

**POST GRADUATE DIPLOMA IN
ANALYTICAL CHEMISTRY
(PGDAC)**

Term-End Examination

December, 2024

MCH-002 : SEPARATION METHODS

Time : 3 Hours

Maximum Marks : 75

Note : (i) *Attempt any **five** questions. All questions carry equal marks.*

(ii) *Marks allotted in parts are indicated on RHS.*

1. Attempt any *five* questions from the following :

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| (a) Enlist <i>three</i> steps of extraction. | 3 |
| (b) Explain the basis of classification of chromatographic methods. | 3 |
| (c) Define R_f value with an illustration. Write down ideal range of R_f values. | 3 |

- (d) Write the characteristics of silica and alumina used as commercial HPLC column packing materials. 3
- (e) Write briefly about agar and agrose gels with a schematic representation of its partial structure. 3
- (f) Explain the basic principle of electrophoresis. 3
2. (a) (i) Discuss the main requisites of a semi-permeable membrane used for various applications. 3
- (ii) Explain the term 'Electro-migration' and name the techniques under its head. 2
- (b) Explain separation factor. Describe various ways of conducting multiple extractions. 2+3
- (c) What are 'diluents' and 'modifiers' ? Explain their role in extraction process with *two* examples for each. $2\frac{1}{2}+2\frac{1}{2}$

3. (a) Explain extraction by ion pair formation with suitable example. $2\frac{1}{2}+2\frac{1}{2}$
- (b) Name and draw structures of derivatives of phosphoric acid used in extraction. Which one of these are most extensively used ? 4+1
- (c) Explain retention factor (k_x). Derive an expression for separation factor and comment on shapes of peaks. 2+2+1
4. (a) Write Deemter equation and explain all its terms. Draw the nature of plot between linear flow rate (u) and plate height in gas and liquid chromatography. 3+2
- (b) Write *three* basic methods of chromatographic developments. Explain any *one* of them. 3+2
- (c) Explain how thin layer chromatography (TLC) is different from paper chromatography (PC) with respect to stationary phase, mobile phase, detection methods and apparatus used in two cases.

5. (a) Are the resolution factor and separation factor same ? What will be the situation at $R = 1$ and the separation factor being unity ? 5
- (b) Explain column efficiency solvent efficiency with the help of illustration. Write the expression for number of plates. 2+2+1
- (c) Draw a block diagram of a typical gas chromatograph indicating all the essential components. 5
6. (a) Illustrate variation of retention time with % of liquid phase. 5
- (b) Write briefly about ion chromatography and draw a schematic diagram of ion chromatograph with separation column. 3+2
- (c) List various approaches followed in interfacing HPLC with mass spectrometry. 5
7. (a) Explain any *five* resin properties briefly. 5

- (b) What are gels ? Explain their typical structure. Write their important properties that make them useful for chromatography. 1+1+3
- (c) Explain cation and anion exchangers including amphoteric exchangers. Write names of any *two* commercial ion exchangers. 3+2
8. (a) Briefly discuss capillary electrophoresis with schematic illustration of its experimental setup. Mention any *four* detection methods. 3+2
- (b) What are various membrane processes ? Devise a method of membrane separation process for protein, sucrose and CaCl_2 from a solution mixture. 2+3
- (c) Define Reverse Osmosis (RO). What are the parameters in terms of which RO is evaluated ? Briefly explain the desirable properties of semi-permeable membrane used in RO process. 1+2+2

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