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Exam. Code : 0006

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

(2053)

CHEMISTRY

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

Paper—XXIII : Physical Chemistry—B

Time Allowed : Three Hours] [Maximum Marks : 22

Note :—Attempt FIVE questions in all, selecting ONE question each form Sections A to D. Section E is compulsory. Use of simple calculator is allowed.

## SECTION—A

I. (a) Derive expression for the distance of separation of the (*hkl*) planes of an orthogonal system.

(b) Define the terms 'proper rotation' and 'improper rotation' as used in crystallography. Represent diagrammatically the various elements of symmetry present in a simple tetragonal unit cell. 2,2

II. (a) Calculate the separation of : (i) (123) planes and (ii) (246) planes of orthorhombic unit cell with a = 0.82 nm, b = 0.94 nm and c = 0.75 nm.

(b) Explain Hauy's law of Rational indices. 2,2

## SECTION—B

III. (a) How do you represent thermal addition reaction in solid state ? Give two examples. How do these reactions proceed ?

(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

IV. (a) Show by calculation what types of diffraction patterns will be obtained for three types of cubic lattices.

(b) Discuss the principle of Bragg's method used for X-ray diffraction studies by crystals. Explain the construction and working of X-ray spectrometer. Give evidence in favour of Bragg's equation. 2,2

## SECTION—C

V. (a) Explain why molecules behave as non-rigid rotors. Write expression for the wave numbers of rotational levels of a non-rigid rotor and hence derive the expression for the wave numbers of the lines produced.

(b) What are the different types of energies possessed by a molecule ? What is Born-Oppenheimer approximation ? 2,2

VI. (a) Find the various degrees of freedom of motion associated with $SF_6$ and $N_2$ molecule.

(b) The internuclear distance of CN molecule is 1.17 Å. Calculate the energy (in joules) of this molecule in the first excited rotational level. The atomic masses are $^{12}C = 1.99 \times 10^{-26}$ kg; $^{14}N = 2.32 \times 10^{-26}$ kg. 2,2

## SECTION—D

VII. (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) Explain the formation of electronic band spectrum on the basis of potential energy curves. How do these help in the calculation of the dissociation energy of the molecules ? 2,2

VIII. (a) What structural information is obtained from the study of infrared spectra ?

(b) HCl molecule is irradiated with 434.8 nm mercury line, calculate the Raman line in nm if the fundamental frequency of HCl is $8.667 \times 10^{13} s^{-1}$. 2,2

## SECTION—E

### (Compulsory Question)

IX. (i) Prove that the net absorption is proportional to the population difference of the two states involved in the transition.

(ii) Define Steno's law of constancy of interfacial angles.

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

(iv) Which type of solids are called pseudo solids and why ?

(v) What do you understand by the terms : Linear dispersion and Angular dispersion ?

(vi) What are the selection rules for transitions in electronic spectroscopy of molecules ? $6 \times 1 = 6$