Seat No. _____

HAK-003-1015006

B. Sc. (Sem.-V) (CBCS)

(W.E.F. 2016) Examination

May - 2023

C-502 : Organic Chemistry & Spectroscopy

Faculty Code : 003

Subject Code : 1015006

Time : $2\frac{1}{2}$ Hours / Total Marks : **70**

Instructions :

(1) This question paper contains five questions and all are compulsory.

(2) All questions carry 14 marks each and figures to the right indicate full marks.

(3) Write sub questions a,b,c and d of particular question together.

1 (a) Answer the following questions : **4**

(1) Write structure of 2-Phenyl ethylamine.

(2) Write structure of Triphenyl phosphine.

(3) How many methoxy groups are present in isoquinoline ring of paperverine ?

(4) Which heterocyclic ring is present in coniine?

(b) Answer any one of the following : **2**

(1) Give one synthesis for $LiA1H_4$.

(2) Complete the reaction :

$$\text{Conyrine} \xrightarrow[\text{[O] Oxidation}]{KMnO_4}$$

(c) Answer any one of the following : **3**

(1) Write only general reaction for Curtius rearrangement.

(2) Give synthesis of Veratric acid.

(d) Answer any one of the following : **5**

(1) Prove the constitution of Nicotine.

(2) Explain Arndt-Eistert reaction with mechanism and give one application.

2 (a) Answer the following questions : **4**

(1) How many asymmetric carbons are present in Fructose ?

(2) Write structure of Tartaric acid.

(3) Write structure of Dulcin.

(4) What is Atenolol ?

(b) Answer any one of the following : **2**

(1) Give synthesis of Glucosazone.

(2) Write synthesis of Chrysodin-G.

(c) Answer any one of the following : **3**

(1) Write step-up (Killiani) reaction.

(2) Write synthesis of Adrenaline.

(d) Answer any one of the following : **5**

(1) Explain configuration of D(+) Glucose.

(2) Explain :

(a) Mutarotation and

(b) Conversion and Fructose from Arabinose

3 (a) Answer the following questions : **4**

(1) Write structure of Imidazone.

(2) Write structure of Thiazole.

(3) What is the symbol of wave length ?

(4) Write range of Visible region.

(b) Answer any one of the following : **2**

(1) Write synthesis of Oxazine.

(2) Explain $\sigma \rightarrow \sigma^*$ transition.

(c) Answer any one of the following : **3**

(1) Write synthesis of Pyrimidine.

(2) Explain Chromophore and Auxochrome with example.

(d) Answer any one of the following : **5**

(1) Write 2-2 synthesis for Pyridazine and Thiazine.

(2) Explain Absorption shifts and Intensity effects.

4 (a) Answer the following questions : **4**

(1) Which point group is present in BF_3?

(2) Which point group is present in HCN ?

(3) Which symmetry is observed in CCl_4 ?

(4) Which symmetry is observed in Ethylene?

(b) Answer any one of the following : **2**

(1) Explain with example : Vertical plane of symmetry.

(2) Discuss point group present in p-Dichloro benzene.

(c) Answer any one of the following : **3**

(1) Distinguish C_n and S_n.

(2) Find out point group present in H_2O and construct multiplication table for it.

(d) Answer any one of the following : **5**

(1) Discuss and explain multiplication table for C_3v point group.

(2) Prove that in eclipsed ethane $S_n^{\,n} \neq E$ but $S_n^{\,2n} = E$ when n is odd number.

5 (a) Answer the following questions. **4**

(1) What information we get about in IR ?

(2) What is the full form of IR ?

(3) What is the range of Middle Infra Red region ?

(4) What is the use of prism in IR spectrophotometer ?

(b) Answer any one of the following : **2**

(1) Explain stretching vibrations.

(2) Explain Fermi Resonance.

(c) Answer any one of the following : **3**

(1) Distinguish Benzyl alcohol and Butanal by IR spectrum and give all possible IR peaks.

(2) The compound having molecular formula $C_8H_{11}N$ shows the following results in IR spectra. Derive the structural formula of the compound.

3105-3035 cm^{-1}, 2290-2805 cm^{-1}, 1604-1509 cm^{-1}, 1345 cm^{-1}, 1200-1135 cm^{-1}, 710-645 cm^{-1}.

(d) Answer any one of the following : **5**

(1) Explain factors affecting IR spectroscopy.

(2) The compound having molecular formula $C_7H_7NO_2$ shows the following results in IR spectra. Deduce the structural formula of the compound.

3425-3475 cm^{-1} (doublet), 3250-2750 cm^{-1} (broad), 1700 cm^{-1}(s), 1600 cm^{-1} (m), 1580-1510 cm,$^{-1}$ and 740 cm^{-1}.

