Enrolment No: .....

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M.Sc. Chemistry, Semester- I
Backlog Supplementary Examinations-July 2023
Paper Title: Analytical Chemistry

Paper Code: MCHCC-104

Time: 3 Hours **Maximum Marks: 60**

Note: *This paper has 3 sections A, B, and C, Attempt all the three sections Section A: Answer all the questions; Section B: Answer any 2 out of 4; Section C: Answer all the questions, each question has an internal choice.*

Abbreviations Used: CLO- Course Outcome, PLO- Program Outcome, BTL- Bloom Taxonomy Level: BT level 1-Remember; BT level 2-Understand; BT level 3-Apply; BT level 4-Analyse; BT level 5-Evaluate, BT level 6-Create.

SECTION A

Attempt **all** questions (very short answer type) (10x1.5=15 Marks)

Q.No	Question	BTL	CLO	PLO
1.	What are two equilibrium processes that underlie a large portion of the chromatographic separation processes?	1	1	1
2.	Define retention volume in chromatography.	1	1	1
3.	What do you mean the term "R_f" used in thin layer chromatography? Describe the various factors affecting R_f values.	3	2-3	3
4.	What is meant by "reverse phase" liquid chromatography?	2	2	2
5.	What is the order in which following salts can be eluted from a strong anion-exchange resin? **K_2SO_4, HNO_3, NaCl, NH_4OAc, CsBr**	2	2	2
6.	How does the retention time of specific solute change when the carrier gas flow is increased from 70 to 90 cc/min.	2	2	2
7.	Describe the essential components of a HPLC system.	2	2	2
8.	What is the scintillation counter? Explain the advantages of the same.	3	2	2,3
9.	State the van Deemter equation. Plot the equation and indicate the contribution of each term.	4	3,4	3,4
10.	Draw and interpret the TGA curve of calcium oxalate monohydrate.	3	3	3

SECTION B

Attempt **any two** out of the following four questions (2x10=20 Marks)

<table>
<tr><th>Q.No</th><th>Question</th><th>BTL</th><th>CLO</th><th>PLO</th></tr>
<tr><td>B 1.</td><td>a. Discuss the effect of experimental conditions on the efficiency of column adsorption chromatography. Also define retention volume and retention time.
b. Explain the curves obtained from differential thermal analysis (TGA). What are the various phenomena which cause change in temperature? How do you evaluate and analyse the TGA curve? Explain with an example.</td><td>5</td><td>5</td><td>4-5</td></tr>
<tr><td>B2.</td><td>a. Define capacity ratio, k. Why is capacity ratio used in gas chromatography theory instead of partition coefficient? Also define retention time and how is it related to capacity ratio?

b. Isobutyl alcohol is eluted from a 10.0 ft, 10% Carbowax column with the retention time of 12 min 43 s. The basewidth of the peak on the chart paper is 8.23 cm. The chart paper is emerging at the rate of 1.00 in/min. Calculate the efficiency of this column for isobutyl alcohol in cm/plate.</td><td>4-5</td><td>4-5</td><td>5</td></tr>
<tr><td>B3.</td><td>a. Why is HPLC called as high performance? Draw the schematic diagram of HPLC system. Explain briefly the different modes of HPLC separation.

b. The R_f values for the thin layer chromatography of amino acids on silica gel using n-butanol-acetic acid-water as the developing solvent are:
<table>
<tr><th>Amino Acid</th><th>R_f</th><th>Amino Acid</th><th>R_f</th></tr>
<tr><td>Aspartic Acid</td><td>0.17</td><td>Glycine</td><td>0.18</td></tr>
<tr><td>Alanine</td><td>0.22</td><td>Glutamic acid</td><td>0.24</td></tr>
<tr><td>Valine</td><td>0.32</td><td>Phenylaniline</td><td>0.43</td></tr>
<tr><td>Leucine</td><td>0.44</td><td>Tryptophan</td><td>1.47</td></tr>
</table>
Which amino acids can be separated from each other and which cannot be?</td><td>3-6</td><td>4-6</td><td>4-6</td></tr>
<tr><td>B4.</td><td>a. Draw and label the block diagram of DTA. What is the principle involved in DTA? Explain the factors affecting DTA curves.
b. State the advantages of semiconductor detectors. What is "doping" in semiconductor detectors? Explain the effect of doping on pulse formation.</td><td>5-6</td><td>6</td><td>5</td></tr>
</table>

SECTION C

Attempt **all** questions. Each question has an **internal choice**. (5x5=25 Marks)

Q.No	Question	BTL	CLO	PLO
C1.	What are ion exchange resins? Give examples. Describe selectivity coefficient. What are the limitations and advantages of ion exchange chromatography. **(OR)** Describe the term "supports" used in gas chromatography. List five materials commonly used as supports. Explain the types of detectors used in gas chromatography.	1-4	1-4	1,4
C2.	Calculate the mass defect and binding energy per nucleon of $_{18}Ar^{40}$ whose mass is 39.9751u. Given: mass of proton (m_p) = 1.0078254u and Mass of neutron(m_n) = 1.008665u. **(OR)** What would be the order of elution for the compounds listed below when separated on an alumina column using pentane as the eluent: (a) CH_3-CH_2-CH_2-COOH, CH_3-CH_2-CH_2-CH_2OH, CH_3-CH_2-CH_2-CHO (b) C_6H_4-NH_2, C_6H_5-OH, C_6H_5-$COOCH_3$, C_6H_5-$COCH_3$	2-5	2-5	2,3
C3.	Which of the adsorbents used in thin layer chromatography will be used in separations listed below: (a) Methylamine, ethylamine, n-propylamine, i-amylamine (b) Resorcinol, phenol, 1,3,5-trihydroxybenzene **(OR)** What are the essential components of a gas chromatograph, Differentiate between isothermal and programmed temperature GC.	3-6	3-6	3-6
C4.	Explain the schematic diagram of proportional counter. Give the disadvantages of the said counter. **(OR)** What is size exclusion chromatography? Describe the chemical and physical structure of dextran gel and styrene divinyl benzene gel.	2,4	4	4
C5.	How is differential scanning calorimetry (DSC) different from differential thermogravimetric analysis (DTA)? Describe the instrumentation of both. **(OR)** What are theoretical plates in chromatography and describe their significance. Explain their applications and limitations.	4-5	3-4	3-4