RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

SECOND YEAR [2018-21]

B.A./B.Sc. THIRD SEMESTER (July – December) 2018

Mid-Semester Examination, September 2018

Date : 24/09/2018 **INDUSTRIAL CHEMISTRY (Honours)**

Time : 11 am – 1pm Paper: III Full Marks : 50

[Use a separate Answer Book for each unit]

Unit-I

Answer **any three** questions**:** (3 × 5)

1. a) Write down the energy expression for simple harmonic oscillator.
   b) Show the energy levels of a simple harmonic oscillator in an internuclear distance vs potential energy diagram.
   c) Calculate the difference in energy of two successive levels. 1+2+2
2. 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. 2+1+2
3. a) Write down the energy expression for a rigid rotor.
   b) Calculate the difference in energy of two successive levels.
   c) With the help of a schematic diagram show how the frequency of transition changes with the quantum number of the ground state. 1+2+2
4. 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
5. a) Find out the rotational quantum level at which the molecular population maximises.
   b) Find out the same for vibrational levels. 4+1

Unit-II

Answer **any three** questions**:** (3 × 5)

6. a) What is the difference between atomic structure and crystal structure?
   b) Define ‘lattice’ and ‘basis’ of a crystal.
   c) What is ‘unit cell’? What are the parameters necessary to define an unit cell? On that basis, how many different unit cell geometry is possible? 1+1+3
7. a) What is ‘Miller indices’? What is its advantage in specifying crystallographic planes? How to determine the Miller indices of plane in crystal?

b) Draw an orthorhombic unit cell, and within that cell, specify the $\left[\bar{2}\,11\right]$ direction and $\left(\bar{2}\,11\right)$ plane. 3+2

8. a) For a tetragonal crystal, cite the following crystallographic directions:
(i) [0 11]; (ii) [100]

b) Convert the [110] and $\left[00\bar{1}\right]$ directions into the four-index Miller-Bravais scheme for hexagonal unit cells.

c) Sketch within a cubic unit cell the following planes.
(i) $\left(10\bar{1}\right)$; (ii) $\left(2\bar{1}1\right)$; (iii) $\left(\bar{2}12\right)$; (iv) $\left(3\bar{1}2\right)$. 2+1+2

9. a) Show that for body-centred cubic crystal structure that the unit cell edge length 'a' and the atomic radius 'R' are related through $a = \frac{4R}{\sqrt{3}}$.

b) Calculate the radius of tantalum atom, given that tantalum has a BCC structure, a density of 16.6 g/cm^3, and an atomic weight of 180.9 g/mol. 2+3

10. a) Derive 'Bragg's law'.

b) For which set of crystallographic planes will a first order diffraction peak occur at a diffraction angle of 44.53^o (2θ) for FC nickel when monochromatic radiation having a wavelength of 0.1542 nm is used? 2+3

Unit-III

Answer **any four** questions**:** (4 × 5)

11. Draw the free energy versus composition relationship for a simple eutectic system at above eutectic temp, at eutectic temp. & below eutectic temp. 5

12. What is the amount of proeutectoid ferrite in a slowly cooled 0.5% C steel?
In the Pb-Sn system determine the fraction of β phase in an alloy of 80% Sn at 184^{o}C. 2½+2½

13. Write down the significance of Ellingham Diagram.
How pressure difference & minimum fludization velocity varies in a fluozold Rousting (Fluidized Bed Rousting) process. 2½+2½

14. How Aluminium is extracted from ALCOA process. Explain the extraction of silver by cyanidation process. 3+2

15. Draw a schematic diagram of Blast furnace & write down the different chemical reaction at different zone of the blast furnace. 5

16. Give three (BF irregularities) for which Blast furnace productivity decreases? Also explain about them. 5

———— × ————