ST. JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27
MID-SEMESTER TEST - AUGUST 2016
M.Sc. CHEMISTRY: I SEMESTER
CH 7415: Spectroscopic methods of analysis - I

Time : 1½ hours   **Max. marks :35**

This question paper contains 1 page and 3 parts

Useful constants: $h = 6.626 \times 10^{-34} Js; k = 1.381 \times 10^{-23}$ J/K; $c = 3 \times 10^8 ms^{-1}$.

Atomic mass of an element = mass number x 1.66×10^{-27} kg.

PART-A

Answer any **three** of the following questions: **3 x 2 = 6 marks**

1. How are moments of inertia (I_C, I_B and I_A) related in the following molecules: NH_3 and BCl_3. Mention the class to which they belong.
2. What is stark effect? Explain using a suitable example.
3. "The lines on the higher frequency side in the vibration - rotational spectra of diatomic molecules become crowded and at very high values , R-branch lines become unresolvable" - Explain.
4. What are classes of operation? How many classes are there in C_{2h} point group?
5. Identify the highest fold symmetry in i) allene molecule ii) PF_5

PART-B

Answer any **two** of the following questions: **2 x 12 = 24 marks**

6. a. Discuss the vibration - rotation spectra of diatomic molecules. State the selection rule and obtain an expression for frequencies of lines(cm^{-1}) in the P and Q branches.
   b. Fundamental absorption and first overtone of $^{14}N\ ^{16}O$ are centered at 1876.06 cm^{-1} and 3724.2 cm^{-1} respectively. Evaluate $\overline{\omega}_e$(in cm^{-1}), x_e, zero-point energy and dissociation energy of NO in $Jmol^{-1}$. ($h = 6.626 \times 10^{-34} Js$; $c = 3 \times 10^{10} cm/s$).   **(6 + 6)**
7. a. Discuss rotational spectra of symmetric top molecules.
   b. What are reducible and irreducible representations. Give any four properties of irreducible representations.   **(6 + 6)**
8. a. With the help of a flow chart show how molecules can be classified into various symmetry groups.
   b. Write the symmetry elements and fix the point groups of SF_4 and SF_6 molecules   **(8 + 4)**

PART-C

Answer any **one** of the following   **1 x 5= 5 marks**

9. Calculate the C = O and C = S bond lengths of OCS molecule from the following data

	Moments of Inertia
$^{16}O^{12}C^{32}S$	1.380×10^{-45} kg m^2
$^{16}O^{12}C^{34}S$	1.415×10^{-45} kg m^2
$^{16}O^{13}C^{32}S$	1.384×10^{-45} kg m^2

10. a. How are the point groups of the chair and boat forms of cyclohexane different?
    b. A molecule AB_6 belongs to Oh point group. Deduce the point group symmetry if it is changed to i) AB_5X ii) cis-AB_4X_2 and iii) trans AB_4X_2 **(2 + 3)**