



**Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET UNIVERSITY)**

M.Sc. (First Semester – Regular/Supplementary) Examinations, January – 2026
24CYPC11004 - Molecular Spectroscopy
(Chemistry)

Time: 3 hrs

Maximum: 60 Marks

Answer ALL questions
(The figures in the right hand margin indicate marks)

PART – A**(2 x 5 = 10 Marks)**Q.1. Answer *ALL* questions

- | | CO # | Blooms Level |
|--|------|--------------|
| a. What is meant by fingerprint region in IR spectroscopy? | CO2 | K2 |
| b. What is polarizability of a molecule? | CO3 | K1 |
| c. Define UPES and XPES. | CO4 | K2 |
| d. Mention any two applications of ESR spectroscopy. | CO5 | K1 |
| e. Define rotational constant (B). | CO1 | K1 |

PART – B**(10 x 5 = 50 Marks)**Answer *ALL* the questions

- | | Marks | CO # | Blooms Level |
|--|-------|------|--------------|
| 2. a. Principle, instrumentation and Application of Auger electron spectroscopy. | 8 | CO4 | K2 |
| b. Define photoelectron spectroscopy (PES). | 2 | CO4 | K2 |
| (OR) | | | |
| c. Describe the basic principle of UPES and XPES? | 7 | CO4 | K2 |
| d. Write the Einstein photoelectric equation used in PES. | 3 | CO4 | K3 |
| 3.a. Derive the change in energy of Vibrational- Rotational spectra of diatomic molecules. Write the selection rule and PQR branch. | 8 | CO2 | K3 |
| b. What is bending vibration? | 2 | CO2 | K1 |
| (OR) | | | |
| c. Explain the theory of vibrational motion of a diatomic molecule using the simple harmonic oscillator model. | 10 | CO2 | K2 |
| 4.a. How will you proceed to determine the bond lengths, rotational energy, rotational spectra and selection rule of a rigid rotator diatomic molecule. | 10 | CO1 | K3 |
| (OR) | | | |
| b. Explain the origin of vibrational coarse structure in electronic spectra of molecules. | 6 | CO1 | K2 |
| c. State and Explain Frank Condon principle. | 4 | CO1 | K1 |
| 5.a. Define the Doppler effect and recoil effect. | 7 | CO3 | K1 |
| b. Write the selection rule for rotational Raman spectra. | 3 | CO3 | K1 |
| (OR) | | | |
| c. Give a detailed account of the classical theory of Raman effect. Derive the mathematical expressions for Rayleigh, Stokes, and anti-Stokes components of Raman spectra and state the limitations of the theory. | 10 | CO3 | K3 |
| 6.a. What is Stark Effect? Explain in details about the splitting of rotational levels in different category molecules? | 10 | CO1 | K2 |
| (OR) | | | |
| b. Write down the principle of ESR spectroscopy. | 4 | CO5 | K2 |
| c. Write a short note on hyperfine theory of ESR? | 6 | CO5 | K1 |

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