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, 2024 to December 31, 2024)

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

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2024)

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

Course Code: MCH-001
Assignment Code: MCH -001/TMA/2024
Maximum Marks: 100

Note: Answer all the questions given below.

1	a) Explain Potentiometric analysis and conductometric analysis.	(5)
	b) With suitable examples differentiate between accuracy and precision.	(5)
2	a) What is meant by sampling? How is the sample dissolved?	(5)
	b) What are the sources of Determinate Errors?	
3	a) What are the ways in which the percentage in liquid samples can be expressed?	(5)
	b) What is the formula for average deviation? What is meant by relative average deviation?	(5)
4	a) What are the specific criteria for selection of location for air sampling?	(5)
	b) How is segregation and grinding carried out during sampling of solid wastes?	(5)
5	a) What should be kept in mind while decanting dangerous liquids?	(5)
	b) Urea of concentration 0.25 mM was hydrolysed using urease of concentration of 10.0 micro mol. Using the values $k_2 = 6 \times 10^4\ s^{-1}$ and Michaelis constant for urease 2.0mM calculate the initial rate of the reaction.	(5)
6	a) Calculate the $[OH^-]$ of 0.20 M Na_2CO_3. ($K_w = 1.0 \times 10^{-14}$; $K_1 = 6.20 \times 10^{-7}$ and $K_2 = 2.8 \times 10^{-11}$ for H_2CO_3).	(5)
	b) What is meant by buffer capacity of a solution.	(5)
7	a) With a suitable example illustrate the titration of a weak base versus strong acid.	(5)
	b) What is the modern quinoid theory. Give the structures of and the colour changes of methyl orange and phenolphthalein based on this theory.	(5)
8	a) What is the role of solvents in acid base reactions?	(5)
	b) What are the criteria for solvent selection during redox titrations in nonaqueous solvents.	(5)
9	a) How does the absorption indicators work for the Fajan's method of precipitation titration.	(5)
	b) Give the differences between coprecipitation and postprecipitation?	(5)
10	a) What are the advantages and disadvantages of using organic precipitants?	(5)
	b) Briefly discuss the principle of the working of a flame photometer. Which are the other atomizers that have been proposed beside the flame and spectrographs for atomization.	(5)

TUTOR MARKED ASSIGNMENT
MCH-002: Separation Methods

Course Code: MCH-002
Assignment Code: MCH -002/TMA/2024
Maximum Marks: 100

Note: Answer all the questions given below.

1.	Briefly explain different forms of distillation.	(5)
2.	Discuss how various separation methods can be classified on the basis of equilibrium processes.	(5)
3.	What is distribution ratio? Discuss the distribution of benzoic acid between benzene and water.	(5)
4.	Give a brief account of carboxylic and sulphonic acids used in extraction by compound formation.	(5)
5.	What conclusions can be arrived at from *D* in the extractions of metal chelates?	(5)
6.	List different criteria used for the choice of organic phase used in extraction/separation of metal ions.	(5)
7.	Brief explain important aspects of super critical fluid chromatography.	(5)
8.	Explain the terms “retention time and retention factor”.	(5)
9.	List the requirements for the ideal support material used in liquid-liquid chromatography.	(5)
10.	Briefly explain any five applications of liquid column chromatography.	(5)
11.	List various detection methods used in planar chromatography.	(5)
12.	What are the requirements of carrier gases used in gas chromatography? Which impurities can be present in them and how can they be removed?	(5)
13.	List the important characteristics of a detector used in gas chromatography.	(5)
14.	Discuss the salient features of ECD used in gas chromatography.	(5)
15.	List the advantages of HPLC.	(5)
16.	Discuss the use of polymers as anion exchangers.	(5)
17.	Briefly explain important properties of gels which can be used for size exclusion chromatography.	(5)
18.	Briefly explain nano filtration and ultra filtration process.	(5)
19.	Explain the applications of membrane separations in (i) desalination and water treatment; and (ii) production of table salt.	(5)
20.	Describe important aspects of capillary electro chromatography.	(5)

TUTOR MARKED ASSIGNMENT

MCH-003: Spectroscopic Methods

Course Code: MCH-003
Assignment Code: MCH-003/TMA/2024
Maximum Marks: 100

Note: Answer all the questions given below.

