RAMAKRISHNA MISSION VIDYAMANDIRA
(Residential Autonomous College affiliated to University of Calcutta)

SECOND YEAR [2018-21]
B.A./B.Sc. THIRD SEMESTER (July – December) 2019
Mid-Semester Examination, September 2019

Date : 16/09/2019

Time : 1 pm – 3 pm

INDUSTRIAL CHEMISTRY (Honours)
Paper: III

Full Marks : 50

[Use a separate Answer Book for each unit]
Unit-I

Answer **any four** questions**:**   [4 × 5]

1. a) Define lattice, basis and crystal.

    b) What are the basis vectors?

    c) Differentiate between 'crystalline' and 'amorphous' materials.   [2+1+2]

2. a) Define 'Brawal's' lattice. How many of then are possible in 3D?

    b) Define 'packing fraction'. Calculate the maximum packing fraction for any cubic system.   [2+3]

3. a) In a simple cubic system, show the following plane and directions.

      i) Planes : (101); $\left(\bar{1}\bar{1}0\right)$, (022).

      ii) Directions: [121], $\left[\bar{1}0\bar{1}\right]$, $\left[0\bar{2}1\right]$.

    b) Copper has an atomic radius of 0.128 nm, an FCC crystal structure and atomic weight of 63.5 g/mol. Compute its theoretical density.   [3+2]

4. a) Establish Bragg's diffraction condition for crystals.

    b) A beam of x-rays have wavelength 0.071 nm is diffracted by (110) plane off rock salt (FCC) with lattice constant of 0.28 nm. Find the glancing angle $\left(\theta\right)$ for the second order diffraction.   [2+3]

5. a) Classify the different kind of materials with examples.   [3]

    b) The average degrees of polymerization of PVC is 2500. Calculate its average molecular weight in g/mol.   [2]

6. a) Write a note on nanostructure materials.   [2]

    b)   The volume fraction of epoxy resin in a glass fiber/epoxy composite is 0.48. The density of glass fiber and composite are 2540 kg/m^3 and 1950 kg/m^3 respectively. The weight fraction of fiber in the coomposite is ....   [3]

Unit-II

Answer **any three** questions**:**   [3 × 5]

7.   Draw free energy versus composition relationship for T_1, T_2 T_e & T_3 temperature for below eutectic system?
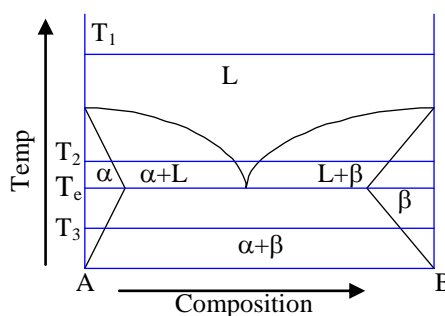
8. a) Find the fraction of proeutectoid $\alpha\left(f_{pro\ \alpha}\right)$ and fraction of pearlite $\left(f_{pearlite}\right)$ for mild steel

    of 0.2 % C.

    b) Describe 'Tabling' process.   [2.5+2.5]

9. a) What are the advantages of Imperials smelting process.

    b)   Describe Hydrometallurgical Extraction of Zinc.   [2.5+2.5]

10. a) How refined lead is obtained from Lead Bullion.

    b) Describe Parke's process for desilverzation of lead.   [3+2]

11. a) What are the main features of WORCRA process.

    b) Describe the Blister formation stage of copper extraction process.   [2+3]

Unit-III

Answer **any three** questions: [3 × 5]

12. a) Write down the energy expression for simple harmonic oscillator.

    b) Calculate the difference in energy between two successive levels.   [1+2+2]

13. a) What is the essential condition for a light-induced vibrational transition?

    b) What is the selection rule for a light-induced vibrational transition?

    c) Calculate the frequency of light which induces a vibrational transition in terms of the
        frequency of vibration for a simple harmonic oscillator.   [1+1+3]

14. a) Write down the energy expression for a rigid rotor.

    b) Calculate the difference in energy of two successive levels.

    c) How this energy gap between successive levels change with quantum number 'J'?   [1+2+2]

15. a) Derive the expression for the rotational state which hosts the largest fraction of
        population.

    b) Find out the same for a vibrational state.   [4+1]

16. a) What is the essential condition for a light-induced rotational transition?

    b) What is the selection rule for a light-induced rotational transition?

    c) Calculate the frequency of light which induces a rotational transition in terms of the
        parameters of rotational motion.   [2+1+2]

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