SUBJECT CODE: CH/PC/MS34

M.Sc. DEGREE EXAMINATION, NOVEMBER 2009
BRANCH IV- CHEMISTRY
THIRD   SEMESTER

REG.NO ……………………..

COURSE   : CORE
PAPER   : MOLECULAR SPECTROSCOPY
TIME   : 30 MINUTES   MAX.MARKS : 20

SECTION – A   (20x1=20)
Answer all the questions:
I   Choose the correct answer:

01.   The wavelength (in metres) of microwave energy is

a) 10^2 b) 10^{-11} c) 10^{-3} d) 10^6

02.   The Hooke's law is given by

a) $\nu = \dfrac{1}{2\pi}\sqrt{\dfrac{k}{\mu}}$ b) $\nu = \dfrac{h}{2\pi c}\sqrt{\dfrac{k}{\mu}}$ c) $\nu = \dfrac{1}{2\pi c}\sqrt{\dfrac{k}{\mu}}$ d) $\nu = \dfrac{h}{2\pi}\sqrt{\dfrac{k}{\mu}}$

03.   The IR vibrational stretching frequency for C≡C is

a) 3430 cm^{-1} b) 2980 cm^{-1} c) 2350 cm^{-1} d) 1785 cm^{-1}

04.   Rayleigh scattering is associated with
a) ESR spectroscopy   b) IR spectroscopy
c) Raman spectroscopy   d) Rotational spectroscopy

05.   NMR active nucleus contains
a) odd mass and even atomic numbers   b) odd atomic and even mass numbers
c) even atomic and even mass numbers   d) all the above

06.   The ε of charge transfer transition is
a) higher than π-π* transition   b) lower than d-d transitions
c) lower than π-π* transition   d) none of the above

07.   The presence of NO_2^+ ion in nitration reactions is suitably confirmed by
a) NMR spectroscopy   b) Raman spectroscopy
c) ESR spectroscopy   d) all the above

08.   The identification of correct species from mass spectral pattern is helped out by
a) Pascal's table   b) Beynon's table   c) Clarke's table   d) none of the above

09.   The Multiplicity of NMR lines obtained for $CH_3\text{-}CH_2\text{-}CH_2\text{-}Cl$ is

a) 3,2,2   b) 3,4,3   c) 3,6,3   d) 4,3,3

10.   The magnetic field ratio between ^1H and ^{13}C nuclei is

a) 1:1   b) 1:10   c) 1:20   d) 1:30

II   Fill in the blanks:

11.   The expression for Beer-Lambert's law is _____

12.   The IR energy range for $\nu(C=N)$ is _____ cm^{-1}.

13.   A complex proton NMR spectrum can be simplified by _____ technique.

14.   The underlined proton in $CH_3CH_2 - \underline{\textbf{CH}} - Cl$ has the _____ δ value.
                                                      |
                                                    CH_3

15.   The double bond equivalence of C_4H_7ON is _____.

III   Answer the questions in one or two lines:

16.   State Born Oppenheimer approximation.

17.   Define chemical shift.

18.   What are Stoke's lines?

19.   How is hyperchromic shift defined?

20.   What is Mc Lafferty rearrangement?

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STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI-86
(For candidates admitted during the academic year 2008–09)
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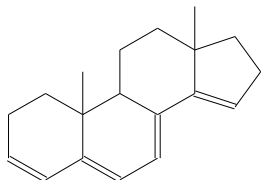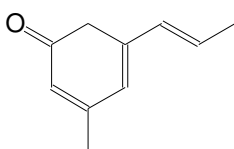TIME   : 2½ HOURS   MAX.MARKS : 80

                         SECTION – B   **(5 x 8 = 40)**
Answer any five questions:

1.   a) Write the selection rules for microwave spectroscopy.   (2)

      b) How the fundamental vibrational frequencies are affected by vibrational coupling
      and H-bonding? Explain with suitable examples.   (3,3)

2.   a) How polarity of solvents affect the absorption spectrum of a chemical compound?
      Explain with specific examples.   (4)

      b) Give any two applications of Raman spectroscopy.   (4)

3.   What are shift reagents? Why are they called so? Explain the function of a shift reagent.
                                                        (2,2,4)

4.   Write a short note on the following.   (3,2,3)
      a) Nitrogen rule
      b) Pascal's triangle
      c) Charge transfer transition

5.   (A) Calculate the λ_{max} of the following compounds.   (4,4)

      (B) Discuss the mass spectrum of benzylchloride.

6.   Identify the compounds from the following NMR spectral data.   (4,4)

      a) Mol. Formula: $C_8H_{10}O$ b) Mol. Formula: $C_8H_{18}O$
           1.8 δ 3 H   singlet   1.2 δ 12 H   doublet
           2.3 δ 2 H   singlet   1.4 δ 2 H   multiplet
           7.8 δ 5 H   singlet   2.4 δ 4 H   doublet

7.   Draw various fragmentation patterns obtained for alcohols and ketones.   (4,4)

8.   Predict possible IR and UV spectral data for the following compound.   (4,4)

                                                                          ..2
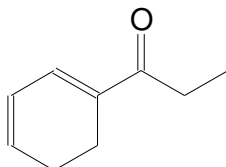
SECTION – C   **(2 x 20 = 40)**

Answer any two questions:

9.   a) What are the limitations of microwave spectroscopy?   (4)

     b) Compare infrared and Raman spectroscopy.   (6)

     c) Compare the electronic transitions in high and low spin Fe^{2+} complexes with suitable

        examples.   (10)

10. a) Predict the possible NMR splitting pattern and mass spectral fragmentation data for
        the following compound.   (10)
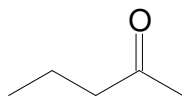
     b) What are the factors influencing chemical shifts in NMR? Explain any two in detail
        with examples.

                    (10)

11. a) Propose a structure consistent with the following ^{1}H NMR spectral data.   (5)
                    i,   2H, quintet, 2.15 ppm
                    ii, 2H, triplet, 2.75 ppm
                    iii, 2H, triplet, 3.38 ppm
                    iv, 5H, singlet, 7.22 ppm

     b) From the following spectral data (See ANNEXURE-1), identify the structure of the

        compound. The molecular formula of the compound is $C_9H_{10}O$. Give suitable

        explanation for your prediction.   (15)

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