ED-308

M.Sc. 1st Semester
Examination, March-April 2021

CHEMISTRY

Paper - IV

Theory and Application of Spectroscopy

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

Note : Answer **all** questions. All parts of answer of each question should be written in one place. Be precise and to the point in your answer. The figures in the right-hand margin indicate marks.

Unit-I

1. (*a*) Explain which of the following molecules exhibit (*i*) pure vibrational and (*ii*) pure rotational spectrum : 4

H_2O, HCl, BF_3, CO_2, CH_4, CCl_4, C_6H_6, N_2, O_2

(*b*) Explain the following terms with reference to electromagnetic radiations : 8

(*i*) Scattering

(*ii*) Dispersion

(*iii*) Absorption and Emission

(*iv*) Polarization

(*c*) Describe uncertainty principle with its significance in spectroscopic techniques. 8

OR

(*a*) "Atomic spectrum is line spectrum whereas molecular spectrum is obtained as band." Give proper explanation. 4

(*b*) Explain the following : 8

(*i*) Natural line width

(*ii*) Intensity of spectral lines

(*c*) In which region of electromagnetic spectrum do the following frequencies exist ? 8

(*i*) 5 cm^{-1}

(*ii*) 1000 cm^{-1}

(*iii*) 12500 cm^{-1}

(*iv*) 60000 cm^{-1}

Explain the spectroscopic techniques associated with these spectrum.

Unit-II

2. (*a*) The rotational constant for H^1Cl^{35} is observed to be 10.5909 cm^{-1}. What are the values of B for H^1Cl^{37} and D^2Cl^{35} ? 4

(*b*) What is rotational constant ? Compare the energy levels of a rigid diatomic rotor with its isotopically substituted molecule and discuss the discrepancy. 8

(*c*) How microwave spectroscopy is useful in the determination of bond length ? Calculate the rotational constants of H_2 and HCl molecules. The bond lengths of H—H and H—Cl are 200 pm and 136 pm respectively. 8

OR

(*a*) How pure rotational spectrum is obtained ? Explain line spacing obtained in this spectrum. 4

(*b*) Classify molecules in terms of their moment of inertia and indicate which of the following molecules will show a microwave rotational spectrum : 8
H_2, CH_3Cl, CH_2Cl_2, O_3, SF_6, C_2H_2, NH_3, CH_3CHO

(*c*) Describe rotational spectra of linear polyatomic molecule. 8

Unit-III

3. (*a*) Write the basic principle of Auger spectroscopy. 4

(*b*) Write the principle and applications of electron diffraction microscopy. 8

(*c*) Explain variables on which intensities of Auger electron spectrum peaks depend. 8

OR

(*a*) Explain the process of phosphorescence describing it's applications. 4

(*b*) Describe theory, instrumentation and applications of fluorometry. 8

(*c*) Explain the terms 'optical density' and 'turbidity'. Describe the instrument that can be used for measurement of optical density. 8

Unit-IV

4. (*a*) Write down the Quantum theory of Raman effect. 4

(*b*) Describe Resonance Raman Spectroscopy 8

(*c*) Explain selection rules for pure-rotational, vibrational and vibrational-rotational Raman spectra. 8

OR

(*a*) Why it is often desirable to determine Raman spectra in the gas phase ? 4

(*b*) Write a note on CARS. 8

(*c*) Write instrumentation, advantages and limitations of Raman spectroscopy. 8

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