ASSIGNMENT BOOKLET

Post Graduate Diploma in Analytical Chemistry (PGDAC)

Basic Analytical Chemistry   (MCH – 001)

Separation Methods   (MCH – 002)

Spectroscopic Methods   (MCH – 003)

Electroanalytical & Other Methods   (MCH – 004)

(Valid from January 1, 2021 to December 31, 2021)

It is compulsory to submit the assignments before filling in the examination form.

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THE PEOPLE'S UNIVERSITY

School of Sciences
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Maidan Garhi, New Delhi-110068
(2021)

Dear Learner,

This assignment booklet consists of the tutor marked assignments (TMAs) of MCH-001, MCH-002, MCH–003 and MCH–004 courses of the Post Graduate Diploma in Analytical Chemistry (PGDAC) programme.

We hope, you are familiar with the system of evaluation to be followed for this programme. You may probably like to re-read the section on assignments in the Programme Guide that was sent to you earlier. As you are aware, a weightage of 30 percent has been earmarked for continuous evaluation component. For this you have to submit the responses of the enclosed tutor marked assignments to the Study Centre Coordinator. The assignments are based on the content of all the blocks of all the courses.

Before attempting the assignment, please read the following instructions carefully.

1   On top of the first page of your assignment response, please write the details exactly in the following format; write your answers from second page onwards.

ENROLMENT NO. : ………………………...

NAME   **:** …………………………

ADDRESS   **:** ………………………...

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COURSE CODE   **:** ……………………………….

COURSE TITLE   **:** ……………………………..

STUDY CENTRE   **:** …………………………...…   **DATE :** ………………………...
(NAME AND CODE)

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2   Use only foolscap size paper (but not of very thin variety) for writing your answers.

3   Leave about 4 cm margin on the left, top and bottom of your assignment response sheet.

4   Your answers should be precise.

5   While writing answers, clearly indicate the Question No. and part of the question being solved.

6   Though the validity of assignment is for one year, we advise you to submit the assignment response within 12 weeks after receiving it.

7   **We strongly suggest that you should retain a copy of your assignment responses.**

Wishing you good luck.

TUTOR MARKED ASSIGNMENT
MCH-001: Basic Analytical Chemistry

Note: Answer all the questions given below.

1. a) Explain the following terms in 2-3 lines: (5)
    i)   Gravimetric analysis
    ii) Volmetric analysis
    iii) Potentiometric analysis
    iv) Coulometric analysis
    v)   Conductometric analysis

    b) Differentiate between accuracy and precision giving suitable examples. (5)

2   a) Explain standard deviation with a suitable example. (5)

    b) What is a precipitation titration? Discuss the factors affecting the sharpness of the end point. (5)

3   a) What is co-precipitation? Explain the role of co-precipitation for the separation of trace quantities. (5)

    b) Discuss the role of computer in analytical instrumentation. (5)

4   a) What are gaseous pollutants? Describe the sampling of atmosphere without concentration of gas and vapours. (5)

    b) Why is it essential to consider the safety aspect at the time of the construction of the laboratory building? List any three requirements that must be met as per the norms in a chemical laboratory. (5)

5   a) Define hazardous materials. Clearly differentiate between the poisonous and infectious substances giving examples. (5)

    b) What are oxidimetric reagents? Illustrate the use of potassium bromate as an oxidimetric reagent with the help of a suitable example. (5)

6   a) What is meant by leveling effect of a solvent? Explain with the help of a suitable example. (5)

    b) Outline the procedure for the determination of hydronium ion concentration in an aqueous solution of a polyprotic acid. Determine the pH of 1.0×10^{-3} M solution of oxalic acid. The successive dissociation constants of oxalic acid are: $K_1 = 5.9 \times 10^{-2}$; $K_2 = 6.4 \times 10^{-5}$. (5)

