G 17003241

Reg. No.....

Name.....

M.Sc. DEGREE (C.S.S.) EXAMINATION, JULY 2017

Second Semester

Faculty of Science

Branch : Chemistry

AN2C08/AP2C08/CH2C08/PH2C08/POH2C08 MOLECULAR SPECTROSCOPY

(2012 Admission onwards)

[Common to all branches of Chemistry]

Time : Three Hours Maximum Weight : 30

Section A

Answer any **ten** *questions, each question carries weight* 1.

1. What is Larmor precession ? Explain its use in NMR spectra.
2. Explain Born-Oppenheimer approximation. List its shortcomings.
3. What is Fermi resonance ? How the Fermi resonance lines are identified in IR spectra ?
4. Give the spectroscopic term symbol for Cl_2 molecule.
5. State and explain Karplus relationships used in NMR spectra.
6. What is Nuclear Overhauser Effect (NOE) ? What is its use in NMR spectra ?
7. Explain Kramer's Theorem. What is its relevance in EPR spectra ?
8. What are 'symmetric tops', spherical tops and asymmetric tops ? Give one example for each.
9. Explain the use of microwave spectroscopy in chemical analysis.
10. What are overtones and hot bands in IR spectra ?
11. Give the principle of NQR spectroscopy.
12. Draw the EPR spectra of C_6H_6 radical.
13. What are shift reagents ? Give examples. Explain how they simplify the second order NMR spectra.

(10 × 1 = 10)

Turn over

Section B

Answer any **five** *questions by attempting not more than* **three** *questions from each bunch*
Each question carries weight 2.

BUNCH 1

14. What is meant by the term 'chemical shift' as given in NMR spectra ? Explain the different factors which affect the value of chemical shifts of different protons giving suitable examples.

15. Explain briefly a method for the determination of bond distance of a homonuclear diatomic molecule

16. Draw Morse potential energy diagram and explain fundamental, overtone and hot bands.

17. Explain the relaxation methods in NMR spectroscopy.

BUNCH 2

18. The first stokes line in the rotational Raman spectrum of $^{14}N^{15}N$ is observed at 11.5416 cm $^{-1}$(1) What is its B value (2) Calculate its bond length (3) would there be an intensity alteration in the spectrum of $^{14}N^{15}N$ (4) Would $^{14}N^{15}N$ show a rotational spectrum.

19. The equilibrium vibration frequency of the Iodine molecule is 215 cm^{-1} and the anharmonicity constant X_e −0.003 What is the intensity of the hot band $v = 0$ to $v = 2$ relative to that of the fundamental $v = 0$ to $v = 1$ if the temperature is 300° K.

20. One of the fundamental vibration modes of H_2O occurs at 3,752 cm^{-1}. What would be the frequency of the corresponding mode in D_2O.

21. A particular NMR instrument operates at 30.256 MHz. What magnetic fields are required to bring a proton nucleus and C^{13} nucleus to resonate at this frequency ? Magnetic moment of proton nucleus = $2.7927\mu_N$ and a $C^{13} = 0.7022\mu_N$

$(5 \times 2 = 10)$

Section C

Answer any **two** *questions.*
Each question carries weight 5.

22. Write briefly on the applications of (1) Mossbauer spectroscopy. (2) X-ray photoelectron spectroscopy

23. Give a brief description of two dimensional NMR spectroscopy with special reference to COSY and HETCOR

24. Explain the following factors which are decisive in determining the line width of spectral lines :

(1) Natural line width.

(2) Pressure broadening.

(3) Doppler broadening.

(4) Power broadening.

25. Write briefly on the following type of lasers :

(1) Solid state laser.

(2) Continuous wave laser.

(3) Gas lasers.

(4) Chemical laser.

(2 × 5 = 10)