Time : 3 Hrs **Marks : 75**

Q.1 Multiple Choice Questions **20**

1. Which of the following can be used for isolation and purification of compounds?
a. UPLC
b. Ion-pair chromatography
c. Chiral HPLC
d. Preparative HPLC

2. HILIC is an acronym of
a. Hydrophobic Interaction Liquid Chromatography
b. Hydrophilic Interaction Liquid Chromatography
c. High Induction Liquid Chromatography
d. Hydrophilic Ion Liquid Chromatography

3. Which of the following is a polysaccharide type chiral stationary phase
a. Cellulose tris (phenylcarbamate) coated on silica gel
b. N,N-dioctyl-L-alanine coated on silica gel
c. Vancomycin
d. β- Cyclodextrin

4. Column efficiency is measured in terms of number of plates which is….
a. Inversely related to the square of the peak width
b. Directly related to square of peak width
c. Directly related to square root of the peak width
d. Inversely related to square root of peak width

5. Which of the following is a detector used in GC
a. UV detector
b. Densitometer
c. Diode array detector
d. Flame ionization detector

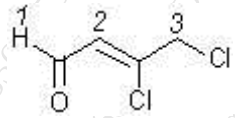
6. Which of the following is a component of HPTLC?
a. Densitometer
b. Rheodyne injector
c. Column oven
d. Degasser

7. Charge and size of components are important for separation in
a. Reverse phase chromatography
b. Normal phase chromatography
c. Electrophoresis
d. Affinity chromatography

8. Proteins A, B and C have sizes 105, 57 and 82 kDa respectively. Their relative retention in size exclusion chromatography would be
a. A > B > C
b. C > B > A
c. B > C > A
d. A > C > B

9. Tetrabutyl ammonium hydrogen sulphate can be used as a mobile phase additive in
a. Ion exchange chromatography
b. Ion pair chromatography
c. Size exclusion chromatography
d. Chiral chromatography
10. Carbon dioxide is a preferred mobile phase in
a. HPLC
b. GC
c. HPTLC
d. Supercritical fluid chromatography
11. Proteins X, Y and Z have pI values 4, 9 and 7 respectively. They are passed through a cation exchange column using aqueous buffer pH 6 as the mobile phase. Predict the order of elution of X, Y and Z.
a. X followed by Y followed by Z
b. Z followed by X followed by Y
c. X followed by Z followed by Y
d. Z followed by Y followed by X
12. Which of the following is associated with analysis of residual solvents?
a. Ion pair chromatography
b. Ion exchange chromatography
c. Head space sampling
d. Chiral chromatography
13. After ionization and fragmentation in ion source the many different ions formed are accelerated and when they enter the mass analyzer they have nearly the same
a. Velocity
b. Mass
c. Kinetic energy
d. m/e
14. Which one of the following molecules is consistent with a molecular ion of m/z 73 in a mass spectrometry experiment?
a. $C_3H_8N_2$
b. $C_4H_{11}N$
c. $C_4H_{10}O$
d. C_3H_5NO
15. In mass spectrometry, Nitrogen rule can be used to
a. Predict whether the molecule contains no nitrogen atoms or odd or even number of nitrogen atoms
b. Predict the molecular weight
c. Predict exact number of nitrogen atoms in the molecule
d. Predict the fragmentation pattern
16. Tropylium ion is observed in mass spectrum of
a. Alkyl benzenes
b. Aliphatic alcohols
c. Primary aromatic amines
d. Alkenes

17. Which of the following can be used as a solvent in ^{1}H NMR spectroscopy?
a. Water
b. Hexane
c. Methanol
d. Carbon tetrachloride
18. A proton magnetic resonance spectrum is said to be of first order if
a. $\Delta\nu/J > 10$
b. $J/\Delta\nu > 10$
c. $\Delta\nu/J < 10$
d. $\Delta\nu/J < 1$
19. Protons belonging to which of the following groups will give the highest δ value in NMR spectrum?
a. -OH
b. -NH2
c. Aromatic
d. Aldehyde
20. Reading from left to right, what multiplicity would be found for the three nonequivalent sets of protons in the ^{1}H NMR spectrum of the following compound?



a. s, s, s
b. d, d, d
c. s, d, d
d. s, s, d

Q.2. Answer the following **(Any two)** **20**

1.a. Give two points of difference between ^{1}H and ^{13}C NMR spectroscopy. Define chemical shift. Enlist factors affecting chemical shift.

1.b. Give two important points of difference between HPLC and UPLC. Draw a neat labelled diagram of HPLC instrument and enlist the various types of pumps and detectors used in HPLC.

2.a. What is affinity chromatography? Draw a neat labelled diagram of GC instrument and write a note on any one detector used in GC.

2.b. Write a note on principle and instrumentation of supercritical fluid chromatography.

3. Enlist ion sources used in mass spectrometry. Describe any one interface used in LC-MS. What are isotope ions and meta-stable ions in mass spectrometry? Depict retro Diels Alder fragmentation.

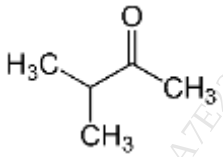
Q.3. Answer the following **(Any 7)** **35**

1 Give reasons for the following problems in HPLC and suggest ways of overcoming them-

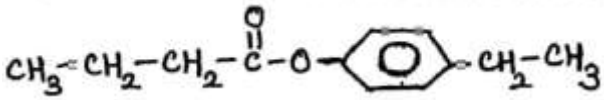
i. Bubbles in the HPLC system

ii. Peak splitting

2 Give the number of signals and multiplicity in the ^{1}H NMR spectrum of



3 Suggest two fragmentation pathways in MS of



4 What is gradient elution? Under which circumstances is gradient elution performed? What is nano liquid chromatography?

5 Write a note on columns used in GC.

6 Write a note on principle involved in ion pair chromatography.

7 What is the principle involved in capillary electrophoresis? Write in brief about the use of crown ethers are buffer additives in capillary electrophoresis.

8 Enlist mass analyzers and describe the working of MALDI – TOF mass spectrometer.

9 What are 2D NMR techniques? Discuss any one 2D NMR technique.

****