7   a) Calculate the pH at different stages of a titration between 100 cm^3 of 0.01 M formic acid and 0.01 M NaOH and draw the titration curve. Given: K_a (Formic acid) $= 1.7 \times 10^{-4}$. Suggest a suitable indicator for the titration. (5)

    b) Compute the standard electrode potential of the cell in which the following reaction takes place and write the Nernst equation for the cell. (5)

    $$Sn^{4+}(aq) + 2Fe^{2+}(aq) \rightleftharpoons Sn^{2+}(aq) + 2Fe^{3+}(aq)$$

    Given $E^0_{Sn^4/Sn^{2+}} = 0.14V$; $E^0_{Fe^{3+}Fe^{2+}} = 0.77v$

8   a) Show that the potential range of the colour change for a redox indicator can be given as $E^0_{ox/red} \pm 0.059/n$ V. (5)

    b) Define metallochromic indicators and explain their mode of working. What are the requirements that these indicators must meet to be used for the visual detection of end points in complexometric titration? (5)

9 a) What is meant by masking and demasking in the context of complexometric determinations? Explain with the help of a suitable example.   (5)

   b) Define and differentiate between coprecipitation and post precipitation.   (5)

10 a) Enumerate the advantages and disadvantages of the use of organic precipitants in inorganic gravimetric analysis.   (5)

   b) Briefly describe the role of computers in analytical instrumentation.   (5)

TUTOR MARKED ASSIGNMENT
MCH-002: Separation Methods

Note: Answer all the questions given below.

1. What are main objectives of carrying out separations? Explain the general scope of separations in the context of daily life applications of separations. (5)

2. What are various types of distillation methods? Briefly explain. (5)

3. Write the expression for distribution ratio. Explain the four types of situations in which the two phases of the extraction system can be brought together. (5)

4. Discuss the important aspects of extractions by use of chelating agents. (5)

5. Why are high molecular weight amines known as liquid anion exchangers? Give the mechanism of extraction by these amines. (5)

6. Explain the extraction by synergism. What are the generalisations for the formation of a synergist adduct? (5)

7. What is selectivity factor? Give various expressions for expressing it in terms of distribution constants retention factors and retention times. (5)

8. What are theoretical plates? Draw and explain the chromatogram for estimating the number of theoretical plates. (5)

9. Explain and compare the experimental aspects of classical and improved liquid column chromatography. (5)

10. Give examples of different adsorbents used in liquid - solid chromatography. Discuss their selectivity towards different types of compounds. (5)

11. Discuss the important properties of paper used as a stationary phase in paper chromatography. Also explain the possible modifications for different purposes. (5)

12. How can the spots of separated compounds be detected? Briefly explain the methods/reagents used. (5)

13. Describe the characteristic properties of the carrier gas used in gas chromatography. Give examples of the gases which can be used under different situations. (5)

14. What are super selective liquid phases? Explain giving suitable examples. (5)

15. Explain the characteristics of different columns used in HPLC giving suitable examples. (5)

16. What are the requisites of a useful ion exchanger? Illustrate the general exchange reactions of cation and anion exchangers. (5)

17. What are dextran gels? Explain the structural features of sephadex and its available varieties. (5)

18. Briefly explain microfiltration and its application. How a this technique different from ultrafiltration ? (5)

19. What is active transport ? Illustrate its importance using suitable examples. (5)

20. Discuss the important features and applications of SDS-PAGE Gel electrophoresis. (5)

TUTOR MARKED ASSIGNMENT
MCH-003: Spectroscopic Methods

Note: Answer all the questions given below.

1	a)	Describe the quantum model of electromagnetic radiation. Compute the energy of a photon corresponding to a frequency of 105 MHz.	(5)
	b)	What is isosbestic point? Explain the deviation from Beer-Lambert's law due to the presence of hydrogen ions	(5)
2	a)	How is a FT-IR spectrometer different from the dispersive IR spectrometer? Write the steps for getting an FT-IR spectrum	(5)
	b)	Define Raman effect. State the 'Rule of mutual exclusion'. What is its significance?	(5)
3.	a)	What is the significance of Jablonski diagram. Explain the origin of radiative by using Jablonski diagram	(5)
	b)	Why do we need to modify the instrumental set up for the fluorescence measurement to make phosphorescence measurements? Describe the modification	(5)
4	a)	Describe the analytical application of chemiluminescence in the area of environmental pollution measurement	(5)
	b)	Describe the application of fluorescence measurements in blood glucose determination	(5)
5.	a)	Explain why	(5)

       i) the atomic spectra are line spectra whereas the molecular spectra are band spectra?

