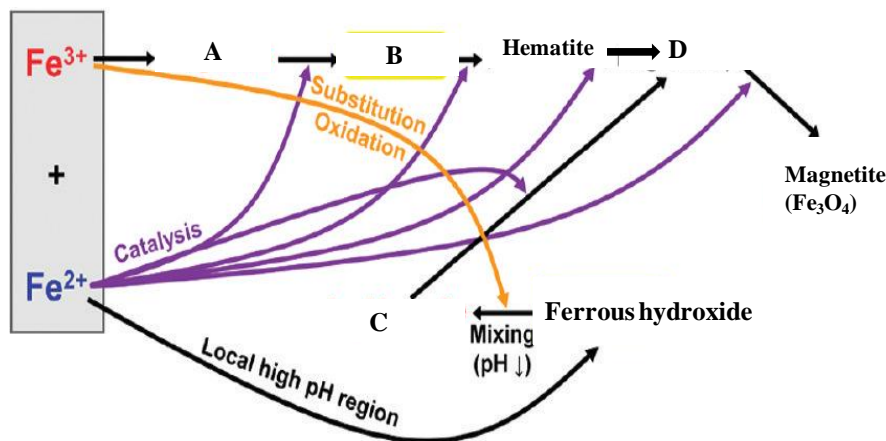
2a) Consider a unit cell having axial lengths $4A$, $8A$, $3A$ for a , b , c axis respectively. A plane intercepts this unit cell and intercept lengths are $2A$, $6A$, and $3A$ for a , b , c axis respectively. What are the Miller indices (hkl) of this plane? (Consider a , b , and c axis are in x , y , and z directions) [4]

2b) In the XRD pattern of a polycrystalline sample, it was observed that the highest intensity peak appeared at $2\theta = 36.1^\circ$. In the X-axis, the distance between 35.5° and 36.5° is 7.2 cm, and the full width at half maxima of the highest intensity peak is 2 cm. Using Scherrer's equation calculate the crystallite size (in nm unit) of this sample (Consider that the wave length of the X-ray corresponds to $\text{CuK}\alpha$). [4]

3a) Write the reaction mechanisms for the following reactions: [4]

- (i) In sol-gel reaction the acid-catalyzed hydrolysis of TEOS.
- (ii) In sol-gel reaction the acid-catalyzed condensation of TEOS.
- (iii) In sol-gel reaction the base-catalyzed hydrolysis of TEOS.
- (iv) In sol-gel reaction the base-catalyzed condensation of TEOS.

3b) In this schematic presentation of Formation pathways of magnetite nanoparticles by coprecipitation method write down the names of A, B, C, and D [4]



4a) Present a schematic diagram showing the comparison of the principal features between Transmission Electron microscope and Scanning Electron Microscope. [4]

4b) Draw a schematic presentation showing all the different scattering types originating from the electron- solid interactions when electron beam strikes a sample in TEM. [4]

5a) Present a flowchart showing all the steps which are involved in Hummer's method of synthesis of Graphene Oxide. [6]

5b) Write the reaction mechanism of reduction of epoxy group of graphene oxide by hydrazine. [2]

Birla Institute of Technology & Science-Pilani, K. K. Birla Goa Campus

First Semester 2022-23, (Closed Book), **PART B**

COURSE TITLE: Chemistry of Materials

COURSE NO: CHEM F333

TOTAL MARKS: 40

Duration: 180 min

Date: 22/12/22

Answer all the parts of a question together.

Marks will be awarded only for completely correct answers.

- Q1. (i) Why fullerenes are super-alkenic and not super-aromatic? [2]
(ii) What is the difference between endo-, exo-, and hetero-fullerenes? [6]
(iii) The wrapping angle in a single walled carbon nanotube (SWCNT) is defined as the angle between armchair line and the chiral vector. Predict the geometry of SWCNT if the wrapping angle is (i) 0° , and (ii) 30° . Also, for both of these write the general designation of CNT. [4]
- Q2. Define following [8]
(i) Coercivity
(ii) Halochromic Materials
(iii) Ferrimagnetic Materials
(iv) Tensile strength
- Q3. What is the difference between [4x4]
(i) Raman Scattering and Mie Scattering
(ii) Xerogels and Hydrogels
(iii) Pseudoplastic and Bingham Plastic
(iv) Blends and Composites
- Q4. Fill in the blanks [4]
(i) The gold nanoparticles change the color with size. This is due to _____
(ii) _____ is the temperature at which ferromagnetic materials loses its magnetism and starts behaving as a paramagnetic material.
(iii) Ketchup is _____ (shear thinning/ shear thickening) fluid.
(iv) _____ is an example of four-point model for viscoelastic materials.

END