(*b*) Write the basic principle of Mossbauer spectroscopy. Discuss the application of this technique to study the bonding and structure of iron compounds in different oxidation states.

MSc-Chem-IS–(404)

January, 2017

PHYSICAL SPECTROSCOPY

Time : Three Hours] [*Maximum Marks* : 80

Note : Answer from both the Sections as directed. The figures in the right-hand margin indicate marks.

SECTION-A

1. Answer any **four** of the following : 4×4

(*a*) Discuss the Franck-Condon principle.

(*b*) Discuss the Quantum theory of origin of Raman Lines.

(*c*) Rotational constant for HCl^{35} is 10 cm^{-1}. What is the value of B for HCl^{37}?

(*d*) Write a note on PES.

(*e*) Write the basic principle of ESR spectroscopy.

(*f*) Write a note on zero field splitting.

OR

2. Answer **all** of the following questions : 2×8

(*a*) List all the electronic transitions possible for :

(*i*) CH_3CHO

(*ii*) $CH_2 = CH - NO_2$

(*b*) Draw ESR spectrum of methyl radical.

(*c*) What is Stark effect ?

(*d*) Write the rule of mutual exclusion principle.

(*e*) Between Stokes' line and anti-Stokes' line which one is more intense and why ?

(*f*) Define Zero Point Energy.

(*g*) What is Kramer's degeneracy ?

(*h*) How will you calculate the internuclear distance for homo-diatomic molecule using Raman Spectroscopy ?

SECTION-B

Answer **all** of the following questions : 16×4

3. (*a*) Discuss the spectra of hydrogen atom.

OR

(*b*) Discuss the origin of electronic spectra. Show diagrammatically the $\sigma \rightarrow \sigma^*$, $n \rightarrow \sigma^*$, $\pi \rightarrow \pi^*$ transition in the electronic spectra of polyatomic molecule.

4. (*a*) Using the energy level expression and appropriate selection rules, draw and discuss an energy level diagram for the rotation-vibration spectrum of a diatomic molecule. Discuss the origin of P, Q, R lines.

OR

(*b*) What is the necessary condition for a molecule to be Raman active ? What is the difference between Raman and Rayleigh lines ? Show that spacing between the Rotational Raman lines is 4B.

5. (*a*) How will you calculate the inter-nuclear distance for HCl molecule considering molecule as a rigid rotor ? Discuss the factors affecting the intensities of spectral line of microwave spectroscopy.

OR

(*b*) Write a note on ESCA. What chemical information can be derived from ESCA ?

6. (*a*) Write the basic principle of ESR spectroscopy. Discuss the zero field splitting and Kramer's degeneracy in case of ESR spectroscopy.

OR