647510 BSCchMJ302x-5C Seat No :_____

B.Sc. Semester - 5 (NEP-2020) Examination

Oct/Nov - 2025

CHE: Higher Chemistry-302 (Major-12)

Time: 2:00 Hours **Marks: 50**

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate marks.

Que.1 Answer the following questions (any two) (10)

a) Write a note on types of CO group in metal carbonyls.

b) Discuss utility of IR spectra in the study of metal carbonyls.

c) Explain constitution and structure of $Fe(CO)_5$.

Que.2 Answer the following questions (any two) (10)

a) Explain fundamental modes of vibrations in IR spectroscopy.

b) Explain Overtone and Fermi resonance.

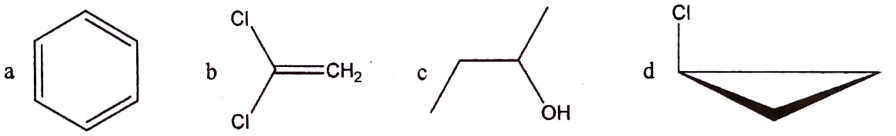
c) Discuss types of transition responsible for UV-Visible Spectrum.

Que.3 Answer the following questions (any two) (10)

a) Give difference between chemical shift and coupling constant j.

b) What is magnetic anisotropy? Explain magnetic anisotropic effect in Acetylene, Ethene and 18-Annulene.

c) Answer as directed for the following molecules.



I. Write expected relative intensities of PMR signals due to compounds a and b in a mixture containing equimolar a and b (as a ratio a:b).

II. Assign PMR signals as a, b, c etc. to Hydrogens of both above given molecule c and d.

Que.4 Answer the following questions (any two) (10)

a) For a molecule with molecular formula C_4H_9NO, the spectroscopic data are as below; UV: No absorption above 200. IR absorptions in cm^{-1}: 3000(s), 2980-2880(w) 1655(s), 1555(w), 1219(w)cm^{-1}. NMR: a) 3H triplet 1.2 δ b) 3H singlet 1.93 δ c) 2H quart 3.22 δ d) 1H broad singlet 8.2 δ. Determine the constitution of the molecule.

b) Explain reversible and irreversible cell with example.

c) Discuss secondary reference electrode:

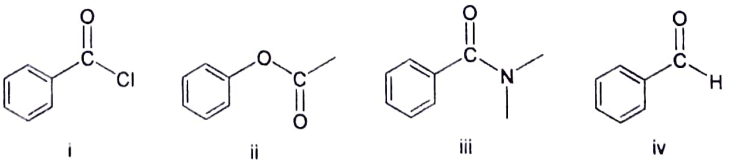
I. Calomel. II. $Ag/AgCl/Cl^-$

Que.5 Answer the following questions (any two) (10)

a) If the complexes obey 18 electron rule, find out x for (a) $Fe_3(CO)_x$ (b) $Ir_x(CO)_{12}$.

b) Answer the following as directed.

I. For the molecules numbered i, ii, iii and iv, which from a,b,c and d is the correct order of carbonyl stretching frequency?

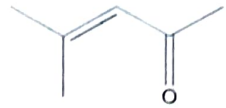


i ii iii iv

(a) ii < i < iii < iv (b) i < iii < ii < iv (c) iv < ii < iii < i (d) iii < iv < ii < i

II. Calculate UV absorption λmax values for the following a and b.

a 

b 

c) A compound with molecular weight 122 gm/mole gives three singlets at the given chemical shift values with area under the curve as given here. a) 3.55 δ, 15sq., b) 4.88 δ 10sq., c) 7.8 δ 25sq. If the elemental analysis shows C=78.68 % and H=8.20 %, Deduce its constitution.

d) For a molecule with molecular formula $C_9H_{11}O_2N$, the UV, IR and PMR spectral properties are λmax = 315nm

IR: 3550 cm^{-1}, 3105-3035(s)cm^{-1}, 2990(s) cm^{-1}, 1720 cm^{-1}, 1590-1490 cm^{-1}, 1220-113-1590-1490 cm^{-1}, 830 cm^{-1}

NMR: a) 6H singlet 2.85 δ b) 2H doublet 6.80
c) 2H doublet 7.95 δ d) 1H singlet 11.0 δ

SPECTRAL DATA

Diene λmax (Base)	Enone λmax	Arone λmax	IR cm^{-1}	Type of Vibrations	Type of H	PMR-δ
Simple=217	Z=C=215	Z=C=246	3550	O-H str	sp^3 C–H	0.9 – 2.0
Homoannu=253	Z=C=205	Z=H=250	3105-3035(s)	ArC-H str	C=C–CH_3	1.6 – 2.3
Heteroann=215	Z=H=210	Z=OH=230	3000(s)-2990(s)	C-H str methyl	Ar–CH_3, Ar-NCH_3	2.2 – 3.0
		Z=OR=230			C≡C–H, CO-CH3	~2.5
			2980-2880(w)	R-C-H str	RO–CH_3	3.3 – 4.0
			1720	C=O str	R–CH_2–X Ar–CH_2–O	3.0 – 4.5 4.4-4.9
			1655(s)	R-C=O str	–OH	1.0 – 5.0
			1590-1490	C=C (Ar)	–NH_2, –NHR	1.0 – 3.3,
			1555(w)	R-C-N	C=C–H	4.5 – 6.5
			1219(w)	Ar-C-N str	Ar–H	6.0 – 8.5
			830	Para-Disub	–CHO,N-H	8.2 -10.5
					–COOH	10.0-13.0

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