      ii) the sensitivity of a determination using pre-mix burner is less than that employing a total consumption burner?

	b)	Write the reactions occurring in the flame during flame photometry.	(5)
6.	a)	Describe the different pathways of atomic fluorescence emission.	(5)
	b)	In what way is halogen cathode lamp better than a continuous source for atomic fluorescence measurement?	(5)
7	a)	Explain the principles of atomic absorption spectrophotometry and atomic emission spectrometry.	(5)
	b)	Enlist the advantages of GFAAS over FAAS.	(5)
8	a)	Enlist different components of ICP torch. What makes argon a good choice for the plasma gas?	(5)
	b)	What are different types of instruments used for ICP-AES? Which of these are better and why?	(5)
9		Explain the following terms:	(10)

- Chemical ionisation in mass spectrometry
- FT NMR
- Larmor precession
- Nebulisation

10	a)	What is meant by IHD? Calculate IHD for the molecule having the molecular formula, $C_5H_9O_2Cl$ and $C_4H_{11}N$.	(5)
	b)	What kind of structural information is available from UV, IR, NMR and Mass spectra of an organic compound?	(5)

TUTOR MARKED ASSIGNMENT
MCH-004: Electroanalytical and Other Methods

Note: Answer all the questions given below.

Q.1 a) What do you mean by electrode potential? Illustrate it with an example of a less active metal when placed in solution of its salt. (5)

b) What is the equation for the cell emf in 'Direct Potentiometry' (5)

Q.2 a) Why is the calomel electrode so popular? Write the equation of its potential using Nernst equation. (5)

b) How is the boundary potential developed when a glass electrode is placed in a test solution? What is the overall boundary potential? Write the supporting chemical equations. (5)

Q.3 a) What is the difference in the material used as the membrane in solid state membrane electrode from a glass electrode? Draw the figure for its typical design. (5)

b) The conductivity of 0.3 M HCl is 0.2384 Ω^{-1} cm^{-1}. What is the molar conductivity of the solution? (5)

Q.4 a) Compare the current/voltage curves for an electrolytic of a galvanic cell (with figure). (5)

b) Calculate the time needed for a constant current of 0.48 A to deposit 0.25 g of Co(II) as elemental cobalt on the surface of a cathode. Relative molar mass of cobalt = 58.93. (5)

Q.5 a) What is the limitation of electrogravimetry in metal analysis? How is it useful in the separation of quantitative determination of metallic species? (5)

b) What is the main advantage of coulometric titration of acids? (5)

Q.6 a) Give the diagnostic test to decide whether a system is quasi-reversible with reference to a redox reaction by cyclic voltammetry. (5)

b) Explain capillary characteristics with reference to diffusion current and the Ilkovic equation. (5)

Q.7 a) Explain with a specific example how catalytic current are useful for trace analysis of number of transition metal ions? (5)

b) In some cases when the reaction product is markedly soluble or appreciably hydrolysed how amperometry is advantageous over potentiometric or visual indicator methods? (5)

Q.8 a) Write the practical steps involved in voltammetry. (5)

b) How can you avoid the errors that arise from condensation of the sample during TGA? How can the calibration of thermoblance be done? (5)

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Q.9 a) What are the instrumental factors that affect the resulting experimental curves in DTA. What is T_g? On what does it depend on? (5)

   b) What are the two important criteria for characterisation of waxes and fats by DSC? (5)

Q.10 a) A sample of ^{64}Cu exhibits 6316 cpm and after 10 h, the sample gave 3972 cpm. Calculate the half-life of ^{64}Cu. (5)

   b) Give the brief description of methodologies of NAA. (5)