(i) Printed Pages : 4 Roll No. .....

(ii) Questions : 9 Sub. Code : 0549

Exam. Code : 0006

B.A./B.Sc. (General) 6th Semester

1048

CHEMISTRY

Paper–XXIII : Physical Chemistry-B

(Same for B.Sc. Microbial and Food Technology)

Time Allowed : Three Hours] **[Maximum Marks : 22**

Note :– (1) Attempt **five** questions in all, selecting **one** question each from Section-A to Section-D and Question No.**9** is compulsory.

(2) Student may use simple calculators.

SECTION–A

1. (a) How is a unit plane in a crystal decided ? Define Hauy's law of rational indices.

(b) How are Miller indices of a plane or a face determined ? What are Miller indices of the faces of a simple cube ?

(c) What are primitive and non-primitive unit cells ? Represent them diagrammatically for a cubic system. 1,2,1

2. (a) Explain the terms Axis of symmetry, Mirror planes and Centre of Inversion. Show them diagrammatically for a cubic system.

(b) Define Steno's law of constancy of interfacial angles. How are interfacial angles measured ? 2,2

SECTION–B

3. (a) Calculate the angles at which X-rays of wavelength 1.54 Å will undergo first order and second order reflections from atomic planes of a crystal separated by a distance of 4.04 Å.

(b) Briefly describe powder method for X-ray diffraction studies by crystals. What are its advantages over Bragg's method ? Using this method, how the interplanar spacing can be calculated ? 2,2

4. (a) What are the co-ordinates of Na^+ and Cl^- ions present in different positions in NaCl crystal ?

(b) What do you mean by coupling effect in the solid state reactions ? Explain with a suitable example.

(c) What type of diffraction pattern will be obtained theoretically for a face centred cubic-lattice ? Explain. 1,1,2

SECTION–C

5. (a) What do you understand by 'width' and 'intensity' of a spectral line ? Briefly explain the factors on which each of these depends.

(b) Briefly explain the terms-Emission and Absorption spectroscopy. Why Absorption spectroscopy is preferred?

(c) What are the different energies possessed by a molecule ? What is Born-Oppenheimer approximation ? 2,1,1

6. (a) What is the moment of inertia of a rigid diatomic rotator with bond distance equal to 130 pm and the reduced mass equal to 2×10^{-47}kg?

(b) What is the effect on rotational energy levels of a molecule if an atom is replaced by its heavier isotope ?

(c) How the intensity of the rotational spectral lines varies and why ? 2,1,1

SECTION–D

7. (a) Why a diatomic molecule should be considered as an anharmonic oscillator ? Write Morse equation for the energy of the vibrational levels of an anharmonic oscillator. Compare the potential energy curve of an anharmonic oscillator with that of a harmonic oscillator.

(b) What is Raman spectrum ? Name the different types of lines present in it and explain the reasons for observing these lines. 2,2

8. (a) Calculate the force constant for the bond in HCl from the fact that the fundamental vibration frequency is $8.667 \times 10^{13} s^{-1}$.

(b) What are the selection rules for transitions in electronic spectroscopy of molecules ?

(c) Briefly explain Franck-Condon principle. 2,1,1

SECTION–E

(Compulsory Question)

9. (i) What important features distinguish crystalline from amorphous solids ?

(ii) Write a short note on Laue's method for X-ray diffraction by crystals.

(iii) Why we don't have 5-fold. 7-fold, 8-fold or higher axis of symmetry ?

(iv) Show diagrammatically the different normal modes of vibration of CO_2 molecule.

(v) Explain why the molecules behave as non-rigid rotors.

(vi) What are chromophores ? Which type of electronic transitions take place in them among the orbitals and why ?

$6 \times 1 = 6$