1. a) Why is an electromagnetic radiation called so? Describe its characteristic parameters alongwith the units of measurement. (5)

   b) How is UV spectrum different in vapour phase from that in solution phase and why? Illustrated your answer. (5)

2. a) A 500 cm^3 solution containing 33.5 mg of potassium permanganate in a cuvette with a path length of 2 cm show a transmittance at 450 m. If the percentage transmittance is observed to be 10, calculate the molar absorpturity of potassium parmangnate. (5)

   b) What is the significance of selection rules for the vibrational spectroscopy? Describe the types of signals obtained in the vibration spectrum of a diatomic molecule. (5)

3. a) Why is the handling of samples for IR spectra measurements is not simple? Describe the sampling of solids for IR spectral measurements. (5)

   b) Differentiate between IR spectra and Raman spectra. (5)

4. a) Describe the phenomena of fluorescence and phosphorescence using the Jablonski diagram. (5)

   b) What is meant by fluorescence quenching? Explain the mechanism responsible for the quenching? (5)

5. a) How is NO–NO_2 determined as atmospheric pollutants by fluorimetry? Describe the method. (5)

   b) Describe in brief the basic principles involved in atomic absorption spectrometry (AAS) atomic emission spectrometry (AES) and atomic fluorescence spectrometry (AFS). (5)

6. a) Describe the processes that occur in the flame during a flame photometric experiment. (5)

   b) What is the advantage of Stokes fluorescence? Explain taking an example and illustrate your answer. (5)

7. a) What is the reason of nonlinearity in the AAS plot? What other factors are responsible for this? Explain how these are resolved for an analyte. (5)

   b) What is the difference between a premix nabuliser-burner and a total consumption burner? Give the advantage of flame atomization method. (5)

8. a) Describe plasma as used in AES. Give an example and write the principle of AEC based on plasma sources. (5)

	b)	Describe the application of AAS in the determination of toxic elements present as environmental contaminants.	(5)
9.	a)	Explain the terms, magnetogyric ratio, spin flip, Fourier transformation, chemical shift and coupling constant.	(5)
	b)	Draw the NMR spectra of methylisopropyl ketone showing the δ values of all the photons.	(5)
10.	a)	Taking a suitable example. Explain the fragmentation due to intermolecular rearrangement in mass spectrometry.	(5)
	b)	Draw all the spectra possible for the molecule of benzoic acid indicating the peak values for each of the spectrum.	(5)

TUTOR MARKED ASSIGNMENT

MCH-004: Electroanalytical and Other Methods

Course Code: MCH-004
Assignment Code: MCH-004/TMA/2024
Maximum Marks: 100

Note: Answer all the questions given below.

Q.1 a) What do you understand by cell potential? Calculate the potential of following electrodes: (5)

i) A copper electrode immersed in 0.022 *M* $Cu(NO_3)_2$

ii) A zinc electrode immersed in 0.030 *M* $Zn(NO_3)_2$.

b) Describe various factors that cause errors in pH measurement. (5)

Q.2 a) What is solid state membrane electrode? Draw a sketch diagram and describe their applications. (5)

b) Define conductivity, cell constant and molar conductivity.

Resistance of a conductivity cell filled with 0.1M KCl solution is 100 Ω. If the resistance of the same cell when filled with 0.02 M KCl solution is 520 Ω, calculate the conductivity and molar conductivity of 0.02 M KCl solution. The conductivity of 0.1 M KCl solution is 1.29 S m^{-1}. (5)

Q.3 a) How will you analyse a binary alloy of copper and silver thermogravimetrically. (5)

b) A solution of CuSO4 is electrolysed for 10 minutes with a current of 1.5 amperes. What is the mass of copper deposited at the cathode? (5)

Q.4 a) Explain how will you determine dissociation constant of a weak acid or base by conductometric method? (5)

b) The conductivity of 0.001028 M acetic acid is 4.95×10^{-5} S cm^{-1}. Calculate its dissociation constant if the limited molar conductivity for acetic acid is 390.5 S cm^2 mol^{-1}. (5)

Q.5 a) Describe the design and principle of constant current coulometry. Write three main applications of coulometric titrations. (5)

b) Enlist various voltammetric methods of analysis. Write briefly about anodic stripping voltammetry(ASV) and its usefulness for trace elemental analysis. (5)

Q.6 a) Explain the terms limiting current, migration current, diffusion current, residual current and half wave potential. (5)

b) What is dropping mercury electrode? Give its advantages. (5)

Q.7 a) What are amperometric titrations? Draw common types of curves obtained in amperometric titrations. Briefly discuss their experimental set up. (5)

b) List the factors affecting TG curve. Taking a suitable example, explain the effect of furnace atmosphere on TG curve. (5)

Q.8 a) Draw a labeled diagram of the TG curve obtained by heating a mixture of 50 mg of calcium oxalate monohydrate and 50 mg of barium oxalate monohydrate to 1200°C. Calculate the amount of all mass losses. (5)

b) Explain the basic principle of Differential Scanning Calorimetry (DSC). Draw a block diagram of DSC instrument. (5)

Q.9 a) Describe various types of neutron sources available for NAA. Which one of these is most suitable for trace element analysis? (5)

b) In what respects nuclear reactions are different from chemical reactions? Calculate Q value of the reaction $^{63}Cu = (n, \gamma)^{64}Cu$. Give that $^{63}Cu = 62.929590$, $^{64}Cu = 63.929760$, $n = 1.008665$ amu. (5)

Q.10 a) Explain why (n, γ) reaction is most suited for NAA. (5)

b) Discuss the principle of isotope dilution technique (5)