(Spectral) I.R. DATA

Type of Vibration		Frequency (cm^{-1})	Intensity
[1] Hydrocarban			
C-H Stretching vibration			
(a) Alkane Stretch vib	$\xrightarrow{CH_3/CH_2}$	2990-2850	m, s
(b) Alkene Stretch vib	$\xrightarrow{>C=CH_2}$	3100-3000	m
(c) Alkyne Stretch vib	$\xrightarrow{-C\equiv C-H}$	3300	S.V.
(d) Aromatic Stretch Vib	$\xrightarrow{Ar-H}$	3030	m
[2] C-H Bending Vibration:			
(a) (i) CH_3-Bending	$\longrightarrow$	1450	s
(ii) CH_2-Bending	$\longrightarrow$	1465	m
(iii) CH- Bending	$\longrightarrow$	1340	w
(b) Isoprobyl $-HC<^{CH_3}_{CH_3}$	$\longrightarrow$	1375, 1385 Doublet	s
(c) Tert-butyl – C $(CH_3)_3$	$\longrightarrow$	1365, 1390 Doublet	m
(d) Alkene bending vib	$\longrightarrow$	1420-690	m
(e) Alkene Cis $H>C=C<H$	$\longrightarrow$	Cis 690, Trans 970–960 cm^{-1}	
(f) Alkyne bending vib	$\longrightarrow$	630	s
CH_2 Roking (More then four CH_2 group)	$\rightarrow$	720 & 625	m
[3] C-C Multiple Bond:			
(a) C = C Alkene stretch vib	$\longrightarrow$	1680-1600	mv
(b) C ≡ C Alkyne stretch vib	$\longrightarrow$	2250-2100	mv
(c) C = C Aromatic Ring scalatal vib	$\longrightarrow$	1600,1580 1500,1450	m
[4] C = O Carbonyl group			
(a)(i) C = O Acid	$\longrightarrow$	1700	(s)
(ii) O – H (Stretch) C-OH acid	$\xrightarrow{broad}$	2700-3200	(w)

(b) Ketone ⟶ 1715 (s)

(c) (i) Aldehyde ⟶ 1745 (s)

(ii) C-H Strech vib —CHO→ 2820, 2750 doublet (s)

(d)(i) Ester ⟶ 1750-1735 (s)

(ii) Aromatic or unsaturated ⟶ 1730-1715 (s)

(e) Acid Halide ⟶ 1800 (s)

(f) Anhydride ⟶ 1810, 1760 doublet (s)

[5] $CONH_2$ Amide:

(i) C = O Stretch vib ⟶ 1650 (s)

(ii) Due to NH_2 Group also at ⟶ 3400 s

[6] C – O

(i) Alconols, acids, anhydrides ⟶ 1300-1000 m

(ii) Ether —R-O-R→ 1200-1100 m

(iii) Ester —COOR→ 1245, 1045 Doublet m

[7] O – H

(i) Free –OH ⟶ 3650-3600 (s)

(ii) H-bonded ⟶ 3500-3200 (m)

(iii) Carboxyls Acid (Broad) ⟶ 3400-2700 (w)

[8] **N-H (Amine)**

(i) Primary amine- –> NH_2 free ⟶ 3500, 3400 Doublet (m)

(ii) N-H bending ⟶ 1650-1550 m

(iii) Secondary amine —$=NH_2$→ 3500-3100 m

[9] C – N

Strech vib Aromatic ⟶ 1350-1200 m

Aliphatic ⟶ 1200-1000 m

C = N → Amines of oximes ⟶ 1690-1640 (w)

C ≡ N → Nitriles ⟶ 2260-2240 (m)

[10] NO_2 Nitrogroup ⟶ 1550-1350 (s)

S –H- > Marcaptans ⟶ 2250 m

S = O → (i) Sulfoxides ⟶ 1050 (s)

(ii) Sulfones, Sulfony,Chlorides ⟶ 1375-1300 (s)

(iii) Sulfats, Sulfonmides $\xrightarrow{SO_2Cl}$ 1200-1140 (s)

$AR\text{-}So_2NH_2$

[11] C – F → Floride ⟶ 1400-1000 (s)

C-Cl → Chloride ⟶ 800-600 s

C-Br → Bromide ⟶ 617 s

C – I → Iodide ⟶ 500 s

Substitution Mono (Two bonds) ⇒ 700 & 650

Ortho(Single) ⇒ 750 ± 20

Meta (Two bonds) ⇒ 710 & 750

Pera(Single) ⇒ 820 ± 20

$$DBE = \frac{(2a + 2) - (b - d)}{2}$$

a = No. of Carbon, b = No. of H, Cl, Br, I, d = No. of N , P