

SECOND SEMESTER M.Sc. DEGREE EXAMINATION APRIL 2021

CHEMISTRY

FCHE2C08- MOLECULAR SPECTROSCOPY

Time: 3 hrs

Maximum Weightage: 30

Section A: Short answer questions. All questions can be answered.**Each carries *one* weightage (Ceiling 6 weightage).**

1. What is meant by rigid rotor? State the selection rule for the rotational transitions of a rigid rotor.
2. State and explain mutual exclusion principle.
3. How will you distinguish between the overtones and hot bands of a spectrum?
4. How many vibrational modes of CO₂ are infrared-active? How many peaks will they totally yield in an IR spectrum of CO₂?
5. Write Karplus relationship and explain the terms in it.
6. What are the factors which affect the chemical shift?
7. Explain the term Kramer's degeneracy.
8. What do you understand by nitrogen rule?
9. Mention the type of absorption and intensity shifts in UV spectroscopy.
10. Why TMS is used as internal standard in NMR studies?
11. Benzene is colorless but its isomer, fulvene is yellow. How will you explain it?
12. Draw the EPR spectrum of methyl free radical.

Section B: Short essay question. All questions can be answered.**Each carries *four* weightage (Ceiling 12 weightage).**

13. Show that for a rigid diatomic rotor the moment of inertia is given by $I = \mu r^2$.
14. State and illustrate with suitable potential energy curves the Frank-Condon principle in the vibrational spectrum of a diatomic molecule.
15. Discuss the relaxation process in magnetic resonance spectroscopy.

16. How will you distinguish between the following compounds by IR spectroscopy?



17. Write notes on chemical shift reagents with suitable examples.

18. (a) How will you distinguish between ethyl amine, diethyl amine and triethyl amine on the basis of mass spectroscopy?

(b) Give the typical fragmentation pattern in benzyl methyl ether.

19. Write short notes on HMBC and HMQC.

**Section C: Essay questions. All questions can be answered.
Each carries six weightage (Ceiling 12 weightage).**

20. An organic compound A with molecular formula C_3H_7NO gives the following spectral data:

UV: λ_{max} 238nm, ϵ_{max} =10500

IR: 3428 cm^{-1} , $2940\text{-}2855\text{ cm}^{-1}$, 1681 cm^{-1} , 1452 cm^{-1}

$^1\text{H NMR}$: δ 1.87 (1H, singlet), 7.30 (3H, singlet), 8.1 (3H, singlet).

Deduce the structure of compound A giving reasons.

21. Discuss the theory of ESR spectroscopy and explain the hyperfine splitting shown by $\cdot\text{NH}$ radical in its spectrum.

22. Outline the principle of Mossbauer spectroscopy. Explain the application of this technique in the study of Fe (II) and Fe (III) cyanides.

23. Describe the important features of mass spectra of the following.

(i) Aldehydes

(ii) Ketones

(iii) Alcohols

(iv) Amides