Total number of printed pages-3

3(Sem-8/FYUGP)BNC(A)/DSCI

2025

CHEMISTRY

(Discipline Specific Core)

Paper Name: Molecular Spectroscopy I

Paper Code: **CHE-DSC-244**

Full Marks: 45

Time: Two Hours

(*The figures in the margin indicate full marks for the questions)*

1. Answer the following questions: 1x4=4

(a) Arrange the following electromagnetic radiation in the increasing order of their energy:

UV, Visible, Microwave and IR

(b) What is chromophore ?

(c) On which factors does the vibrational stretching frequency of a diatomic molecule depend ?

(d) Define Beer-Lambert law.

2. Answer any three questions from the following: 2x3=6

(a) Explain why absorption peaks obtained in UV-spectra are broader than those obtained in IR spectra.

(b) How is IR spectroscopy useful to distinguish between inter-molecular and intra-molecular hydrogen bonding ?

(c) Why O_2 is Raman active but microwave and IR inactive ?

(d) State the quantum efficiency of a photochemical reaction or process.

3. Answer any three questions from the following: 5x3=15

(a) What are the different types of electronic excitations in UV-Visible regions ? Represent them with the help of a diagram in an increasing order of energy. 5

(b) Illustrate and discuss 'Jablonski diagram'. 5

(c) How the Collision broadening and Doppler broadening influences the width of spectral lines ? Why the concentration of the sample solution is important to determine the intensity of the spectral line ? 4+1=5

(d) An organic compound (A) with molecular formula, C_3H_9N shows the following peaks in the IR spectrum; (i) 3012 cm^{-1} (m) (ii) 3423 cm^{-1} (s) (iii) 3236 cm^{-1}(m) (iv) 1615 cm^{-1}(m). When the compound A is treated with nitrous acid, a compound B is formed which shows a strong peak at 3430 cm^{-1}. What are A and B and explain the reactions involved ? 5

(e) Explain the following: 2½x2=5

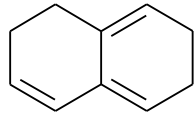
(i) Zero-point energy

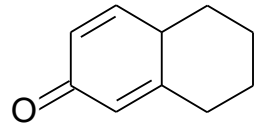
(ii) Isotopic effect in rotational spectra

4. Answer any two from the following questions: 10x2=20

(a) (i) Write Woodward-Fieser rules for calculating λ_{max} for conjugated dienes and α,β –unsaturated carbonyl compounds.

(ii) Calculate the λ_{max} for the following compounds using Woodward-Fieser rules:





6+4=10

(b) State and illustrate Franck-Condon principle with suitable potential energy curves. 10

(c) (i) Explain the term- Red shift, Blue shift, hypsochromic shift and bathochromic shift.

(ii) Explain the effect of conjugation in UV spectroscopy.

(iii) What is photoelectric effect? What is the cause of photoelectric effect ? 4+4+2=10

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